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Measuring a Just Transition in the EU in the context of the 8th Environment Action Programme

An assessment of existing indicators and gaps at the socio-environmental nexus, with suggestions for the way forward

Issue paper under Task 3 of the 'Service contract on future EU environment policy' for DG Environment

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Background

In October 2020, the European Commission published a proposal for an 8th Environment Action Programme (EAP) (EC 2020). The proposal aims to "accelerate the transition to a climate-neutral, resource-efficient and regenerative economy" to support the environment and climate action objectives of the European Green Deal (EGD).

The EGD and the 8th EAP proposal call for a new monitoring framework to measure and communicate "progress towards environmental and climate objectives in the wider context of sustainability, wellbeing and resilience" via a set of headline indicators.

Some preparatory work, collecting and categorising of environment-related indicators, for this monitoring framework has already been done (cf. Trinomics 2020) as part of a service contract to assist DG ENV in investigating future EU environmental policy (cf. disclaimer above).

The following paper, part of the same service contract, aims to contribute to the development of the new monitoring framework by adding a Just Transition perspective. It builds upon the general monitoring framework, and thematically on a separate issue paper on Just Transition which systematises and analyses different social (justice) effects of environmental policy on households/consumers as well as jobs/workers/regions (Heyen et al. 2020).

Summary

This paper discusses how to measure whether and to what degree EU environmental policy is socially just by using easily interpretable indicators. Its main task is to assess existing (or officially discussed) European-level indicators at the socio-environmental nexus on their suitability to serve as Just Transition (headline) indicators, and to identify gaps. The paper focuses on social justice within Europe and looks at three broad socio-environmental issue areas:

- Environmental benefits, pollution & risks
- Consumption- and social-participation opportunities for vulnerable groups
- Employment & regional cohesion (as affected by environmental policies/transitions).

The paper builds on the diversity of social effects of environmental policy and reveals a broad range of existing European indicators to monitor certain aspects of them. Given the variety of effects, it seems impossible to define a single 'perfect' Just Transition indicator. Monitoring a Just Transition from an environmental-policy perspective needs a combination of indicators from different issue areas. Moreover, many indicators need to be developed further to serve as Just Transition indicators. Suggestions (from short-term to long-term) for improving indicators and closing gaps are made in this paper, with reference to some national-level good practices. In addition to single-number indicators, in-depth analyses are also necessary on many issues. The suggestions put forward should be taken as a starting point for further discussion.

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Abbreviations

AAQ	Ambient Air Quality (Directive)
CE	Circular Economy
CVET	Continuing Vocational Education and Training
DG EMPL	Directorate-General for Employment, Social Affairs and Inclusion
DG ENV	Directorate-General for Environment
DG REGIO	Directorate-General for Regional and Urban Policy
DG SANTE	Directorate-General for Health and Food Safety
EAP	Environmental Action Plan
EC	European Commission
EEA	European Environment Agency
EGD	European Green Deal
EPOV	Energy Poverty Observatory
EU	European Union
EWCS	European Working Conditions Survey
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
JTF	Just Transition Fund
LFS	Labour Force Survey
MS	Member States
NUTS	(French:) Nomenclature des unités territoriales statistiques
OECD	Organisation for Economic Co-operation and Development
PM	Particulate matter
SDGs	Sustainable Development Goals
SME	Small and medium-sized enterprise
TPI	Transitions Performance Index
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
WHO	World Health Organization

1. Introduction

Europe "*faces environmental challenges of unprecedented scale and urgency*", including climate change, biodiversity loss, resource use and pollution (EEA 2019b). As a response to these, the European Commission published a proposal for an **8th Environment Action Programme (EAP)** in October 2020 (EC 2020). The proposal aims to "*accelerate the transition to a climate-neutral, resource-efficient and regenerative economy*" (ibid.) in support of the environment and climate action objectives of the **European Green Deal (EGD)** (EC 2019).

Building on the EGD, the 8th EAP proposal has six priority objectives (cf. EC 2020):

- achieving the 2030 greenhouse gas emission reduction target and climate neutrality by 2050
- enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change
- advancing towards a regenerative growth model, decoupling economic growth from resource use and environmental degradation, and accelerating the transition to a circular economy
- pursuing a zero-pollution ambition, including for air, water and soil and protecting the health and well-being of Europeans
- protecting, preserving and restoring biodiversity, and enhancing natural capital (notably air, water, soil, and forest, freshwater, wetland and marine ecosystems)
- reducing environmental and climate pressures related to production and consumption (particularly in the areas of energy, industrial development, buildings and infrastructure, mobility and the food system).

Environmental protection and climate change mitigation help the environment but usually also preserve or improve human health and well-being, particularly among vulnerable groups in society (ILO 2018; WHO 2018). Moreover, many economic sectors and jobs depend on ecosystem services; and green technologies, often stimulated by environmental regulation, create new jobs (ILO 2018; NEC 2018; OECD 2017; UNEP et al. 2008).

However, as past socio-economic transformations have shown, they do not happen without trade-offs, conflicts and resistance since they disrupt and challenge established investments, jobs, behaviours, knowledge and values (EEA 2019a). In the case of sustainability transformations, the decline of incumbent firms, e.g., in the oil and coal business, can have negative (often regionally focussed) economic and employment effects. Regions which lack diversification and have a limited capacity for innovation will face the greatest challenge, as will workers with skills that are in less demand or who are unable to acquire new skills (UNFCCC 2016). Moreover, if energy or other commodity prices rise due to environmental policy, this may disproportionately affect low-income households.

Effective and socially acceptable transformation governance should strengthen (and highlight) synergies between environmental and social justice objectives, and avoid conflicts, i.e., short-term economic hardships and social inequalities caused by transformations. In order to describe this objective, the term '**Just Transition'** has come into use during recent years. It has become recognised, inter alia, by UN bodies and conferences, e.g., within the Paris Climate Agreement (cf. ibid.). While the term is mostly used in the context of fossil-fuel dependent regions and workers, it can also be understood in a much broader sense, not only with regard to economic sectors but also including the issues of access to energy ("energy justice") and other basic goods, and the socio-economic distribution of health-related environmental pollution and risks ("environmental (in-)justice") (Heffron & McCauley 2018; Heyen et al. 2020; Newell & Mulvaney 2013).

In its EGD communication, the European Commission declares that "*this transition must be just and inclusive. It must put people first, and pay attention to the regions, industries and workers who will*

face the greatest challenges" (EC 2019). In the previous year, the Commission's long-term vision for a climate-neutral Europe already spoke about "*ensuring a fair and socially acceptable transition for all in the spirit of inclusiveness and solidarity*" (EC 2018). The text continued: "*The social consequences of the transition cannot be addressed post factum. Both the EU and the Member States must take into account social implications from the outset and deploy all relevant policies to the fullest to mitigate this challenge*" (ibid.).

The following paper aims to contribute to monitoring a Just Transition, reflecting the EGD's and 8th EAP proposal's call for a new **monitoring framework** to measure and communicate "*progress towards environmental and climate objectives in the wider context of sustainability, wellbeing and resilience*" via a set of headline indicators (EC 2020). Specific monitoring frameworks are foreseen for the key elements in the context of the EGD, namely the EU Climate Law, the Circular Economy Action Plan, the Biodiversity Strategy and the Farm to Fork Strategy; as well as a set of key "headline indicators" as part of the 8th EAP. A recent consultative paper from the Commission on this EAP monitoring framework (development) also mentions the "*opportunity to reflect on the coherence with indicators related to sustainable and inclusive prosperity (e.g., green economy, social economy, sustainable investments, quality green jobs and social fairness) and on the possible need to develop new indicators linking environment, employment and social policy (e.g. on the link health/inequalities, potential job creation and job reallocation, as well as distributional impact), in line with the European Pillar of Social Rights*" (EC 2021).

Against this background, the main task for this paper is to assess existing (or officially discussed) European-level indicators at the environmental-social nexus on their suitability to serve as Just Transition (headline) indicators, and to identify gaps in this coverage. In addition, suggestions (from short-term to long-term) for improving indicators and closing gaps are made, with some references to national-level good practice. However, it is beyond the scope of the paper to systematically analyse indicators at national level, as well as to precisely define perfect indicators for the future. The focus lies on social justice within Europe, international spill-over effects are an important justice dimension but are beyond the scope of this paper.

This paper builds upon a preparatory study for the general monitoring framework (cf. Trinomics 2020), and thematically on an issue paper summarising evidence on social effects of EU environmental policy (cf. Heyen et al. 2020). All three reports have been prepared for the European Commission, DG Environment, within the context of the "Service contract on future EU environment policy" under framework contract No. ENV.F.1./FRA/2014/0063.

We start this paper by giving an overview on social effects of environmental policies (2.1) and clarifying the related goals for "socially just environmental policies" (2.2). We then introduce the general monitoring framework (2.3) and discuss the methodological challenges for selecting environment-related Just Transition indicators (2.4) as well as the methodological approach chosen (2.5). In the main chapter (3) that follows, we give an overview of existing European-level indicators for different environmental-social nexus issues, combined with an analysis of their strengths, shortcomings and gaps from a Just Transition perspective. Within each issue domain, this is followed by implications and suggestions for the way forward (from short-term to long-term). We end with some more general conclusions and recommendations (Chapter 4).

2. Conceptual background, clarifications and challenges

2.1. Systematisation of social effects of environmental policy

Environmental policies can have a large variety of social effects, both monetary and non-monetary. Another issue paper on Just Transition (Heyen et al. 2020) has collected and systematised social effects (observed and potential) of environmental policies and sustainability transitions – with regard to households / consumers as well as to jobs / workers and regions. The following table taken from this paper gives an overview of different types of effects. While different ways of systematisation are possible, this one clearly distinguishes between positive and negative impacts, and potential biases of positive impacts. This differentiation made it easy to focus on the avoidance of negative and social bias impacts as envisaged for that issue paper.

Table 1: Potential social effects of environmental (transition) policies

	Potential impacts on <u>jobs / workers & regions</u>	**Potential impacts on <u>households / consumers</u>**
Positive impacts	• **Healthier working conditions** (e.g. by emissions or air quality standards) • **Long-term economic prosperity** and jobs depend on the preservation of resources, biodiversity and ecosystem services • **Avoiding high costs of inaction**: In the long run, not acting (especially on climate change and biodiversity) is more expensive in (socio-) economic terms	• **Well-being:** Less environmental degradation and pollution, safer products as well as better access to intact ecosystems and their services (food, clean air, water, climate stability etc.) secure livelihoods and benefit health and well-being • **Equality**: Environmental policies can also reduce inequalities in the distribution of environmental hazards and in the access to ecosystem services • **Inclusion**: Green infrastructures and public services improve social inclusion of all people (e.g., public gardens, public transport, bike lanes, sharing facilities)
Positive impacts with limitations	• **Cost savings**: Environmental policies can induce cost savings for both business and consumers (e.g., energy savings lower energy cost; more durable products lower costs for replacement; lower costs for environmental clean-up and public health generally decrease companies' and consumers' tax burden); however: – **Social bias**: Some saving opportunities might not be (easily) available for everybody because of high upfront investment costs or because the investment depends on others (e.g., tenants in poorly insulated houses) • Green industries & services create **new jobs** & **income opportunities** – even beyond employees (e.g. renewable energy (RE) for farmers & homeowners); however: – **Social & regional bias**: Jobs may not emerge equally among different socio-demographic / socioeconomic groups, skill levels, and regions – **Labour conditions**: New sectors may have inferior labour conditions such as	– **Social bias**: Opportunities for (return on) investment in new technologies might not be (easily) available for low-income households – **Side effects**: New plants (e.g., factories for environmental goods, RE installations) may

	Potential impacts on jobs / workers & regions	Potential impacts on households / consumers
	pay, job security, worker protection, worker rights, etc.	involve impairments of neighbours (e.g. emissions, noise)
Potential negative impacts	• **Sectoral job losses**: Destabilisation, shrinkage or even exnovation[1] of "brown" industries may lead to job losses – which, if lasting, impair employees' livelihoods and quality of life • **Regional value creation**: Regions currently dependent on "brown" sectors could struggle with rising unemployment, shrinking tax revenues and public spending, possibly lowering infrastructure endowments and quality of life in the region and increasing territorial or social inequities	• **Reduced purchasing power:** Green taxes and price rises for (e.g. energy- / CO_2-intensive) products and services can disproportionately affect their affordability for low-income households or other vulnerable groups (e.g. migrants relying on air travel for family visits) • **Obstacles to inclusion**: Restrictions of resource-intensive goods challenge established ways of inclusion into society (e.g. traveling, symbolic consumption)

Source: Heyen et al. 2020

The **types of social effects most often discussed** in academic literature, policy papers or impacts assessments on environmental policy are (cf. Heyen et al. 2020; Heyen forthcoming):[2]

a) **employment and income**,

b) **commodity prices and household costs**, and

c) **environmental pollution/risk exposure** (or access to environmental benefits) and its **impact on human health**.

The three categories are not independent. For example, employment might affect health, and, vice versa, health effects might also affect employment opportunities or household costs. And all three affect people's general well-being and social inclusion.

