EUROPEAN COMMISSION
DIRECTORATE-GENERAL FOR COMMUNICATIONS NETWORKS, CONTENT AND TECHNOLOGY

Connectivity
Radio Spectrum Policy Group
RSPG Secretariat

Brussels, 16 June 2021
RSPG Secretariat

RSPG21-026 FINAL

RADIO SPECTRUM POLICY GROUP

RSPG Report

on

the role of radio spectrum policy to help combat climate change

RSPG Secretariat, Avenue de Beaulieu 33, B-1160, Bruxelles, office BU33 7/65
Telephone: direct line (+32-2)29.21.261, switchboard 299.11.11
E-mail: cnect-rspg@ec.europa.eu Web-site: http://rspg-spectrum.eu
Web-site CIRCABC : https://circabc.europa.eu/ui/group/f5b44016-a8c5-4ef6-a0bf-bc8d357debcb

Index

List of Abbreviations

AAS	Active antenna system
ADCO	Administrative Cooperation Group
C3S	Copernicus Climate Change Service
CBTC	Communications-based train control
CEPT	European Conference of Postal and Telecommunications Administrations
CO_2	Carbon dioxide
ECC	Electronic Communications Committee of the CEPT
ECS	Electronic communications system
EECC	European Electronic Communications Code
EESS	Earth-exploration satellite service
EGNOS	European Geostationary Navigation Overlay Service
ETSI	European Telecommunications Standards Institute
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EV	Electric vehicle
FRMCS	Future Railway Mobile Communication System
GaN	Gallium nitride
GHG	Greenhouse gas
GMES	Global Monitoring for Environment and Security
GNSS	Global Navigation Satellite System
GSM	Global System for Mobile Communications
GSMA	Global System for Mobile Communications Association
GSM-R	Global System for Mobile Communications – Railway
ICT	Information and communications technology
IEA	International Energy Agency
IoT	Internet of things
IRENA	International Renewable Energy Agency
IT	Information technology
ITS	Intelligent transportation system
ITU	International Telecommunication Union
LPWAN	Low-power wide-area network
LTE	Long-term Evolution

M2M	Machine to machine
MetAids	Meteorological aids
MetSat	Meteorological satellite service
MIMO	Multiple input and multiple output
mmWave	Millimetre wave
MS	Member State
NDC	Nationally determined contribution
PA	Power amplifier
PAMR	Public access mobile radio
PLT	Power-line telecommunication
PMR	Private mobile radio
PV	Photovoltaic
RED	Radio Equipment Directive
RLAN	Radio local area network
RR	Radio Regulations
RSPG	Radio Spectrum Policy Group
SRD	Short-range device
V2X	Vehicle to-X
WAS	Wireless access system
WB	Wideband
WMO	World Meteorological Organisation
WPT	Wireless Power Transmission
WPT-EV	Wireless Power Transmission for electric vehicles

Introduction

The EU has set ambitious measures and goals to reduce its greenhouse gas (GHG) emissions in order to tackle climate change. It has done so by defining emissions targets for key sectors of its economy. The EU's first package of climate and energy measures was agreed in 2008 and sets targets for 2020. These were 1) reducing GHG by 20% (compared to 1990), 2) increasing the share of renewable energy to 20% and 3) making a 20% improvement in energy efficiency. The EU reached those targets ahead of schedule. In 2014, the 2030 climate and energy framework was agreed with a set of targets for the period 2021-2030. By these targets, the EU is committed to cutting its GHG emissions by at least 40% by 2030, compared to 1990.

In December 2019, EU leaders endorsed the objective of achieving a climate-neutral EU by 2050. EU leaders invited the Commission to prepare a proposal for the EU’s long-term strategy as early as possible in 2020 with a view to its adoption by the Council and its submission to the UNFCCC, as required by the Paris Agreement. EU environment ministers adopted the EU's long-term climate strategy in March 2020. The European Council also called on the Commission to develop, after a thorough impact assessment, a proposal for an update of the EU’s nationally determined contribution (NDC) under the Paris Agreement for 2030. EU leaders also took note of the European Green Deal strategy[1] adopted on 11 December 2019 and asked the Council of EU to take forward the work on the strategy. It provides an action plan of making the EU economy more sustainable in order to achieve the objective of zero level of net GHG emissions by 2050. On the basis of the Green Deal, many initiatives have been launched by now, for example the European Commission published the Circular Economy Action Plan[2] which includes measures for the ICT sector. It foresees regulatory measures under the Ecodesign Directive[3] applied to ICT equipment so that devices are designed for energy efficiency and durability, reparability, upgradability, maintenance, reuse and recycling.

One of the key roles of the Radio Spectrum Policy Group (RSPG) is to assist and advise the European Commission and other EU institutions on radio spectrum policy issues, on the coordination of policy approaches, on the preparation of multiannual radio spectrum policy programmes and, where appropriate, on harmonised conditions with regard to the availability and efficient use of radio spectrum necessary for the establishment and functioning of the internal market.

The RSPG supports the fight against climate change. Therefore, in its Work Programme for the years 2020 and beyond the RSPG established a work item to focus on spectrum policy aspects which are closely related to the efforts of ensuring climate-neutrality. Under the Climate Change work item, the RSPG initiated a debate amongst its Members, as well as with the relevant stakeholders, on how spectrum policy can help to combat climate change. To this end, the RSPG addressed the following questions:

i) What are the climate change related aspects within spectrum management?

[1] The European Green Deal COM/2019/640

[2] https://ec.europa.eu/environment/circular-economy/pdf/new_circular_economy_action_plan.pdf

[3] Directive 2009/125/EC : https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32009L0125

ii) How can spectrum management help to combat climate change?
iii) What concrete actions at EU-level can RSPG recommend?

This Report gathers information related to those issues and accompanies an Opinion that sets out possible options in radio spectrum policy in order to help combat climate change.

The Report is divided into four chapters:

Chapter 1: Tackling the climate impact of the wireless sector.

Chapter 2: How wireless communications can help other sectors reduce their climate impact.

Chapter 3: Spectrum usages relevant for monitoring climate change or gathering climate-related data.

Chapter 4: The legal basis and spectrum management instruments for combatting climate change.

The Annexes complement the information presented by introducing some background material on standardisation and work in standards development bodies regarding energy efficiency, circular economy and e-waste.

When developing the Report, RSPG consulted extensively and at an early stage:

- On 18 and 21 September 2020 RSPG held an online workshop, in order to collect input for the topics from stakeholders on: Climate mitigation within the wireless sector; Agriculture and energy; Smart cities and public transport; Spectrum usages relevant for monitoring climate change or gathering climate-related data.

