COUNCIL

REPORT ON THE IMPLEMENTATION OF THE RECOMMENDATION OF THE COUNCIL ON INFORMATION AND COMMUNICATION TECHNOLOGIES AND THE ENVIRONMENT

(Note by the Secretary-General)

JT03435823

This document, as well as any data and map included herein, are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.
1. This note presents a monitoring report by the Committee on Digital Economy Policy (CDEP) on the implementation of the Recommendation of the Council on Information and Communication Technologies and the Environment [C(2010)61] (the Recommendation) and CDEP’s conclusions regarding the Recommendation’s continued relevance, dissemination and whether it requires updating or revision. The monitoring report, reproduced in Annex A to this document, presents progress made by Members and non-Members having adhered to the Recommendation (Adherents) in implementing the Recommendation. The report was discussed and approved by CDEP on 16 May 2018 [DSTI/CDEP/M(2018)1] with an agreement that its structure would be adjusted to align with most recent OECD practice, prior to its transmission to the Council.

Background

2. The Council adopted the Recommendation on 8 April 2010 to help strengthen the role of Information and Communication Technologies (ICTs) in addressing pressing challenges of climate change and resource sustainability. The Recommendation was developed in the run-up to the 2009 United Nations Climate Change Conference (the Copenhagen Summit), including the 15th Conference of the Parties (COP15) to the United Nations Framework Convention on Climate Change.

3. Adherents to the Recommendation acknowledge that ICTs can deliver results on many aspects of climate change and the environment, at three levels: i) directly through improving their own environmental performance, ii) via enabling investments in other sectors, for example, in “smart” infrastructures, and iii) through systemic effects, that change social and cultural behaviour.

4. The Recommendation instructs CDEP (referred to as the Committee for Information, Computer and Communications Policy at the time of its adoption) to “promote the implementation of this Recommendation and review such implementation after three years, and as required subsequently, to enhance the positive effects of information and communication technologies on the environment”. Non-Members are invited to adhere to this Recommendation and to collaborate with other Adherents in its implementation.

Methodology

5. The main tools used to collect information on the Recommendation’s implementation, dissemination, and relevance were questionnaires. In addition to information collection via the Committee’s Outlook questionnaires, a dedicated questionnaire (Annex B) was sent to Adherents, as well as Colombia and Costa Rica. This questionnaire was designed to collect information on strategies for ICTs and the environment, government initiatives, strengthening supply and demand, evaluating environmental impacts of ICTs and ICT policies, how the Recommendation has been used, and whether it should be updated and strengthened to better address environmental challenges and recent developments. All ten principles of the Recommendation are covered in the questionnaire and they were regrouped to cover recent developments and concerns. The review of the Recommendation’s implementation was co-ordinated with

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1 To date, Peru is the only non-Member Adherent.
the Environment Policy Committee (EPOC) to collect input from EPOC delegates on the questions that they deemed most relevant to their policy domain.

6. As of 6 April 2018, eighteen Adherents as well as Colombia and Costa Rica had provided replies to most parts of the questionnaire (Respondents):

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Note: ² The reply from Israel was provided by the Delegation to the EPOC. ³ Japan replied to question 6 on public procurement only.

Process

7. Main steps from the adoption of the Recommendation to this monitoring report included the following.

- Adoption of the Recommendation of the Council on Information and Communication Technologies and the Environment
- Monitoring of implementation of the Recommendation - first scheduled for PWB 2015-16, deferred to PWB 2017-18 due to resource constraints
- Discussion of background report and draft monitoring of implementation questionnaire
- Discussion of a first version of the monitoring report, based on a preliminary analysis of 13 replies to the questionnaire received by 3 November 2017
- Discussion of a revised version of the monitoring report, based on an analysis of 20 replies (including EPOC) to the questionnaire received by 6 April 2018
- Formatting and restructuring of the report to align with most recent OECD Practice
- Monitoring report to ExCo and Council

Dissemination

8. The Recommendation was effectively disseminated and increased awareness of the potential of ICTs to improve environmental performance among policy makers, among non-governmental organisations and the private sector, and among non-Members. Dissemination was achieved in three ways. First, the OECD promoted the Recommendation through dedicated discussions of ICTs and the environment in several publications, including flagships such as the *OECD Digital Economy Outlook* and its predecessor outlook publications in 2010 and 2012, as well as through the monitoring report on progress made since the Seoul Declaration for the Future of the Internet
Economy. Second, Adherents promoted the Recommendation to and among non-governmental organisations and the private sector. Third, Adherents promulgated the Recommendation to non-Members, notably in Latin America and in Asia.

Summary and conclusions

9. The global challenges of climate change and resource sustainability are of crucial and increasing importance, and ICTs play an important role in tackling these challenges. In this context, policy has a key and sometimes leading role, and the Recommendation has continuing relevance in providing a set of principles and a general policy framework for strengthening policies and enhancing their environmental impacts.

10. Implementation of the Recommendation has been effective to the extent that Adherents have increased their awareness of the potential of ICTs to enhance and improve environmental performance, and that policies increasingly consider and leverage this potential. Furthermore, replies indicate that issues related to ICTs and the environment have increased in importance for the majority of Respondents to the questionnaire, but also show that policies focus more on the ICT industry and direct ICT use, particularly on energy efficiency and reducing CO₂ emissions, and focus less on enabling “smart” applications and life cycle approaches. Environmental criteria are widely used in ICT goods and services procurement, but could be applied more rigorously, while Research and Development (R&D) and innovation policies are widespread. Relatively little information was provided on ICT-related green skills, education and training. Finally, targets, indicators (KPIs), assessment and evaluation are not yet systematically used and there is yet to be a widespread “evaluation culture”.

11. In their replies to the questionnaire, twelve respondents provided suggestions for improving the Recommendation, some of which could be considered in a future review or revision of the Recommendation. There were further suggestions regarding updating the Recommendation to take into account new developments, e.g. in emerging technologies. Nevertheless, at this time, the balance of responses to the questionnaire suggests satisfaction with the current Recommendation text.

12. In conclusion, the Recommendation provides useful guidance and is still relevant. Policies increasingly take into account the potential of ICTs to improve environmental performance and progress has been made particularly in terms of improving sharing of best practices, public procurement and more generally enhancing government leading by example (principles 6, 7 and 8 were specifically cited). However, there remain areas of weakness and lack of policy coherence that suggest more efforts are needed to further incentivise Adherents to implement the Recommendation as a whole in order to make a difference in helping meet global challenges, realise green growth and enhance the potentially positive impacts of ICTs on the environment.

13. In the near-term, CDEP can take the opportunity of on-going work on Going Digital to emphasise the importance of leveraging ICTs to improve environmental performance. In the medium term, Adherents should take a more pro-active stance in disseminating and fully implementing the Recommendation.

14. In summary, the Recommendation is still relevant. However, more implementation efforts are needed that could be further monitored by the CDEP, which may report to Council as appropriate.
Proposed Action

15. In the light of the preceding, the Secretary-General invites the Council to adopt the following draft conclusions:

THE COUNCIL

a) noted document C(2018)117, in particular the report set out in its Annex A, and agreed to its declassification;

b) encouraged Adherents to intensify their efforts to actively disseminate and implement the Recommendation as a whole;

c) instructed the Committee on Digital Economy Policy (CDEP) to continue promoting and monitoring the implementation of the Recommendation, and to report to the Council as appropriate.
Annex A.

1. BACKGROUND

1.1. Introduction

1. The Council adopted the Recommendation of the Council on Information and Communication Technologies and the Environment (the Recommendation) [C(2010)61] on 8 April 2010. The Recommendation instructs the Committee on Digital Economy Policy (CDEP, formerly the Committee for Information, Computer and Communications Policy) to promote the implementation of this Recommendation, review such implementation after three years, and as required subsequently, to enhance the positive effects of information and communication technologies on the environment. Non-Members are invited to adhere to this Recommendation and collaborate with other Adherents in its implementation.

2. The Recommendation was adopted to help strengthen the role of ICTs in addressing the pressing challenges of climate change and resource sustainability. Advances in ICTs can improve environmental performance in transportation and logistics, building and city management, manufacturing, and the distribution and consumption of electricity. Nevertheless, environmental challenges continue to increase and the means to address them need further reinforcement.

3. The Recommendation was based on extensive analysis of the role of ICTs in improving environmental performance. It was developed in the run-up to the 2009 United Nations Climate Change Conference (the Copenhagen Summit), including the 15th Conference of the Parties (COP 15) to the United Nations Framework Convention on Climate Change. It was widely seen that ICTs can deliver results on many aspects of climate change and the environment, at three levels: i) directly through improving their own environmental performance, ii) via enabling investments in other sectors, for example, in “smart” infrastructures, and iii) through systemic effects, that change social and cultural behaviour. The digital revolution is a pre-condition and driver to address the challenges of climate change and resource efficiency.

