European Commission

# Science for Standards: a driver for innovation

JRC thematic report

## Joint Research Centre (JRC)

*The European Commission's in-house science service*

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*Joint Research Centre*

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# Foreword by Dominique Ristori

## JRC Director-General

This report, part of a series of thematic reports, shows how the Joint Research Centre, as the European Commission's in-house science service addresses key societal challenges. The JRC is the only Commission service carrying out direct research, and it works in an inter-disciplinary manner, close to society, the scientific community, industry stakeholders and policy makers at the EU, national and international levels. This collaborative approach enhances the relevance of the JRC's work and its solid reputation for scientific excellence.

The role of standards is now high on the policy agenda. Europe is facing major economic challenges that require an ambitious economic policy for the 21st century. To accelerate EU growth, industry needs framework conditions that provide them with the basis upon which to invest, to innovate and to gain global market share in an increasingly competitive world. Standards are a cornerstone of these conditions and will be an integral part of Horizon 2020, the EU's forthcoming Framework Programme for research and innovation.

Science has a key role to play in supporting, and accelerating, the standardisation process. Across the JRC, three quarters of its work contributes to supporting the standardisation system. This ranges from pre-normative research, harmonised methods and the development of reference measurements and methodologies. The JRC's work in the area of standardisation encompasses everything from environmental monitoring to critical infrastructure protection, and from food and feed safety to nuclear safety and security. Together with DG Enterprise, the JRC has created the European Forum for Science and Industry in order to strengthen dialogue and cooperation between industry and science, with a strong focus on standardisation initiatives.

International collaboration is also vital to the standardisation process. The JRC collaborates with international bodies and organisations in the US and across the globe to harmonise scientific techniques and standardise analytical processes. For example, the JRC is working on establishing standards to help address the interoperability between smart grids and electric vehicles in close collaboration with the Argonne National Laboratories in the USA. This type of cooperation allows for the effective exchange of information and enables efficient international trade.

One of the most innovative current technologies is nanotechnology. It has potential to provide sustainable, cost-effective solutions to problems in areas as diverse as energy supply and healthcare. However, as a new technology, it needs to be subject to certain standards to ensure that protection of the citizen is maintained, and also to maximise on the benefits of this cutting edge science. The JRC has contributed to the Commission's definition of nanomaterials and has also developed the world's first certified nanoparticle reference material based on industry-sourced nanoparticles. This new material will help ensure the comparability of measurements worldwide, thereby facilitating trade and ensuring compliance with legislation.

A set of EU standards known as the EUROCODES provide information for a common approach for the design of buildings and other civil engineering works and construction products. The JRC carries out pre-normative research, contributing to the development of harmonised methods and internationally recognised standards for the construction and building sector. In this context, the JRC's European Laboratory for Structural Assessment (ELSA) tests structures to assess their behaviour when exposed to earthquakes or other forms of cyclic loads, and is capable of examining structures as high as five storeys. This research combined with the JRC's work in the areas of energy efficiency and sustainability contributes to the health and well-being of the citizen, as well as providing cost-effective and economically viable options for industry.

Part of Europe 2020, the EU's current growth strategy, sets the target of creating 20% of the EU's total energy as coming from renewable sources. The JRC supports EU and world standards in the areas of clean transport and renewable energies, helping to meet this target, and promote a cleaner, greener planet for the next generation. The European Solar Test Installation (ESTI) laboratory tests the electrical performance and shelf-life of photovoltaic (PV) devices, meaning emerging technologies can be examined under certain standards and conditions. It also carries out pre-normative research, helping to develop measurement techniques that benefit industry and investors. The Vehicle Emissions Laboratory (VELA) tests CO2 emissions of vehicles of all sizes and types, producing standardised procedures and practical recommendations that will contribute to future amendments of relevant legislation.

This is only a snapshot of the vast body of work carried out by the JRC, providing reliable, salient scientific and technical support to standardisation policy and legislation. This work is vital in helping the EU to meet its Europe 2020 targets, and will extend far beyond this. This report provides a comprehensive insight into the necessity for standards throughout the policy spectrum and illustrates the extensive role the JRC plays in this important field.

# Introduction

This report aims to give an overview of the standardisation work being carried out by the European Commission's in-house science service, the Joint Research Centre (JRC). Examples are taken from diverse fields such as health and consumer protection, low-carbon economy, nuclear safety and security, and the environment. As a whole, they clearly demonstrate how the JRC is actively stimulating innovation, fostering industrial competitiveness and managing those technological infrastructures needed to continually improve our products and services.

Standards are seen to be evolving more and more from product standards to process and production standards covering a broad range of subjects. There are different types of standards which can be classified into **documentary standards** (also called 'norms'), which provide prescriptions of characteristics for products, processes (incl. services), systems or persons, and **material standards.** Examples for the latter are the measurement standards, which establish the measurement scales for various quantities and allow the performance control of equipment, procedures and operators.

In the future, European standardisation will play a crucial role in an even wider variety of areas than it does today, ranging from supporting European competitiveness, protecting the consumer and the environment, improving accessibility of disabled and elderly people to tackling climate change and the resource efficiency challenge. Not only this, but as the European Council of 4 February 2011 confirmed, standardisation is a crucial framework condition to boost private investment in innovative goods and services. To achieve this, the standardisation processes should be accelerated, simplified and modernised. It is essential for the EU economy that European standardisation further adapts to the fast changing global landscape and economic environment.