- In December 2020, RSPG issued a public questionnaire seeking responses to the following questions:

  Q1. How can the wireless technologies contribute to the efforts to reduce the climate impact of your sector?

  Q2. Which actions relating to radio spectrum issues and contributing to climate protection are taking place in or being planned for your sector(s)? These may be actions based on your own initiative, on the initiative of a group of stakeholders, or adopted as part of national or European policies.

  Q3. How can radio spectrum administration help to reduce the climate impact of your sector?

  Q4. Do you identify any issues involving radio spectrum administration which might prevent combat against climate change, decrease of carbon emissions and reducing energy consumption?

  Q5. Do you have any other comments that you would like to address to RSPG on this topic?

The inputs both from the workshop and from public consultations have been taken into due consideration when drafting this report. They will also be considered further during the drafting of the RSPG Opinion on Climate Change.

Chapter 1: Tackling the climate impact of the wireless sector

The impact of the ICT sector in general on the climate

The use of radio spectrum impacts upon GHG emissions through emissions associated with all equipment and devices needed to fulfil the service throughout a product's lifecycle (from manufacturing to end-of-life), and all the activities associated with or enabled by the spectrum use. It has been shown that in a general sense the operations of wired technologies (e.g. optical fibre, Ethernet, cable, etc.) are, compared to wireless technologies, more energy efficient and therefore less harmful to the climate.[4] However energy efficiency is improving with every new generation of wireless technologies.

Due to the lack of data available today, it is quite challenging to determine precisely the impact of technologies that use the radio spectrum. However, to give an idea of the magnitude of the impact, a report from Green IT[5] estimated that the digital world accounts for 3.8% of world GHG emissions. Furthermore, a report from IEA[6] estimated that data networks consumed 1% of total energy demand of which two-thirds are due to mobile networks. These figures give some clue of the presumed contribution to climate change of technologies using radio spectrum and the need to provide solutions to tackle it.

At present, we lack precise data on the environmental impacts of wireless technologies. It is clear, though, that these impacts are associated mainly with the manufacturing and operation of equipment and vary according to the equipment category. While manufacturing accounts for the greater percentage of GHG emissions for user equipment, at present the greater part of the GHG emissions due to network equipment come from its operation[7,8]. Thus, it is necessary to take into consideration the complexity and extent of the ICT ecosystem to propose measures to fight against climate change.

User devices, networks and data centres are the three main parts of the ICT sector. Currently, user devices (including phones, tablets and computers) account for the largest chunk of the sector's overall carbon footprint. The emissions during use emerge almost entirely from electricity consumption. Clearly some electricity is also consumed in the other stages of these devices' lifecycle. However many key ICT players invest in renewable energy, such as solar and wind power, in a bid to lower their carbon emissions.

---

[4] https://www.bmu.de/en/pressrelease/video-streaming-data-transmission-technology-crucial-for-climate-footprint/

[5] Green IT, The environmental footprint of the digital world: https://www.greenit.fr/wp-content/uploads/2019/11/GREENIT_EENM_etude_EN_accessible.pdf

[6] IEA , Digitalisation and Energy: https://www.iea.org/reports/digitalisation-and-energy#energy-use-by-information-and-communications-technologies

[7] https://www.bmu.de/en/pressrelease/video-streaming-data-transmission-technology-crucial-for-climate-footprint/

[8] Bieser, Jan; Salieri, Beatrice; Hischier, Roland; Hilty, Lorenz: *Next generation mobile networks: Problem or opportunity for climate protection?* Zurich, St. Gallen: University of Zurich 2000, p. 28, https://www.zora.uzh.ch/id/eprint/191299/1/5G%20and%20climate%20protection_University%20of%20Zurich_Empa.pdf

The direct impact of radio spectrum *use* stems from the GHG emissions associated with the energy used throughout the life cycle of a product and the material used in the manufacture of a product. This includes raw material acquisition, production and assembly, transportation, operation and end-of-life treatment. These are the activities that determine the *carbon footprint* of the wireless sector.

The indirect impacts of radio spectrum use are not included in the carbon footprint and are often much more significant than the footprint itself.

Thus, the effects can be divided into three aspects:

1. "Direct" carbon emissions associated with material extraction, manufacturing, use and disposal - the carbon footprint of radio spectrum use.
2. "Indirect" emission effects from using radio spectrum (e.g. travel substitution and transportation optimisation).
3. Their impact on user behaviours and preferences (reshaping how we lead our lives on a societal level).

Tackling the impact of emissions from operations

There are two ways to tackle the impact of GHG emissions from the operation of equipment in use to provide radio spectrum technologies: i) operating equipment with greener electricity and ii) optimising consumption through using energy-efficient equipment.

i) Operating equipment with greener electricity

There are measures that are sustainable regardless of the emission budget associated with different parts of the supply and consumption chain. These measures should be prominent among climate protection policy priorities until comprehensive information on carbon footprint is available. One such measure with a positive net effect is using electricity produced by renewable energy sources. If the ICT industry and its users only consumed electricity produced by renewable energy sources, more than 80 percent of ICT's carbon footprint could be reduced.[9]

According to the IRENA report "Reaching zero with renewables"[10], the electricity from renewable energy sources is a central pathway to reduce emissions. There is a high potential for the use of these sources of energy in the industry that needs to be further explored. In another report[11] on the use of energy from renewable sources, IRENA found that 64% of the companies in the telecommunications sector participating in the study implemented corporate sourcing of renewables. That is to say that the companies actively procured or self-generated renewable electricity to supply their own operations. Furthermore, the report highlighted that the information technology sector is a pioneer of corporate sourcing models.

[9] The energy and carbon footprint of the ICT and E&M sector in Sweden 1990-2015 and beyond, Malmodin & Lundén

[10] IRENA, reaching zero with renewables: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Sep/IRENA_Reaching_zero_2020.pdf

[11] IRENA (2018), Corporate Sourcing of Renewables: Market and Industry Trends – REmade Index 2018. International Renewable Energy Agency, Abu Dhabi.

Many stakeholders of the sector are committed to decreasing the impact of their activities in order to reverse climate change trends. For instance, the RE100[12] is a collaborative initiative led by non-profit organisations that work on climate change issues bringing together influential businesses committed to 100% renewable electricity. There are many telecommunications firms among the participants. Science-based targets[13] is another initiative that guides companies to take climate action and there are 35 telecommunications companies that are committed to these targets. Such initiatives from the industry should be recognised as an important driver to achieve climate targets.