4. The Recommendation lays out ten policy principles that Members and non-Members having adhered to the Recommendation (Adherents) should implement, providing a general framework for enhancing the contribution of information and communications technologies to improving environmental performance. The ten principles cover: co-ordinating ICT, climate, environment and energy policies; adopting life cycle perspectives; supporting research and innovation in green technologies and services; developing green ICT skills; increasing public awareness of the role of ICTs in improving environmental performance; encouraging best practices; governments leading by example; improving public procurement; encouraging measurement; setting policy targets and increasing evaluation. Adherents are invited to disseminate this Recommendation throughout the public and private sectors, including governments, businesses, civil society and other international and regional organisations. Non-members are invited to adhere to the Recommendation and collaborate with other non-Members in its implementation, including its dissemination. Currently the only non-Member Adherent to the Recommendation is Peru (since January 2018).
1.2. Background to the 2010 Recommendation

5. Improving environmental performance, tackling climate change and boosting resource efficiency are urgent global challenges. The ICT industry was seen to need to improve its environmental performance, being responsible for around 2-3% of the global carbon footprint in 2008, and ICT applications were seen to have major potential to enhance performance across the economy and society (the remaining 97-98%).

6. A survey of policies and instruments in the public and private sectors undertaken in 2009 provided a firm basis for the Recommendation. The survey analysed 92 government programmes and business initiatives aimed at improving environmental performance via ICTs across 22 OECD countries plus the European Union. Fifty were introduced by governments and forty-two by business associations, mostly international. Over two-thirds focused on improving performance directly in the ICT industry and the use of ICTs. Only one-third focused on enabling applications of ICTs across the economy and society for example in “smart” urban, transport and power grid applications.

7. Close to two-thirds of government and business initiatives, many with multiple objectives, concentrated on reducing energy consumption and CO₂ emissions during ICT use. One-quarter of initiatives targeted reducing environmental impacts of disposal, and using ICT applications to reduce energy consumption and CO₂ emission during distribution and use of non-ICT goods. Other environmental impact categories such as biodiversity, water or land use were rarely targeted.

8. Government programmes covered the following policy domains:
   - R&D programmes were moderately common, including government Green ICT procurement often designed to increase innovation among providers.
   - Green ICT diffusion and applications was the largest group, including sharing best practices and eco labels and standards. Governments also encouraged organisational change - tele-working, e-government, and e-business - to reduce environmental impacts.
   - Promoting green ICT awareness and skills: These measures mainly included increasing awareness of consumers and users, and using applications such as smart metering.

9. Only one-fifth of all government programmes and industry association initiatives had measurable targets and performance indicators. Government programmes had hard targets more frequently than industry initiatives. On the input side, most government R&D programmes published R&D budgets. On the impact side, measurable targets most frequently focused on CO₂ emissions and energy costs.

10. It was concluded that much more was needed to develop and apply clear and measurable policies and initiatives to improve environmental performance of ICTs, and to apply “smart” ICT applications across the economy, and that policies and initiatives could be better co-ordinated and implemented internationally. The Recommendation built on these findings and was developed and adopted to help meet these challenges.

1.3. Recent developments

11. At global level, the importance of technology in tackling environmental challenges is crucial, underlining the pertinence of the Recommendation. ICTs contribute
in many ways to the seventeen United Nations (UN) Sustainable Development Goals, notably to: Goal 7, Affordable and clean energy, where technologies can improve efficiency and enable renewable energy sources to be harnessed; Goal 9, Industry, innovation and infrastructure, where technological development, research and innovation are driving forces; Goal 11, Sustainable cities and communities, where ICTs can help reduce the impacts of urban sprawl and air, land and water pollution; and Goal 13, Climate action, where ICTs are a crucial part of the process to slow and eventually reduce the global carbon footprint. Goal 9 can be accomplished specifically through enhanced international and domestic financial, technological and technical support, research and innovation, and increased access to ICT.

12. Policy and strategies to slow climate change are also shaped by technical development. The 2015 Paris Climate Conference (COP21) resulted in the Paris Agreement, entering into force in November 2016. The agreement aims to strengthen the global response to climate change by holding the global average temperature increase below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C. Although there is nothing specific on ICTs in the Agreement, Article 10 is devoted to technology, setting up a technology framework and a functioning Technology Mechanism (Points 4 and 5), and many of the technology solutions will be built around ICTs and smart ICT applications. As of July 2018, 178 Parties have ratified the Agreement of the 197 Parties to the Convention.

13. To tackle these challenges, recent research emphasises the large potential of improvements in direct ICT use and in broader enabling applications of ICTs. For example, the Global e-Sustainability Initiative (GeSI) projected that the ICT sector’s direct emissions “footprint” would decrease to 1.97% of global emissions by 2030, compared to 2.3% in 2020, due to actual and planned energy savings. The study estimated that in 2015 enabling applications of ICTs abated roughly 1.5 times the ICT sector’s direct emissions and the study projected these savings to be nearly ten times greater than direct ICT emissions in 2030. This projection is equivalent to a 20% reduction of global CO₂ emissions by 2030, holding total emissions at 2015 levels.

14. Similar results have been found in analysis of improvements in direct ICT use at national level. A study of the ICT and entertainment and media (E&M) sectors in Sweden for the period 2010-2015 showed that ICT energy consumption decreased from 2010 despite increased smartphone and optical fibre use and exponentially increasing data traffic, and the amount of ICT and E&M scrap has also decreased. Life-cycle analysis shows that the total carbon footprint (embodied carbon plus energy consumption) for ICT, E&M, ICT services and E&M content declined from 2010 and the trend is estimated to continue until 2020.

15. However, with the rapid increase of some energy intensive digital technology usages, such as for bitcoin mining, as well as “Internet of Things” applications, it is imperative to boost life cycle analyses and sustainable production and disposal of billions of connected devices, to avoid environmental rebound effects where negative volume effects outstrip positive individual emission savings. To tackle some of these issues the business sector has also launched initiatives to improve sustainability and environmental performance directly along the ICT supply chain. For example in 2018 GeSI launched E-TASC (Electronics Tool for Accountable Supply Chains), the ICT industry standard solution to improve environmental and social practices and to assess and monitor suppliers’ corporate social responsibility (CSR) practices within the ICT supply chain.
16. The potential of ICTs to improve environmental performance is further demonstrated in the distribution of ICT applications selected for the “Sustainia 100” sustainable solutions 2013-2016, an annual competition to promote global sustainability through new technologies. In this forward-looking competition, enabling ICT consumer applications (smart homes, energy monitoring, etc.) were the most common sustainable ICT innovations, and enabling applications in smart buildings and smart cities were also significant. The two made up 30% of the Sustainia 100 ICT sustainable solutions. Applications designed to foster systemic behavioral change were also important (over 10%), as were applications to reduce water use and improve agricultural production (17% combined). Overall the trend was towards enabling and systemic change.

17. In terms of systemic changes in consumer behaviour, large-scale studies of behavioural change are becoming available, triggered, for example, by the use of smart electricity meters. A recent study of the impacts of in-home real-time electricity use displays in Ontario, Canada, showed that these devices result in permanent systemic changes in consumer behaviour, rather than short-term real-time adjustments to price fluctuations. The metering systems are cost-effective over a 4-10 year period, with significant reductions in electricity use. These real-time displays also have potential to complement and substantiate the input of renewable energy into the smart grid.

18. In the policy sphere, many principles in the Recommendation are picked up in the 2015 OECD Green Growth Challenge No. 7, Orienting innovation systems. These include that: (ICT) innovation is critical for green growth; government intervention is required in some areas to overcome market failures; strong overall framework innovation policies, including support for basic R&D, are an important but insufficient element; more-tailored policies are necessary to address specific barriers to innovation; policy should be technology-neutral, but in practice governments provide incentives for specific (e.g. “smart”) technologies; measurement is an important issue since "green" innovation comes from a wide variety of domains; and that considerable scope remains for further government action across different policies.

19. Finally, the role of standards should not be under-estimated. The International Telecommunications Union’s standardisation Study Group 5, “Environment, Climate Change and Circular Economy”, has an ambitious work programme on Green ICT standards focused on the ICT sector itself, comprising: universal power adaptors and chargers for mobile devices, power feeding systems, rare metals, green data centres, and energy efficiency for telecommunications equipment and networks. Standards for enabling “smart” applications still have major potential for development.