Discussions on social justice effects in the context of environmental policy are mostly[3] about **distributional effects / distributional justice**, i.e., the distribution of benefits and burdens among different societal groups (cf. Heyen forthcoming):

- socio-economic groups, e.g., income group, employment status, job category, sector,
- socio-demographic groups, e.g., education level, household type, gender, age, ethnicity,
- different localities, e.g., different countries / regions, community size, rural vs. urban,
- or, on a temporal dimension, between generations.

[1] As the flipside of innovation, "exnovation" means the purposeful termination of existing (infra)structures, technologies, products and practices (Heyen 2017; Heyen et al. 2017).

[2] Other, less frequently discussed social effect categories are: values & assets; conditions for organising and self-determining one's everyday life; social relations & participating in community life; people's social recognition & self-esteem; feelings like fun & pleasure; and political participation (cf. overview and systematisation by Heyen forthcoming).

[3] The discourse on "environmental justice", "energy justice" and "climate justice" not only looks at distributional justice but also at procedural justice (i.e., inclusive participation decision-making but also access to information and legal protection), and recognitional justice (i.e., recognition of everyone's equal dignity) (cf., e.g., Williams & Doyon 2019).

2.2. Defining policy goals for a Just Transition to be monitored

For a discussion of indicators, it is important to clarify the policy goals for which progress should be monitored. Stating that environmental policy or a sustainability transition should be "socially just" or "leave no one behind" is not precise enough. At the same time, social justice (or fairness) is very hard to define and people often differ on their understanding or judgment. Ethical discourses distinguish between different fairness principles for distributional justice, e.g., "equality" (everybody equally), "equity" (everybody according to his/her responsibility – or capacity), and "need" (everybody according to his/her needs) (cf., e.g., Deutsch 1975).

Given that we can neither discuss in depth nor replace necessary societal discourses on such ethical issues in this paper, we take a **pragmatic approach to defining some basic Just Transition policy goals in the context of environmental policy**. To do this, we took up the three most commonly discussed social effect categories and the key issue of distributional effects (cf. Section 2.1) and reflected the often underlying goal in discourses on Just Transition and on environment / climate / energy justice to protect vulnerable groups.

Following discussions with Commission staff, we defined three basic policy goals for socially just environmental policies and transitions (applicable across different environmental sub-fields, economic sectors or consumption areas):

1. While generally improving the state of the environment to people's benefit, socially just environmental policies also **reduce inequalities in the distribution of environmental benefits, pollution and risks.**
2. Socially just environmental policies **do not disproportionally burden vulnerable households with regard to consumption needs but rather offer opportunities for financial savings and social participation.**
3. Socially just environmental policies **positively affect the quality and quantity of employment** and, together with structural policy, also **open up perspectives for workers & regions affected by the transition.**

While the existing issue paper on Just Transition includes a large collection of political measures to reach these goals (Heyen et al. 2020), the remainder of this paper focusses on indicators to monitor the progress in reaching these goals across the range of environmental policy sub-areas.

2.3. The monitoring framework concept for the 8th EAP

Conceptually and methodically, this paper builds upon the paper by Trinomics (2020) laying the foundations for a coherent and robust monitoring framework for EU environmental policy in the context of the 8th EAP. Its aim is to suggest an approach for monitoring progress against their goals as well as to identify those areas of environmental policy where progress may be lacking, and additional action may be required.

Since the 8th EAP aims to coordinate and improve policy response, the monitoring framework should help analyse and communicate progress along the whole process from policies to impacts. To do so, the framework takes up the Commission's 'Better Regulation Guidelines' and differentiates between the following categories (cf. EC 2017; Trinomics 2020):

1. **Output indicators**: The existence of policies, targets or other measures in a policy area, including their transposition and implementation at Member State level.

2. **Outcome/Result indicators**: The progress (against key policy targets) regarding desired immediate effects of the intervention, with particular reference to the direct addressees.
3. **Impact indicators**: The progress regarding the intended impact on the wider economy/society or state of environment beyond those directly affected by the intervention.

If a policy is working, the output should lead to outcomes/results and then impacts, albeit with some delay between them. While the Trinomics report also used the DPSIR cycle model[4] for categorising indicators, this is not the case for the following analysis since the DPSIR model focuses on environmental pressures and states, while Just Transition is mainly about social effects.

The suggested framework and the resulting suggestions for an "indicator library" take into account existing monitoring frameworks and indicators (sets), such as the 'Environment Implementation Review' (EIR), the 'State of the Environment Reports' (SOER), the EU's SDG indicator assessment coordinated by ESTAT and the 'European Semester' country reports now integrating these SDG indicators, and numerous specific monitoring provisions in environmental legislation.[5] Some of these frameworks focus on specific environmental policy areas, others like SOER on environmental states but not policy responses and their effectiveness, still others have very wide cross-cutting agendas (e.g., sustainable development). Against this diverse background, the suggestion for a new monitoring framework aims to find a suitable set of headline indicators of a manageable number (fitting on "a single piece of paper") that would be "easier to review and digest" (Trinomics 2020).

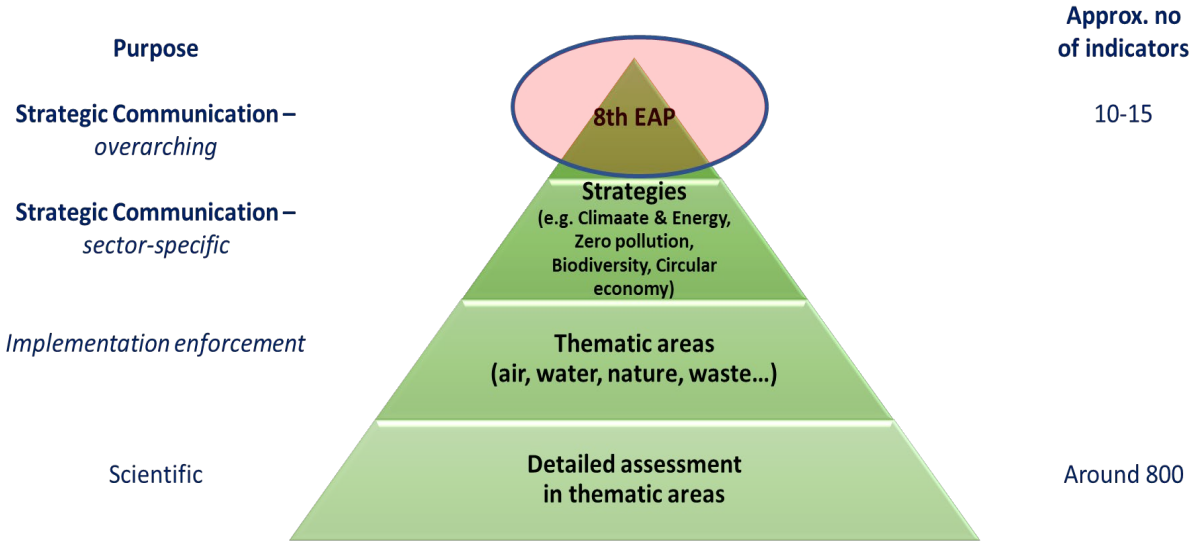
While Trinomics collated long lists of the many indicators already used in different environmental policy areas to form an "indicator library", the monitoring framework foresees a prioritisation of the indicators within a "pyramid structure" (see Figure 1), with the final classification being carried out in conjunction with Commission specialists, Member States and stakeholders in each policy area:

1. Top of the pyramid would contain a small number of indicators (a couple of indicators per policy area, or EAP goal) that best capture the outputs, results and possibly impacts of EU environmental policy in that area, and when combined show EU environmental policy as a whole.
2. Middle of the pyramid, those indicators that are well known in each respective policy area and may well already be used in policy specific indicator sets (e.g., the Circular Economy Monitoring Framework) and strategies. These provide useful detail for policy makers in each area but go in to too much detail for the reporting of environmental policy as a whole.
3. Bottom of the pyramid would include all the other, most detailed, indicators that are useful for detailed analysis, but may be infrequent or even one-off analysis. These are indicators used in detailed implementation / enforcement in each policy area by policy specialists and those engaged in scientific research.

[4] DPSIR is the EEA's causal framework for describing the interactions between society and the environment within a cycle that consist of the following elements: driving forces, pressures, states, impacts, responses. The EEA's 'State of the Environment Reports' (SOER) make use of these categories to structure the indicators.

[5] For an overview, see, for example, Annex 1 in the Environmental Reporting Fitness Check

Figure 1: Indicator pyramid in the concept for the 8th EAP monitoring framework



Source: EC 2020

2.4. Methodological challenges

The task to select appropriate Just Transition indicators is faced with several challenges, namely:

- Due to a lack of concrete policy goals and, more generally, different concepts of justice, it is not always clear what Just Transition means in a particular case and, thus, how to measure it.
- Just Transition concerns many different social effects on different groups (cf. Section 2.1) as well as a broad range of environmental (policy) areas (cf. Section 3.2). To end up with a manageable number of high-level indicators, it is necessary to take difficult prioritisation decisions.
- There are lot of existing, partly overlapping indicator sets with a huge number of environmental indicators (cf. Trinomics 2020) and of social (justice) indicators, too, but to date relatively few cover the environmental-social nexus. Therefore, a smart combination of existing indicators or the development of socially more disaggregated or even new indicators appears necessary.
- Some environmental (sub-)areas are currently covered better by monitoring than others, with regard to the number of indicators as well as the quality of coverage, i.e., the extent to which the indicators are robust, accepted by all, and regularly updated (Trinomics 2020).[6]
- Data availability (or comparability between MSs) can be a problem – especially in areas where the monitoring required is extensive and detailed and/or relies on modelling (Trinomics 2020).
- One has to keep in mind that outcome and impact indicators can reflect the success of public policies only indirectly and roughly (let alone the success of an action programme or of a single

[6] As Trinomics (2020) writes: "The best-accepted indicators (i.e. with the most consistency between different sets – on the assumption that indicators which are used in multiple sets are better accepted than those indicators only used in one set) can be found in the energy, waste and air quality areas. There is a much larger number of indicators in the biodiversity and water areas, with certain indicators being well accepted, but there is less consistency between the indicator sets(i.e. the number of indicators which appear in more than one set is low)and the number of indicators in some areas (e.g. soil quality) is low; - There are some areas which are of clear concern, but there is (as yet) no agreed indicator (or group of indicators) to capture the state: A good example of such an area is chemicals, where sales of chemicals is commonly used as a proxy, but this is a reflection of what data is available, rather than what damage chemicals might do. This is partly because the exact nature of the damage that chemicals do to the environment is not obvious, and is still a subject of research and debate."

instrument) since multiple cause-effect relationships are at work, affected by many additional factors and framework conditions. On the other hand, indicators for policy outputs can only be a rough indication of societal impacts.

2.5. Methodological approach

The search for Just Transition indicators in this paper is based on the following (partly parallel) steps:

1. Collecting existing environmental-social nexus indicators at the European level by a literature and web research, in particular of relevant (partly overlapping) indicator sets such as
   - the EU SDG Indicator Set,
   - the SDG index by SDSN & IEPP (2019),
   - the "State of the Environment" and other indicators from the EEA,
   - the European Core Health Indicators and "Health at a Glance" report (OECD & EU 2020)
   - the "Employment and Social Developments in Europe" 2019 report (DG EMPL 2019),
   - the EU Social Scoreboard,
   - the EU survey of income and living conditions (EU-SILC),
   - the Circular Economy Monitoring Framework
   - the EU Transport Scoreboard,
   - the European Semester country reporting
   - the Transitions Performance Index (TPI)
   - the Just Transition Mechanism/Fund eligibility indicators, and the Just Transition Fund output and result indicator list (Annex III of the proposed Regulation establishing the Just Transition Fund, COM(2020) 22 final)
   - the prototype resilience dashboards, as developed by the JRC (JRC121729, JRC121633) for the European Commission's 2020 Strategic Foresight Report
   - Several global/international indices (including European data), namely the Green Economy Progress Index, the Global Green Growth Index, the OECD Green Growth Indicators and the OECD Better Life Index, as well as the "Lancet Countdown" (Watts et al. 2021).
2. Categorising the existing indicators according to different thematic fields, social effects and actor groups affected (cf. Section 2.1), respectively the related policy goals (cf. Section 2.2)
3. Reflecting on the indicators' suitability for being (by themselves or in combination) a pyramid level 1 or 2 indicator (cf. Section 2.3), i.e., a headline indicator for a Just Transition
4. Reflecting on indicator gaps with regard to important aspects of a Just Transition taking into account the variety of thematic fields, social effects, actor groups, output/result/impact stages
5. Collecting feedback from experts from several Commission DGs / organisations & Oeko-Institut
6. Making suggestions for a small number of best available or potential (would-be) Just Transition headline indicators at pyramid level 1 & 2, taking into account the Better Regulation Guidelines on monitoring (see textbox), including the criteria of data availability / collection effort.

