# Identifying common indicators for measuring the environmental footprint of electronic communications networks (ECNs) for the provision of electronic communications services (ECSs)

## Initial findings

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Stakeholder workshop
10 October 2023, Brussels, Belgium

# Structure of the presentation

- Brief Overview of the JRC
- Structure of the study
- The survey and the results
- Key findings of the preliminary study
- Future plan

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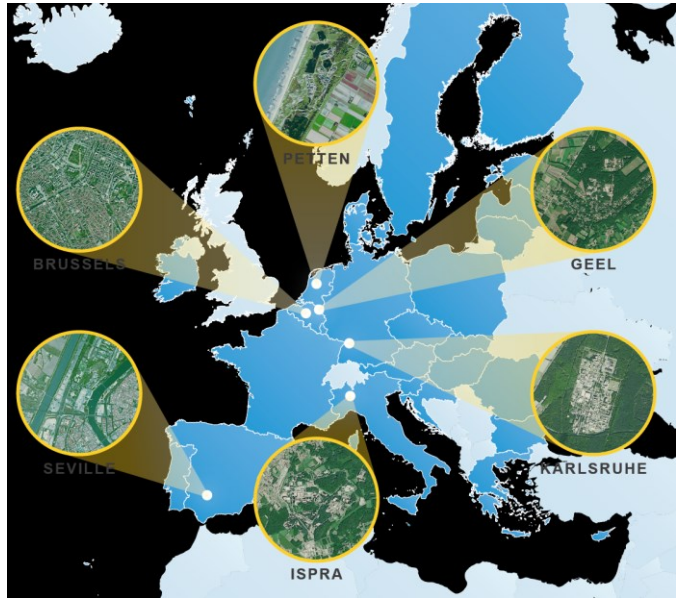
# JRC Mission

As the science and knowledge service of the European Commission our mission is to support EU policies with independent evidence throughout the whole policy cycle

- **Independent** of private, commercial or national interests
- **Policy neutral**: has no policy agenda of its own
- Works for more than **20 EC policy departments**




Over **1 400 scientific publications per year**

About **2 800 staff,** nearly **70 %** of whom are **scientific/technical staff**