1.4. Purpose of this report

20. The 2010 Recommendation instructed the CDEP’s predecessor, the Committee for Information, Computer and Communications Policy to promote implementation of the Recommendation and review such implementation after three years, and as required subsequently, to enhance the positive effects of information and communications technologies on the environment. This report intends to provide an assessment of the implementation and dissemination of the Recommendation, analyse and explain the continued relevance of the Recommendation, and provide conclusions as to the need for any further work to improve implementation or to update or revise the Recommendation.
2. METHODOLOGY

2.1. Information collection

21. The main tools used to collect information on the implementation of the Recommendation were questionnaires. In addition to information collection via the Committee’s Outlook questionnaires, a dedicated questionnaire (Annex B) was sent to Adherents, as well as active Colombia and Costa Rica. This questionnaire was designed to collect information on strategies for ICTs and the environment, government initiatives, strengthening supply and demand, evaluating environmental impacts of ICTs and ICT policies, how the Recommendation has been used, and whether it should be updated and strengthened to better address environmental challenges and recent developments. All ten principles in the Recommendation are covered in the questionnaire and they were regrouped to cover recent developments and concerns.

22. The review of the Recommendation was coordinated with the Environment Policy Committee (EPOC). The CDEP Chair wrote to the EPOC Chair in November 2017 to collect input from EPOC on the questions that they deemed most relevant to their policy domain. These comprised questions 4, 5, 6, 8, 10, 11, 12, and 13 (cf. Annex B).

2.2. Responses to the questionnaire

23. As of 6 April 2018, eighteen Adherents as well as Colombia and Costa Rica had provided replies to most parts of the questionnaire (Respondents):

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Note: \(^2\)The reply from Israel was provided by the Delegation to the EPOC. \(^3\)Japan replied to question 6 on public procurement only.

24. Replies to the questionnaire provided by delegates to EPOC were provided to the EPOC Secretariat (deadline mid-February 2018) and forwarded to the CDEP Secretariat on 15 February 2018. Replies were received from Israel, Sweden and the United States. The reply from Israel is the unique source of information; Israel did not reply to the CDEP. Sweden’s reply is identical to that provided to the CDEP. The United States reply to the EPOC added further information to the reply to the CDEP; this supplementary information is footnoted when referred.\(^2\)
3. PROCESS

25. The monitoring of the implementation of the Recommendation was first scheduled in the CDEP PWB 2015-16, but this was deferred to the PWB 2017-18 due to resource constraints. After presentation by Mr Graham Vickery, OECD consultant, of a short background report and draft questionnaire to the CDEP at its meeting of 17-19 May 2017, the Committee agreed to provide replies to the questionnaire for its meeting of 21-22 November 2017. A first analysis of 13 questionnaire replies received by 3 November was presented to the CDEP at the 21-22 November 2017 meeting.

26. At the November 2017 CDEP meeting it was agreed that the Chair of the CDEP write to the Chair of the OECD Environment Policy Committee (EPOC) to collect input from EPOC on the questions that they deemed most relevant to their policy domain (see also Section 2). Subsequently, 7 more replies were received, 6 from CDEP delegations, and one additional reply from a delegation to the EPOC. Extra material for one country was also supplied from a delegation to the EPOC.

27. Main steps from the adoption of the Recommendation to this monitoring report included the following.

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<tr>
<th>Date</th>
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<tr>
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<td>Format Jul-Aug 2018</td>
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<td>Council Sep-Oct 2018</td>
<td>Monitoring report to ExCo and Council</td>
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4. DISSEMINATION

28. **Dissemination by the OECD.** The main means used by the OECD to promote the Recommendation are publications and related CDEP policy discussions. Most notably, the following publications either directly promote the Recommendation or discuss topics covered in the Recommendation.

- 2010 OECD *Information Technology Outlook*, with a dedicated chapter (Chapter 5) on “Greener and Smarter: ICTs, the Environment and Climate Change”, which provides an in depth discussion of green ICTs and promotes the Recommendation;
- 2012 OECD Digital Economy Paper no. 190 “ICT Applications for the Smart Grid”, examining the potential of smart grids to help sustain electricity supply while limiting environmental impacts and promoting the Recommendation;
- 2013 OECD report “The Internet Economy on the Rise: Progress since the Seoul Declaration” with a chapter (Chapter 3) on Green ICTs, promoting the Recommendation and providing examples of good practices among Members;
- 2015 *OECD Digital Economy Outlook* and the 2012 *OECD Internet Economy Outlook*, which respectively discuss environmental implications of ICTs and related policies in several places.

29. **Dissemination by Adherents to non-governmental organisations and the private sector.** The private sector provides ICT infrastructure, and is the driving force for countries in digital applications in construction, transport and energy. The private sector also has a major role in electronic waste management and recycling. All of these are areas where the Recommendation can provide guidance for setting the framework for policy. The majority of Respondents (12 of 16 Respondents) reported successful dissemination of the Recommendation to the private sector, including through public-private partnerships in half of these, particularly in Latin America. A good example for the role of non-governmental organisations is the operations of SWICO (Swiss Economic Association for the Suppliers of Information, Communication and Organizational Technology), the private non-profit recycling entity in Switzerland. A good example for private sector involvement is the United States’ EPA’s Sustainable Materials Management Electronics Challenge, which encourages electronics manufacturers, brand owners and retailers to send used electronics to third-party certified electronics refurbishers and recyclers.

30. **Dissemination to non-Members** was reported by three Respondents to the questionnaire. Two Latin American countries specifically replied that they promoted the Recommendation to non-Members and helped them with the implementation (Chile, Mexico). Chile has run seminars with non-Members, while the Mexican Ministry of Environment and Natural Resources has been active in sharing experience, in particular on climate change in international fora. The Mexican reply pointed out that the exchange of experiences with other non-Members would be more efficient if the environmental aspect of ICTs were better defined within Ministries and federal programs and strategies.
There are many aspects that are not yet properly addressed and others that are addressed are not properly labelled. Promotion of the Recommendation can help raise awareness of such aspects. Korea is promoting ICT-related international cooperation in general, and provided examples of working in Viet Nam on developing a green ICT smart farm, and cooperating with Saudi Arabia on the Smart Cities ICT master plan – approaches that are also promoted by the Recommendation.

31. Overall, dissemination has been effective to the extent that the replies to the questionnaire showed Adherents’ increased awareness of the role of ICTs in enhancing and improving environmental performance. Nevertheless, most Adherents need to make further efforts across all of the Recommendation’s principles to better harness ICTs for the desired and necessary improvements in environmental performance.
5. IMPLEMENTATION

32. This section presents aggregate analysis of responses to Outlook publications’ questionnaires in 2010, 2012 and 2014 and the 20 replies received to the 2017 questionnaire (contained in Annex B). It contains a first part on the information from the Outlook questionnaires and a second part on the information collected through the 2017 questionnaire. The second part includes a general overview as well as a discussion of the implementation of each of the individual policy principles (1-10) of the Recommendation, including examples of good practice where relevant. At the end are short sections on Areas in which the Recommendation could be updated to account for technological advances and on other Inputs for improving the Recommendation.

5.1. Responses to Outlook publications’ questionnaires in 2010, 2012 and 2014

33. Following the Council’s adoption of the Recommendation, questions covering ICTs and the environment were included in the policy questionnaires of the Committee’s Outlooks (Outlook questionnaires) for 2010, 2012 and 2014, but not for the following Outlook. Core questions are comparable for the three Outlooks, and the responses provided a starting point for this monitoring report and for considering where the Recommendation could be revised and strengthened.

34. ICTs and the environment in national digital economy strategies. ICTs and the environment were specifically mentioned in digital economy strategies by around one-half of countries responding to the Outlook questionnaires, with the number increasing through 2014. Nine of 23 Outlook questionnaire respondents (including the European Union) provided information in the 2012 survey, and 15 of 23 respondents in 2014, suggesting that the role of ICTs in improving environmental performance was increasingly recognised.

35. Institutions responsible for policy implementation. Ministries, departments and agencies administering policies for ICTs and the environment are very heterogeneous, ranging from agriculture and environment, through to education, science and finance, depending on policy targets, structures of national administrations and coordination mechanisms. Nevertheless, the 2014 Outlook questionnaire showed that economics ministries and related finance/development agencies were involved in one-half of policy implementation, and environment and related agencies also in one-half, sometimes jointly.

36. Priorities for ICTs and the environment. The replies to the 2012 Outlook questionnaire showed that ICTs and the environment was medium priority for one-half of the 23 respondents. Nevertheless, almost one-half of Outlook questionnaire respondents replied that this priority is being increased, only matched in increasing priority by R&D programmes and broadband. This would be expected for an area only recently receiving ICT policy attention. Enabling ICTs had the highest number of countries giving increased
priority. In terms of individual respondents, Japan, the United States (US) and the European Union (EU) gave this area high priority overall and the US and the EU were increasing their priority for “smart” enabling ICT applications.

37. The 2014 ICT policy priorities Outlook questionnaire showed somewhat similar patterns. ICTs and the environment was an area of medium priority, and it was being given increased priority by one-third of 29 respondents, around the same as for R&D programmes and broadband, also favoured in 2012. Enabling ICTs was also more frequently given increased priority. In comparison, in 2014 policies for IT specialists/advanced ICT skills were by far the most favoured, with two-thirds of Outlook questionnaire respondents planning to increase policy priority in this area.