Textbox: Better Regulation Guidelines on regulatory monitoring

The Better Regulation Guidelines from the European Commission (EC 2017) suggest that monitoring frameworks should comply with the following principles:

- Collect *only what is relevant so as to minimise administrative burden.*
- *Automate as much as possible with the use of IT tools to shorten data collection and processing time.*
- *Use common reporting standards to increase interoperability and ease sharing of data in the context of different policy areas.*
- *Make maximum use of existing data to save time and increase coherence of results.*
- *Be transparent towards the stakeholders and opt for making data publicly available, preferably as "open data" (c.f. principles of the eGovernment Action plan).*

The Guidelines also suggest that a monitoring framework and its indicators should comply with the following 'RACER' criteria:

- *Relevant, i.e. closely linked to the objectives to be reached. They should not be overambitious and should measure the right thing (e.g. a target indicator for health care could be to reduce waiting times but without jeopardising the quality of care provided).*
- *Accepted (e.g. by staff, stakeholders). The role and responsibilities for the indicator need to be well defined (e.g. if the indicator is the handling time for a grant application and the administrative process is partly controlled by Member States and partly by the EU then both sides would assume only partial responsibility).*
- *Credible for non-experts, unambiguous and easy to interpret. Indicators should be simple and robust as possible. If necessary, composite indicators might need to be used instead – such as country ratings, well-being indicators, but also ratings of financial institutions and instruments. These often consist of aggregated data using predetermined fixed weight values. As they may be difficult to interpret, they should be used to assess broad context only.*
- *Easy to monitor (e.g. data collection should be possible at low cost).*
- *Robust against manipulation (e.g. administrative burden: If the target is to reduce administrative burdens to businesses, the burdens might not be reduced, but just shifted from businesses to public administration).*

3. Screening and assessment of existing indicators at the European level

This chapter provides an overview on existing (or officially considered) indicators at the European level, with reflections on their suitability for being a meaningful headline or strategy-level indicator for a Just Transition, either as they are, by further disaggregation, or in combination.

In Section 3.1, we start with important and established social indicators that already help monitoring justice and equality in the EU and member states, and which could also monitor a Just Transition in general. However, they seem to be too broad for monitoring environmental (transition) policy or even concrete actions in the EGD or the 8th EAP since environmental policy is only a very small factor in determining the broad social impacts monitored by these indicators.

The following sections (3.2-3.4) compile and assess more specific existing indicators that can help to monitor progress against the above mentioned (environmental) policy goals for a Just Transition. While all indicators listed have an environmental (policy) dimension as well as a social (e.g., socio-economic or health) dimension, they differ in the degree that (in)equality between different societal groups is already reflected, e.g., through disaggregation by income or other criteria.

Mirroring the three policy goals mentioned, these three sections are structured as follows:

- Environmental benefits, pollution & risks (3.2)
- Consumption- & social-participation opportunities for vulnerable groups (3.3)
- Employment & regional cohesion (affected by environmental policies/transitions) (3.4)

Each of the three sections is further divided into different sub-issues within the thematic field. For each sub-issue, these indicators are listed in tables (left column), together with important strengths and shortcomings (right column). Each sub-section concludes with a short summary assessment, followed by some preliminary suggestions for the way forward – in the short-term (possible to implement within 1 year), medium-term (around 3-5 years), and long-term ("ideal state", beyond 5 years) basis. Each of the three sections concludes with a cross-issue reflection, an identification of issue gaps and prioritised suggestions.

3.1. Important social indicators and indices too broad for an environmental policy perspective

The EU's '**Social Scoreboard** for the European Pillar of Social Rights' and, largely based on it, the EU's **SDG indicator list** include important and closely monitored social indicators. The following Table 2 presents key indicators in different social (policy) domains. For many of these, data disaggregated by socioeconomic or -demographic factors exists, e.g., by national employment statistics, or EU SILC survey data on self-reported health issues.

However, since environmental policy is a relatively small factor influencing these social indicators, they are *not* appropriate to specifically monitor environmental policy or transition effects, e.g., in the context of the 8th EAP or of environmental-policy strategies and action plans.

Indicators that are more closely linked to environmental (policy) aspects are taken up in the following section (3.2).

Table 2: Selection of existing key social indicators in the EU

Domain	Key indicators (selection)
Health	• "Share of people with good or very good perceived health" (SDG Indicator 03_20) (disaggregated, e.g., by age, sex, and income in the EU-SILC survey) • "Healthy life years [expectancy] at birth" (new SDG Indicator for goal 3, replacing "Life expectancy at birth" in future reporting (Eurostat 2021)) • "Share of the population aged 16 and over who report self-assessed unmet needs for medical care due to one of the following reasons: 'Financial reasons', 'Waiting list' and 'Too far to travel'" (SDG Indicator 03_60) (disaggregated, e.g., by age, sex, and income in the EU-SILC survey) More indicators available as part of the "European Core Health Indicators" (ECHI)
Poverty & social exclusion	• "People at risk of poverty or social exclusion" (SDG Indicator 01_10) (differentiated by age / childhood) and by tenancy status (owner, renter)) • "Severely materially deprived people" (SDG Indicator 01_30), potentially to be replaced by "Material and social deprivation rate (MSD)" (Eurostat 2021) • "In-work at-risk-of-poverty rate" (SDG Indicator 01_41) (e.g., differentiated by sex) More indicators and many sub-indicators differentiated along sociodemographic factors available in the Social Scoreboard and by the EU-SILC survey
(Un-) Employment	• "Employment rate", disaggregated by sex (SDG Indicator 08_30) • "Long-term unemployment rate", disaggregated by sex (SDG Indicator 08_40) • "Young people neither in employment nor in education and training", disaggregated by sex (SDG Indicator 08_20) • "Gender employment gap" (SDG Indicator 05_30)
Working conditions & skill development	• "Involuntary temporary employment" (Labour Force Survey indicator, tesem190) • "People killed in accidents at work (by sex) (SDG Indicator 08_60)[7] • "Standardised incidence rate of accidents at work per 100,000 workers" (European Core Health Indicator, ECHI 31) • "Percentage of employees who think that their health or safety is at risk because of their work" (European Core Health Indicator, ECHI 53) • "Adult participation in learning", disaggregated by sex (SDG Indicator 04_60) More indicators/data on working conditions available on the Eurofound website
Income & income distribution	• "Disparities in household income per capita" by country (SDG indicator 10_20) • "Income distribution" (SDG Indicator 10_41) • "Income share of the bottom 40% of the population" (SDG Indicator 10_50) • "Income quintile share ratio (S80/S20)" (Social Scoreboard indicator, tessi180) • "Gender pay gap" (unadjusted) (SDG Indicator 05_20)[8] More sub-indicators along sociodemographic factors available by the EU-SILC survey
Regional cohesion	• "Disparities in GDP per capita" by country (SDG indicator 10_10) • "Disparities in household income per capita" by country (SDG indicator 10_20) • "Disposable income of private households by NUTS 2 regions" (Eurostat, tgs00026)

[7] The corresponding global SDG indicator is more encompassing: Frequency rates of fatal and non-fatal occupational injuries, by sex and migrant status (global SDG indicator 8.8.1).

[8] The corresponding global SDG indicator is more encompassing: Average hourly earnings of female and male employees, by occupation, age and persons with disabilities (global SDG indicator 8.5.1).

	• "Employment rate by NUTS 2 regions" (Eurostat, tgs00102) • "Severe material deprivation rate by NUTS 2 regions" (Eurostat, tgs00104) • "People at risk of poverty or social exclusion by NUTS 2 regions" (Eurostat, tgs00107) • "People living in households with very low work intensity by NUTS 2 regions" (Eurostat, tgs00108)

Author's compilation of indicators taken from sources mentioned

The Joint Research Centre (JRC) aims to publish soon an "**EU Multidimensional Inequality Monitoring Framework**" as an interactive tool to monitor, map, track and compare inequalities across the EU along 10 "key life domains".[9] This will feature new (MS-level) indicators and offer new insights on inequalities related to a broad range of issue areas. However, apart from the domain "natural and environmental conditions", these indicators, too, will probably not be related closely enough with environmental policy as intended in the paper here.

Moreover, two important composite indicators (indices) exist:

- The "**Transitions Performance Index**" (TPI) is a new scoreboard that monitors and ranks (currently 72) countries on their transition(s) to sustainability, based on indicators (mainly SDG indicators) in four dimensions: a) economic (education, wealth, labour productivity, R&D intensity, industrial base), b) social (health life, work & inclusion, free or non-remunerated time, equality), c) environmental (greenhouse gas emissions reductions, biodiversity, resource productivity, energy productivity), and d) governance (fundamental rights, security, transparency, sound public finances). The TPI comes with (single-number) country performance score for each of the four dimensions as well as an overall score.
- The **SDG Index and Dashboards developed by SDSN & IEEP** (2019) include some more social indicators than the official EU SDG monitoring, such as the "Palma ratio"[10] or the "Subjective Wellbeing" Index[11] from Gallup. They finally come up with a "**Leave-No-One-Behind (LNOB) Index**" that summaries (as a single figure) the indicators related to the following four dimensions: a) extreme poverty and material deprivation; b) income inequality; c) access to and quality of services; d) gender inequality.

However, in both indices, social and environmental issues are measured separately from each other. Socio-environmental nexus issues, as discussed in the following sections (3.2-3.4), are not taken into account (apart from some housing and energy indicators in the LNOB).

Assessment & implications:

The TPI**,** LNOB or some of the official and well-established, often disaggregated EU SDG indicators just mentioned **could be used, even in the short term, as headline indicators to monitor a Just Transition in general**. (In addition, indicators on taxation level differentiated by income groups could be another option.) However, since environmental policy is only a very small factor influencing these indicators, they are **not appropriate to specifically monitor environmental policy or transition effects**, e.g., in the context of the 8th EAP or of environmental-policy strategies and action plans.

[9] These are (1) knowledge and skills, (2) health, (3) material living conditions, (4) natural and environmental conditions, (5) working life, (6) cultural life and recreation, (7) political participation and voice, (8) social and family life, (9) bodily integrity and safety and (10) overall life experience.

[10] The share of all income received by the 10% of people with highest disposable income divided by the share of all income received by the 40% of people with the lowest disposable income (SDSN & IEEP 2019).

[11] Subjective self-evaluation of life, where respondents are asked to evaluate where they feel they stand on a ladder where 0 represents the worst possible life and 10 the best possible life (SDSN & IEEP 2019).

3.2. Indicators on environmental benefits, pollution & risks

This sub-section compiles existing indicators that can help to monitor progress against the following policy goal for a Just Transition (cf. Section 2.2): "*While generally improving the state of the environment to people's benefit, socially just environmental policies also reduce inequalities in the distribution of environmental benefits, pollution and risks.*"

In the long-term, nearly all environmental aspects affect human well-being. However, only the more direct (health) effects on current generations are considered here.

The section is structured under the following fields:

- Air quality / exposure to air pollution
- Access to clean water
- Access to green (and blue) spaces
- Noise exposure
- Climate change effects
- Hazardous chemicals.

3.2.1. Air quality / exposure to air pollution

The following table shows European indicators on exposure to, and health risks from, air pollution.

Table 3: Indicators on air quality / exposure to air pollution

	Indicator	Strengths (+) & shortcomings (-)
1	**"Exposure to air pollution by particulate matter"**[12] (EU SDG indicator 11_50, ECHI 55)	+ health-related socio-environmental nexus issue + annual data updates for all measuring points in Europe and aggregated at country level - not put into relation with socioeconomic/-demographic data (exception: with regional socioeconomic data on a NUTS 2 and 3 level in the EEA 22/2018 report (EEA 2018) and the EEA geospatial data platform)[13]
2	"**Exposure to air pollutant concentrations above selected EU air quality standards**" and "… **above WHO air quality guidelines**"[14] (EEA indicator IND-34-en, CSI 004)	+ health-related socio-environmental nexus issue + annual data updates for all measuring points in Europa and aggregated at country level - not put into relation with socioeconomic/-demographic data

[12] Air pollution measured as the population weighted annual mean concentration of particulate matter at urban background stations in agglomerations (EEA/Eurostat).

[13] The report concluded that NUTS 2 regions characterised by lower socio-economic status tended to have higher levels of PM2.5, PM10 and O_3 pollution. However, for NO_2, the opposite was found: NUTS 2 regions with higher socio-economic status generally experienced higher levels of NO_2 pollution. The strongest associations were found between low socio-economic status and exposure to PM10, with both relatively poor and polluted NUTS 2 regions occurring in central, eastern and south-eastern parts of Europe (EEA 2018).

[14] Share of urban population exposed to air pollutant concentrations above selected limit and target values and above WHO air quality guidelines (EEA).

3	"**Premature deaths**" due to exposure to air pollution[15] (EEA Air Quality Report indicator)	+ reflecting direct health effects + annual data updates, aggregated at country level - methodological uncertainties - not put into relation with socioeconomic/-demographic data (exception: with regional GDP/capita data on a NUTS 3 level in the EEA geospatial data platform)
4	"**Years of life lost**" (YLL) due to exposure to air pollution[16] (EEA Air Quality Report indicator)	+ reflecting direct health effects + annual data updates, aggregated at country level - methodological uncertainties - not put into relation with socioeconomic/-demographic data (exception: with regional GDP/capita data on a NUTS 3 level in the EEA geospatial data platform)

Author's compilation of indicators taken from sources mentioned

The upcoming "EU Multidimensional Inequality Monitoring Framework" is expected to include additional indicators on unequal distribution of clean/polluted air.