**83 %** of core **research staff with PhDs**



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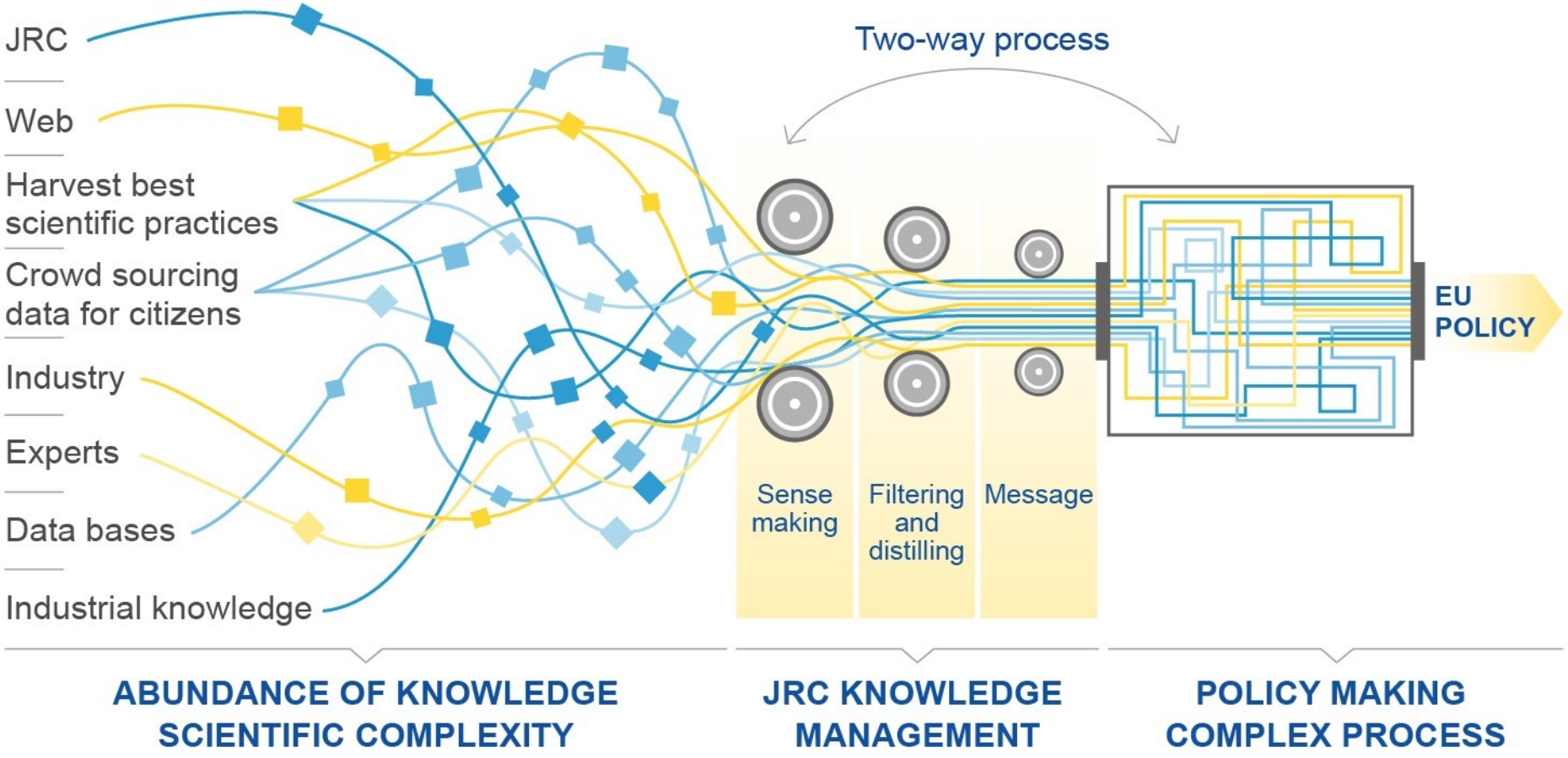
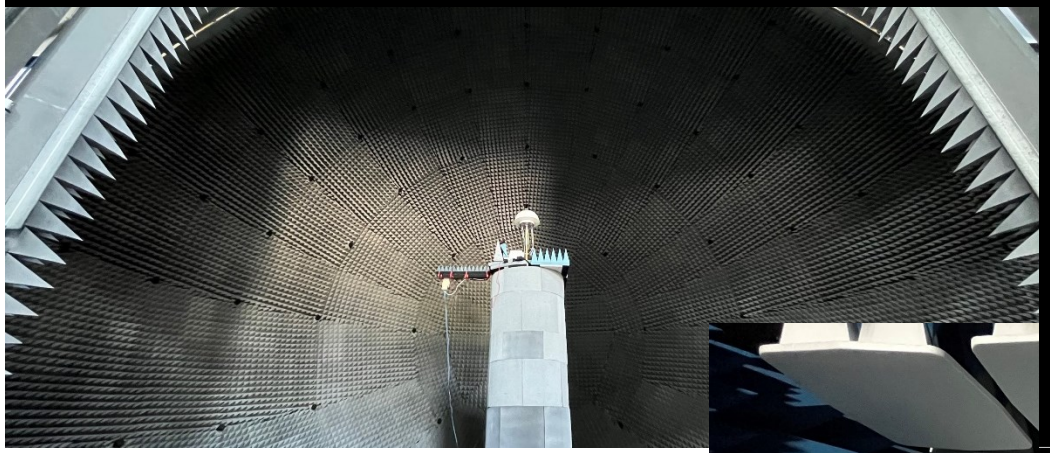
# Dealing with the information overload



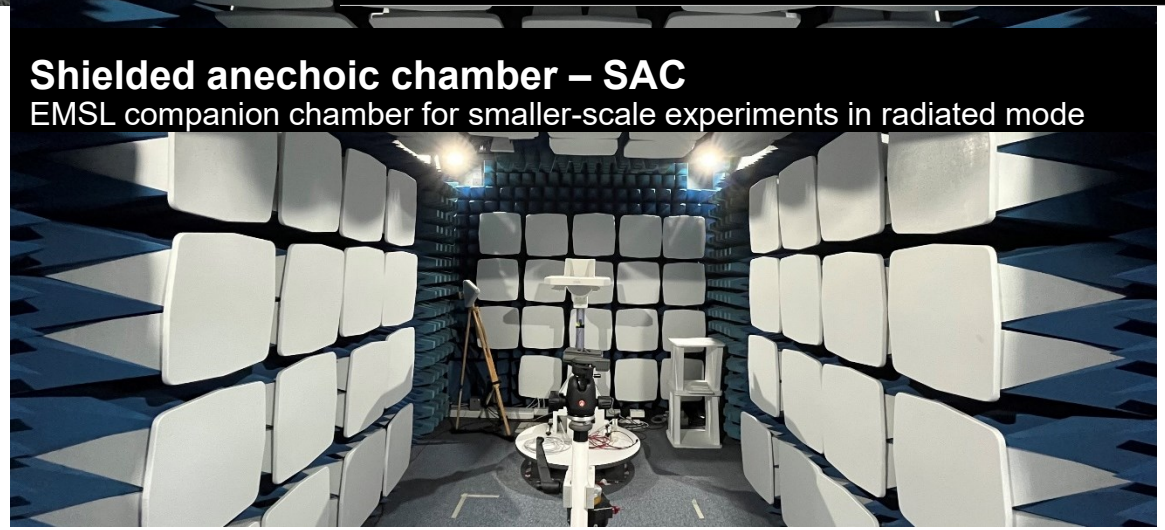
# Our team: Unit JRC.E.2

**European Microwave Signature Laboratory – EMSL**
20-meter diameter anechoic chamber for experiments in radiated mode



**Radio Spectrum Laboratory – RSL**
Research facility for prototyping and experimentation in conducted and radiated mode

**Shielded anechoic chamber – SAC**
EMSL companion chamber for smaller-scale experiments in radiated mode





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# Developing common indicators to enable the monitoring and benchmarking of the energy consumption and environmental footprint of communications networks