38. Focusing on direct impacts of ICTs. Policies and programmes continue to focus more frequently on reducing the direct effects of ICTs on the environment. This is most marked in responses to the 2014 Outlook questionnaire, when 20 out of 23 respondents provided information on policies and programmes aimed at the direct impacts of ICTs. This compares with 16 respondents providing information on policies to support enabling applications, often in the areas of “smart” applications, despite the avowed intentions to increase the priority given to “smart” enabling applications.

39. Increasing energy efficiency is the main focus for both direct and enabling applications. Policies and programmes were largely focused on reducing energy use and increasing energy efficiency. This applied for all three surveys. For the direct effects, in 2010 energy use (i.e., making ICTs more energy efficient) was the aim of policies for 13 of 25 Outlook questionnaire respondents, in 2012 for 12 of 18 respondents, and in 2014 for 11 of 20 respondents. The same applied for enabling effects. In 2010, 10 of 25 respondents reported reducing energy use as the main policy area, often in “smart” applications, in 2012, 11 of 18 respondents, and in 2014 for 12 of 16 respondents.

40. Reducing electronic waste and improving disposal, re-use and recycling. The second most important focus was in disposal, re-use and recycling. This was particularly important in 2010 in the ICT industry when it was second only to energy efficiency (9 policies compared with 13 for energy efficiency), but it declined subsequently in 2012 (5 compared with 12) and 2014 (3 compared with 11 for direct ICT energy efficiency). This decline is most likely due to widespread implementation of disposal and recycling following adherence to the EU WEEE and RoHS Directives, and similar initiatives in other countries. Policies for enabling applications are so far less concerned with waste toxicity and disposal. However, with the rapid spread of connected objects (the “Internet of things”), disposal of e-waste is of continuing, and probably of increasing, importance.

41. Climate change and resource efficiency. Global warming (reducing the carbon footprint), and resource efficiency were also significant policy targets. Policies to mitigate climate change and low carbon strategies were the third most important overall. They were more significant for enabling ICTs, e.g., in “smart” applications, and somewhat less for direct use of ICTs, e.g. in procurement of ICT equipment. Resource efficiency/resource depletion was a somewhat less frequent target, equally balanced between direct and enabling effects of ICTs. Direct effects were concerned with the use of rare metals / scarce materials, and enabling applications often to use fewer resources.

42. Additional policy areas: In 2012 additional questions on ICTs and the environment were spread throughout the Outlook questionnaire. These covered:

- R&D to support green ICTs or ICT applications. Eleven of 22 respondents (including the EC) mentioned specific R&D programmes for ICTs and the
environment, including green ICT/green growth innovation and competence centres, smart grids and smart mobility, low carbon strategies and energy efficient applications.

- **Procurement of green ICTs or applications that enable green growth.** Green procurement was a common element in government policies, particularly in the purchase and use of ICT equipment. Fourteen of the 22 respondents had specific ICT procurement policies aimed at implementing “greener administration”.

- **Increasing diffusion and use of “smart” applications.** Policies for smart grids, smart mobility/transport, and smart meters were specified by 8 of the 22 respondents.

- **Encouraging ICT-related “green jobs”.** Relatively few respondents provided information on green jobs (5 of 22 respondents), but policies to develop green ICTs and initiatives to build energy-efficient green infrastructures, buildings, smart mobility, etc., generate green jobs, many high-skilled.

- **Standards for smart infrastructures.** Few respondents mentioned standards development. Nevertheless, standards are an important component of green ICTs and enabling applications ranging from smart meters to smart mobility/transport.

43. **Assessment and evaluation.** Evaluations of the impact of ICTs on the environment and related policies were not widespread. In both 2012 and 2014 less than one half of respondents (respectively 8 of 22 and 11 of 23) provided information on evaluations in the area of ICTs and the environment. However, the trend is rising and an “evaluation culture” may be slowly gaining traction in overall strategies, in annual policy monitoring, and through collection of statistics on disposal, recycling, and energy use.

44. These trends continue those in the 2009 Outlook survey of policies and business instruments, with the majority of programmes concentrating on reducing energy consumption and CO₂ emissions in direct ICT use. Mobile broadband, ubiquitous computing and massive data centres are major energy consumers, and they are amplifying this focus. Important targets were toxic waste / recycling and reducing environmental impacts of ICT disposal, and using enabling ICT applications (e.g. smart meters, smart homes, smart grids) to reduce energy consumption and CO₂ emission, and climate change and, to a lesser extent, resource efficiency. Green ICT procurement and support for R&D were significant, but performance measurement and policy evaluation are still lacking.

5.2. **Responses to the 2017 questionnaire**

45. On the basis of the replies to the 2017 questionnaire, the Recommendation is perceived to be useful, contributing to national strategies in general and in particular areas. Areas where individual principles provide specific guidance for policy development include spreading best practice, improving performance within government, and developing green public procurement.

46. **Developing national strategies:** Specific information on how countries have used the Recommendation to develop their national strategies and policies was provided by seven countries out of thirteen replying to this part of the questionnaire. These seven countries found the Recommendation directly useful in preparing their policies (Chile, Costa Rica, the Czech Republic, Germany, Korea, Lithuania, and the Netherlands). In the cases of Costa Rica and Lithuania it is being used in current policy preparation and elaboration. In addition, Mexico indicated that a chapter on green ICT and related
indicators should be added to the National Digital Strategy. On the other hand, Denmark replied that measuring the effects of the ten principles has not yet been sufficiently detailed to answer the question. Switzerland replied that elements of the Recommendation have been integrated into the overarching Digital Switzerland Strategy via existing projects / laws / strategies that are the foundations for the national Strategy.

47. Areas where the Recommendation contributed particularly are:

- Making policy makers aware of green ICTs and the potential of technology for enhancing sustainability and improving environmental performance Principle 6 (Encouraging best practice) and Principle 7 (Governments leading by example - Improving environmental performance within government) (Chile);

- Developing a new Green Public Procurement methodology (Principle 8, Improving public procurement), and contributing to policy development in the areas of awareness, environment management tools, and using low impact products (the Czech Republic);

- In preparing the national Digital Agenda (Germany);

- By promoting eco-friendly policies in the ICT sector, and broader applications in smart cities, green certification, energy analysis technologies and demonstrating efficiency in production (Korea);

- The ten policy principles have been generally useful and have been applied particularly with regard to the energy sector (the Netherlands).

48. The environment in ICT / Digital economy strategies: Almost all Respondents answering the questionnaire reported that environmental considerations are explicitly included in their national ICT / Digital Economy strategies. Nevertheless, there are no separate stand-alone dedicated strategies for ICTs and the environment. Policies and programmes aimed at improving the positive contribution of ICTs to environmental performance are spread across a range of areas and are particularly associated with broader climate change (8 out of 19 replies, particularly in Latin America, and also Canada and the Netherlands) and sustainable development / clean growth strategies, including renewable energy (see e.g. the Smart systems and flexibility plan to upgrade energy systems in the United Kingdom). Agriculture, forest and land management applications are also a feature in the development of Latin American countries.

49. A further strand of ICT and environment policies where the Recommendation’s principles have an important role is centred on the development of enabling applications of ICTs in smart cities/smart mobility, smart infrastructures and smart specialisation. This is particularly marked in Europe, e.g., the Czech Republic, Denmark, Lithuania, Portugal, Spain and Sweden. Electronic waste collection and recycling (WEEE in the EU, and similar schemes in Australia, Canada and the United States) is a feature of all strategies, but this is a direct policy target and implementation is treated separately in Section 5, for example in Principle 2 and Principle 8.

50. One country has an explicit overarching ICT and Environment Commission designed to develop and oversee implementation of policies and programmes in this area (Costa Rica) and two countries have specific clean growth and climate change strategies, including technologies. The 2016 Pan-Canadian Framework on Clean Growth and Climate Change including green ICT and smart solutions is a direct response to the Paris Agreement, and the Netherlands Ministry for Economic Affairs and Climate is developing a new Climate and Energy Agreement with an important role for new
technologies. Only one country makes no mention of environmental or sustainable development concerns in the development of its Digital Economy Strategy planned for 2018 (Australia). Overall, strategies have focused on climate change and energy use (direct and enabling effects) and smart applications in cities/regions, mobility/transport and production (enabling and systemic effects).

51. **Increasing priority:** The role of ICTs in improving environmental performance has increased in priority in fifteen of the seventeen countries including environmental considerations in their national ICT / Digital Economy strategies. Addressing climate change and related energy saving / energy transition / alternative energy sources were the most commonly cited areas of increasing priority (10 of the 17 countries reporting including environmental considerations in their strategies). Almost equally commonly cited as increasing in priority were smart cities, smart mobility and related enabling ICT applications (9 of the 17 countries reporting). Water quality, agriculture and forests were also cited, notably in Latin America. The areas of increasing priority are nevertheless somewhat dispersed due to differing national ICT policy foci, structures and strategies and environment policies and programmes, and the contribution of the Recommendation’s policy framework and principles will vary across countries.