Assessment of suitability and gaps:

- Air quality is an important environmental-social issue with major health impacts (although effects by exposure are influenced by personal vulnerability). Moreover, the EU has substantial policy competences in this domain.
- However, to be a real Just Transition indicator, concerned with distributional injustices, the indicators would need to be regularly put into relation with socioeconomic / -demographic factors – as done in the EEA 22/2018 report on a NUTS 2 and 3 level (EEA 2018). This might be local enough, if the purpose is to link to EU cohesion policy, as these spending routes are typically targeted within these spatial boundaries. However, if the reason is to highlight and address issues such as 'unjust' proximity to point sources between different social groups the spatial definition would need to be finer. The challenge here is to get very local socioeconomic data to match up / combine with very local environmental pollution data.

Implications & suggestions for the way forward:

- Short-term: Use one of the indicators above as a headline indicator for the monitoring framework of the Zero Pollution Action Plan, even without regular disaggregation (communicate instead the evidence from research on unequal distribution). The fact that indicator 1 has already been chosen as an SDG indicator and has already been disaggregated in the EEA 22/2018 report speaks in favour of it. (Meanwhile, indicator 4 has been included in the Resilience Dashboard for a green transition.)
- Medium-term: Regularly update the disaggregation and analysis by NUTS 2 and 3 levels as done in the EEA 2018 report and the EEA geospatial data platform.
- Long-term: Get and integrate more localised (yet standardised) socioeconomic and -demographic data to analyse the social distribution of air pollution.

[15] "Premature deaths (deaths that occur before a person reaches the expected age, i.e. the life expectancy for a country, stratified by sex) attributable to PM2.5, NO2 and O3 exposure in European countries (EEA).

[16] Number of years of life lost per 100,000 inhabitants attributable to PM2.5, NO_2 and O_3 exposure (EEA).

3.2.2. Access to clean water

The following table shows European indicators on people's access to clean water.

Table 4: Indicators on access to clean water

	Indicator	Strengths (+) & shortcomings (-)
1	"**Using safely managed water services**"[17] (SDG indicator in SDSN index)	+ access to clean water is environmental justice & health issue - latest country-level data from 2015 (WHO/UNICEF JMP) - most EU countries & EU average already above 95% (lowest value: 81.5%), i.e., only limited progress/change possible - not put into relation with socioeconomic/-demographic data
2	"**Bathing water quality**"[18] (EEA indicator CSI 022, WAT 004) ("Bathing sites with excellent water quality" used as EU SDG indicator 14_40)	+ access to clean bathing water is an environmental justice & health issue + annual data base until 2020 (aggregated at country level) - 95% of bathing sites met the minimum water quality standards and 85% had excellent quality (2019), i.e., only limited progress/change possible - not put into relation with socioeconomic/-demographic data - the indicator has recently been discontinued; no more assessments are foreseen (EEA Website)

Author's compilation of indicators taken from sources mentioned

Assessment of suitability and gaps:

- There are not many European indicators on access to clean water. Moreover, the existing ones lack socioeconomic/-demographic aggregation to be a real Just Transition Indicator.
- As the two indicators in the table show, water quality in the EU is pretty good, so the progress that can still be made in the future is finite, limiting the suitability as headline indicators.

Implications & suggestions for the way forward:

- Short- to medium-term: Further contribute to the WHO/UNICEF data collection for indicator 1, which could be updated on a more regular basis in the future.
- Medium- to long-term: Reflect how to integrate the socioeconomic distribution of access to clean water if problems remain in some EU countries.

3.2.3. Access to green (and blue) spaces

The following table shows European indicators on access to green spaces which have health-related and social benefits for people.

[17] Percentage of the population using a safely managed drinking water service. A safely managed drinking water service is one where people use an "improved" source meeting three criteria: it is accessible on premises, water is available when needed, and the water supplied is free from contamination. Improved sources are those that have the potential to deliver safe water by nature of their design and construction (SDSN & IEEP 2019, using WHO/UNICEF JMP data).

[18] Quality of identified bathing waters (inland and coastal) in EU in terms of compliance with standards for parameters introduced by the EU Bathing Water Directive (76/160/EEC), i.e. microbiological parameters (total coliforms and faecal coliforms) and physicochemical parameters (mineral oils, surface-active substances and phenols), as well as in terms of meeting standards for parameters introduced by the New Bathing Water Directive (2006/7/EC), i.e. microbiological parameters (intestinal enterococci and *Escherichia coli*) (EEA).

Table 5: Indicators on access to green space

	Indicator	Strengths (+) & shortcomings (-)
1	"**Share of green space in urban areas**"[19] (SDG indicator in SDSN index)	+ socioenvironmental issue related with health & well-being - no regular data collection (data on country-level) - not put into relation with socioeconomic/-demographic data[20]
2	"**Share of urban population without green urban areas in their neighbourhood**" (under consideration as EU SDG indicator (Eurostat 2021))	+ socioenvironmental issue related with health & well-being, with a clearer distributional dimension than indicator 1 - no regular data collection yet and important challenges for data collection according to the Commission (Eurostat 2021)

Author's compilation of indicators taken from sources mentioned

Assessment of suitability and gaps:

- Currently, there is no appropriate indicator. Regular data collection is necessary, together with putting the data into relation with income levels / poverty status or sociodemographic criteria.
- Access to blue spaces (i.e., waterbodies) has not yet been considered in European-level indicators but is included in a Scottish indicator (see following textbox) and academic discussion (e.g., Haeffner et al. 2017).

Implications & suggestions for the way forward:

- Short-term: Continue use of indicator 1 but advance preparations for a better (disaggregated) indicator (see next points, including reflections whether to include "blue spaces").
- Medium-term: Implement a survey-based indicator like in the Scottish best-practice example (see textbox) by including a question on proximity to green (blue) space in the EU SILC Survey.
- Long-term: Overcome the methodological challenges for implementing indicator 2, building upon existing geospatial data on green infrastructure from the EEA and the Copernicus Urban Atlas (see also DG REGIO's "A walk to the park?" report (Poelman 2018)), and putting the data into relation with regional socioeconomic-/demographic data.

Best-practice example from Scotland: Indicator "Access to Green and Blue Space"

This indicator measures the proportion of adults (i.e., population aged over 16 and residing in Scotland) who live within a five-minute walk of their local green or blue space. Green or blue space is defined as comprising public green, blue, or open spaces within residents' local areas (e.g., a park, countryside, wood, play area, canal path, riverside, or beach).

The figures for this indicator come from the Scottish Household Survey (SHS), which is a National Statistics product, produced by the Scottish Government.[21] It is reported under the "Environment" chapter. The indicator is considered stable when the annual change remains within two percentage points higher or lower than the previous year.

[19] The average share of urban green spaces and forests as a percentage of land area (SDNS & IEPP 2019), based on data from DG Regio (2018).

[20] According to information from the EEA, its briefing planned for autumn 2021 will explore the issues of access to green space at intra-city level for different socio-economic and demographic groups, using proxies such as locations of schools, hospitals, and population data at local administrative unit level wherever possible.

[21] In the most recent SHS publication (2019), access to green and blue space was reported under the heading "Environment". The publication reported that, in 2019, most adults (66%) lived within a five-minute walk of a green or blue area (the fraction remained stable since 2016). A five percentage-point difference can be observed between adults in deprived

The "access to green and blue space" indicator is disaggregated using the Scottish Index of Multiple Deprivation (SIMD), which looks at the extent to which an area is deprived across seven domains: income, employment, education, health, access to services, crime, and housing.

The frequency of visits and the level of satisfaction with the nearest green or blue space by rating of neighbourhood are also monitored by the SHS. All of these indicators are used to inform policy-making such as "open space strategies" and the Scottish Outdoor Access Code.

Sources: Scottish Government (n.d.) Access to Green and Blue Space, SHS Annual Report 2019, Scottish Government (2020) Access and enjoy nature – knowledge account, SHS Survey Data Explorer, Scottish Government (2020) Scottish Index of Multiple Deprivation 2020

3.2.4. Noise exposure

The next table shows European indicators on exposure to noise in residential areas/settings.

Table 6: Indicators on noise exposure

	Indicator	Strengths (+) & shortcomings (-)
1	"**Population living in households considering that they suffer from noise**" (by poverty status)[22] (EU SDG indicator 11_20; further disaggregated in EU-SILC survey)	+ the disaggregation by poverty status makes it a typical "environmental justice" indicator with a strong social component + yearly updated data base so far (changing now to a 3-year-cycle within the EU SILC survey: 2023, 2026…) +/- based on subjective perception (also reflecting noise tolerance which might differ between social groups) - includes noise from neighbours which is less an environmental policy issue than noise from traffic and industry
2	"**Exposure of Europe's population to environmental noise**"[23] (EEA indicator, IND-233-en)	+ focuses on unhealthy levels of noise from traffic and industry + yearly updated data base +/- based on the best available noise data reported by MS but limited comparability due to methodological differences and uncompleted data submissions by MS - not put into relation with socioeconomic/-demographic data (exception: EEA 22/2018 report relating exposure to some socioeconomic criteria on a NUTS 2 and 3 level and in cities covered by the Urban Audit)[24]

Author's compilation of indicators taken from sources mentioned

areas compared to adults in least deprived areas, whereby 62% of adults in the first group and 67% of adults in the second group have quick access to green or blue spaces.

[22] Proportion of the population who declare they are affected either by noise from neighbours or from the street (Eurostat).

[23] Two indicators available (both disaggregated by source of noise and by urban/rural areas):

a) Number of people exposed to average day-evening-night noise levels (Lden) ≥ 55 dB in Europe;

b) Number of people exposed to night-time noise (Lnight) ≥ 50 dB in Europe (EEA).

[24] The report concluded that generally, the associations between noise exposure and social vulnerability on a regional scale were weak. This may have been caused by the high spatial variability of noise, which was not captured in this assessment on account of the size of spatial units or the low noise threshold used, not distinguishing areas severely affected by noise. Nonetheless, people living in NUTS 2 regions characterised by lower income levels and in cities with high levels of unemployment tend to experience higher levels of noise (EEA 2018).

Assessment of suitability and gaps:

- Both indicators have important shortcomings: the first indicator is not focused on environmental noise, the second one cannot yet (EU-wide) be put into relation with socioeconomic/-demographic data at a spatial resolution sufficiently high to capture noise exposure.

Implications & suggestions for the way forward:

- Medium-term: Focusing the question in the EU-SILC survey for indicator 1 on environmental noise, or adding a separate question focusing on environmental / traffic noise.
- Long-term: Overcoming the methodological challenges and differences between MS to collect data for indicator 2 and allow for socioeconomic/-demographic disaggregation at a local level.

3.2.5. Climate change effects

The following table shows European indicators on different climate change effects that already have a clear social impact dimension (human health / vulnerability, household costs, adaptation). Indicators only on the frequency of flood or storm events are not included.

Table 7: European indicators on climate change effects

	Indicator	Strengths (+) & shortcomings (-)
1	"**Economic losses from climate-related extremes in Europe**"[25] (EEA indicator IND-182-en, CSI 042, CLIM 039)	+ relevant socioeconomic dimension of climate change effects + losses put into relation with demographic data (loss per capita) + regular data collection with calculations on MS level - based on statistics on natural catastrophes prepared by MunichRE, not publicly accessible - no disaggregation by socioeconomic/-demographic groups
2	"**Heating and cooling degree days**"[26] (EEA indicator CLIM 047)	+ temperature-based index designed to describe the need for the cooling (air-conditioning) or additional heating of buildings which has both a health and a household costs dimension + regular data collection on MS level (Eurostat series nrg_chdd_a) - does not reflect adaptation measures; i.e., no direct indication of well-being or increase of mortality (within vulnerable groups) - no disaggregation by socioeconomic/-demographic groups
3	"**Frequency of flood events**", "**Frequency of storm events**", "**Frequency of extreme temperature events**", "**Frequency of wildfire events**" (EM-DAT data)	+ time series on natural hazard events that get more frequent with climate change, including insurance data on single events and development of damage costs for the insured building portfolio + regular data collection (EM-DAT) on events per year since 1970 + country level timelines - no disaggregation by socioeconomic/-demographic groups

[25] Number of fatalities, and the overall and insured economic losses from weather and climate-related events in EEA member countries since 1980. "Weather and climate-related extreme events" are defined as meteorological events (storms), hydrological events (floods, mass movements) and climatological events (heatwaves, cold waves, droughts, forest fires) (EEA).

[26] Population-weighted heating and cooling degree days averaged over Europe (° C*d/yr) (EEA). "Heating degree days (HDDs) and cooling degree days (CDDs) are proxies for the energy demand needed to heat or cool. Degree days are the difference between the daily temperature mean, (high temperature plus low temperature divided by two) and 65°F. If the temperature mean is above 65°F, we subtract 65 from the mean and the result is Cooling Degree Days. If the temperature mean is below 65°F, we subtract the mean from 65 and the result is Heating Degree Days."