- Background of the JRC team: telecommunication networks and connectivity
- Aim of the work: Identification and prioritisation of the key sustainability indicators for telecom networks
  - Specific focus on evolution of the networks towards 5G and 6G
  - User equipment not in scope
- Ultimate goal: definition of Code of Conduct for sustainable telecom networks (by Q4 2025)
- Key points:
  - Literature review
  - Survey to collect input from stakeholders
  - Focus on links between indicators, their actual sustainability impact, standardisation and auditability (‘taxonomy-readiness by design’)
  - Building on the previous work by BEREC, IDEA, Öko-Institut, GSMA and others
  - Quantitative analysis to support the qualitative analysis

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# Survey

Published at: https://ec.europa.eu/eusurvey/runner/d02d3d09-69eb-0d64-0a7c-cf2d91fd3b74

Open from 26/5/2023 to 23/6/2023

**CNECT/JRC classification:**

"Must have" (essential)

"Should have" (preferable)

"Nice to have" (optional)

| Name of the indicator | CNECT/JRC classification: |
|---|---|
| Energy consumption | "Energy" indicators |
| Energy efficiency | |
| Use of renewable energy (rate) | |
| Carbon emissions - Direct emissions (e.g., scope 1) | "Climate" indicators |
| Carbon emissions - Energy direct emissions (e.g., scope 2) | |
| Carbon emissions - Other indirect emissions (e.g. scope 3) | |
| E-waste production | "Environment" indicators |
| Distribution or utilisation of recycled/refurbished/ reused products | |
| Recycled/refurbished/ reused components (also excavated masses) us*/895ed in products | |
| Recyclability | |
| Reparability | |
| Expected lifetime | |
| Raw materials depletion (mineral) | |
| Water usage/consumption | |
| Waste heat recovery | |
| Land use | |
| Eco toxicity (including incidence on biodiversity, water pollution…) | |
| Human toxicity (including air pollution) | |
| Eutrophication (terrestrial, freshwater, marine) | |

# Survey Scope

Scope: Collect feedback on the sustainability indicators for telecom networks and services from relevant stakeholders

- Survey should build on existing work by BEREC(1), IDEA, Öko-Institut, Visionary Analytics(2) and others
- Feedback should help identify the **acceptance** and **existing gaps** regarding sustainability indicators (e.g., standardisation and uniformity)

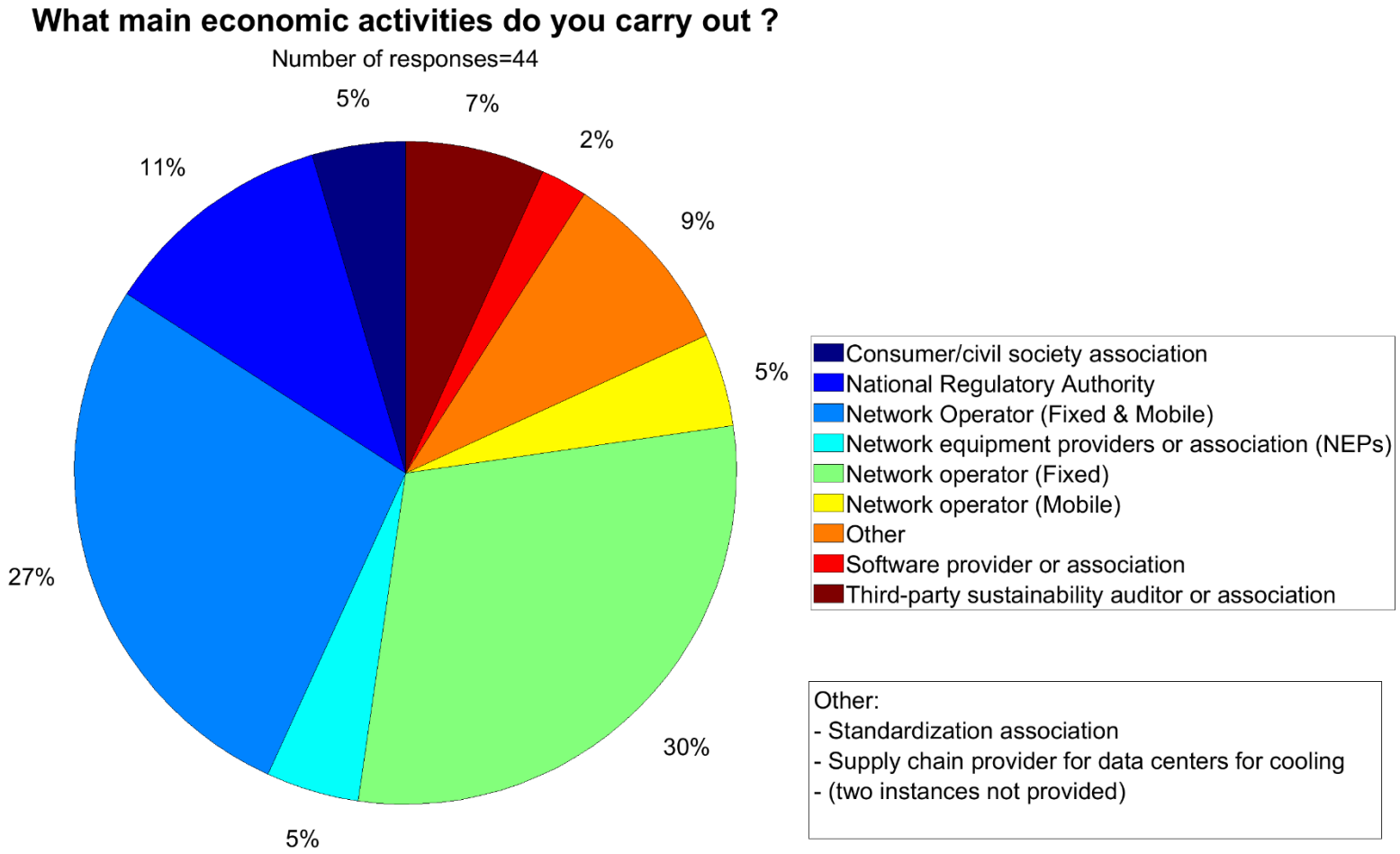
(1) BEREC, “Draft BEREC Report on Sustainability Indicators for Electronic Communications Networks and Services”, https://www.berec.europa.eu/system/files/2023-03/BoR%20%2823%29%2046%20Draft%20Report%20on%20sustainability%20indicators%20for%20ECN%20ECS%20%20%281%29.pdf