Mobile operators can contribute to the decrease in energy use and reduce their carbon emissions by using renewable energy, in line with the Paris climate agreement. For example, GSMA members have committed to achieving a global warming target of 1.5 degrees.[14] Additionally, operators can make their ambitions transparent by disclosing their climate impacts, energy and GHG emissions. This will enable benchmarking and the identification of best practices.

ii) Decreasing consumption through using energy efficient equipment

Another way to decrease the impact of wireless technologies is by incentivising energy-efficiency solutions. This energy-efficiency pathway is a win-win solution for the industry because it enables a significant decrease of the GHG emissions whilst also contributing to savings on the operational costs. Some studies[15] estimate that energy costs represent on average 5% of the operational costs of telecommunication operators.

The lack of information on the carbon footprint in the various parts of the supply and consumption chain as well as the future efficiency gains make decision making complex. For example, if pushing for new, more energy efficient technology leads to an earlier disposal of the current equipment, the measure might, or might not, lead to less net emissions of GHG depending on the emission budget associated with the disposal and manufacturing etc. compared to the gains in energy efficiency.

Decision makers must therefore carefully explore the emissions in the whole supply and consumption chain and over time, in order to be able to decide if a measure is leading us closer to or further from the goal of a climate neutral EU.

The efforts to develop more energy-efficient technologies have concrete results. The IEA estimates that mobile-access network energy efficiency has improved by 10-30% annually in recent years. In this context, RSPG recognises the commitment of international organisations to continually search for better practices and standards in the industry to drive energy efficient-wireless technologies.

ETSI, for example, has a technical committee "Environmental Engineering"[16] which defines the environmental and infrastructural aspects for all telecommunication equipment and its environment. The committee works on metrics and methods to measure the energy efficiency of ICT equipment, standardisation terms and trends in energy efficiency. ITU is also committed to fighting against the

[12] https://www.there100.org/
[13] https://sciencebasedtargets.org/
[14] GSMA Climate Policy : https://www.gsma.com/betterfuture/wp-content/uploads/2020/07/GSMA-Climate-Policy.pdf
[15] https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-case-for-committing-to-greener-telecom-networks#
[16] https://www.etsi.org/technologies/environmental-aspects

adverse environmental impact of wireless technologies. The ITU-T Study Group 5[17] is responsible for studies on methodologies for evaluating ICT effects on climate change and publishing guidelines for using ICTs in an eco-friendly way.

Through extensive cooperation, standards organisations, equipment manufacturers, operators and academic institutions have continuously improved the energy efficiency of 5G networks. At the equipment level, improvements have been made in power amplifier (PA) efficiency and equipment dormancy.

A stakeholder has mentioned in response to the questionnaire that in the 2G/GSM era, the efficiency of PAs was typically below 20%. However, they tell us that in the past 20 years, the efficiency of PAs has been gradually improved due to improvements in PA structure design and semiconductor material technology. In particular, the use of Gallium Nitride (GaN) technology in the PAs has increased their efficiency to more than 50%[18].

A shutdown of legacy 2G/3G networks would significantly reduce the energy consumption per transported bit, thus lowering the climate footprint. However, RSPG is aware that there might be further implications of a shutdown of legacy technologies besides the aspect of energy efficiency that needs to be considered since these networks may well provide important services in MS. The RSPG recommends in its Opinion on a future Radio Spectrum Policy Programme that the European Commission and Member States anticipate any impact of any possible future phasing out of legacy systems.

Current trends in new mobile technology include the investigation/standardisation of dormancy modes, reduction of energy consumption at radio site level and new modes of cooperation between various types of networks. These raise new challenges for mobile operators for continuity of service, and attractive solutions for energy cost reduction. From the spectrum management view point, such initiatives are currently developed in a voluntary approach and are welcomed.

A multi-criterion assessment approach could be used in any assessments of performance of mobile telecommunications networks. Such an approach could consider the environmental sustainability of the networks in terms of their operational energy consumption, GHG emissions, waste and use of environmentally friendly energy.

Analysing the impact of spectrum related elements for energy consumption

The two initiatives – (i) renewable energy and (ii) energy efficiency– present a sustainable pathway for the industry. However, a remaining challenge for the sector is to describe the precise impact of wireless technologies on the climate. This depends on the network structure, on the energy mix and on the equipment used which will vary across Member States and service providers.

RSPG confirmed a need to better analyse the impacts of the operating frequency, the usage of higher frequency bands (such as mmWave), active antennas and small cells on the energy consumption of wireless equipment, and the interaction of these elements with energy consumption.

[17] https://www.itu.int/en/ITU-T/about/groups/Pages/sg05.aspx
[18] https://circabc.europa.eu/ui/group/f5b44016-a8c5-4ef6-a0bf-bc8d357debcb/library/15a556a2-a6a2-4768-b028-3d80444713bb/details

Moreover RSPG noted that the currently available data on the impact of the wireless sector comes from different sources such as academia, non-profit organisations and the industry. They are based on different methodologies and data sources and it is complex to establish a comparison between them. Nevertheless, there is currently a lack of data and transparent, trustworthy information is essential to enable policymakers to move in the correct direction and to empower technology users to make more sustainable choices.

The following components could impact energy consumption and should be considered in further analysis of the energy consumption of ECS radio solutions:

- The efficiency of signalling between base stations and terminals. Technical aspects such as antennas (AAS/MIMO) and modulation also impact on the energy efficiency of the network. For example the bands included/available in handsets could constrain the options for networks to manage handset connections within the service area of the cell.

- Spectrum related issues including the frequency band in use. This includes the number of base station sites (including small cells), whether sites are shared, whether dedicated spectrum is assigned, the type of traffic (flow of data, size of data flow) and the evolution of uses (including spectrum assigned to or used by verticals).

Chapter 2: How wireless communications can help other sectors reduce their climate impact.

The wireless sector has a direct impact in energy consumption and GHG emissions, as described in the previous chapter. However, wireless technologies can also have abating effects when applied in other sectors. It is estimated that ICT, in which wireless technologies play a very important role, has the potential to enable a 15% reduction in other sectors, such as energy, industry and transport[19].

As a consequence of the Green policy and regulatory initiatives described in the introduction of this report, all sectors are progressively engaged in combating climate change. This could increase their usage of or desire to use wireless networks or wireless services.

There are several examples of sectors that may be able to reduce their GHG emissions by means of wireless technologies. However, an evaluation of any of them will have to take into account possible rebound effects from new uses and services.[20]

The following sections describe how wireless technologies can contribute to making a number of sectors more environmentally friendly.