5.2.1. **Co-ordinating ICT, Climate, Environment and Energy Policies.**

“Members should coordinate ICT policies and climate, environment and energy policies to improve environmental performance, tackle climate change, enhance energy efficiency and improve sustainable resource management. They should aim to bridge the gap between ICT, climate, environment and energy experts, policy makers and stakeholders and extend understanding among these groups of: i) the direct effects of ICTs themselves on the environment, ii) the enabling effects of ICT applications in other sectors, and iii) the systemic effects to change social and cultural behaviour through the use of ICTs.”

52. All Respondents had either comprehensive coordination strategies in place, or had initiatives led by different ministries and agencies within their responsibilities across the spectrum of government activities. One half of Respondents had clear coordination mechanisms, with either one single lead Ministry or government entity leading and coordinating (e.g. in Canada, Costa Rica, Korea, the Netherlands and the United Kingdom), or with clear leaders in specific areas, but with tight coordination (e.g. Colombia, the Czech Republic, Mexico). One half of Respondents had looser mechanisms for coordination, with wide participation across a range of responsible ministries and agencies (Chile, Germany, Israel, Lithuania, Portugal, Spain, Sweden, Switzerland, and the United States). In Germany sustainability guides Federal government policy, with implementation by all Federal ministries within their responsibility. As another example, the United States EPA coordinates with the Department of Commerce on the US Environmental Solutions Toolkit to provide lists of companies providing particular environmental goods or services.³

- In terms of coordination across ICT, climate, environment and energy policies most Respondents are addressing policy challenges in these areas in a more coordinated fashion than was the case when the Recommendation was introduced in 2010.

³ Information provided by the United States Delegation to the EPOC.
Nevertheless there appears to be room for further improvement by focusing coordination mechanisms more explicitly on improving environmental performance, and better articulating the links between ICT / digital economy policies and strategies and improved environmental performance.

5.2.2. Adopting Life Cycle Perspectives

“Members should encourage the adoption of life cycle perspectives in ICT and ICT-enabled applications for sustainable management of natural resources and materials in production, use and end-of-life phases. They should, to the extent possible, promote coherent environment-friendly and sustainable R&D, design, production, use and disposal of ICTs, and extend their working life wherever environmentally efficient. Members should also encourage the development of methodologies and indicators to measure and monitor impacts over the life cycles of ICT goods and services and “smart” ICT-enabled applications in buildings, transport and energy systems, including developing baseline measures of embedded and actual green-house gas emissions.”

53. Life-cycle perspectives and analysis and energy/resource efficiency approaches are becoming more generalised, with fourteen Respondents providing information on their approaches. Nine Respondents specifically use or promote life-cycle analysis or environmental sustainability criteria including total cost of ownership approaches when purchasing or using ICTs or ICT-enabled applications (Australia, Chile, Germany, Israel, Korea, the Netherlands, Switzerland, the United Kingdom and the United States). Mexico replied that although they still use cost-benefit criteria exclusively, they are working towards establishing life-cycle/resource efficiency guidelines in the framework of the National Digital Strategy. Waste management, recycling and the principle of extended producer responsibility are other common areas where life-cycle analysis is commonly referred.

- Life-cycle analysis, resource efficiency and circular economy criteria are increasingly cited and are gaining traction in government policy for ICTs and the environment, but there is still a great deal of scope for extending these approaches, and moving life-cycle analysis from narrow direct ICT applications to more broad-based ICT-enabled applications in, for example smart cities and smart mobility.

5.2.3. Supporting Research and Innovation in Green Technologies and Services

“Members should support long-term basic research, and where possible stimulate research and development in resource-efficient ICTs and “smart” applications for example through technology-neutral tax incentives or carbon offset mechanisms, and encourage user-driven innovation. They should encourage development of ICT applications for measuring and monitoring environmental challenges and promote co-operation and knowledge exchange between ICT and non-ICT firms, research institutions, governments, and other stakeholders. Finally they should use flagship demonstration projects to diffuse promising “smart” ICT-enabled applications.”

54. All Respondents have programmes and policies that support R&D and innovation aimed at developing the positive impacts of ICTs on the environment. Almost all
Respondents have general tax incentives to support R&D, and all Respondents have financial support programmes that may impact environment-related ICT R&D and innovation in various areas. Fifteen Respondents outlined specific programmes aimed at supporting environment-related ICT R&D. These range from ICT R&D programmes in Germany, Korea, the Netherlands (eco-friendly ICTs and data hubs, and eco-friendly towns) and Portugal, Sweden and the United Kingdom (smart energy / cities / mobility, and digitised industry where environmental and climate considerations are firmly embedded in programmes), and clean growth and climate change / eco-innovation / green industry programmes covering ICT applications in Canada, Denmark and Lithuania. Sustainable development, agriculture, water, land and forest resource use and climate change are marked for attention in R&D and innovation programmes in Colombia, Costa Rica, the Czech Republic, Mexico and Spain, often through information system development, environmental management applications and support for the infrastructure for R&D and innovation. Using technology transfer mechanisms to share government expertise to facilitate private R&D was cited by the United States.

- Despite these efforts, more could be done to support the development of smart cities and smart mobility via ICT applications and innovations. The agri-food ecosystem is another area where ICTs can play a role along the value chain from field to plate, combined with better husbanding and management of natural resources.

5.2.4. Developing Green ICT Skills

“Members should promote green ICT related education, training and skill development to meet demand for environmental skills and expertise at all levels and in all industries. They should also encourage interdisciplinary co–operation in developing green ICT education and training.”

55. The fundamental importance of developing green ICT skills is widely acknowledged, but replies to this question were general or indirect. This is in part due to responsibilities for training and education being located in education ministries rather than in ICT and environment ministries that were the principal respondents to the questionnaire. Twelve Respondents provided information on skills development. The most direct and promising education and training examples are vocational education and training in sustainables, renewable resources and mobility (Germany), online technical university education, and training in water technology and energy efficiency (Mexico), incorporating awareness and skills issues in the circular economy policy (the Netherlands), including agriculture, water and energy in the national digital competence initiative (Portugal), and supporting sustainability and ICTs education in technical universities (Sweden).

56. The other main avenues described are via the development of expertise and skills through project and programme development for smart cities and renewable energy (Australia), aligning sectorial developments with environment policy (Chile), implementing environmental management systems (Lithuania), expertise development via the application of energy labels and green ICT investments (the Czech Republic), and training procurement officials in green ICT procurement (United States).

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4 Information provided by the United States Delegation to the EPOC.
Further efforts to develop green ICT skills and competences are needed in most countries, but the modalities and co-ordination with educational institutions vary greatly across countries, depending on needs and national education and training structures. In some countries, public administrations face constraints in acquiring legal and technical expertise for green public procurement, and specific training programs for procurement officials can encourage increased adoption of effective green public procurement.\(^{21}\)

5.2.5. Increasing Public Awareness of the Role of ICTs in Improving Environmental Performance

“Members should increase public and consumer awareness of environmental implications of using ICTs and their potential to improve environmental performance. They should promote widespread development and adoption of clear standards and eco-labels based on life cycle approaches to production, use and disposal of ICT goods and ICT-enabled applications. This includes spreading awareness of the direct effects of ICTs, enabling effects of ICT applications in buildings, transport and energy, and the potential of ICTs to have systemic effects on social and cultural behaviour.”

57. A range of mechanisms is used to increase general public awareness of the environmental implications of using ICT. Fifteen Respondents reported various mechanisms for increasing awareness. A good example is the approach adopted in Chile where awareness is increased in direct and enabling ICT applications via smart lighting and transport programming, while systemic behavioural change is encouraged via programs promoting recycling and eco-labelling. Eco-labelling is also part of approaches to raising awareness in Canada, Denmark and Germany. Climate change awareness and sustainable resource management, including energy management, are featured in a range of countries (Colombia, Costa Rica, Lithuania, Mexico, Sweden, Switzerland), but this is often piecemeal with “no coherent national strategy” as one respondent pointed out. A structured approach to smart energy installation and awareness building is an integral part of the United Kingdom’s Clean Growth Strategy’s Smart Systems and Flexibility Plan. Public awareness on reuse and recycling are featured in the Netherlands and the United States.

A more consistent approach to awareness raising is required at all three levels – direct, enabling and systemic behavioural change – to benefit more fully from the improved environmental performance that ICTs can bring. This is a task for all actors in the ICT and environment ecosystem.
5.2.6. Encouraging Best Practices

“Members should encourage the wide sharing of best practices to maximise the diffusion of green ICTs and “smart” ICT-enabled applications in the public and private sector, including governments, businesses, civil society and regional and international organisations. They should exchange information and good practices on how to ensure data protection, security and privacy in “smart” ICT-enabled applications. They should themselves share good practices in measuring economic and social environmental impacts of ICTs and ICT-enabled applications. Finally, they should use these principles to review and collect information on national policies and initiatives and exchange information on policy development.”