(2) Valentijn Bilsen et al. “Study on Greening Cloud Computing and Electronic Communications Services and Networks”, https://ec.europa.eu/newsroom/dae/redirection/document/84281

# Survey Questions

1. Identification of respondent
2. Acceptance of each sustainability indicators
3. For the indicators identified as “must have” by the respondent:
    a. Standards/guidelines used
    b. Standardisation maturity and gaps
    c. Auditing (e.g., mandatory, voluntary)
    d. Level of the network (RAN, fixed access, backbone, data centers for telecom, organisation, facilities)
    e. Complexity and cost of implementation
    f. Metrics
5. For network operators only: relevance of energy indicators in purchases and in Corporate Social Responsibility reports
6. For auditors only: uniformity of the indicators (high/medium/low)

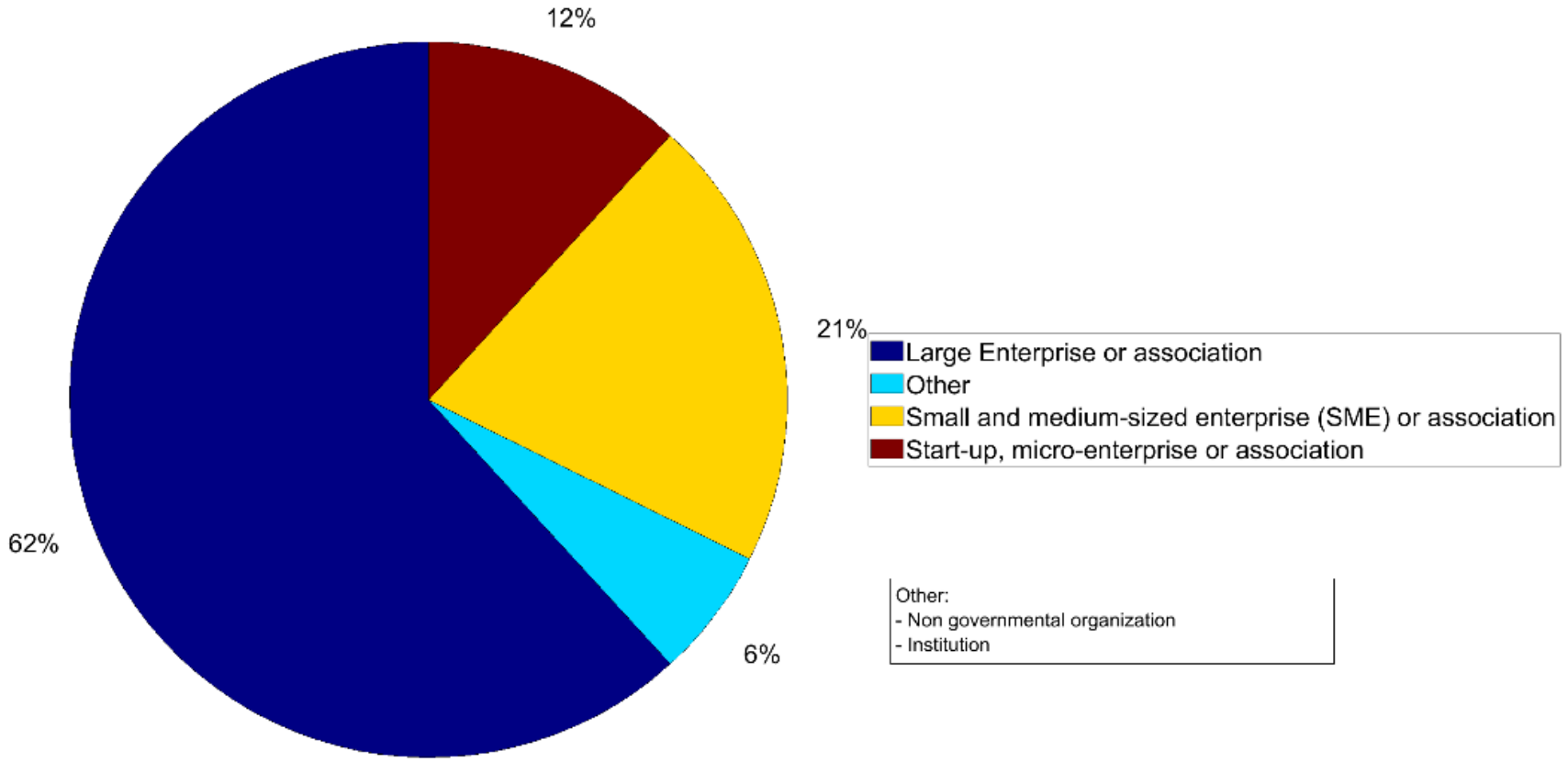
# Survey results:
## *Main economic activities of the respondents*