Smart Energy – Smart Grid

There is a potential for energy efficiency improvements and further use of renewable energy sources in the energy sector. Energy utilities are evolving in a competitive environment triggered by EU regulation[21] and innovation of the energy market (including new types of more sustainable energy generation technologies). Recent energy regulation, evolution of energy production, evolution of energy demands (e.g. the trend towards electric vehicles) are contributing to the migration towards smart energy and smart Grid.

Smart Energy and Smart Grid are examples of how wireless communications can enable more efficient energy use with associated environmental benefits and reduced costs. For example, wireless technologies can be used by grid operators to monitor processes in the grid and boost energy transmission efficiency and implement distributed generation. This is crucial to support a higher penetration of intermittent energy sources, such as wind and photovoltaic generation, in the electricity network, and will become increasingly important as the demand for electricity increases as a result of the growing use of electric vehicles and heat pumps.

Smart grid

Smart Grid technologies can optimise energy consumption according to demand in real time, by applying Power-to-X mechanisms to redirect the surplus of renewable energies to other sectors. Smart Grid solutions require reliable and secure communications with low latency to manage the electricity supply in real time and resilient and reliable communications to unmanned sites and plants in remote locations at all times.

Smart energy

Likewise, smart technologies can be used to incentivise or encourage consumers to alter the times during which they use energy to times when renewable energy sources are available. It is estimated that increased storage and digitally-enabled demand response could reduce the switch-off of wind power and solar photovoltaics (PV) sources due to grid balance issues from

[19] https://www.ericsson.com/en/news/2020/3/breaking-the-energy-curve
[20] GSMA: The Enablement Effect, page 50. https://www.gsma.com/betterfuture/enablement-effect
[21] https://ec.europa.eu/energy/

7% to 1.6% in the European Union by 2040, avoiding 30 million tonnes of carbon dioxide emissions in 2040. The main requirements are telemetry and telecontrol services and network operations for various components/services (energy generation and distribution) with increasing data flows as new assets are added. With regard to spectrum requirements and needs, some of these services can also be provided by narrowband wireless systems.

All these various trends and technologies will impact upon the strategy of implementation of wireless solutions for smart energy and smart grid, including combinations of fixed networks and new wireless solutions such as 5G. As a consequence, smart grid applications may differ between networks and countries, depending on network configuration, density of nodes, rate of data collection etc.

Smart meters

For residential users, smart meters can lead to more responsible behaviours due to dynamic pricing and increased transparency, as well as providing an easier way of measuring energy consumption and valuable data for smart energy systems. Smart meter solutions may also differ between the networks, energy networks' strategies and countries, depending on network configurations and the evolution of demands. Concerns about data privacy and security, which are challenges to be addressed by wireless technologies including in network implementation, might result in a lack of consumer support for and use of smart meters.

A portfolio of solutions for smart meters, smart grid and smart energy supported by harmonised spectrum for M2M, resulting from recent interactions between ETSI and CEPT, is already available to respond to the above needs:

- SRD data in networks, SRD (LPWAN, networks SRD, SRD)[22],
- M2M cellular [23]
- PMR, PAMR[24]
- 5G[25]
- M2M communications, including by satellite systems where voluntary harmonisation measures are on-going in order to support development of M2M communications satellite systems below 1 GHz
- Fixed links (narrow band harmonisation on CEPT level: 6 GHz and above) (requiring protection)

Harmonised spectrum is already available at EU level (SRD[26], M2M cellular and 5G), CEPT level (PMR, PAMR, fixed links) and internationally.

Power-Line Telecommunication (PLT) technologies are also under development and in operation in some areas as possible components of a smart grid network including the smart meters component. RSPG noted that to avoid radio interference to spectrum users, there is a need for consistency with the radio framework whilst also complying with standards[27].

[22] EU Decisions on SRD (EU 2019/1345, EU/1538/18).
[23] I e. EU Decision 2018/637
[24] https://cept.org/ecc/topics/private-professional-land-mobile-radio
[25] https://cept.org/ecc/topics/spectrum-for-wireless-broadband-5g
[26] EU Decisions on SRD (EU 2019/1345, EU/1538/18).
[27] Regional PLC standards EN 50 561 & 50065

Smart home

Another example concerns the use of energy in buildings. Buildings are responsible for approximately 40% of energy consumption and 36% of emissions in the EU[28]. Smart Home solutions can minimise these figures by connecting thermostats and heat pumps with the electricity grid, thereby encouraging the use of energy when it comes from renewable sources. Digitalisation in buildings could cut energy use by about 10% by using real-time data to improve operational efficiency[29].

Where appropriate, relevant mobile coverage or fixed broadband availability is needed for Smart Home solutions, as well as setting up a large amount of sensors to collect the necessary data. Smart Home solutions also require a solid telecommunications infrastructure, since they have a large amount of IoT devices that will inevitably push the necessary network capacity.

A portfolio of solutions supported by harmonised spectrum for M2M is already available to respond to the above needs (EC Decisions on SRD and RLAN, cellular M2M).

Smart city

Smart City services may also have a significant impact in reducing daily energy consumption[30]. Other services, such as waste collection and recycling, can also significantly benefit from Smart City solutions based on data collection from IoT devices.

A portfolio of solutions similar to those for smart meters is already available to respond to the above needs.

Smart vehicles (and road ITS)

Smart vehicles supported by Intelligent Transportation Systems (ITS) could contribute to improving travelling times and GHG emissions, thus helping climate change mitigation and improving air quality. ITS can reduce the fossil fuel consumption of large vehicles used for transporting goods, as it may not be possible to use electric vehicles for this purpose in the short term. Traffic flows can be optimised by providing real-time information on the traffic situation through data transmission, e.g. between traffic lights, public transport infrastructure, and parking systems. By improving traffic congestion, commuting times are reduced and so are GHG emissions.

Spectrum is already harmonised at EU level for non-safety ITS (EC SRD decision) and for safety ITS at 5.9 GHz (EC Decision on ITS). Additional work is on-going in ETSI in order to address co-channel and adjacent-channel co-existence methods between ITS G5 and LTE-V2X. In case of lack of results of this standardisation process, there could be a need for the European Commission to consider relevant action in order to ensure a long term efficient usage of road ITS.

Other complementary solutions are also under development in conjunction with EU proposals on Connected and Automated Mobility and national initiatives which are supporting 5G coverage of main

[28] https://ec.europa.eu/info/news/new-rules-greener-and-smarter-buildings-will-increase-quality-life-all-europeans-2019-apr-15_en
[29] https://www.iea.org/reports/digitalisation-and-energy
[30] https://www.c40.org/

roads[31]. The introduction of 5G in lower bands will contribute to better 5G coverage with better latency. Galileo services and geolocation data are used, for example, to plan and operate mobility services such as "mobility on demand", parking management or bus fleet management and car, bicycle or scooter sharing.