58. Best practice approaches take a variety of forms across Respondents. Eleven out of fifteen Respondents replying to this question provided examples of spreading best practice (Australia, Canada, Denmark, Germany, Korea, Lithuania, Mexico, the Netherlands, Switzerland, the United Kingdom and the United States). These covered a range of different direct and enabling applications in different economic areas from agriculture to renewable/sustainable energy systems and smart cities (Australia, Mexico), eco-labels, certification systems and green procurement training and advice to spread best practice (Canada, Denmark, Germany, Korea, the United States), awards and competitions (Lithuania), and systemic behavioural change in the area of consumer ICT energy consumption (Switzerland) or business organisation (the United Kingdom). Costa Rica is still developing its policy and best practice examples. Chile, the Czech Republic and Portugal did not report specific examples related to ICTs and the environment.

➢ This analysis shows that more could be done to spread best practice more consistently across more areas, particularly as a major aim of policies and programmes for ICTs and the environment is to highlight how direct (better environmental performance of ICT goods and services) and enabling applications (smart cities, smart mobility) can be used to achieve systemic behavioural change by consumers and citizens.

5.2.7. Governments Leading by Example

“Members should minimise the environmental impact of ICTs in public administration through green ICT approaches, applications and services. To the extent possible, they should maximise resource efficiency of public facilities by using “smart” ICT applications in lighting, heating and cooling, and building control, including enhancing process efficiency and organisational change in public administration through teleworking and videoconferencing to reduce commuting and travelling. They should also minimise ICT-related disposal through reduce, reuse, and recycle policies.”

59. All Respondents have programmes to improve environmental performance within government, thereby leading by example. A recurrent focus is on improved energy management and energy efficiency, including telework and green government office programmes in fifteen Respondents (Australia, Canada, Chile, Colombia, Costa Rica, Denmark, Germany, Israel, Korea, Lithuania, the Netherlands, Sweden, Switzerland, the United Kingdom and the United States). The second major tool for improving government performance is green public procurement, cited by nine Respondents.
(Canada, the Czech Republic, Germany, Lithuania, the Netherlands, Portugal, Spain, Switzerland and the United States). Recycling and improved waste management is also frequently cited (Canada, Chile, Costa Rica, Denmark, Germany, the United Kingdom and the United States). (See also Principle 8 below.)

- Many of these activities are good or best practice, but they are not necessarily used to the maximum extent as examples, or leveraged to improve performance outside of government. For example, German public procurement contracts use best practices in energy efficiency and materials use, life cycle analysis and recycling, as well as eco-labelling criteria for various ICT products, and these criteria could be spread more widely across different economic actors. Equally, Israel has a green government initiative introduced in 2009 that aims to position the government as a leader in environmental performance and sustainable practices, reducing resource consumption and increasing efficiency, which could be diffused more widely.

5.2.8. Improving Public Procurement

“Members should take greater account of environmental criteria in public procurement of ICT goods and services and increasing environmental innovation among suppliers. This includes providing an appropriate policy framework that incorporates environmental price and performance criteria in public procurement, where it is economic to do so, including total life cycle costs of ICT goods and services, and providing information, training and technical assistance to officials in the ICT public procurement and use chain.”

60. All Respondents use environmental criteria in public procurement (18 out of 20 Respondents). In most cases environmental criteria are included in procurement criteria across all products including ICT products (Australia, Canada, Czech Republic (in planning), Denmark, Israel, Japan, Korea, the Netherlands, Portugal, Spain, the United Kingdom, the United States), or in comprehensive lists of ICT products (Germany, Lithuania). Environmental and energy criteria are used in the majority of public purchasing contracts, including ICTs, in Sweden and Switzerland, and also in other countries listed above. As incentives for suppliers, examples include public purchasing favouring the use of ICT goods and services that take their environmental footprint into consideration (Chile), count environmental criteria as part of the scores that determine who wins the bidding process (Israel, the Netherlands), or give a 20% price premium when purchasing ICT products that meet environmental criteria (Costa Rica). Colombia is developing sustainable procurement plans including contract management based on sustainability and life cycle analysis, granting a specific score for providers including sustainability elements, and evaluating the impacts of this procurement.

61. Life cycle costs, recycling considerations and comprehensive environmental footprints are used as purchasing criteria in some but not all Respondents, and eco-labels and more general product standards are also used as the criteria for public purchasing. For example, EU guidelines/eco-labels and green product criteria are specifically noted by Denmark and Lithuania, and ENERGY STAR certification cited as a compulsory element in purchasing in Spain and the United States.

5 Japan replied only to question 6 on public procurement. Two countries did not reply to this question.
Nevertheless in many Respondents green public procurement criteria could be strengthened by adding dimensions of environmental quality such as material use and energy efficiency, or ensuring that environmental quality attributes are fully monetised, discounting the bidders’ submitted prices, and applied universally across all purchasing to improve environmental performance.\textsuperscript{22}

\textbf{5.2.9. Encouraging Measurement}

“Members should encourage development of comparable measures of the environmental impacts of ICT goods and services and ICT-enabled applications and among similar products. They should also increase understanding of the effects of government policies (information, incentives, regulations) on improving measurement tools and increasing public awareness.”

62. Measurement tends to be partial. It is good in specific areas but weak overall. Most Respondents have comprehensive measurement of ICT recycling and waste handling that generates data on volumes and composition of ICT waste (see for example the EU WEEE Directive and similar legislation in other countries including Australia, Canada and the United States) as well as on the use of hazardous substances in ICT equipment (see for example the EU RoHS Directive and similar legislation in other countries). Similarly, policies and regulations on green public procurement of ICT goods and services and eco-labelling practices rely on statistics of the direct impacts of ICTs and ICT-enabled goods and services on various measures of environmental performance, usually electricity consumption and resource use.

63. Despite the widespread use of these general measurement frameworks only eleven Respondents provided information on this area vital for advancing the case for the benefits and costs of ICT use and applications. Responses mainly focused on measuring energy use (Canada, Colombia, Lithuania via data centre consolidation, Mexico, the Netherlands, Switzerland, the United Kingdom, and the United States), waste handling and material re-use (Canada, Costa Rica, Denmark, Mexico, the Netherlands, the United Kingdom and the United States), and on more general measurement of environmental impacts (Chile, Switzerland).

The rather limited number of responses on measurement of outputs and impacts clearly show that an evaluation culture is still to be developed in the area of ICTs and the environment. Where measures do exist they tend to focus on inputs and physical measurements, rather than on outputs and economic and environmental impacts including qualitative impacts on the environment.
5.2.10. Setting Policy Targets and Increasing Evaluation

“Members should set transparent policy objectives and targets to measure and improve government green ICT strategies, including ICT-enabled applications across the economy. They should monitoring compliance with policies on a regular basis to set clear responsibilities and improve accountability. Where appropriate, they should apply voluntary approaches where self-monitoring and self-reporting can be effective and where tough but achievable voluntary targets can be met. Finally, they should encourage the adoption of appropriate national legislation that sets the ground for implementation of green ICT strategies.”

64. Policy targets, related performance indicators and policy evaluation are relatively undeveloped. Only seven Respondents of the thirteen responding to this question have developed targets and performance indicators to improve policy and they use a diverse mix of approaches. They cover individual institutional reporting on environmental performance and improvements (Australia), an ambitious set of aggregate Key Performance Indicator (KPI) targets for government departments (Canada, Shrinking the Environmental Footprint theme in the Federal Sustainable Development Strategy), a set of indicators to help measure the achievement of green growth targets (Korea), using energy consumption to measure the greening of ICTs (Sweden, “greening by ICT is seldom measured”), initiatives to reduce the environmental footprint in the administration (Switzerland, RUMBA programme), an ambitious and comprehensive list of ICT-specific KPIs and government-wide quantitative targets (the United Kingdom, Green ICT Delivery Unit and Greening Government Commitments respectively), and energy and sustainability scorecards (the United States, Office of Management and Budget). Two further Respondents are working on extending measurement systems to cover green ICT strategies and policies / environment policies (Chile, the Czech Republic). Other areas mentioned are waste and recycling (Denmark), sustainable public procurement of ICT products (Germany) and developing remote sensing technologies to monitor pollution (Israel). Mexico is considering adding green ICT indicators to its existing set of ICT-related indicators.