4	"**Fatalities due to flood events**", "**Fatalities due to storm events**", "**Fatalities due to extreme temperature events**", "**Fatalities due to wildfire events**" (EM-DAT data) ("fatalities due to floods" are also used as EEA indicator IND-347-en, CLIM 046)	+ fatalities as a clear health impact by natural hazard events, that also reflects effects of adaptation measures + regular data collection (EM-DAT) on events per year since 1970 + country level timelines - although fatalities are an important effect, other effects (injuries, but also financial effects) are not included - no disaggregation by socioeconomic/-demographic groups
5	**"Extreme Temperatures and Health"**[27] (EEA indicator CLIM036, IND-189-en)	+ Indicates association between extreme temperatures & mortality - no timeline - based on data from only four European cities - no disaggregation by socioeconomic/-demographic groups
6	"**Exposure of vulnerable populations to heatwaves**"[28] (Lancet Countdown indicator 1.1.2)	+ refers specifically to vulnerable population groups +/- data on European country level available as a map but data seems not available as data tables +/- Yearly data views for the period 1987-2018, but not clear whether indicator will receive regular updates
7	"**Vulnerability to Extremes of Heat**" (Heat vulnerability index)[29] (Lancet Countdown indicator 1.1.1)	+ refers specifically to vulnerable population groups +/- data on European country level available as a map but data seems not available as data tables +/- Yearly data views for the period 1990-2017, but not clear whether indicator will receive regular updates
8	"**Adaptation preparedness scoreboard**"[30] (SWD(2018) 460)	+ Indicates the level of adaption of important adaptation policies +/- Indicates policy action but not outcomes and impacts - no disaggregation of affectedness by socioeconomic/-demographic groups, or of policies particularly addressing vulnerable groups

Author's compilation of indicators taken from sources mentioned

Assessment of suitability and gaps:

- Some existing indicators provide insight about climate change effects (mainly through extreme weather events) on various geographic scales. While some reveal the frequency of and exposure

[27] Associations between temperature and mortality in four European cities (EEA). "Daily temperature and mortality data for four locations in Europe from the period 1985–2012 have been used to fit a standard time-series Poisson model for each location, controlling for trends and day of the week. Temperature–mortality associations were estimated with a distributed lag non-linear model and a multivariate metaregression that included temperature average and range". The cities are: London, Stockholm, Rome, Madrid.

[28] The change in the number of heatwave exposure events (with one exposure event being one heatwave experienced by one person aged over 65) and days of heatwave exposure in this population compared with the average number of events in the reference period (1986–2005). A heatwave was defined as a period more than 3 days at a given location where the minimum daily temperature was greater than the 99th percentile of the distribution of minimum daily temperature at that location over the 1986-2005 reference period for the entire year (Lancet Countdown).

[29] Population's vulnerability to heat using a composite index ranging from 0 to 100, which takes into account the proportion of the population over 65, prevalence of chronic disease, and the proportion of the population living in urban areas (Lancet Countdown).

[30] Share of adopted policies identified in the dashboard. Actions in progress count as half.

to extreme weather events, not directly reflecting the consequences (also influenced by adaptation measures), other indicators reveal specific impacts like fatalities or economic losses.

- However, most indicators lack a socioeconomic/-demographic disaggregation. Few indicators specifically take into account vulnerable groups, e.g., with regard to age and health status. The 22/2018 EEA report put data on extreme temperatures in relation to socioeconomic / -demographic data (i.e., vulnerability) on a NUTS 2 and 3 level and in Urban Audit cities.[31]

Implications & suggestions for the way forward:

- Short- to medium-term: Continue the use of the indicators listed in the table; and identify data needs and relevant data reporting streams to disaggregate and analyse the data by social (particularly vulnerable) groups (see also medium- to long-term suggestion). To do so, make use of the new European Climate and Health Observatory.
- In the meantime, distributional aspects could be also integrated in the Adaptation Policies Scoreboard (see indicator 8) and/or in the template for MS on "Information on national adaptation actions" in the Commission Implementing Regulation (EU) 2020/1208 (Annex 1).
- Medium- to long-term: Improve, regularly update and combine data sets so that they allow for analysis of distributional effects and evaluate in particular the affectedness of vulnerable groups with regard to damages, health risks and costs. One option could be to include questions in the EU SILC survey on climate-related health effects and costs, and/or investments in adaptation measures. (On the ability to keep homes adequately cool in summer, see also Section 3.3.1.)

3.2.6. Hazardous chemicals

The following table shows European indicators on chemicals with potential human health impacts.

Table 8: Indicators on hazardous chemicals

	Indicator	Strengths (+) & shortcomings (-)
1	"**Production and consumption of chemicals by hazard class**"[32] (Eurostat indicator env_chmhaz)	+ focuses on chemicals hazardous to human health + annual data updates (on aggregated EU level) - does not reflect actual exposure and health impacts, or their socioeconomic/-demographic distribution
2	**Use and risk of plant protection products** as shown by the Harmonised Risk Indicator No. 1[33] (EU Food Safety indicator, described in Directive (EU) 2019/782)	+ best available indication for trends on risks from pesticide use in farming and indirectly with regard to food consumption + annual data updates (on MS and aggregated EU level) - does not reflect actual exposure and health impacts, not to speak of their socioeconomic/-demographic distribution
3	**"Pesticide use per area of cropland (kg/ha)"**[34]	+ annual data updates, available on country level - does not take into account hazardousness of pesticides

[31] The report concluded that the NUTS 2 regions with low GDP, a high proportion of people of low socio-economic status and a high percentage of elderly people overlap with areas affected by high temperatures (EEA 2018).

[32] EU-27 production as well as consumption (considering net imports) of chemicals hazardous to human health, analysed according to five hazard classes (Eurostat overview, statistics).

[33] Harmonised Risk Indicator 1: Quantities of active substances placed on the market in plant protection products, calculated by a weighting factor (Commission website).

[34] Use of pesticides per area of cropland (which is the sum of arable land and land under permanent crops) at national level (FAO).

	(FAO indicator, taken up in the Transitions Performance Index)	- does not reflect actual exposure and health impacts, or their socioeconomic/-demographic distribution.

Author's compilation of indicators taken from sources mentioned

DG SANTE plan to publish two new indicators from 2021 onwards related to the two pesticide targets in the "Farm to Fork" Strategy: on a) the use and risk of chemical pesticides, and b) the use of more hazardous pesticides. These indicators are not finalised yet but will likely have the same strengths and weaknesses as indicator 2 in the table above.

Assessment of suitability and gaps:

- Having a high-level indicator on chemicals use or, more specifically, pesticide use seems important given that the EU's Farm to Fork and Biodiversity Strategies aim for a 50% reduction of both the overall use and risk of chemical pesticides and the use of more hazardous pesticides.
- However, the existing indicators do not reflect actual exposure and health impacts ("human biomonitoring"), or their socioeconomic/-demographic distribution. So far, there has been a lack of harmonised information at European level on this. The large Horizon 2020 project "European Human Biomonitoring Initiative" (HBM4EU, 2017-2021) responds to his gap. A main aim of the project is to bring together knowledge on how exposure to chemicals affects the health of different vulnerable groups, such as children, pregnant women, or highly exposed workers. Data will be made available via the "Information Platform for Chemical Monitoring Data" (IPCHEM). The project team proposed a methodology to develop human biomonitoring chemical exposure indicators and applied it to specific substances (Buekers et al. 2018).

Implications & suggestions for the way forward:

- Short-term: Continue the use of the indicators listed in the table.
- Medium-term: Develop core human-biomonitoring indicators (on issues with already good data availability) based on the work by the HBM4EU project.
- Long-term: Develop additional human-biomonitoring indicators by solving methodological challenges, including harmonising national datasets.

3.2.7. Cross-issue reflection, issue gaps and main suggestions

Reflection across sub-issues

- In general, the environmental pollution / risks issues in this section represent an important dimension of Just Transition in a broad understanding that includes "environmental justice", i.e., the social distribution of environmental benefits, pollution and risks.
- All indicators discussed in this section have a clear link to social issues, mainly in relation to human health and well-being. However, most of the indicators lack any disaggregation by socioeconomic or -demographic groups in order to be a "real" Just Transition / environmental-justice indicator. This is the main shortcoming which needs to be tackled in the future.
- The EEA 22/2018 report and the EEA geospatial data maps use socioeconomic / -demographic data at NUTS 3/2 level (and Urban Audit cities data) to consider air quality, noise and exposure to extreme temperatures. This is useful work but, as the report recognises, the level of spatial disaggregation possible (mainly NUTS 2) may well not be local enough. If the purpose is to link to EU cohesion policy then NUTS 2 is suitable, as these spending routes are typically targeted

within these spatial boundaries. However, if the reason is to highlight and address issues such as 'unjust' proximity to point sources the spatial definition would need to be finer.

- Whether disaggregated or not, most indicators deal with rather specific aspects that are not among the top political priorities, which makes them not particularly suitable as headline indicators at the level of the EGD or the 8th EAP. However, they might still be used as headline indicators at the strategy level (e.g., Zero Pollution Strategy, Chemicals Strategy).

Issue gaps

Some issue areas lack any established indicator in the EU (while in-depth research does exist):

- (unequally distributed) actual exposure to and health impacts from hazardous chemicals
- (unequally distributed) proximity to waste facilities & hazardous sites (as in the US, cf. textbox)[35]
- (unequal) distribution of natural resource consumption ("footprint inequality") and sharing of the further benefits from eco-system services beyond clean air and water

Best practice example: US Environmental Justice Screening & Social Vulnerability Index

With regard to socioeconomic and -demographic disaggregation, the **US Environmental Justice Screening (EJSCREEN)** can be seen as a role model. Eleven environmental indicators are combined with six demographic indicators (see Table 9).

Table 9: Indicators in the US Environmental Justice Screening

Environmental indicators	Demographic indicators
National Scale Air Toxics Assessment Air Toxics Cancer Risk	Percent Low-Income
National Scale Air Toxics Assessment Respiratory Hazard Index	Percent Minority
National Scale Air Toxics Assessment Diesel PM (DPM)	Less than high school education
Particulate Matter (PM2.5)	Linguistic isolation
Ozone	Individuals under age 5
Lead Paint Indicator	Individuals over age 64
Traffic Proximity and Volume	
Proximity to Risk Management Plan Sites	
Proximity to Treatment Storage and Disposal Facilities	
Proximity to National Priorities List Sites*	
Wastewater Discharge Indicator	

*Sites of national priority among the known or threatened releases of hazardous substances, pollutants, or contaminants

Source: EPA Website.

The environmental and demographic indicators come together to form Environmental Justice (EJ) Indices. Each environmental indicator has its own EJ Index but combines multiple demographic indicators. An EJ Index is calculated using the following equation: (The Environmental Indicator) x (Demographic Index for Block Group – Demographic Index for US) x (Population count for Block Group).

The EJ Index is higher in block groups with large numbers of low-income and/or minority residents with a higher environmental indicator value.

[35] There is some data on contaminated sites and their management in EU Member States (EEA) but large data gaps and methodological challenges remain, and the data is not put into relation with sociodemographic factors.

This analysis highlights which locations drive overall net disparity within a certain environmental indicator – disparity being defined as the difference between the environmental indicator's average value among certain demographic groups and the average in the rest of the US population.

The US Center for Disease Control and Prevention (CDC) has also developed a **Social Vulnerability Index** with 15 census variables at census tract level (which is approximately neighbourhood level, ranging from 2,500-8,000 inhabitants) that can, inter alia, be used to assess the distribution of climate vulnerabilities and adaptive capacities.

Main suggestions for the way forward

- Use the best available indicators as discussed in the sub-sections above. Especially the air quality indicators, and some indicators on climate change effects, are both well established and reflect political priorities which already make them suitable as headline indicators on the strategy level, even if data disaggregation is still lacking.
- Integrate, in a medium-term perspective,[36] new questions in the EU SILC survey (allowing disaggregation by different criteria) on a) access to green (& blue) space, and b) proximity to waste facilities & hazardous sites – or a more general question as in the SILC 2018 survey, when people were asked whether they experience "pollution, grime or other environmental problem in the area where they live", with SILC survey data allowing for social disaggregation.
- Continue and extend detailed analysis on distributional inequalities around issues for which coherent data collection, disaggregation and single-number indicators are more difficult, namely exposure and vulnerability to air quality, climate change and chemicals (risks).

3.3. Indicators on consumption- & social-participation opportunities for vulnerable groups

This sub-section compiles existing indicators that can help to monitor progress against the second of the above-mentioned policy goals for a Just Transition (cf. Section 2.2): "*Socially just environmental policies do not disproportionally burden vulnerable households with regard to consumption needs but rather offer opportunities for financial savings and social participation*".

It is further structured along the domains of

- Housing, including energy & water
- Mobility
- Food / nutrition.

3.3.1. Housing, including energy & water

The following table shows key European indicators on housing, energy and water.

For the complex issue of "energy poverty", no uniform definition exists and there are a large range of different (imperfect) indicators, as listed by the European Energy Poverty Observatory (EPOV Website). The following table includes three of them deemed particularly useful in the context of this paper as they take into account subjective well-being or household expenditure. The latter seem more appropriate than pure energy price indicators that do not reflect net cost effects, i.e., are not

[36] Only medium-term option because the regulation defining the content of the EU-SILC survey has just been updated (entering into force as of 1st January 2021) and will probably not be changed again within the next couple of years.

put into relation to other monetary developments like disposable income, transfer payments nor energy efficiency measures. The first two indicators in the table have also been central in the "Employment and Social Developments in Europe" 2019 report (DG EMPL 2019).