Powering electric vehicles

The car industry is currently shifting to electric power. The trend is on-going and creates challenges for power generation, supply and energy storage. It will impact energy networks as mentioned earlier. A market demand is emerging for Wireless Power Transmission for electric vehicles (WPT-EV) systems.

WPT-EV systems equipment generate electromagnetic waves whose energy is mainly contained in their operating band in part of HF band which is also used by radio communications services. Considering the future density of wireless power transmission (WPT) systems for electrical vehicles (EV) stations, their positions and the emission power targeted, and the potential proximity with mobile and fixed radio equipment operating in HF band , there is a risk that interference could be caused to such communications equipment.

A widespread deployment of WPT systems could make the use of electric vehicles more convenient for long distances as well as decrease the required size of batteries. However, the decreased charging efficiency of WPT systems compared to traditional wired connections may offset some of the benefits of using electric vehicles in terms of GHG emissions.

RSPG noted that harmonisation decisions regarding Wireless Power Transmission for electric vehicles (WPT-EV) systems are under development including relevant harmonised standards.

Industry 4.0

Wireless communications will play a vital role in developing industry 4.0, where digitalisation can optimise manufacturing processes and reduce the use of resources in general. Wireless technologies support the modernisation of existing facilities, flexibility in production, savings in cabling costs and faster retrofitting of existing machines.

5G and other technologies such as WiFi and SRDs may support industry 4.0 in meeting the specific requirements of each factory, which may also help make industrial production more energy efficient. In addition to that, Industry 4.0 could also contribute to a trend towards more locally manufactured goods, thus reducing the size of the logistic chain (national and international) and relevant energy needs.

Smart agriculture

Agriculture emissions correspond to around 20% of GHG total emissions[32]. Consequently, a climate-smart agriculture approach which integrates solutions to address the challenges of food security and climate change needs to be implemented. The use of wireless technologies can help optimise resources and reduce emissions, thus achieving the expected outcomes of a climate-smart agriculture approach: increased productivity, enhanced resilience and reduced emissions. For example, the use of drones can help farmers increase crop yield through precision farming. Radiolocation systems such as Galileo could contribute to precision fertilisation and targeted spraying can increase yield and reduce

[31] https://ec.europa.eu/digital-single-market/en/news/europe-sets-5g-investment-agenda-connected-and-automated-mobility

[32] https://www.worldbank.org/en/topic/climate-smart-agriculture

pesticide consumption. Irrigation systems and monitoring systems for environment variables based on IoT can help improve soil quality and productivity to avoid deforestation and optimise the use of resources. Wireless monitoring of cattle can improve living conditions on the farm and reduce animal mortality, hence improving the productivity rates. These solutions can in turn decrease the amount of land needed for farming and create possibilities for reforestation and decarbonisation.

In the case of the agricultural and farming sector, the focus should be on identifying which technology can optimise production the most (e.g., field surveillance, an improved use of fertilisers, cattle monitoring, etc.), so that technical requirements can be established.

A portfolio of solutions supported by harmonised spectrum is already available to respond to the identified needs:

- 5G
- LPWAN
- Widespread coverage for M2M communications, satellite systems
- GNSS: Galileo and EGNOS solution to move towards precision agriculture[33]
- Copernicus Climate Change Service (C3S)[34] supports European climate policies and actions, contributing to building a European society with more resilience against human-induced changes in the climate and gives access to information about the past, current and future states of the climate in Europe and worldwide.

Current barriers to the use of wireless technologies within smart agriculture include, for example lack of coverage:

- Underinvestment in communications networks in rural areas in countries which follow a market-based approach to network roll-out; Rural areas gain late access (if at all) to new technologies, which results in devices not being designed for the latest technology, emphasising a negative feedback loop.
- For some technologies coverage issues may exist (e.g. 5G).

Public transport

Public transportation in cities contributes to reducing the saturation of urban traffic networks, and to responding to the environmental challenge of cities, by reducing local pollutant emissions including fine particles and their greenhouse effect. On a nationwide and international scale, trains are an alternative to planes or individual cars, contributing positively to the reduction in carbon emissions.

Urban Rail ITS

Urban rail ITS, which is nowadays based on communications-based train control (CBTC) systems, offers a better exchange of information between trains, resulting in a more efficient and safe way to manage the urban rail traffic. More metros are therefore able to progress on the same line, in a safer way. Moreover, these systems offer flexibility in terms of operational schedules or timetables, enabling urban rail operators to respond to the specific traffic demand more swiftly and efficiently and to solve traffic congestion problems. In fact, automatic operation systems have the potential to significantly reduce the headway and improve the traffic capacity compared to manual driving systems. Those urban rail ITS systems have also proven to be more energy efficient than traditional manually driven

[33] https://www.gsa.europa.eu/segment/agriculture

[34] https://climate.copernicus.eu/about-c3s

systems. The use of new functionalities, such as automatic driving strategies or a better adaptation of the transport offer, contributes to the overall objectives of increasing performance and security of public transport.

Dedicated spectrum has been harmonised across Europe for ITS Urban Rail and road safety purposes. This recent EU harmonisation in 5.9 GHz will benefit urban rail ITS in Europe, contributing to the combat against climate change.

Railways (GSM-R /FRMCS)

A harmonised frequency solution will soon be in place, where additional spectrum in 900 MHz and supplementary spectrum in 1900 MHz will enable railways and EU Member States to migrate from GSM-R to the new 5G based FRMCS. The evolution of rail communications from GSM-R towards FRMCS will support applications like Automatic Train Operations (ATO) to smoothen and densify the traffic. These new possibilities will help train transport to become smoother and reduce the number of interruptions. This will also have a positive impact on train transportation. Thanks to these elements, the railway sector may participate positively to the reduction of carbon emissions.

GSM-R also benefits from EU spectrum harmonisation. Harmonisation of spectrum supports the development of and migration from GSM-R to FRMCS. Spectrum for FRMCS will also be harmonised soon, enabling the creation of European wide radiocommunication systems supporting railway critical applications and beyond according to railways needs for both passenger and freight trains. The EU harmonisation will benefit FRMCS by providing additional spectrum in 900MHz and supplementary spectrum in 1900 MHz helping railways and EU Member States to manage at national level the migration from GSM-R to FRMCS.