# Survey results:
## *Enterprise size of the respondents*

**If you are a private undertaking how would you categorise yourself ?**

Number of responses=34



# Proposed “Must Have” Indicators:

*Level of agreement of the respondents with MH/SH/NH classification*

Question: should the proposed MH indicator be classified as:

- MH: “Must have” → agreement with the proposal
- SH: “Should have”
- NH: “Nice to have”

| | (MH) Energy consumption | (MH) Energy efficiency | (MH) Use of renewable energy (rate) | (MH) Carbon emissions - Direct emissions (e.g., scope 1 emissions) | (MH) Carbon emissions - Energy indirect emissions (e.g., scope 2 emissions) | (MH) Carbon emissions - Other indirect emissions (e.g., scope 3 emissions) | (MH) E-waste production | (MH) Distribution or utilisation of recycled/ refurbished/ reused products |
|---|---|---|---|---|---|---|---|---|
| **MH** | 98% | 89% | 80% | 91% | 89% | 76% | 80% | 67% |
| **SH** | 2% | 4% | 7% | 2% | 7% | 13% | 11% | 22% |
| **NH** | 0% | 7% | 13% | 4% | 4% | 11% | 9% | 11% |

Percentage of respondents to the question agreeing (or not agreeing) with the proposed classification

# Proposed “Should Have” Indicators:

*Level of agreement of the respondents with MH/SH/NH classification*

Question: should the proposed SH indicator be classified as:

- MH: “Must have”
- SH: “Should have” → agreement with the proposal
- NH: “Nice to have”

| | (SH) Recycled/refurbished/ reused components (also excavated masses) used in products | (SH) Recyclability | (SH) Reparability | (SH) Expected lifetime | (SH) Raw materials depletion (mineral) | (SH) Water usage/ consumption |
|---|---|---|---|---|---|---|
| **MH** | 20% | 20% | 24% | 28% | 15% | 22% |
| **SH** | 59% | 72% | 72% | 63% | 65% | 59% |
| **NH** | 20% | 9% | 4% | 9% | 20% | 20% |

Percentage of respondents to the question agreeing (or not agreeing) with the proposed classification

# Proposed “Nice to Have” Indicators:

*Level of agreement of the respondents with MH/SH/NH classification*

Question: should the proposed SH indicator be classified as:

- MH: “Must have”
- SH: “Should have”
- NH: “Nice to have” → agreement with the proposal

| | (NH) Waste heat recovery/ reuse | (NH) Land use | (NH) Eco toxicity (including incidence on biodiversity, water pollution…) | (NH) Human toxicity (including air pollution) | (NH) Eutrophication (terrestrial, freshwater, marine) |
|---|---|---|---|---|---|
| **MH** | 9% | 11% | 13% | 13% | 11% |
| **SH** | 17% | 15% | 11% | 13% | 7% |
| **NH** | 74% | 74% | 74% | 72% | 80% |

Percentage of respondents to the question agreeing (or not agreeing) with the proposed classification