For indicators related to extreme weather, including heat waves and cooling needs, see Section 3.2.5 on climate change effects.

Table 10: Indicators on housing, including energy & water

	Indicator	Strengths (+) & shortcomings (-)
1	"**Inability to keep home adequately warm**" (by poverty status)[37] (SDG Indicator 07_60; further disaggregated as EU-SILC survey indicator ilc_mdes01)	+ well-established (SDG) "energy poverty" indicator + annual data updates for all MS available + detailed disaggregation by poverty status and other criteria +/- reflect both energy prices & housing quality, influenced by environmental policy – but also many other factors +/- "adequately warm" based on subjective perception - does not cover energy (expenses) beyond heating
2	"**Arrears on utility bills**" (e.g., by income decile, by household type)[38] (EU-SILC survey indicator ilc_mdes07)	+ well-established "energy poverty" indicator + annual data updates for all MS available + detailed disaggregation by income deciles and other criteria + include all forms of household energy & water supply - influenced by many factors beyond environmental policy
3	**Energy expenses as share of total expenditure** (by income quintile)[39] (Eurostat consumption expenditure data, hbs_str_t223)	+ well-established "energy poverty" indicator + disaggregation by income quintiles (in all MS) + includes all forms of household energy supply +/- reflect energy prices & energy efficiency, both influenced by environmental policy – but also many other factors - does not reflect subjective well-being / desired temperatures - data collection only every five years (2010, 2015, 2020…)
4	"**Population living in a dwelling with a leaking roof, damp walls, floors or foundation or rot in window frames or floor**" (by poverty risk threshold)[40] (SDG Indicator 01_60; further disaggregated as EU SILC survey indicator ilc_mdho01)	+ well-established (SDG) "energy poverty" and living-standard indicator + annual data updates for all MS available (changing now to a 3-year-cycle within the EU SILC survey: 2023, 2026…) + disaggregation by poverty status and other criteria +/- reflecting renovation (rate), influenced by energy retrofitting policies but also many other factors - does not cover energy expenses

[37] The share of population who are unable to keep home adequately warm (in total and by poverty status). The data collection is based on a survey, which means that indicator values are self-reported (Eurostat).

[38] The share of (sub)population having arrears on utility bills, based on question "In the last twelve months, has the household been in arrears, i.e. has been unable to pay on time due to financial difficulties for utility bills (heating, electricity, gas, water, etc.) for the main dwelling?" (EPO).

[39] Consumption expenditure for electricity, gas and other fuels as a share of income for different income quintiles (EPO).

[40] The share of the population (in total and by poverty status) experiencing at least one of the following basic deficits in their housing condition: a leaking roof, damp walls, floors or foundation, or rot in window frames or floor (Eurostat).

5	"**Using safely managed water services**"[41] (SDG indicator in SDSN index)	+ access to clean water is an important living standard issue - most EU countries & EU average already above 95% (lowest value: 81,5%), thus only limited progress/change possible - latest country-level data from 2015 (WHO/UNICEF JMP) - not put into relation with socioeconomic/-demographic data
6	"**Using safely managed sanitation services**"[42] (SDG indicator in SDSN index)	+ sanitation services is an important living standard issue, with still much leeway for progress in many Eastern EU countries - latest country-level data from 2015 (WHO/UNICEF JMP) - not put into relation with socioeconomic/-demographic data - not considerably influenced by environmental policy

Author's compilation of indicators taken from sources mentioned

Assessment of suitability and gaps:

- The indicators have a clear social (justice) dimension and most of them are already disaggregated by socioeconomic criteria (income group, poverty status), and also several sociodemographic criteria, which makes them suitable Just Transition indicators.
- However, it has to be kept in mind that environmental & climate policy is only one factor among others influencing energy costs / affordability and other housing / living issues.
- Given the importance of "energy poverty" and its political salience, it seems nevertheless advisable to have a headline indicator on the issue. The different energy poverty indicators all have their strengths and shortcomings (cf. Table above); no single indicator can capture the whole picture.

Implications & suggestions for the way forward:

- Short-term: Select one of the existing energy poverty indicators as a headline Just Transition indicator in the context of the EGD and/or 8th EAP. Since indicator 1 has already been chosen as an EU SDG indicator, it seems obvious to choose this one also as a headline indicator in the context of the EGD and/or 8th EAP. However, indicators 2 or 3 might be chosen in order to also cover important energy needs beyond heating (including cooling in summer, electric water heating, or cooking).
- Short- to medium-term: Consider communicating disaggregation by certain sociodemographic factors as prominent as currently done on income / poverty level.
- Medium-term: If indicator 1 is chosen, extend the question in the SILC survey from adequate heating ability to the ability to keep house adequately cool in summer (as already done in the 2012 EU SILC survey and foreseen as an option for the 2023 survey), or energy needs in general.

[41] Percentage of the population using a safely managed drinking water service. A safely managed drinking water service is one where people use an "improved" source meeting three criteria: it is accessible on premises, water is available when needed, and the water supplied is free from contamination. Improved sources are those that have the potential to deliver safe water by nature of their design and construction (SDSN & IEEP 2019, using WHO/UNICEF JMP data).

[42] Percentage of the population using safely managed sanitation services. Safely managed sanitation services are "improved" sanitation facilities that are not shared with other households, and where the excreta produced should either be treated and disposed of in situ, stored temporarily and then emptied, transported and treated off-site, or transported through a sewer with wastewater and then treated off-site. Improved sanitation facilities are those designed to hygienically separate excreta from human contact (SDSN & IEEP 2019, using WHO/UNICEF JMP data).

3.3.2. Mobility

The next table shows European indicators on access to and affordability of mobility.

Table 11: Indicators on mobility

	Indicator	Strengths (+) & shortcomings (-)
1	"**Real change in transport prices"** (by mode)[43] (EEA indicator, IND-173-en)	+ important issue influenced by environmental (transport) policy +/- yearly database until 2018 but recently discontinued! - difficult interpretation of rising costs for private car travel without information on availability of alternative modes
2	**Transport expenses as share of total expenditure** (by income quintile)[44] (Eurostat consumption expenditure data, hbs_str_t223)	+ important issue influenced by environmental (transport) policy + disaggregation by income quintile available - data collection only every five years, latest data from 2015 - desired level of mobility (without financial restrictions) unknown
3	"**Satisfaction with public transport**"[45] ("Quality of life in European cities" indicator from the European Commission's Urban Audit)	+ important issue influenced by environmental (transport) policy + survey asks about affordability, safety, accessibility, frequency, and reliability of service + data disaggregated by age group, household characteristics, gender, education level, and working status (not: income group) + survey conducted every three years (the 2019 survey was the first one that specifically asked about affordability, safety etc.) - survey conducted in 83 rather large cities (2019) across Europe, i.e., not representative, particularly leaving out rural areas.
4	"**Satisfaction with public transport**"[46] (SDG indicator in SDSN index, based on Gallup surveys)	+ important issue influenced by environmental (transport) policy + not limited to urban population (in contrast to indicator 3 above) + country-level data from 2018 ("or closest year available") - no timeline yet, and update uncertain - no disaggregation by socioeconomic/-demographic criteria
5	"**Consumer satisfaction with urban transport**" / "...**rail transport**"[47] (Consumer Market Scoreboard + EU Transport Scoreboard indicator)	+ important issue influenced by environmental (transport) policy + not limited to urban population (in contrast to indicator 3) +/- country-level data from 2013, 2015, 2017, but no update available since then - no disaggregation by socioeconomic/-demographic criteria

[43] Real (i.e. inflation-adjusted) change in transport prices by mode (EEA; based on detailed HICP data, prc_hicp_aind).

[44] Consumption expenditure for transport as a share of income for different income quintiles (Eurostat).

[45] Percentage of people satisfied with public transport in their city (Commission).

[46] Percentage of the surveyed population that responded that they were satisfied with the public transportation system in the city or area where they live (SDSN & IEPP 2019, based on survey data from Gallup).

[47] Based on the 'Market Performance Indicator' (MPI) – a composite index which indicates how well a given market performs, according to consumers (urban transport; rail transport). The MPI is calculated based on the components: comparability, trust, problems & detriment, expectations and choice.

6	"**Share of population with access to public transport by service level**"[48] (potential EU SDG indicator "on hold" due to data limits (Eurostat 2021))	+ important issue influenced by environmental (transport) policy + not limited to urban population (in contrast to indicator 3) - no data at MS or EU level expected in short-term (Eurostat 2021)

Author's compilation of indicators taken from sources mentioned

Assessment of suitability and gaps:

- There is no good indicator that reflects affordability (especially for low-income groups) and/or accessibility (especially for rural population) of mobility in general or public transport in particular.
- Indicator 3 has many strengths (including disaggregation) but is limited to cities, thereby neglecting the mobility needs and perspective from the rural population.
- Most of the indicators (apart from indicator 3) lack regular or ongoing updates.

Implications & suggestions for the way forward:

- Medium-term: Continue with indicator 2, if possible, on a more regular basis than only every five years. Moreover, develop & integrate, in a medium-term perspective,[49] an EU SILC survey question (which includes the rural population and allows disaggregation by several criteria).
  - on the ability to fulfil one's mobility needs in daily life – similar to the existing "ability to keep home adequately warm" data, and/or
  - more specifically, on the affordability and accessibility (maybe frequency) of public transport.
- Medium- to long-term: Overcome the data challenges for a non-survey-based indicator 6 (building upon the EU guidelines for local "access to mobility services" indicators), combined with socioeconomic/-demographic data, if possible – and/or create a non-survey-based indicator on the affordability of public transport (building upon the EU guidelines for local "affordability of public transport for the poorest group" indicators).

Best-practice example from Sweden: Use, costs, and accessibility of public transport

Statistics Sweden (SCB) collects data for the Swedish National Travel Survey (RVU Sweden) on behalf of the government agency Transport Analysis. A survey was conducted daily (through telephone interviews) during the period 2011-2016 and encompassed the entire Swedish population aged 6-84. More data was collected in 2019.

From the survey, it is possible to discern how public transport patronage varies by income50 and by geographic area (metropolitan vs rural). Municipalities are also grouped according to their profile (e.g. manufacturing municipalities, tourism and travel industry municipalities, municipalities in sparsely populated regions).

[48] Share of population with access to public transport by service level (EC 2019). This indicator is "on hold" due to limited data availability. Until 2019, the EU SDG indicator set already included a similar indicator ("Difficulty in accessing public transport by level of difficulty and degree of urbanisation") but always with data from 2012 (Eurostat).

[49] Only medium-term option because the regulation defining the content of the EU-SILC survey has just been updated (entering into force as of 1st January 2021) and will probably not be changed again within the next couple of years.

[50] Data on income is not publicly available but was used by Bondemark et al. (2020) to assess differences in public transport use by income level and geographic environment. The authors conclude that public patronage is widespread among those with very low and low incomes. In metropolitan areas, public transport use is common among more affluent individuals, but in the rest of the country, public transport use is more common among those with very low income relative to those with higher incomes. Using data from the Swedish household expenditure survey (HUT), they also conclude that low income individuals spend a larger share of their disposable income on public transport.

In addition, Transport Analysis conducted a population survey to clarify the accessibility of public transport for various groups of people with functional impairments, as well as for the Swedish population as a whole (aged 18+). Simple random sampling was used to select the respondents for an initial set of screening questions. The survey collected data on self-reported impairment, self-reported barriers to the use of public transport, and self-reported experience of avoiding public transport (bus, rail).

Sources: Transport Analysis (2020) Travel survey, Transport Analysis (2019) Barriers to public transport – A government investigation into public transport accessibility for people with functional impairments, The Swedish National Travel Survey 2019

3.3.3. Food / nutrition

The following table shows European indicators on food / nutrition related to access & affordability.

Table 12: Indicators on food / nutrition

	Indicator	Strengths (+) & shortcomings (-)
1	"**Inability to afford a proper meal every second day**"[51] (EU SILC indicator ilc_mdes03, hlth_dm030)	+/- reflects affordability of food as an important social issue – influenced by environmental policy but mainly by other factors + disaggregation, e.g., by poverty status, sex, and age + yearly updated data
2	"**Prevalence of moderate or severe food insecurity in the population**"[52] (global SDG indicator 2.1.2., no official EU SDG indicator)	+/- reflects affordability of food as an important social issue – influenced by environmental policy but mainly by other factors + captures more sub-aspects than indicator 1 above +/- yearly data 2014-2018 for EU-28 and 23 MS (incl. UK) +/- disaggregation by gender but no other criteria
3	**Food expenses as share of total expenditure** (by income quintile)[53] (Eurostat consumption expenditure data, hbs_str_t223)	+/- reflect food prices as an important social issue – influenced by environmental policy but mainly by other factors + disaggregation by income quintile available - data collection only every five years (2010, 2015, 2020...) - does not reflect actual food insecurity
4	**Annual price inflation of unprocessed food**	+ allows focus on unprocessed food which tends to be healthy food and reflects food prices as an important social issue + monthly data update

[51] Inability to afford a meal with meat, chicken, fish (or vegetarian equivalent) every second day (Eurostat).