In addition, to these EU spectrum harmonisation initiatives, European standards harmonisation is needed in order to fully implement the benefit of the spectrum harmonisation. The follow-up actions at ETSI are covering Urban Rail ITS (CBTC), GSM-R, and FRMCS.[35]

Furthermore, the railway and urban rail sector, as verticals, benefit from EU spectrum harmonisation for operating a large range of communications (voice and data) beyond critical applications: Mobile, M2M, drones, RLAN, etc.

Concluding remarks on reducing the climate impact of sectors

Digitalisation, data use and smart technologies using (fixed and) wireless infrastructure could lead both to resource efficiency gains and GHG reductions in a wide array of areas such as logistics, energy, housing, manufacturing, agriculture, etc. The use of (fixed and) wireless electronic communication and other radio based services is however itself associated with energy consumption during use as well as GHG emissions associated with energy and materials used throughout the life cycle of a product.

The examples above lead to the question of whether any of the known as well as future services needed for climate change mitigation require additional spectrum resources including additional harmonised spectrum. Due to different national strategies and needs, there is no one size fits all solution. At this stage, current harmonised spectrum could respond to various technology needs, stakeholders' strategies and development trends. The important task for the EU is to lead the

[35] Rail ITS sharing (non priority) with ITS Road (priority) , Improved CBTC receiver (blocking) and GSM R and FRMCS : Improvement of RMR receivers : GSM R Cab radio , WB RMR cab radio (FRMCS (robust against SRD emissions below 919.4 MHz) , improvement of Wideband RMR cab radio (FRMCS) for coexistence with usages below 1800 MHz and above 1920 MHz

transformation to a climate neutral EU in such a way that the efficiency gains obtained while reducing the carbon footprint from the sector are as large as possible.

Chapter 3: Spectrum usages relevant for monitoring climate change or gathering climate-related data

The past decade has seen increasing public concern about the Earth, its environment and mankind's impact upon it. Global threats such as climate warming, stratospheric ozone depletion, tropospheric pollution and an increasing number of extreme weather events have left us more concerned than ever about the need to monitor and understand what is going on in the Earth's environment.

Climate change monitoring and the gathering of climate-related data requires observing weather and atmospheric data (Earth observations) over a long period of time, all around the globe. Earth observations are used for monitoring climate change, gathering climate-related data as well as for producing daily weather forecasts and predictions. They enable safety of life and property, and the protection of the environment.

These activities, part of global climate and weather observing and monitoring systems, are undertaken by the World Meteorological Organisation, meteorological intergovernmental organisations such as EUMETSAT, and the national meteorological services around the world. Radio spectrum applications are fundamental to monitoring the climate and helping countries to mitigate and adapt to the effects of climate change.

Most of the associated investments come from public funds. In addition, these efforts are supported by strategic inter-governmental commitments, among which are the European Union's Copernicus initiative[36] (previously known as Global Monitoring for Environment and Security, GMES), and the World Weather Watch program of the World Meteorological Organisation[37], which relies on the availability of observations on every point of the Earth.

Climate change monitoring and weather forecasting are based on continuous global measurements of the state of the atmosphere. These measurements include ground-based and satellite-based active and passive observing systems. Earth observations are either based on measurements from radiocommunication systems, or gathered, provided and distributed by other radiocommunication systems.

The following radio services[38], described in the Radio Regulations (RR), are used for climate monitoring and weather forecasting:

1) The **Earth-exploration satellite service (EESS)** defined in No. 1.51 RR of the Radio Regulations (RR) includes passive and active sensors on satellites and various emissions transmitting data from Earth-to-space, space-to-Earth, and space-to-space,

---

[36] https://www.copernicus.eu/en
[37] https://public.wmo.int/en/programmes/world-weather-watch
[38] The full list of radio-spectrum applications used for monitoring climate and weather is contained in the WMO-ITU Handbook for the Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction.

2) The **meteorological satellite service (MetSat)** is defined in No. 1.52 RR as "an earth exploration-satellite service for meteorological purposes". It allows the radiocommunication operation between earth stations and one or more space stations.
3) The **meteorological aids (MetAids) service** is defined in No. 1.50 RR as a radiocommunication service used for meteorological, including hydrological, observations and exploration.
4) Ground-based meteorological radars as well as wind-profiler radars operate under the **radiolocation service** and are used for operational meteorology, weather prediction, atmospheric research and aeronautical and maritime navigation.

All applications used within these radio services form the frame for gathering climate-related data as described above. This is why those services benefit from international harmonisation and long term international regulatory protection.[39] Harmful interference to the above mentioned services, with a level which varies according to the type of EESS services, affects the various types of EESS, passive sensors, active sensors[40], data links, in different ways, with a negative impact on weather forecasting and monitoring of climate change in the long term.

The scientific use of spectrum was previously addressed by the RSPG in the RSPG opinion RSPG06-144.[41] The RSPG has provided further recommendations on this subject in the RSPG Report on Strategic Sectoral Spectrum Needs (RSPG 13-540rev2).[42]

With regard to climate monitoring and weather forecasting, the long-term collection of data (over many decades) is needed to address environmental issues in an informed manner. Frequencies have already been identified for both passive and active sensing and transmitting and distributing data information from satellites to the Earth or between satellites. Where appropriate, long-term spectrum availability and protection need to be ensured.

Passive sensing measurements are performed in multiple frequency bands that uniquely correspond to resonances of important atmospheric molecules and which cannot be changed as they are fixed by nature. These bands are covered by ITU RR No 5.340 prohibiting all emissions in those bands. The acceptable level of interference for passive measurements is much lower than for active radiocommunication services.

It should also be noted that the scientific and meteorological communities coordinate among themselves in order to make the most efficient use of the corresponding frequency bands. The communities also work together to safeguard their interests and with Member states to avoid any type of emissions in those bands

[39] Furthermore, the meteorological observing system is dependent on many other radiocommunication services in addition to the MetSat, MetAids, radiolocation and EESS services to collect observations from many remote sites, and to disseminate information and warnings to customers. However, this is not climate change specific and therefore not covered by this document.

[40] Active sensors differ from passive sensors in that they illuminate the object under observation and respond to the reflected energy.

