European Commission

Study on Greening Cloud Computing and Electronic Communications Services and Networks

Towards Climate Neutrality by 2050

EXECUTIVE SUMMARY

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Öko-Institut e.V.
Institut für angewandte Ökologie
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VISIONARY ANALYTICS

Internal identification

Contract number: LC-01568995
VIGIE number: 2020-652

EUROPEAN COMMISSION

Directorate-General for Communications Networks, Content and Technology
Directorate E — Future Networks
Unit E2 — Cloud and Software

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European Commission
B-1049 Brussels

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2022 EN

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PDF	ISBN 978-92-76-46941-4	doi:10.2759/385014	KK-06-22-044-EN-N

Manuscript completed in November 2021

1st edition

Luxembourg: Publications Office of the European Union, 2022

Directorate-General for Communications Networks, Content and Technology

2022 EN

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Abstract

The current rapid digital transformation is characterized by an increase in the generation, use and transmission of data, and IT infrastructure, which in turn leads to an increased energy and resource consumption. Therefore in view of the EU Green Deal and related policy strategies, the digital transformation also requires a green transformation.

Therefore the broad objectives of this study are to propose i) policy measures for increasing the energy and resource efficiency of data centres as well as ii) policy options that could be included in a transparency mechanism on the environmental footprint of electronic communications services and networks (ECNs) and criteria for environmental sustainability assessments. A dual research strategy was followed, focussing on data centres and cloud computing on the one hand and ECNs on the other hand.

For data centres the study proposes primarily (a combination of) the following policy measures:

- Improvements to the Code of Conduct;
- Compulsory green public procurement criteria for publicly procured data centres, server rooms and cloud services; and
- The set-up of a European Data Centre Registry.

Concerning ECNs, the two main propositions are:

- The deployment of a energy efficient network infrastructure;
- The provision of eco-friendly telecommunications services by ECN operators.

Executive Summary

Context

The current rapid digital transformation is characterized by an increase in the amount of data to be recorded, processed, stored, and transmitted, entailing an increase in IT infrastructure and subsequent energy and resource consumption. This digital trend therefore raises concerns on its environmental impact, especially in the light of the European Green Deal which is aimed at a more digital and environmentally sustainable economy. To enable this twin – digital and green – transition, it will be important to introduce policy measures that enhance energy efficiency and circular economy practices in the ICT value chains. This study aims to inform and propose future policy measures, focusing specifically on cloud computing and data centres (DCs), as well as electronic communications services and networks (ECNs).

Objectives of the study

The objectives of this study can be categorized according to the two main parts of the ICT-value chain that are subject of this study:

Data centres and cloud computing:

1. To propose policy measures for increasing the energy and resource efficiency of data centres and assess the environmental, social and economic impact.
2. In support of that objective to perform:
    - An analysis of data centre definitions and types and determine meaningful size thresholds;
    - An analysis of current market practices related to circularity and identify potential ways to increase circularity;
    - An analysis of standards, metrics, indicators, methods and methodologies that are currently used in the field for assessing energy and resource efficiency and an assessment of their suitability for inclusion in policy measures
    - To identify gaps in the value chains where potential for energy efficiency and/or circularity is lost and potential measures to bridge these gaps;

Electronic communications services and networks:

1. To propose policy options that could be included in a transparency mechanism on the environmental footprint of ECNs and in view of this:
    - To report practices, indicators, standads and methodologies related to the environmental footprint of electronic communications networks and services;
    - To report on sustainability aspects of the service offered to consumers (in particular to assess a number of possible indicators in view of end-user communication and for analysing the impact of a voluntary and

mandatory transparency mechanism on the environmental footprint of electronic communications services and on relevant stakeholders.

2. To consider criteria for the assessment of the environmental sustainability of new electronic communications networks.

Methodology

In line with the objectives for respectively the data centres, and electronic communications services and networks, a sequential research approach was elaborated focussing first on indicators, practices and standards, and subsequently on the elaboration of policy measures for greening data centres, and policy options for transparency mechanisms for electronic communications services and networks.