5.3. Areas in which the Recommendation could be updated to account for technological advances

65. Thirteen Respondents replied to this question and, of these, two found the Recommendation directly relevant in its current form (Costa Rica and Lithuania). The remaining eleven Respondents suggested a variety of changes to update the Recommendation to include new and fast-moving areas, including Korea and Mexico who found the Recommendation still valid and relevant but that it could be updated. Their suggestions covered:

- Adding the dimension of climate change and applications for rural areas (Colombia);
- Links between ICTs and the environment are not strong enough for many policy/decision makers. Wording changes could be made to highlight the importance of ICTs for the environment (Mexico);
- Need to spread awareness to other sectors of economy. The ICT sector already has high awareness of energy and materials use (the Netherlands);
• Updating to take rapid technological change into account (Denmark);
• Adding the dimension of Internet ubiquity (Chile);
• More directly considering interoperability of software / hardware (the United States);
• Increasing connectivity and industrial advancement (Korea);
• Expanding on smart grids and environment management systems (Czech Republic);
• Using cloud computing as a lens for review and including the Internet of things (Canada);
• Including cutting-edge technologies - big data, machine learning, AI, robotics, 3D printing (Sweden);
• Protecting the population from electromagnetic fields (Germany).

66. Overall, the rapid pace of technological change coupled with the increasing challenges of climate change, resource sustainability and protecting biodiversity suggest multiple and diverse areas that could be considered for updating in a future revision of the Recommendation.

5.4. Inputs for improving the Recommendation generally

67. Twelve Respondents provided suggestions for improving the Recommendation in a diversity of areas with no convergence around major themes or areas that are not already covered in the Recommendation. Suggestions that could be considered in a future revision of the Recommendation include:

• Take the COP21 Agenda 2030 and the 17 Sustainable Development goals into account (Denmark).


• Provide more direction on electronic waste management, and include compliance to the Basel Convention on the Control of trans-boundary movements of hazardous wastes and their disposal among the Recommendations (Canada).

• Consider interoperability of software and hardware, in addition to re-manufacturing and reparability (the United States).

• Structural coverage and tools. There were two proposals in terms of extending coverage and promoting wider uptake: take a more sector-specific approach, e.g. where the use of green ICTs has more relevance, or targets for particular sectors (Chile); and take greater steps to encourage private sector adherence through voluntary agreements and fiscal measure (Czech Republic).

68. Other suggestions covered issues related to: climate change, sustainability, rural areas, and differing levels of development (Colombia, Korea and Mexico); addressing large-scale transformation and the circular economy (Portugal and Sweden); and health issues (Germany).
6. SUMMARY AND CONCLUSIONS

6.1. Summary of implementation

69. The global challenges of climate change and resource sustainability are of crucial and increasing importance, and ICTs play an important role in tackling these challenges. In this context, policy has a key and sometimes leading role, and the Recommendation has continuing relevance in providing a set of principles and a general policy framework for strengthening policies and enhancing their environmental impacts.

70. As illustrated in the information gathered through the Outlook questionnaires (2010, 2012, 2014), policies for ICTs and the environment have increased somewhat in importance but have tended to focus more on the ICT industry and direct ICT use, particularly energy efficiency and reducing CO₂ emissions, and less on enabling “smart” applications coupled with life-cycle approaches. Green ICT procurement is a major policy area, and R&D and innovation policies are also significant. There is relatively little reported activity on ICT-related green jobs and standards, although they are implicitly important in many policies. Finally, assessment and evaluation are increasing but are not yet part of a widespread “evaluation culture”.

71. Replies to the 2017 questionnaire prepared specifically for this monitoring exercise confirm the information gathered through the Outlook questionnaires. The area has increased in importance for the majority of Respondents, but policies still tend to focus more on the ICT industry and direct ICT use, particularly energy efficiency and reducing CO₂ emissions, and less on enabling “smart” applications coupled with life-cycle approaches. Environmental criteria are widely used in public procurement of ICT goods and services but could be more comprehensively and rigorously applied, and R&D and innovation policies are also significant. Fewer Respondents provided information on ICT-related green skills, education and training, although they are of fundamental importance. Finally, targets, indicators (KPIs), assessment and evaluation are not yet widespread and systematically used.

6.2. Summary of dissemination

72. The Recommendation was effectively disseminated and increased awareness of the potential of ICTs to improve environmental performance among policy makers, among non-governmental organisations and the private sector, as well as among non-Members. Dissemination was achieved in three ways. First, the OECD promoted the Recommendation through dedicated discussions of ICTs and the environment in publications, including flagships such as the 2015 OECD Digital Economy Outlook and its predecessor outlook publications in 2010 and 2012, as well as through the monitoring report on progress since the Seoul Declaration for the Future of the Internet Economy. Second, Adherents promoted the Recommendation to and among non-governmental organisations and the private sector. Third, Adherents promulgated the Recommendation to non-Members, notably in Latin America and in Asia.
6.3. Continued relevance

73. In their replies to the questionnaire, twelve Respondents provided suggestions for improving the Recommendation, some of which could be considered in a future review or revision of the Recommendation. There were further suggestions in terms of updating the Recommendation to take into account new developments, e.g. in emerging technologies. Nevertheless, at this time, the balance of responses to the questionnaire suggests satisfaction with the current Recommendation text.

74. In conclusion, the Recommendation provides useful guidance and is still relevant. Policies increasingly take into account the potential of ICTs to improve environmental performance and progress has been made particularly in terms of improving sharing of best practices, public procurement and more generally enhancing government leading by example (Principles 6, 7 and 8 were specifically cited). However, there remain areas of weakness and lack of policy coherence that suggest more efforts are needed to further incentivise Adherents to implement the Recommendation as a whole in order to make a difference in helping meet global challenges, realise green growth and enhance the potentially positive impacts of ICTs on the environment.

75. In the near-term, CDEP can take the opportunity of on-going work on Going Digital to emphasise the importance of leveraging ICTs to improve environmental performance. In the medium term, Adherents should take a more pro-active stance in disseminating and fully implementing the Recommendation.

76. In summary, the Recommendation is still relevant. However, more implementation efforts are needed that should be further monitored.
Annex B. Questionnaire on strategies and policies for ICTs and the environment, and applying the Recommendation

The OECD Recommendation provides a general framework for enhancing the contribution of ICTs to improving environmental performance. It is based on three analytical levels: 

1. the direct effects of ICTs themselves on the environment (e.g., improving energy-efficiency of ICT networks and devices, putting data centres in cold areas, recycling ICTs),
2. the enabling effects of ICT applications in other sectors (e.g., using ICTs in managing traffic flows, improving building efficiency, developing smart cities), and
3. the systemic effects to change social and cultural behaviour through the use of ICTs (e.g., changing energy use by installing user-controlled smart electricity meters).

It focuses on government policy, including policies to increase public awareness, change consumer behaviour and improve business performance.

The questions linked to specific Recommendations are indicated in italics.

Section I: Strategies for ICTs and the environment

1. Are ICTs and the environment (green ICTs) addressed in your national strategy and policies for the digital economy? Have recent developments (e.g., COP21) or scientific observations (e.g., increases in global temperatures) had an impact?

2. If ICTs and the environment are part of your national strategy, has their priority increased, remained unchanged or decreased over the last two years? Are particular areas more prominent (e.g., energy saving, recycling, smart cities, smart mobility)?

3. Are private sector initiatives or PPPs of particular importance in your country?

4. Please indicate which institutions (ministries/departments/agencies) are responsible for the implementation of policies for ICTs and the environment. Are there efforts to coordinate ICT, climate, environment and energy policies, including with industry and research initiatives, or to bridge the gap between ICT, climate, environment and energy experts? (Recommendation 1).

Section II: Framing government initiatives

5. Do you have policies or programmes to improve environmental performance within government (e.g., energy efficiency, organisational innovations, life-cycle approaches)? Are there areas where your government or institutions are leading with best practice? (Recommendation 7).

6. Do you use environmental criteria in public procurement of ICT goods and services, including life cycle costs / the environmental footprint? (Recommendation 8).

7. Are you actively spreading best practices for the diffusion of green ICTs and smart applications, including best practices in policy development? (Recommendation 6).
Section III: Strengthening supply and demand

8. Do you have R&D and innovation measures to support green ICTs or enabling ICT applications that foster green growth? (Recommendation 3).

9. Do you have policies to develop green ICT skills and expertise throughout the economy and encourage green ICT education and training? (Recommendation 4).

10. Do you have specific strategies or policies to increase public and consumer awareness of the environmental implications of using ICTs: directly, in enabling applications (e.g., in buildings, transport and energy use), or systemically (e.g., to change social and cultural behaviour)? (Recommendation 5).

Section IV. Assessing environmental impacts of ICTs and ICT policies

11. Have you developed comparable measures of the environmental impacts of ICT goods and services, and enabling applications? (Recommendation 9).

12. Have you adopted life-cycle analysis / resource efficiency benchmarking when purchasing and using ICTs and ICT-enabled applications? (Recommendation 2).

13. Do you have clear policy targets and performance indicators to measure, evaluate and improve government green ICT strategies and policies? (Recommendation 10).