[41] https://rspg-spectrum.eu/wp-content/uploads/2013/05/rspg06_144_final_rspg_report_opinion_scientific_use_pectrum.pdf

[42] https://circabc.europa.eu/d/d/workspace/SpacesStore/f15d622c-183f-44d4-8412-19f2335a714d/RSPG13-540rev2_RSPG%20Report%20on%20Sectoral%20needs.pdf

Interference from 5 GHz WAS/RLAN to meteorological radars (5600 - 5650 MHz)

Ground-based meteorological radars operating in the frequency range 5600 - 5650 MHz have been suffering from interference by RLAN devices for many years. A number of actions have addressed the issue, including updates of requirements contained in the harmonised standard EN 301 893 for RLAN devices[43]

Even if the RLAN 5GHz harmonised standard has been improved over the years, including recently on "user access restrictions", and ADCO RED[44] and CEPT deliverables[45] have been published, there is still an increase in the cases of interference to meteorological radars reported by CEPT administrations in recent years[46], noting that in parallel, ADCO RED campaigns have reported the non-compliance of RLAN devices at 5 GHz[47].

In reacting to this issue preventing interference, detecting sources of interference and efficient enforcement within national jurisdictions are equally important. The elements of a solution to reverse the trend may involve, to varying degrees, detailed collection of data on interference,[48] measures and processes supporting equipment and compliance,[49] improved measures to identify and solve interference and measures leveraging further technology developments, including but not limited to cognitive spectrum sharing solutions. Many different bodies have the lead role in undertaking these tasks. In addition to that, CEPT launched a study on the possible use of part of the 5365-5470 MHz band by meteorological radars. This does not imply a mandatory migration of existing radars but would aim at offering an additional option on a case-by-case basis for existing or future radars in coexistence with incumbent services (other radars and EESS).

[43] For a summary, see ECC Report 192, *The Current Status of DFS (Dynamic Frequency Selection) In the 5 GHz frequency range*, section 1.4, https://docdb.cept.org/download/96969047-6c70/ECCRep192.pdf.

[44] ADCO RT&T, *Report on the 5th Joint Cross-Border R&TTE Market Surveillance Campaign (2013): WLAN 5 GHz*, https://ec.europa.eu/docsroom/documents/9922/attachments/1/translations/en/renditions/native;
ADCO RED, *Report on the 9th Joint Cross-Border RED Market Surveillance Campaign (2018): WLAN 5 GHz*, https://ec.europa.eu/docsroom/documents/35443/attachments/1/translations/en/renditions/native

[45] See ECC(21)027 Annex 11:
https://www.cept.org/Documents/ecc/63347/ecc-21-027-annex-11_options-for-weather-radars-at-56-ghz-clean

[46] https://cept.org/ecc/groups/ecc/wg-fm/fm-22/client/introduction/annual-radio-interference-statistics-and-special-interference-cases/

[47] https://ec.europa.eu/docsroom/documents/9922/attachments/1/translations/en/renditions/pdf

[48] As suggested already by ECC Report 192.

[49] One example is a portal for automatic alerts to and self-remedy by RLAN station operators, as implemented by the Czech Hydrometeorological Institute. See https://radar4ctu.bourky.cz/Ruseni.html

Chapter 4: The legal basis and spectrum management instruments for combatting climate change

Is the EU legal framework for radio spectrum administration ready to accommodate measures necessary to protect climate? This question can be affirmatively answered.

The most impactful actions aiming at climate protection must be EU-wide and society-wide. These measures will be implemented in radio spectrum use and administration no less than in any other area of life, not least because the authority of *"measures taken at Union or national level, in accordance with Union law, to pursue general interest objectives"* is explicitly granted by the European Electronic Communications Code (EECC)[50]. Important actions need to be taken at the level of the ICT industry[51] . This will result in industry-wide law making or measures taken in accordance with the law, to which the EECC is without prejudice again.

Radio spectrum administration

Specific actions to combat climate change can be taken within the radio spectrum administration domain too. The current EU legal framework on electronic communications networks and services is prepared to accommodate these actions, because it places the consideration of requirements arising from various objectives of public interest among the key responsibilities of national administrations. Combatting climate change enters among these public interest objectives naturally, and with no additional legislation required.

The measures adopted by spectrum managers in the interest of climate protection will have to respect the provisions imposed by the EECC. In particular, these measures must be established in conformity with the general principles of predictability and consistency, objectivity, transparency, non-discrimination, and proportionality.[52] The principle of non-discrimination will be relevant because possible measures aimed at combatting climate change might become discriminatory – for instance, if the deadline specifying a measure's entry into force was significantly shorter than the lifecycle of equipment. The principles of objectivity and proportionality may come into play when climate-related criteria are applied across different communication services and/or radio technologies.

Clearly, the need to pursue new public interest objectives related to climate protection targets will increase the pressure on spectrum managers. It is worth asserting, however, that the EU legal framework represents a tool for handling exactly this kind of situation. While acknowledging the multiplicity and potentially conflicting nature of interests, both public and private, it asserts that radio spectrum is a finite public resource[53] and mandates Member States to ensure effective and efficient use thereof. Furthermore, spectrum administrators are required to provide justified regulatory solutions and submit those to public consultation in conformance with the principle of transparency.[54]

[50] EECC Article 1(3)(b), cf. also Rec. 108.
[51] For instance, when implementing the Circular Economy Action Plan in the ICT sector, as presented in more detail in Annex 2 below.
[52] EECC Articles 3(4), 45(1) and 45(2). See also article 48(2) relating to the award of individual rights.
[53] EECC Rec. 107.
[54] See in particular EECC Article 23.

In the practice of European spectrum management, the above framework has been providing both a firm basis and the flexibility needed for decision-making in situations that featured conflicting claims and needs. The present situation is analogous, with its imperative to reduce the possible impacts on climate, while at the same time providing benefits for citizens and businesses[55] and supporting European Green Deal policies which involve various kinds of radio spectrum usage as a crucial component. The standing EECC legal framework should therefore be maintained and utilised to the full extent.

As argued throughout this report, the most efficient measures in radio spectrum regulation will be the result of a coordinated action by Member States some of which may be triggered by the sharing of best practices. For these actions, the ECCC stipulates explicitly that public interest aspects of Union policies must be taken into consideration.[56] These actions will not only be the most impactful in terms of their possible effects on the climate, but will also help to preserve competition, economies of scale and interoperability of networks and services, which all translate into customer benefits.[57]

The tools of strategic planning and coordination of radio spectrum policy at the Union level are defined by the EECC:

- Which requires that Member States, through the RSPG[58] develop best practices, facilitate coordination between Member States; and undertake coordinated spectrum assignment and authorisation.
- Which requires the European Commission to submit a legislative proposal to the European Parliament and to the Council for the purpose of establishing a multiannual radio spectrum policy programme[59]. The RSPG provided input into this process, including points aimed at supporting climate protection policies.[60]

Possible instruments for climate change mitigation

In the text above and in previous chapters, the relevant spectrum management actions to combat climate change have been highlighted

- spectrum planning and developing the regulatory framework (International , European, national)
- ECS awards, authorisations, assignments
- monitoring, solving interference

The RSPG, together with the Commission, is determined to continue the work towards the EU climate goals.