Although each of the research topics listed in the objectives has its own approach and specificities, a set of cross-cutting methodologies were applied. First thorough desk research was performed where relevant academic and grey literature was reviewed. In parallel, in-depth interviews were held with top executives of data centres, network operators, cloud service providers, industry associations and experts with the purpose of gaining deeper insight in current market practices related to circularity. Additionally, three surveys were launched, tailored to the two respective target groups: DCs and ECNs/ECSs providers. These surveys provided further input from a total of 124 individual respondents. The interim results were presented and discussed in an online validation workshop and event. The validation workshop for the data centres was held Friday the 4th of June 2021 with representatives from private companies, and national associations from various Member States. The discussion of the intermediate results for the ECNs was held on Friday the 25th of June 2021 with company representatives and a representative from an EU association and 28th June with BEREC (Body of European Regulators for Electronic Communications) ad hoc working group on sustainability.

Policy measures for increasing energy and resource efficiency of greening data centres and cloud computing

On the basis of careful analyses, stakeholder feedback from the surveys, interviews, and more prominently from the online workshop, a number of policy measures can be proposed that are feasible, effective and specifically targeted to data centres and cloud computing. In our view this is a combination of:

- Improvements to the Code of Conduct (from here on referred to as the CoC);
- compulsory green public procurement criteria for publicly procured data centres, server rooms and cloud services; and
- the set-up of a European Data Centre Registry.

Other measures are interesting and useful as well, yet appear to be more focussed on particular aspects of data centres and cloud computing or rather indirectly affecting their energy and resource efficiency.

The **Code of Conduct** (CoC) is an important instrument in greening data centres. In this study a number of potential improvements have been assessed. Consultation with the stakeholders indicates that it is important to maintain the best practice approach and that its voluntary nature should be kept. Setting quantitative energy efficiency goals was perceived as challenging due to large regional differences across the EU in terms of climate, access to renewable energy sources and business models. An EU level playing field is key. Nevertheless in our view introducing a widely accepted quantitative energy efficiency target such as the PUE in combination with ranges that reflect differences in regional conditions and a classification of data centres should be feasible. Third-party monitoring is perceived as having a value added provided that the independence of the certifiers and confidentiality of the information can be guaranteed. In view of the perceived benefits of an improved version of the CoC, methods for increasing participation are valuable. Especially initiatives that reach out to SME data centres are welcomed, both to disseminate the expertise to implement the best practices as well as improvements in financing and business model development.

The change from voluntary to **mandatory GPP core criteria** for publicly procured data centres and cloud services would not only have an important signal function from authorities putting action to word in their own areas of operation, but would also foster the greening of data centres and cloud computing services overall. It has to be admitted that the private market segment is much larger. Yet in view of the increasing digitalisation of government services the public sector can create a critical mass and lead the market in the data centre and cloud services segment. As with the CoC, an EU level playing field is important, as well as equal access to the public data centre procurement market for small data centres.

The third most feasible policy measure is creating a **European Data Centre Registry** where energy consumption and material use are transparently reported. The registry can be developed in parallel and in consistency with the CoC improvement and mandatory GPP criteria indicated above. Critical points to be resolved are the treatment of confidential business information, the precise definition of indicators to be provided, and the control and management of the Registry. These are not unsurmountable challenges which can be adequately solved using e.g. a mutually agreed protocol between the data centre operators and the organisation responsible for the Registry. The Registry would be instrumental in monitoring and analysing the progress towards greening data centres, as well as in providing valuable market information for the stakeholders. In combination with the EU Data Centre

Registry and third-party control a voluntary **self-regulation initiative** might be worth considering. Yet opinions remain divided about the ultimate effectiveness of such an initiative.

Stricter requirements for the **Ecodesign Regulation on servers and data storage products** are instrumental to greening data centres and cloud computing. Yet the ultimate contribution to energy efficiency also depends on the entire operational process as well as the business model used. At the time of the study the Regulation is under review. After the adoption of the amendments which focus on a methodology to measure active and idle state power, it would be useful issuing an ecodesign preparatory study defining the minimum requirements for active and idle state performance, resource efficiency and operational conditions.

Although workshop participants indicated that access to finance is not a problem for DCs, the **Sustainable Finance Taxonomy Climate Delegated Act** remains a valuable policy measure that can facilitate investments in the refurbishment and introduction of new and greener technologies in DCs. In this context the streamlining with the eligibility criteria for Important Projects of Common European Interest, which at the time of the study are under revision, is important.