# Preliminary Results on Selected Indicators on **Energy**

| Selected sustainability indicators | Main standard/ methodology/ procedure used | Standardisation gap | Most important network components covered | Main audit process for this procedure | Main metrics for this procedure | Highest implementation cost for this procedure (CAPEX and OPEX) |
|---|---|---|---|---|---|---|
| **Energy consumption** | ISO **(25%)**<br>GHG Protocol **(18%)**<br>Global Reporting Initiative **(14%)**<br>ITU **(14%)** | No gaps **(28%)**<br>Minor standardisation gaps **(26%)**<br>Significant standardisation gaps for data collection **(23%)**<br>Significant standardisation gaps for data analysis **(19%)**<br>Other Considerations **(5%)** | BB **(19%)**<br>RAN **(18%)**<br>FAN **(18%)**<br>SF **(13%)** | Voluntary **(39%)**:<br>• self (21%), third party (18%)<br>Mandatory **(36%)**:<br>• third party (30%), self (6%)<br>No Audit **(21%)**<br>Other **(3%)** | Power consumed (e.g., MWh) **(68%)**<br>Tons of Carbon Dioxide **(18%)** | CAPEX <0.1%<br>OPEX <0.1%<br>* |
| **Energy efficiency** | ISO **(26%)**<br>Global Reporting Initiative **(18%)**<br>GHG Protocol **(15%)**<br>ITU **(15%)** | Significant standardisation gaps for data analysis **(39%)**<br>Significant standardisation gaps for data collection **(22%)**<br>Minor standardisation gaps **(22%)**<br>No gaps **(17%)**<br>Other Considerations **(0%)** | BB **(19%)**<br>RAN **(19%)**<br>FAN **(19%)**<br>SF **(13%)** | Voluntary **(52%)**:<br>• third party (32%), self (20%)<br>No Audit **(28%)**<br>Mandatory **(20%)**:<br>• third party (16%), self (4%)<br>Other **(0%)** | Power saved (e.g., MWh) **(34%)**<br>Data volume divided by energy consumption **(23%)** | CAPEX 0.5-1%<br>OPEX 0.5-1%<br>* |
| **Use of renewable energy (rate)** | ISO **(27%)**<br>GHG Protocol **(25%)**<br>Global Reporting Initiative **(23%)** | No gaps **(29%)**<br>Minor standardisation gaps **(29%)**<br>Significant standardisation gaps for data analysis **(21%)**<br>Significant standardisation gaps for data collection **(18%)**<br>Other Considerations **(3%)** | RAN **(18%)**<br>BB **(17%)**<br>FAN **(17%)**<br>SF **(12%)** | Voluntary **(48%)**:<br>• third party (26%), self (22%)<br>No Audit **(30%)**<br>Mandatory **(23%)**:<br>• third party (19%), self (4%)<br>Other **(0%)** | Share of renewable energy of total energy consumed **(51%)**<br>Renewable energy consumed **(28%)** | CAPEX 0.1%<br>OPEX 0.1%<br>* |

BB: backbone, RAN: radio access network, FAN: fixed access network, SF: server farm for distributed unit and centralised unit

*Low number of responses (less than one third of total participants)

# Preliminary Results on Selected Indicators on Climate

| Selected sustainability indicators | Main standard/ methodology/ procedure used | Standardisation gap | Most important network components covered | Main audit process for this procedure | Main metrics for this procedure | Highest implementation cost for this procedure (CAPEX and OPEX) |
|---|---|---|---|---|---|---|
| **Carbon emissions - Direct emissions (e.g., scope 1 emissions)** | GHG Protocol **(34%)**<br>ISO **(25%)**<br>Global Reporting Initiative **(14%)** | No gaps **(38%)**<br>Minor standardisation gaps **(32%)**<br>Significant standardisation gaps for data collection **(18%)**<br>Significant standardisation gaps for data analysis **(9%)**<br>Other Considerations **(5%)** | Facility **(17%)**<br>Organisation **(17%)**<br>BB **(15%)**<br>FAN **(14%)** | Voluntary **(42%)**:<br>• third party (21%), self (21%)<br>Mandatory **(40%)**:<br>• third party (29%), self (11%)<br>No Audit **(14%)**<br>Other **(4%)** | Tons of carbon dioxide equivalent **(65%)**<br>Power **(27%)** | CAPEX <0.1%<br>OPEX <0.1%<br>* |
| **Carbon emissions - Energy indirect emissions (e.g., scope 2 emissions)** | ETSI **(36%)**<br>GHG Protocol **(24%)**<br>ISO **(15%)** | Minor standardisation gaps **(38%)**<br>No gaps **(32%)**<br>Significant standardisation gaps for data collection **(16%)**<br>Significant standardisation gaps for data analysis **(11%)**<br>Other Considerations **(0%)** | BB **(17%)**<br>FAN **(17%)**<br>RAN **(15%)**<br>Facility **(14%)** | Voluntary **(55%)**:<br>• third party (36%), self (19%)<br>Mandatory **(37%)**:<br>• third party (30%), self (7%)<br>No Audit **(4%)**<br>Other **(4%)** | Tons of carbon dioxide equivalent **(69%)**<br>Power **(24%)** | CAPEX <0.1%<br>OPEX <0.1%<br>* |
| **Carbon emissions - Other indirect emissions (e.g., scope 3 emissions)** | GHG Protocol **(33%)**<br>ISO **(22%)**<br>Global Reporting Initiative **(17%)** | Significant standardisation gaps for data collection **(36%)**<br>Significant standardisation gaps for data analysis **(29%)**<br>Minor standardisation gaps **(17%)**<br>No gaps **(14%)**<br>Other Considerations **(5%)** | RAN **(16%)**<br>BB **(15%)**<br>FAN **(14%)**<br>Organisation **(14%)** | Voluntary **(56%)**:<br>• third party (36%), self (20%)<br>Mandatory **(24%)**:<br>• third party (20%), self (4%)<br>No Audit **(16%)**<br>Other **(4%)** | Tons of carbon dioxide equivalent **(72%)**<br>Power **(18%)** | CAPEX <0.1%<br>OPEX <0.1%<br>* |