The importance of basing spectrum management decisions and policies on facts, considering the overall objective to make the best use of spectrum for society, remains crucial. In that respect, RSPG has considered the lack of data surrounding energy consumption in the sector as a whole, and the lack

[55] As per EECC Article 3(2).
[56] EECC Article 4(1).
[57] EECC Article 45(2), cf. also RSPP Rec. 6.
[58] EECC Articles 4(3).
[59] EECC Articles 4(4).
[60] *RSPG Opinion on Radio Spectrum Policy Programme (RSPP) RSPG21-033*, especially sections 3.6 and 6.2.

of understanding of the extent of renewable energy use in individual parts of the sector. Measures aimed at collecting data could help in tailoring effective and specific terms and conditions.

Nonetheless from a regulatory point of view, terms and conditions in spectrum authorisations in accordance with the EECC are one of many ways to alter the carbon footprint of radio communication, in particular to reduce energy consumption and to decarbonise the electricity used[61]. It is, however, a political issue whether this should be done and under what circumstances. The regulatory decision lies within the scope and responsibility of the MS of course. Sharing best practices on reducing the carbon footprint related to wireless communication networks and equipment in the European Union will contribute to overall steps to combat against climate change. Spectrum administrations are already engaged in matching spectrum plans across national borders in order to avoid areas with unused spectrum or poor service and avoid the installation of additional infrastructure and systems.

The timely awarding of spectrum would enable enterprises to develop innovative services to mitigate climate change. The making available of large contiguous frequency blocks per operator could avoid the energy consumption associated with the support of multiple carriers and carrier aggregation[62,63]. Indoor networks might to some extent reduce the need for high power levels in outdoor networks.

The ICT sector is at the forefront of technology. If the sector could promote climate neutrality, this could also be considered in regulatory aspects. The sector's own initiatives, including research and development to combat climate change, should be examined and built upon where appropriate. Examples of such action by the sector include i) self-regulation and other voluntary initiatives undertaken by the wireless ECS sector to reduce its carbon footprint and incentivise the increase of the share of electricity consumption from renewable energy sources, ii) wireless ECS sector cooperation and coordination to develop energy efficient standards and to design services and equipment based on such standards. Thus, a self-regulatory approach could be an alternative or additional measure to promote climate neutrality within the wireless sector.

[61] https://www.noticiasaominuto.com/economia/1746480/nos-e-edp-celebram-acordo-de-compra-de-eletricidade-renovavel
[62] https://www.sbrt.org.br/sbrt2020/papers/1570661121.pdf
[63] https://ieeexplore.ieee.org/document/9289502

ANNEX 1: Background material on work in standards development bodies regarding energy efficiency, circular economy and e-waste

International standardisation bodies address the human impact on the environment due to ICTs.

In particular in the study period 2017 -2020, the Study Group 5 of the ITU Standardisation Bureau (ITU-T) has prepared a number of recommendations under the "L-Series" of recommendations from ITU-T.[64]

The European Telecommunications Standards Institute under EC Mandate M/462 has already developed and is continuing to develop the standards needed to support the EC's energy efficiency targets. In particular ETSI established Technical Committee Environmental Engineering which is currently working on:

- Metrics and Measurement Method for Energy Efficiency of ICT equipment
- Standardisation terms and trends in energy efficiency
- Energy aware networking measurement methods

The interested reader can see details at:

https://www.etsi.org/technologies/environmental-aspects

A listing of relevant ETSI standards can be seen at:

https://www.etsi.org/committee/1395-ee

[64] https://www.itu.int/ITU-T/recommendations/index_sg.aspx?sg=5

ANNEX 2: EU framework for introducing climate protection among the criteria for equipment compliance

EU initiatives and legislation already address to a certain extent the sustainability aspects of products, either on a mandatory or voluntary basis. Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products[65] and Regulation (EU) 2017/1369 of the European Parliament and of the Council of 4 July 2017 setting a framework for energy labelling and repealing Directive 2010/30/EU[66] provide the frame on EU level for certain products that must comply with minimum requirements related to energy efficiency.[67] Herewith specific requirements are set, when exact values are measured and a limit is given (for example, maximum energy consumption, or minimum quantities of recycled material to be used in production). Alternatively, generic requirements are set which do not set limit values, but may require for instance that the product is 'energy-efficient' or 'recyclable'. The introduction of minimum requirements can result in a ban on all non-compliant products from being sold in EU countries.

There is no comprehensive set of requirements to ensure that all products placed on the EU market will become increasingly sustainable and stand the test of circularity *(within the recycling sense of the phrase)*. In order to make products fit for a climate-neutral, resource-efficient and circular economy, thus reducing waste, and in order to ensure that the performance of front-runners, under the heading of sustainability, progressively becomes the norm, the Commission has adopted a new Circular Economy Action Plan[68]. This Action Plan is a main block of the European Green Deal[69]. The core of this initiative will be to widen the Ecodesign Directive beyond energy-related products so as to make the Ecodesign framework applicable to the broadest possible range of products and make it deliver on circularity. Priority will be given to addressing product groups identified in the context of the value chains, such as electronics and ICT. The new Action Plan announces initiatives along the entire life cycle of products, targeting for example their design, promoting circular economy processes, fostering sustainable consumption, and aiming to ensure that the resources used are kept in the EU economy for as long as possible.

Currently, additional harmonised EU standards are gradually being produced to support the ecodesign measures adopted so far. Harmonised standards are rules that have been developed by the European standardisation bodies (ETSI, CENELEC and CEN). The use of harmonised standards helps provide a presumption of conformity: products are presumed to comply with the requirements covered by EU law implementing measures when tested using a harmonised standard.

Finally, voluntary agreements under the Ecodesign legislation exist.[70] Self-regulation may achieve the ecodesign policy objectives more quickly or at lesser expense than mandatory requirements. Therefore, industry sectors may propose voluntary agreements as alternatives to potential ecodesign

[65] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0125&locale=en
[66] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32017R1369
[67] The product types currently covered by these rules are listed here: https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/ecodesign_en.
[68] https://ec.europa.eu/environment/circular-economy/
[69] https://ec.europa.eu/info/node/123797
[70] https://ec.europa.eu/energy/sites/ener/files/documents/list_eco-design-voluntary_agreements.pdf

regulations. Such agreements need to fulfil specific criteria of the Ecodesign Directive and are assessed and monitored by the Commission.