Other policy measures that initially were not directly targeted at data centres such as EMAS, the EED, the WEEE Directive, the CSR Directive, the EPBD, and the Green Claims, do have an effect on greening data centres, yet rather in an indirect manner. These measures surely help shaping a favourable regulatory environment, yet given that data centres and cloud computing services are the prime target of this study, and the indirect nature of these measures, these policy measures are not main candidates for greening data centres and cloud computing. However it remains important to guard the consistency and coherence between the direct measures, in particular the CoC and mandatory GPP, and the other measures as this would reduce compliance costs, create (lead) market leverage and as such increase the energy and resource efficiency of data centres. An important step in this direction has been taken by the adoption of the Fit for 55 package in July 2021.

Evidently policy measures need to be implemented and one of the key hindrances that need to be overcome in this respect is the myriad of concepts and **definitions of data centres** and the metrics to measure energy and resource efficiency. We analysed the various concepts that are used at the time of the study and concluded that it is recommended to use the definition in the CoC as a starting basis and further align it with the one of the EN50600 standard and then add these to the participant or best practice guidelines documents. We also recommend avoiding the use of the term ‘managed service provider’ to prevent confusion. More detail is provided in chapter 2.1. (Task 1.1.1.) where we among others present a taxonomy of DCs, and chapter 3.2. (Task 2.1.) where we analyse the definition in the context of applications for policy measures. The size criteria and thresholds as defined in the following table were perceived by the workshop participants as realistic.

Criteria and thresholds for dividing data centres according to size class (small, large, hyperscale)

	Small deployment	Large deployment	Hyperscale deployment
Floor size	100 m² - 1000 m²	1000 m² - 10.000 m²	more than 10.000 m²
Number of racks	6 to 200	200 to 2000	2000+
Power capacity	50kW – 1 MW	1MW – 10MW	10MW+

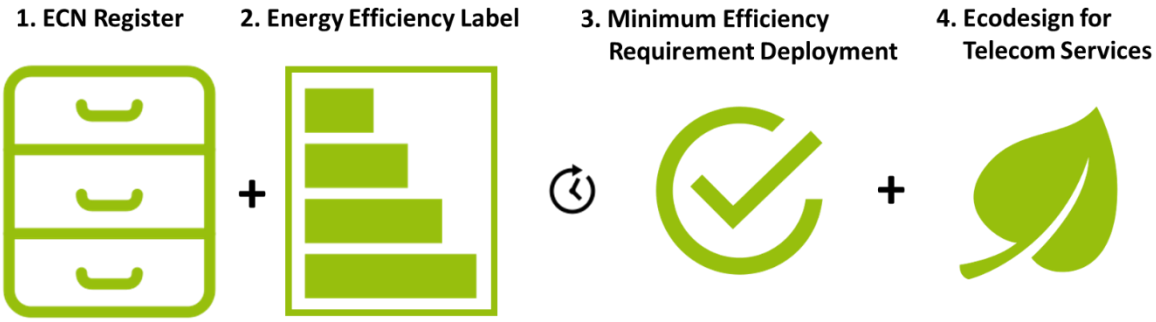
Concerning the **methods for measuring the energy and resource efficiency of data centres** (task 1.1.3) our analyses have shown that there are already a large number of different methods and metrics that focus on data centres and their individual components. Particularly useful are the metrics from the European Data Centre Standard EN 50600-4 key performance indicators (KPIs) series, some of them still under development, which very systematically describe the different environmental characteristics of data centres and support them with measurement methods. However the existing metrics have a clear focus on energy-related issues, and circular economy aspects are still insufficiently covered by the metrics. With regard to climate protection, leakage quantities of refrigerants from cooling systems and the associated greenhouse gas emissions are still insufficiently recorded.

Despite the challenges in terms of definitions and metrics, we conclude that by pursuing the three policy measures namely (i) improvements to the Code of Conduct, (ii) compulsory green public procurement criteria for publicly procured data centres, server rooms and cloud services and (iii) the set-up of a European Data Centre Registry and by simultaneously implementing coherent specifications in other (indirect) policy measures a favourable regulatory environment can be established that fosters greening of data centres and cloud computing, both for large multinational data centres as well as for SMEs operating in the edge segment.