[52] Prevalence of moderate or severe food insecurity in the population, based on the FAO's Food Insecurity Experience Scale (FIES) (cf. FAO). The FIES Survey Module (FIES-SM) consists of eight questions on people's food-related behaviours and experiences associated with increasing difficulties in accessing food due to resource constraints: "During the last 12 months, was there a time when, because of lack of money or other resources:

1. You were worried you would not have enough food to eat?
2. You were unable to eat healthy and nutritious food?
3. You ate only a few kinds of foods?
4. You had to skip a meal?
5. You ate less than you thought you should?
6. Your household ran out of food?
7. You were hungry but did not eat?
8. You went without eating for a whole day?"

[53] Consumption expenditure for food and non-alcoholic beverages as a share of income for different income quintiles.

	(Item in the Eurostat indicator for annual inflation in the euro area)	- does not reflect actual food insecurity

Author's compilation of indicators taken from sources mentioned

Assessment of suitability and gaps:

- The existing indicators have some strengths and shortcomings. A common shortcoming and general challenge for defining a Just Transition food indicator from an environmental policy perspective is the fact that food prices are influenced by many other factors than environmental policy.

Implications & suggestions for the way forward:

- Short-term: Use indicators 1 (or 2) and 4 in combination to reflect affordability of healthy food.
- Medium-term: Integrate, in a medium-term perspective,[54] a question in the EU SILC survey on the ability to buy healthy food, as a change to or in addition to an existing SILC survey question (every three years from 2022 onwards) on frequency of consumption of fruit and vegetables, and similar to the existing "ability to keep home adequately warm" question.

Best-practice example from the UK: Indicator "low or very low food security"

Data on food insecurity in the UK comes from the "Food and You" survey run by the UK's Food Standards Agency and includes a suite of food insecurity questions developed by the US Department of Agriculture (USDA). The data is used for reporting under the SDG 2.1.2 food insecurity indicator (mentioned indicated in Table 8 above). Respondents are allocated a score based on their responses – households that report three or more conditions indicating food insecurity are classified as 'food insecure'. A score of 0 indicates high food security, marginal food security consists of a score equal to 1 or 2, low food security consists of a score equal to 3-5, and very low food security consists of a score of 6-10.

Results are presented by a range of socio-demographic factors such as income level, working status, presence of children in households, age, gender, and country.

The survey takes place every two years and uses a random probability sample of adults aged 16+, living in private households in England, Wales, and Northern Ireland. Random probability sampling ensures that the results are representative of the population. Since 2014, results from "Food and You" have been published as an official statistic, reflecting the robust methodology of the survey.

Sources: SDG Indicator 2.1.1, Food Standards Agency (n.d.) Food and You, The Food and You Survey Wave 5 – Combined report for England, Wales and Northern Ireland, The Food and You Survey Wave 5 – Technical report

3.3.4. Cross-issue reflection, issue gaps and main suggestions

Reflection across sub-issues

- The indicators in this section deal with key consumption areas and most of them have a clear social (justice) dimension, with data already disaggregated by socioeconomic criteria (income group, poverty status). In principle, this makes them suitable Just Transition indicators.
- However, while several well-established and regularly updated indicators exist on "energy poverty", the status quo is worse with regard to mobility and food.
- For interpreting the indicators and drawing political conclusions from them, one has to keep in mind (and communicate well) that environmental & climate policy is only one factor among others influencing access to and affordability of energy, mobility and food.

[54] Only medium-term option because the regulation defining the content of the EU-SILC survey has just been updated (entering into force as of 1st January 2021) and will probably not be changed again within the next couple of years.

Issue gaps

Some issue areas lack any established indicator in the EU (while in-depth research does exist):

- Developments of residential rental prices and net housing costs (including energy costs) due to climate and environmental policy (e.g., retrofitting, "green upgrade" of residential areas)
- Social distribution of "prosuming", i.e., the ability to become a prosumer, e.g., by installing solar panels on rooftops, investing in local energy projects, or having a garden to plant vegetables
- Unequal distribution of resource consumption and emissions ("footprint inequality")
- The "fairness" of green taxes (in the context of overall taxation), including revenue recycling.

Main suggestions for the way forward

- Select one of the existing energy poverty indicators as a headline Just Transition indicator: probably the SDG indicator "ability to keep home adequately warm" while extending the question from heating needs only to also cover electricity needs.
- Develop & integrate, in a medium-term perspective,[55] EU SILC survey questions on the ability a) to fulfil one's mobility needs in daily life and b) to buy healthy (unprocessed) food, disaggregated by income or poverty status – similar to the existing "ability to keep home adequately warm" data.

3.4. Indicators on employment and regional cohesion (as affected by environmental policies / transitions)

This sub-section compiles existing indicators that can help to monitor progress against the third of the above-mentioned policy goals for a Just Transition (cf. Section 2.2): "*Socially just environmental policies positively affect quality & quantity of employment and, together with structural policy, they also open up perspectives for workers & regions affected by the transition*".

It is further structured along the domains of

- (Net) employment
- Working conditions
- Skill development
- Regional wealth and cohesion.

Section 3.1 already listed some key EU indicators in these domains but without a clear link to environmental policy and green transitions. As one will see in the following, the number of available indicators with such a clear link is very limited. Since most of them share the same shortcomings with regard to this paper's intention, their strengths and shortcomings are not mentioned separately in tables, as done above, but discussed together in the text.

3.4.1. (Net) employment

To generally reflect a Just Transition with regard to employment, one could use the well-established (un)employment (rate) indicators, as listed in Section 3.1. However, these indicators are too broad to reflect environmental policy impacts, as envisaged in this paper.

[55] Only medium-term option because the regulation defining the content of the EU-SILC survey has just been updated (entering into force as of 1st January 2021) and will probably not be changed again within the next couple of years.

To better reflect environmental policy impacts, one could, in principle, focus on "green jobs" that are created, in relation to lost jobs in "brown sectors" (net employment effect). It seems, however, that this is not usually or even officially done so far in monitoring or discussions on transitions to a Green Economy – apart from the "Lancet Countdown" which puts, in a global perspective, the number of jobs in fossil fuel extraction in relation to renewable and other low-carbon technologies (indicator 4.2.3). Existing EU indicators focus on "green jobs" (see following table):

- Employment in the environmental goods and services sector (EGSS) (Eurostat, env_ac_egss1)[56]
- Number of persons employed in circular economy sectors (CEy Indicators, cei_cie010)[57].

Assessment of suitability and gaps:

- While the number of "green jobs", however defined exactly, can be used as a headline indicator for a Green Economy, it is not an indicator reflecting a Just Transition.
- There are several challenges for defining a meaningful Just Transition indicator on employment from an environmental policy perspective:
  - First, it is not clear where to set boundaries in the definition of "green" and "brown jobs" beyond some core sectors. The "green job" indicators above have a rather narrow scope.[58] Moreover, people leaving "brown" jobs could move into other sectors than just "green" jobs.
  - Second, the extent and timing of a reallocation between "brown" and "green jobs" is also influenced by many other, especially economic factors beyond environmental policy.
  - Third, a single EU indicator does not say anything about the regional distribution of job reallocation (for the regional dimension, see Section 3.4.4), nor its sociodemographic distribution (with regard, e.g., to gender, age, or education / skill level[59]). People that benefit from new green jobs might be others than those losing a "brown job".
- While detailed economic analysis of sectoral, regional and sociodemographic job reallocation in the course of a transition is necessary, it seems unrealistic to have a suitable one-figure EU headline indicator that captures such distributional effects.

Implications & suggestions for the way forward:

- Short-term: Continue to use the existing employment indicators and reflect on the appropriateness of an (EU) indicator like in the (global) Lancet Countdown Report which puts the number of jobs in fossil fuel sectors in relation to the jobs in green economy sectors.
- Medium-term: Prepare, (let) conduct and regularly update detailed analysis of distributional employment issues, i.e., how well different social groups (particularly with regard to gender, age, and

[56] The EGSS is defined as that part of a country's economy that is engaged in two broad groups of activities and products: (1) environmental protection, i.e. preventing, reducing and eliminating pollution or any other degradation of the environment or (2) resource management, i.e. preserving and maintaining the stock of natural resources, hence safeguarding it against depletion (Eurostat).

[57] The total number of persons who work in the observation unit, i.e. the firm (inclusive of working proprietors, partners working regularly in the unit and unpaid family workers), as well as persons who work outside the unit who belong to it and are paid by it – e.g. sales representatives, delivery personnel, repair and maintenance teams – in the following three sectors: the recycling sector, repair and reuse sector and rental and leasing sector (Eurostat).

[58] DG EMPL has recently worked on a broader understanding of green jobs and varying degrees of "greenness" (DG EMPL 2019). They have also worked on a taxonomy of "greenable" jobs to identify the potential for "greening" activities or tasks within existing jobs (ibid.). The latter task goes beyond the question of created and lost jobs.

[59] DG EMPL has worked on education levels in the current Green Economy and in the transition to a climate-neutral economy, differentiated by sector (DG EMPL 2019).

education / skill level) adapt to the structural economic change in the green transition. (For regional distribution, see Section 3.4.4).

3.4.2. Working conditions

Indicators on the quality of employment (working conditions) are less straight forward than on the quantity of employment. Nevertheless, indicators on different aspects of job quality do exist: apart from the EU/Eurostat indicators already mentioned in Section 3.1 (on earnings, involuntary temporary employment, fatalities/injuries and perceived health risk at work), further indicators beyond Eurostat data exist, for example, on trade union membership and collective bargaining (cf. DG EMPL 2019), although data availability is more challenging here. However, all these indicators are not particularly influenced by environmental policy.

Environmental policy considerably influences only a small part of working conditions, namely environmental health issues such as dangerous substances and radiation, or emissions and immissions (including noise). However, to the best of our knowledge, there is no (regularly updated) EU indicator focused on such environmental health risks at work. At least, the EU Labour Force Survey (LFS) and the European Working Conditions Survey (EWCS) have sometimes (but not continuously) included survey modules asking for exposure to main risks, including chemicals, radiation, smoke/fumes or noise (cf. Eurostat 2010).

Assessment of suitability and gaps:

- Most indicators on working conditions are not very much linked to environmental policy.
- Data on environmental health risks at work seems to have been assessed only sporadically so far on the EU level.

Implications & suggestions for the way forward:

- Short- to medium-term: Make the existence and the social and sectoral distribution of environmental health risks at work an integral (regularly updated) issue of the LFS and/or the EWCS.
- Medium- to long-term: Prepare, (let) conduct and regularly update detailed analysis of socioeconomic working conditions (e.g., earnings, job security, right to organize) in Green Economy sectors, differentiating between different social groups (e.g., by age, gender, education / skill level), and also compared to other (including declining) sectors.

3.4.3. Skills development

Similar to the issues above, there are EU indicators on labour-market-related skill development (in particular, the SDG indicator 04_60, see Section 3.1) but they are not particularly linked to the transition to a Green Economy which will include changes in job profiles and skills required.

Beyond indicators, DG EMPL has worked on skill requirements in the current Green Economy and in the transition to a climate-neutral economy, differentiated by sector (DG EMPL 2019).

Closely linked to that transition, the proposed Regulation on the Just Transition Fund (COM(2020) 22) has a list of regional output and result indicators (Annex III) that aim to measure the impact of the JTF money spent and which includes the following indicators on skill development:

- RCR 97: Apprenticeships supported in SMEs, and
- RCR 98: SMEs staff completing Continuing Vocational Education and Training (CVET) (by type of skill: technical, management, entrepreneurship, green, other).

Assessment of suitability and gaps:

- Existing EU-wide indicators are not particularly linked to the transition to a Green Economy to serve as Just Transition indicators.
- Skill-development indicators for the Just Transition Fund are limited to SMEs and will only by assessed for those regions eligible to receive money from the fund.[60] Moreover, the data is not disaggregated by social groups benefitting.
- It is difficult to define a consistent set of qualifications that can be considered as green skills, and a key issue in work on this has been the need to include "green" issues in a wide range of conventional qualifications, from construction to law, to accountancy to architecture and purchasing. Assessment of such a "greening" of all qualifications has been difficult to achieve.

Implications & suggestions for the way forward:

- Medium-term: Collect, summarise and publish data on the JTF skill-development indicators.
- Medium- to long-term: Prepare, (let) conduct and regularly update detailed analysis of skill development needs and the impact of measures in the transition to a Green Economy, differentiating between different social groups (e.g., by age, gender, education / skill level, or sector).

3.4.4. Regional wealth and cohesion

As already shown in Section 3.1, there are many comparative EU indicators on wealth and cohesion between MS and also sub-national regions (mainly at the NUTS 2 level, see Eurostat). However, they are again not particularly linked to the transition to a Green Economy.

Assessment of suitability and gaps:

- The existing indicators mentioned in Section 3.1 are, in principle, suitable to monitor regional cohesion over time, also in the course of a transition. However, they can't be used to reflect effects from policies towards a Green Economy.

Implications & suggestions for the way forward:

- Short- to medium-term: Group "carbon-intensive regions" (based on the Just Transition Fund criteria)[61] and measure and communicate the development over time of one or several of the regional wealth / cohesion indicators for this group.
- Medium- to long-term: Prepare, (let) conduct and regularly update detailed economic analysis of the influence of Green Economy policies (not only on climate) on regional cohesion in the EU.