Section V. Using the Recommendation (the OECD Recommendation is reproduced in Annex C)

14. Has the Recommendation influenced or contributed to your national strategy? In what areas has it been most useful, and have you used any of the 10-point policy checklist directly?

15. Is the Recommendation still technologically relevant, or does it need updating to take into account the ever-growing ubiquity of the Internet, connectedness and the digital economy?

16. Have you collaborated with non-Members to implement the Recommendation, and if so with which?

17. Should the Recommendation be modified to better address environmental challenges and improve environmental performance? In what areas?
Annex C. Recommendation of the Council on Information and Communication Technologies and the Environment

THE COUNCIL

HAVING REGARD to Article 5 b) of the Convention on the Organisation for Economic Co-operation and Development of 14 December 1960;


HAVING REGARD to the OECD aim to build a “stronger, cleaner, fairer world economy”, and the need to strengthen efforts to pursue green growth strategies as outlined in the Ministerial Declaration on Green Growth, which considered that “international co-operation will be crucial in areas such as the … application of green ICT for raising energy efficiency” and recognised “that special efforts need to be made at the international level for co-operation on developing clean technology, including by reinforcing green ICT activities” [C/MIN(2009)5/ADD1/FINAL];

CONSIDERING that better use of information and communication technologies (ICTs) is a major factor in improving environmental performance and addressing climate change and that they have key roles in increasing energy efficiency, managing scarce resources, combating climate change, and tackling other environmental challenges including protection of biodiversity, directly, in other sectors, or by underpinning systemic behavioural change;

AIMING to support national efforts to establish, improve and review policies on ICTs and the environment;

RECOGNISING that this Recommendation focuses on government policy and environmental performance, including policies to increase public awareness, change consumer behaviour and improve business performance.

On the proposal of the Committee for Information, Computer and Communications Policy:

I. RECOMMENDS that, in establishing or reviewing their policies for information and communication technologies and the environment, Members take due account of and implement the following principles, which provide a general framework for enhancing the contribution of information and communication technologies to improving environmental performance:

Co-ordinating ICT, Climate, Environment and Energy Policies

1. Members should coordinate ICT policies and climate, environment and energy policies to improve environmental performance, tackle climate change, enhance
energy efficiency and improve sustainable resource management. They should aim to bridge the gap between ICT, climate, environment and energy experts, policy makers and stakeholders and extend understanding among these groups of: i) the direct effects of ICTs themselves on the environment, ii) the enabling effects of ICT applications in other sectors, and iii) the systemic effects to change social and cultural behaviour through the use of ICTs.

**Adopting Life Cycle Perspectives**

2. Members should encourage the adoption of life cycle perspectives in ICT and ICT-enabled applications for sustainable management of natural resources and materials in production, use and end-of-life phases. They should, to the extent possible, promote coherent environment-friendly and sustainable R&D, design, production, use and disposal of ICTs, and extend their working life wherever environmentally efficient. Members should also encourage the development of methodologies and indicators to measure and monitor impacts over the life cycles of ICT goods and services and “smart” ICT-enabled applications in buildings, transport and energy systems, including developing baseline measures of embedded and actual greenhouse gas emissions.

**Supporting Research and Innovation in Green Technologies and Services**

3. Members should support long-term basic research, and where possible stimulate research and development in resource-efficient ICTs and “smart” applications for example through technology-neutral tax incentives or carbon offset mechanisms, and encourage user-driven innovation. They should encourage development of ICT applications for measuring and monitoring environmental challenges and promote co-operation and knowledge exchange between ICT and non-ICT firms, research institutions, governments, and other stakeholders. Finally they should use flagship demonstration projects to diffuse promising “smart” ICT-enabled applications.

**Developing Green ICT Skills**

4. Members should promote green ICT related education, training and skill development to meet demand for environmental skills and expertise at all levels and in all industries. They should also encourage interdisciplinary co-operation in developing green ICT education and training.

**Increasing Public Awareness of the Role of ICTs in Improving Environmental Performance**

5. Members should increase public and consumer awareness of environmental implications of using ICTs and their potential to improve environmental performance. They should promote widespread development and adoption of clear standards and eco-labels based on life cycle approaches to production, use and disposal of ICT goods and ICT-enabled applications. This includes spreading awareness of the direct effects of ICTs, enabling effects of ICT applications in buildings, transport and energy, and the potential of ICTs to have systemic effects on social and cultural behaviour.

**Encouraging Best Practices**

6. Members should encourage the wide sharing of best practices to maximise the diffusion of green ICTs and “smart” ICT-enabled applications in the public and private sector, including governments, businesses, civil society and regional and
international organisations. They should exchange information and good practices on how to ensure data protection, security and privacy in “smart” ICT-enabled applications. They should themselves share good practices in measuring economic and social environmental impacts of ICTs and ICT-enabled applications. Finally, they should use these principles to review and collect information on national policies and initiatives and exchange information on policy development.

**Governments Leading by Example**

7. Members should minimise the environmental impact of ICTs in public administration through green ICT approaches, applications and services. To the extent possible, they should maximise resource efficiency of public facilities by using “smart” ICT applications in lighting, heating and cooling, and building control, including enhancing process efficiency and organisational change in public administration through teleworking and videoconferencing to reduce commuting and travelling. They should also minimise ICT–related disposal through reduce, reuse, and recycle policies.

**Improving Public Procurement**

8. Members should take greater account of environmental criteria in public procurement of ICT goods and services and increasing environmental innovation among suppliers. This includes providing an appropriate policy framework that incorporates environmental price and performance criteria in public procurement, where it is economic to do so, including total life cycle costs of ICT goods and services, and providing information, training and technical assistance to officials in the ICT public procurement and use chain.

**Encouraging Measurement**

9. Members should encourage development of comparable measures of the environmental impacts of ICT goods and services and ICT-enabled applications and among similar products. They should also increase understanding of the effects of government policies (information, incentives, regulations) on improving measurement tools and increasing public awareness.

**Setting Policy Targets and Increasing Evaluation**

10. Members should set transparent policy objectives and targets to measure and improve government green ICT strategies, including ICT-enabled applications across the economy. They should monitoring compliance with policies on a regular basis to set clear responsibilities and improve accountability. Where appropriate, they should apply voluntary approaches where self-monitoring and self-reporting can be effective and where tough but achievable voluntary targets can be met. Finally, they should encourage the adoption of appropriate national legislation that sets the ground for implementation of green ICT strategies.

**II. INVITES:**

1. Members to disseminate this Recommendation throughout the public and private sectors, including governments, businesses, civil society and other international and regional organisations to encourage all relevant participants to take the necessary steps to better harness information and communication technologies to tackle environmental challenges and to improve the environmental performance of information and communication technologies;
2. Non-members to adhere to this Recommendation and collaborate with Members in its implementation.

III. INSTRUCTS the Committee for Information, Computer and Communications Policy to promote the implementation of this Recommendation and review such implementation after three years, and as required subsequently, to enhance the positive effects of information and communication technologies on the environment.

NOTES


3 See OECD, “ICTs, the environment and climate change”, available at www.oecd.org/sti/ict/green-ict.

4 For an overview of the digital revolution and related policy see DSTI/CDEP/GD(2017)2, “Going digital: Making the transformation work for growth and well-being”.


10 See GeSI (2015), *op. cit*. The direct ICT emissions footprint was calculated to cover end-user devices, data centres and networks. CO$_2$e = carbon dioxide equivalent.


Data for 86 ICT solutions reviewed in detail for the Sustainia 100 in 2013, 2014, 2015 and 2016. Around 120 solutions were compiled annually for each of 10 sectors, of which around 25 were reviewed in detail in each sector. Innovations were allocated as for the OECD analytical framework. Sustainia 100, A guide to 100 sustainable solutions, various years, Monday Morning, Copenhagen, Denmark.


Detailed questions based on the Recommendation were included in the policy questionnaires for the 2015 OECD Digital Economy Outlook and its predecessor outlook publications in 2010 and 2012.


More detailed analysis is presented for 2012 and 2014 than for 2010. Each country reply to the questionnaire was allocated to one major area, despite some replies covering multiple areas. Country replies were very heterogeneous, and this approach avoids giving greater prominence to countries describing numerous programmes. The 2009 analysis is more detailed across different activities (R&D, manufacturing, use, etc.) and different environmental impacts (global warming, energy use, toxicity, etc.), and one programme could have effects in multiple areas.

The US specifically flagged training procurement officials in green ICT procurement in their reply to the questionnaire. In addition, according to DIW analysis, this is a challenge in Germany, and the European Commission and a consortium of 8 European countries including Germany and the NL “are conducting training- and networking sessions on the subject of GPP (Green Public Procurement), and extending support structures such as helpdesks in the partner...

22 See, for example, Chiappinelli, O. and V. Zipperer (2017), op.cit.