Policy options for a transparency mechanism on the environmental footprint of ECNs and ECSs

Based on extensive analyses in the study one may conclude that there are currently **two main areas of focus to the ecological optimisation of telecommunications infrastructures**:

- The first focus is the **deployment of energy efficient network infrastructure**, for example in the construction of new mobile radio base stations or antennas, new fixed Internet access cabinets or the deployment of broadband cables.
- The second focus is the **provision of eco-friendly telecommunications services by ECN operators**, i.e. mobile telephony or broadband contracts, fixed telephone connections, fixed internet connections, business-to-business data lines, cable TV or other services that require a fixed or mobile connection to the electronic communications network.



Deployment of new network components

For the planning of new networks, the ECN sector has developed a variety of metrics (see tasks 1.2.3 and 1.2.5) to determine the energy efficiency of the components used already in the planning phase and to build energy-optimised systems. This practice could be further promoted by giving particularly energy-efficient networks a more favourable treatment, for instance in permit granting (e.g. accelerated procedures), in the use of public infrastructure (roads, cable ducts, facilities, frequencies), or in the selection procedures for state aid projects. This could be based on indicators such as the energy intensity of the network [kWh/GByte]. In addition, the study proposes that telecom operators record the energy intensity of the network in a central or national register (**ECN Energy Register**), similar to the register proposed for the data centres, in order to create an overview of the different providers and the efficiency of the different network technologies. Regulators, professional buyers as well as investors or financial institutions can get an overview of the efficiency of the respective provider by comparing within the database. The data contained in the proposed ECN energy register should be made available in such a transparent way that it can be further processed, for example to generate information for end-users on the efficiency of providers.

Transparency towards customers in the delivery of telecommunication services

One of the objectives of this study was to investigate what transparency measures by ECN providers could help to ensure that customers of telecommunication services can choose energy-efficient offers, thus creating competition for the most environmentally friendly services (see task 1.2.4). For this purpose, various metrics were considered as well as the opinions of consumer protection organisations were surveyed. The most promising possible transparency measure identified is the **introduction of an energy efficiency –type of label for telecommunications services**. The specific energy consumption of the communication service could be shown on the label in a colour scale as well as a classification from A to G. The label could also include information on the carbon footprint of the service and the share of renewable energies used. When selling and advertising telecommunication services, the energy efficiency label would need to be shown.

The existing instrument is already very well established on the market for many electrical appliances (lamps, refrigerators, washing machines, air conditioners, etc.) and it therefore offers good conditions for it to be well accepted by consumers. However, it should be noted

that in addition to methodological challenges, the existing efficiency label is assigned for physical products (goods) and could not be used for services. In addition to private customers, the information provided by the energy efficiency label could also be used by professional buyers and the public sector in the context of green public procurement (GPP). As a metric on which the efficiency scale is based, various options were discussed in the study.

It is important for a suitable metric that it should not be a pure performance metric that for example assumes maximum data traffic, but that the **energy demand must be related to an understandable and realistic usage unit** (e.g. per connection, per average subscriber or per hour of usage). In order to identify the best calculation method for the efficiency indicator, more research is therefore needed in the further design of an energy efficiency –type of label.

The need for minimum efficiency and Ecodesign requirements

Both proposed policy options (ECN energy register and energy efficiency label) are information tools that are intended to promote competition for the most efficient telecom service. So far, information on the energy efficiency of telecommunication networks and services is still very scarce. Network operators typically do not make such information publicly available. Therefore, it is also not possible to identify what energy consumption is appropriate for an electronic communications network. After the introduction of the transparency measures mentioned above, however, this data situation would change. The evaluation of the data in the proposed ECN energy register and the information on the energy efficiency label per telecom service could create the basis for identifying inefficient systems and services.

For the future, pure transparency measures could be expanded and policy instruments to set minimum efficiency requirements could be introduced. The study proposes two further instruments that could be considered in the coming years. With regard to the **deployment of electronic communication networks** (ECNs), the **introduction of minimum efficiency requirements** in the permit granting process or as prerequisite for subsidising deployment projects could promote efficiency competition. With regard to the telecommunication services (ECSs), **Ecodesign –type of requirements for telecom services** could set efficiency standards, and thus make the market more climate-friendly. However, it should be noted that the existing Ecodesign Directive applies to “energy-related products”, defined as goods, and not to services. For these two additional policy instruments, it was not yet possible to carry out impact assessments within the framework of the present study due to the unsatisfactory data situation.

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KK-06-22-044-EN-N

Publications Office
of the European Union

doi:10.2759/385014
ISBN 978-92-76-46941-4