3.4.5. Cross-issue reflection, issue gaps and main suggestions

Reflection across sub-issues & issue gaps

- While established indicators exist on employment & regional cohesion issues exist (cf. Section 3.1) and can be used to monitor a Just Transition in general, they don't sufficiently reflect effects of environmental and climate policies for a Green Economy.

[60] For the eligibility and allocation method of the fund, DG REGIO has calculated at the NUTS 3 level the carbon intensity of the regional industry (ratio between its GHG emissions and gross added value) using the EPRTR database released by the EEA.

[61] For the eligibility and allocation method of the fund, DG REGIO has calculated at the NUTS 3 level the carbon intensity of the regional industry (ratio between its GHG emissions and gross added value) using the EPRTR database.

- In contrast, typical Green Economy indicators (e.g., number of green jobs) lack a social dimension, e.g., net (employment) effects and/or disaggregation by social groups.
- Moreover, most indicators or data collection is focused on climate & energy issues (sectors, carbon-intensive regions). Less attention is given to other issues, like agriculture & fishery.
- In general, distributional issues in this issue domain seem to be mainly a topic for detailed (economic) analysis than for easily collectable and interpretable indicators.

Main suggestions for the way forward

- Prepare, (let) conduct and regularly update detailed analysis of the influence of Green Economy policies (not only on climate) on the issues mentioned above and distributional effects.
- Group “carbon-intensive regions” (based on the Just Transition Fund criteria) and measure and communicate the development over time of one or several of the established regional wealth / cohesion indicators for this group.
- Another option could be some kind of public expenditure indicator that provides information about the (EU) money spent in support of regions and workers affected by the transition to a Green Economy (e.g., via Just Transition Fund, Modernisation Fund, Structural Reform Support Programme (SRSP), ETS auctioning revenues). (Some reporting on that is already done in the EU Climate Action Progress Report, but not as a single-number indicator.) This may also include spending on research & innovation for a green transition.

4. Summary and conclusions

The paper has confirmed the **diversity of social effects of environmental policy** and has revealed a broad range of existing European indicators to monitor certain aspects of them. Given the variety of effects within quite distinct issue domains (see the three Just Transition policy goals in Section 2.2, and the Sections 3.2-3.4), it seems **impossible to define a single 'perfect' Just Transition indicator**. Monitoring a Just Transition from an environmental-policy perspective **needs a combination of indicators** from different issue domains, and also **in-depth analyses going beyond single-number indicators**. Moreover, **many indicators need to be developed** further as has been shown in the previous sections and will be summarised in the following.

While the scope of the paper has been limited to social (distributional) impacts within Europe, it is also important to monitor international spill-over effects from EU policies to avoid burden shifting.

4.1. Shortcomings of the existing indicator landscape

The shortcomings of the existing European indicator landscape can be summarised as follows:

- Many **key EU social (SDG) indicators** (e.g., on health, poverty, income – often already disaggregated by certain social criteria) **and also composite indicators** such as the "Transition Performance Index" and the "Leave-No-One-Behind Index" (cf. Section 3.1) could be used as general justice or Just Transition indicators but **not to reflect environmental policy effects,** as envisaged in this paper, since there are far too many and more important influencing factors on these indicators apart from environmental policy.
- The **environmental benefits, pollution & risks issues** presented in Section 3.2 (e.g., air quality, climate change effects, chemicals) represent an important dimension of Just Transition and all indicators discussed in this section have a **clear link to social issues, mainly in relation to human health and well-being**. However, most of the indicators **lack any disaggregation by socioeconomic or -demographic groups** in order to be a "real" Just Transition (environmental justice) indicator. The EEA 22/2018 report combines pollution/risk data with socioeconomic data at a NUTS 2 or 3 level, but this does not show socially unequal distribution between different groups within communities.
- Some indicators **in key consumption areas** (cf. Section 3.3) have a **clear social (justice) dimension, with data already disaggregated by socioeconomic criteria** (income group, poverty status). However, while several **well-established and regularly updated indicators exist on "energy poverty", the status quo is less good with regard to mobility and food**.
- With regard to employment and regional cohesion in the context of a Green Economy, the situation is particularly challenging: while the **established employment & regional cohesion indicators lack a substantial link to Green Economy policies** (as mentioned above), **typical Green Economy indicators lack a social dimension**, not to speak of disaggregation by social groups (cf. Section 3.4). Moreover, most data and indicators are **focused on climate & energy issues**. Less attention is given to other issues and sectors, like agriculture & fishery.
- In general, there are **hardly any EU-wide policy output/response indicators** on these issues.

Beyond the gaps in the employment & regional cohesion domain, further **issues gaps** exist, i.e., issue areas at the environmental-social nexus which lack any established EU indicator so far (while there is, of course, research on these issues):

- (unequally distributed) actual exposure to and health impacts from hazardous chemicals

- (unequally distributed) proximity to waste facilities & hazardous sites
- (unequal) distribution of natural resource consumption ("footprint inequality") and sharing of the further benefits from eco-system services beyond clean air and water
- developments of residential rental prices and net housing costs (including energy costs) due to climate and environmental policy (e.g., retrofitting, "green upgrade" of residential areas)
- social distribution of "prosuming", i.e., the ability to become a prosumer, e.g., by installing solar panels on rooftops, investing in local energy projects, or having a garden to plant vegetables
- the "fairness" of green taxes (in the context of overall taxation), including revenue recycling.

4.2. Main suggestions

The sections in Chapter 3 already included suggestions for the way forward within each of the three issue domains related to the Just Transition policy goals (Sections 3.2 - 3.4). In the following, we summarise our suggestions across the issue domains and along the time horizon.

Main suggestions for making the best of the status quo:

- **Use composite indicators like the "Transition Performance Index" and the "Leave-no-one-behind Index" or (another selection of) the EU social SDG indicators** (cf. Section 3.1) as headline indicators to **monitor a Just Transition in general**[62], but not from an environmental policy perspective, e.g., in the context of the 8th Environment Action Programme.
- With regard to environmental benefits, pollution and risks, **use well-established indicators** as presented in Section 3.2 **as headline indicators at a strategy level, even if data is not yet disaggregated by social groups**. For example, use the SDG indicator for air quality as a headline indicator for the Zero Pollution Strategy – communicating that research shows that low-income groups and certain vulnerable groups are particularly affected.
- With regard to consumption issues (cf. Section 3.3), **select an energy poverty indicator as a headline indicator** at strategy level or even above (EGD), while communicating that environment and climate policy is only one influencing factor. Since indicator 1 has already been chosen as an EU SDG indicator, it seems obvious to choose it also as a headline indicator in the context of the EGD or 8th EAP. However, broader indicators might be chosen to cover important energy needs beyond heating, including cooling in summer, electric water heating and cooking.
- With regard to employment and regional cohesion issues in the transition to a Green Economy (cf. Section 3.4), continue to **use the general EU employment indicators**. One might also introduce an indicator like in the (global) Lancet Countdown Report which, over time, puts the **number of jobs in fossil fuel sectors in relation to the jobs in green economy sectors**.

Suggestions for continuing efforts:

- Essentially and across issue domains, start **discussions and preparations to better and continuously integrate** distributional **issues** (socioeconomic/-demographic disaggregation) **in data collection and assessment used for indicators**, starting with prioritised indicators.
- Continue and extend **detailed analysis on distributional inequalities** around issues for which coherent data collection and disaggregation for single-number indicators at EU-level remain challenging, including:

[62] E.g. as part of a potential European Green Deal monitoring.

- Exposure and vulnerability to air quality, climate change and chemicals (risks)
- Access to eco-system services, sharing of their benefits, resource consumption
- Access to and affordability of public transport, and mobility in general
- Distributional aspects of green taxes, retrofitting and "prosuming" opportunities
- Employment, working conditions, skill development, and regional wealth / cohesion effects in the context of a green transition.

Main suggestions for medium-term improvements (approx. 3-5 years):

- Introduce, as policy output/response indicators, one or several **public expenditure indicator(s) on (EU) money spent in support of consumers, workers and regions affected by the transition to a Green Economy** (e.g., via Just Transition Fund, Modernisation Fund, Structural Reform Support Programme, ETS auctioning revenues). This might also include spending on research & innovation, skill developments and infrastructure for a green transition. Outcomes and impacts of the money spent should be monitored accordingly.
- **Group "carbon-intensive regions" (based on the Just Transition Fund criteria) and start measuring and communicating the development over time of one or several of the established regional wealth / cohesion indicators** (cf. Section 3.1, e.g., employment rate or disposable income) for this group of regions.
- **Integrate new questions in the EU SILC survey**[63] which allows disaggregation by different criteria, for example (some prioritisation or generalisation[64] might still be necessary) on:
  - Access to green (& blue) space
  - Proximity to waste facilities & hazardous sites
  - Personal effects (damages, costs, investments) related to extreme weather events
  - Ability to keep home adequately cool in summer
  - Ability to fulfil one's mobility needs in daily life
  - Ability to buy healthy food.
- One might also think about **changing existing EU SILC questions** as follows:
  - regularly extending the EU SILC question on the "ability to keep home adequately warm" to the ability to keep home adequately cool in summer, or to energy needs in general
  - limiting the question on suffering from noise to only environmental (traffic, industry) noise.

Main suggestions for a nearly perfect situation in the long term:

- Overcome methodological challenges to **introduce easily interpretable indicators for those issues for which data collection and disaggregation is difficult** (see above), or **for which only survey-based indicators have been introduced so far** (e.g., affordability of mobility).
- Combine different indicators and **assess multiple exposure of certain social groups or regions** across the three Just Transition goals (e.g., combining energy poverty with losses of carbon-intensive jobs).

[63] Only medium-term option because the regulation defining the content of the EU-SILC survey has just been updated (entering into force as of 1st January 2021) and will probably not be changed again within the next couple of years.

[64] In the SILC 2018 survey, there was a general question on whether people experience "pollution, grime or other environmental problem in the area where they live".

Table 13 summarises the main suggestions along the three Just transition goals and a timeline.

Table 13: Overview on main suggestions

	Just transition goal 1 "While generally improving the state of the environment to people's benefit, socially just environmental policies also reduce inequalities in the distribution of environmental benefits, pollution and risks."	**Just transition goal 2** "Socially just environmental policies do not disproportionally burden vulnerable households with regard to consumption needs but rather offer opportunities for financial savings and social participation."	**Just transition goal 3** "Socially just environmental policies positively affect the quality and quantity of employment and, together with structural policy, also open up perspectives for workers & regions affected by the transition."
Immediate	• Use well-established health-related pollution/risk indicators, even without disaggregation yet, as headline indicators at a strategy level (e.g., air quality ind. for the Zero Pollution Strategy)	• Select one or two of the well-established indicators on energy poverty as headline indicator(s) at strategy level or even above (overall EGD monitoring)	• Use the general EU employment indicators, and eventually introduce an indicator which puts the number of jobs in fossil fuel sectors in relation to "green jobs"
Continuing effort	• Start discussions and preparations to better and continuously integrate distributional issues (socioeconomic/-demographic disaggregation) in data collection and assessment used for indicators, starting with prioritised indicators. • Continue and extend detailed analysis on distributional inequalities around issues for which coherent data collection, disaggregation and single-number indicators at EU-level are challenging, including: – Exposure and vulnerability to air quality, climate change and chemicals (risks) – Access to eco-system services, sharing of their benefits, resource consumption	– Access to and affordability of public transport, and mobility in general – Distributional aspects of green taxes, retrofitting and "prosuming" opportunities	– Employment, working conditions, skill development, and regional wealth / cohesion effects in the context of a green transition

Medium-term	• Integrate new questions in the EU SILC survey, e.g. (some prioritisation or generalisation might be necessary): – Access to green (& blue) space – Proximity to waste facilities & hazardous sites – Personal effects (damages, costs, investments) related to extreme weather events	• Integrate new questions in the EU SILC survey, e.g. (some prioritisation or generalisation might be necessary): – Ability to keep home adequately cool in summer – Ability to fulfil one's mobility needs in daily life – Ability to buy healthy food	• Introduce one or several public expenditure indicator(s) on money spent in support of workers & regions (& consumers) affected by the transition to a Green Economy • Group "carbon-intensive regions" (based on the JTF criteria) and measure one or several of the established regional wealth / cohesion indicators for this group of regions over time
Long-term	• Overcome methodological challenges to introduce easily interpretable indicators for issues for which data collection and disaggregation is difficult (see above) or for which only survey-based indicators exist so far. • Combine different indicators and assess multiple exposure of certain social groups or regions across the three Just Transition goals (e.g., combining energy poverty with losses of carbon-intensive jobs).		

Authors' own compilation

All suggestions should be taken only as a starting point for further discussion. The debate on monitoring the 8th EAP and the European Green Deal is very dynamic, with new indicators currently developed (also as part of the upcoming EU Multidimensional Inequality Monitoring Framework, cf. Section 3.1).[65] Taking advantage of new data and indicators, exploiting synergies, assuring coherence and avoiding duplicate work seem key.

[65] The JRC is also currently laying the groundwork for further development of just transition indicators via several current or upcoming streams of work related with the social aspects of the energy transition in domains such as energy and transport poverty, employment and skills, as well as energy communities. During the 2021-2022 work programme, an analysis of Eurostat's microdata will take place shedding light to sub-national inequalities and trends in the above thematises.

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