 BB: backbone, RAN: radio access network, FAN: fixed access network, SF: server farm for distributed unit and centralised unit

*Low number of responses (less than one third of total participants)

# Preliminary Results on Selected Indicators on **Environment**

| Selected sustainability indicators | Main standard/ methodology/ procedure used | Standardisation gap | Most important network components covered | Main audit process for this procedure | Main metrics for this procedure | Highest implementation cost for this procedure (CAPEX and OPEX) |
|---|---|---|---|---|---|---|
| **E-Waste production** | ISO **(24%)**<br>GHG Protocol **(24%)**<br>ETSI **(20%)** | No gaps **(27%)**<br>Minor standardisation gaps **(27%)**<br>Significant standardisation gaps for data collection **(27%)**<br>Significant standardisation gaps for data analysis **(15%)**<br>Other Considerations **(3%)** | FAN **(22%)**<br>BB **(18%)**<br>RAN **(15%)**<br>SF **(11%)** | Voluntary **(54%)**:<br>• third party (31%), self (23%)<br>No Audit **(27%)**<br>Mandatory **(16%)**:<br>• third party (12%), self (4%)<br>Other **(4%)** | Weight of produced e-waste **(87%)** | N/A* |
| **Distribution or utilisation of recycled/ refurbished/ reused products** | ISO **(22%)**<br>Global Reporting Initiative **(20%)**<br>GHG Protocol **(17%)** | Significant standardisation gaps for data analysis **(33%)**<br>Significant standardisation gaps for data collection **(26%)**<br>Minor standardisation gaps **(22%)**<br>No gaps **(19%)**<br>Other Considerations **(0%)** | FAN **(19%)**<br>Network Switches and Routers **(18%)**<br>BB **(16%)**<br>RAN **(14%)** | Voluntary **(55%)**:<br>• third party (30%), self (25%)<br>No Audit **(40%)**<br>Mandatory **(5%)**:<br>• self (5%), third party (0%)<br>Other **(0%)** | Weight of recycled/refurbished/ reused products **(25%)**<br>Share of returned products **(23%)**<br>Number of refurbished products **(21%)** | CAPEX <0.1%<br>OPEX <0.1%<br>* |

BB: backbone, RAN: radio access network, FAN: fixed access network, SF: server farm for distributed unit and centralised unit

*Low number of responses (less than one third of total participants)

# Survey results: Summary

- The survey provided very good insights. We are thankful to all the participants!
- Many more figures and data on all indicators in the report
- Confirmed the initial assessment on most meaningful sustainability indicators
- Still some gaps in some areas:
  - standardisation
  - auditing

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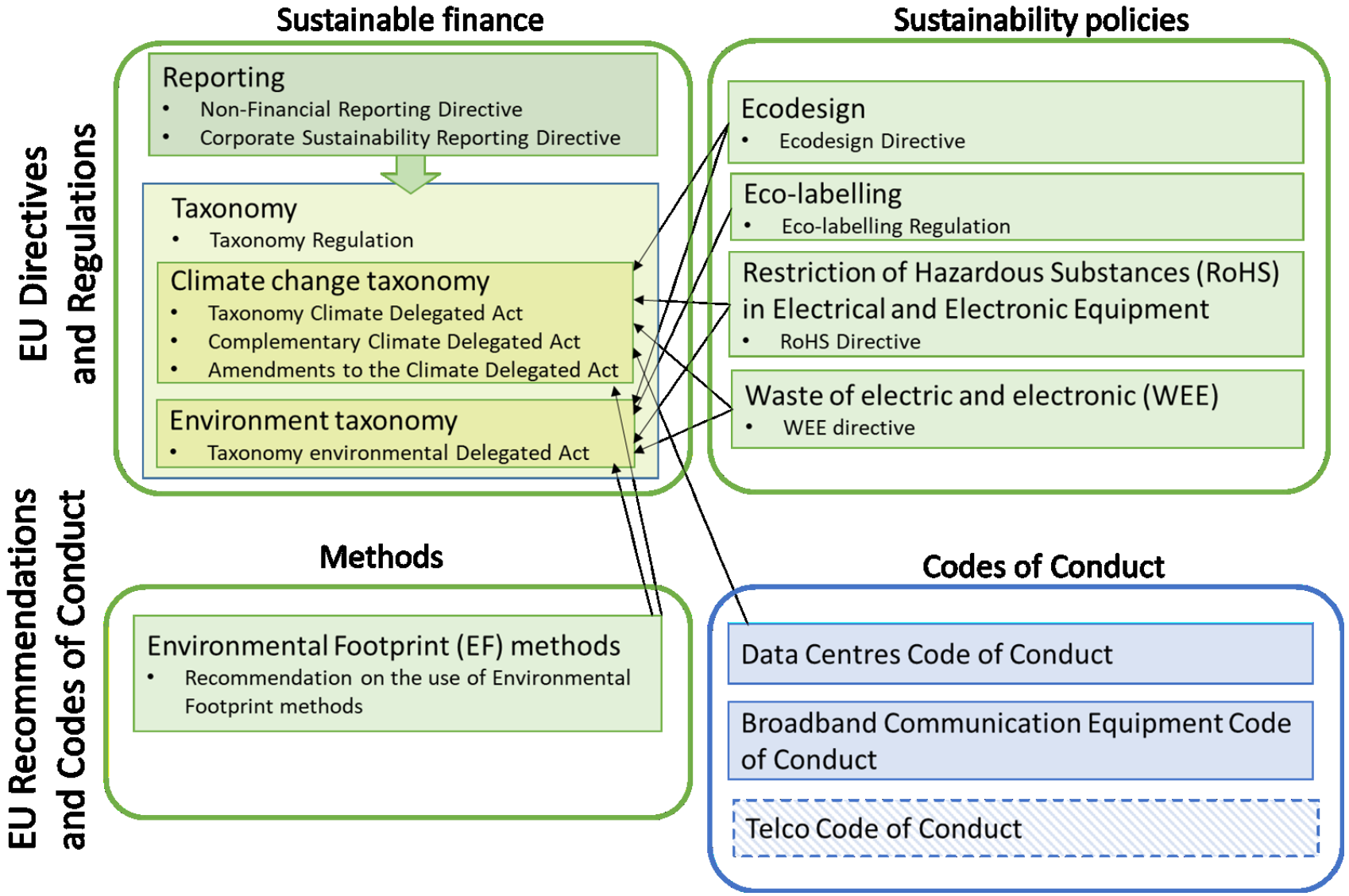
# Key findings:
## *Ongoing Policy and regulatory initiatives*



# Key findings:
## *Standardisation activities*

- Ongoing standardisation activities on measuring the environmental impact:
  - European Telecommunications Standards Institute (ETSI)
  - International Telecommunications Union – Telecommunications Sector (ITU-T)
  - International Organisation for Standardisation (ISO)
  - Greenhouse Gas Protocol Standards (GHG protocol)
  - Global Reporting Impact (GRI)
- ETSI Technical Committee Environmental Engineering and ITU-T SG5 are working together to develop technically aligned standards on energy efficiency, power feeding solutions, circular economy and network efficiency KPI and eco-design requirements for ICT

# Key findings:
## *Qualitative analysis*

For each sustainability indicator, analysis of the following aspects:

- Results from the EU survey
- Inputs and recommendations from literature and parallel studies
- Our own analysis and recommendations

Note 1: For some sustainability indicators (e.g., eutrophication), the input for the analysis was limited and some aspects were not addressed.

Note 2: We also conducted an analysis to evaluate the impact of the sustainability indicator across different stakeholders.

# Key findings:
# *An example for the energy consumption*

- **EU survey** results show that 98% of the participants consider this an important indicator (Must have).
- The *review of the literature* and parallel studies confirm this assessment (High relevance).
- **Standardisation maturity** (High): There are various standards already defined in telecoms networks to measure energy consumption.
- **Measurability** (High): Energy consumption can be calculated either from direct data collection from the power supply or from models based on data rate throughput.
- **Uniformity** (Medium): While there are many standards, this also led to fragmentation, as a company may choose among different standards, which can be a problem for reporting and auditing.
- **Minimisation of the implementation costs, pre-network deployment** (High): The collection of data on energy consumption in the network can be easily implemented with data collection points, even if the cost of an additional interface must be taken in consideration. It would be more effective to design and deploy data collection points in the design and pre-network deployment, but this could also be done in the deployment phase with power probes.
- **Minimisation of the operational costs, post-network deployment** (High): The collection of data on the energy consumption in the network at operational level can be relatively straightforward, even if some operational processes must be set up and personnel may be involved (but possibility of automation).

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# Future plan

Finalisation by the end of the year:

- Summarise the key findings of this stakeholder workshop in the report and revise the report in line with feedback
- Conduct a quantitative analysis of the trends in nationwide telecommunication networks
- Identify a list of key recommendations for a way forward towards a code of conduct

# Thank you

This presentation has been prepared for internal purposes. The information and views expressed in it do not necessarily reflect an official position of the European Commission or of the European Union.