The importance of standardisation as an important element to stimulate and enable innovation and competitiveness in Europe is reiterated in the EU growth strategy Europe 2020. Europe 2020 makes reference to the need for the *"setting of common standards"* and *"speeding the setting up of interoperable standards"* to *"improve the way in which European standard setting works to leverage European and international standards for the long term competiveness of European industry".*

As a result of these policy initiatives, a new Regulation[1] on standards was adopted in 2012. This Regulation aims at modernising and improving the European standards process, making it faster and at the same time more inclusive.

The inputs from the JRC into the standardisation process cover the full standardisation cycle:

- **Pre-normative research:** This is a pre-requisite in many promising industrial applications as a means to establish a level playing field for industrial cooperation and a predictable regulatory environment for future market development. This is one of the drivers for the JRC's contribution to standardisation.

- **Harmonised methodologies:** The JRC contributes scientific knowledge on harmonised and validated methods in the framework of methodologies to the development of EU policy; some of which are adopted in European legislation. Many of these methods, by being adopted at the EU policy level, become de facto standards.

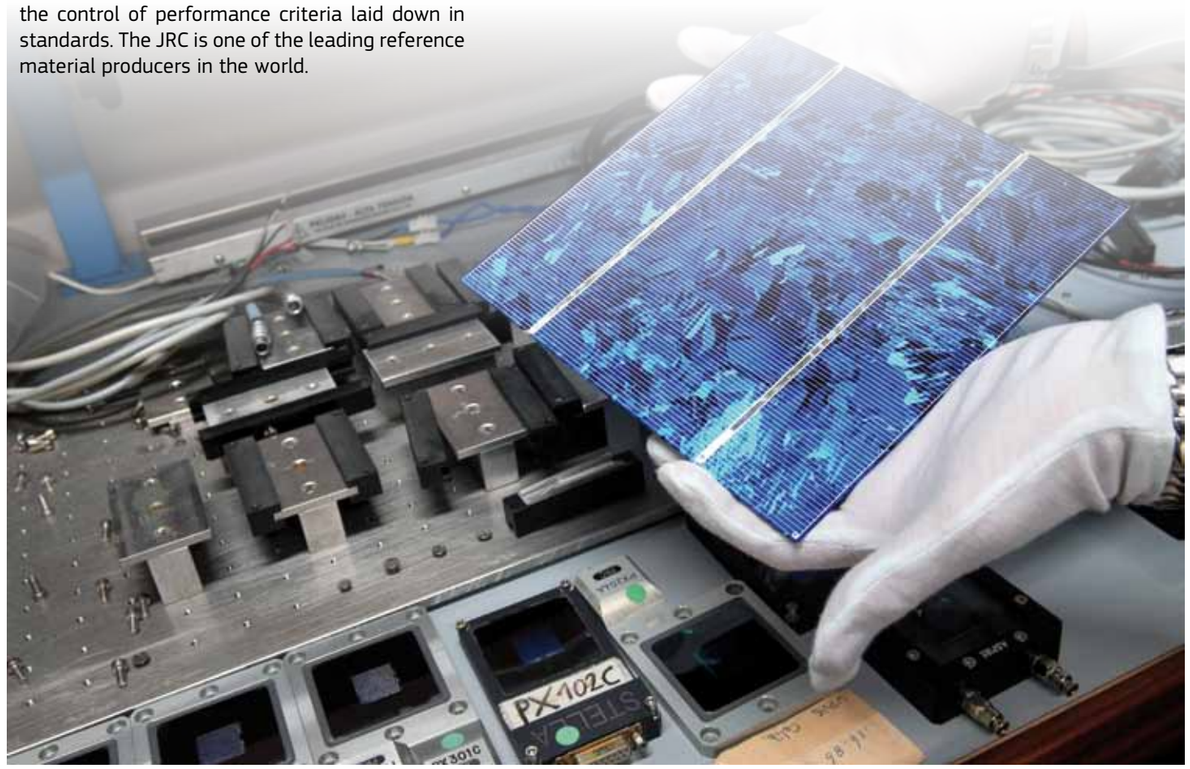
- **Formal documentary standards:** In some cases the JRC's work goes one step further; the methodologies that have been developed contribute to formal documentary standards that are adopted by relevant standards organisations and become European or international standards.

1 Regulation (EU) No 1025/2012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 October 2012 on European standardisation, amending Council Directives 89/686/EEC and 93/15/EEC and Directives 94/9/EC, 94/25/EC, 95/16/EC, 97/23/EC, 98/34/EC, 2004/22/EC, 2007/23/EC, 2009/23/EC and 2009/105/EC of the European Parliament and of the Council and repealing Council Decision 87/95/EEC and Decision No 1673/2006/EC of the European Parliament and of the Council

- **Internationalisation of standards:** In many international settings, the JRC represents the European position from a scientific and technical stand point. This is possible due to the JRC's mission and role as a reference for scientific input into EU policy. Moreover, JRC experts are acting as facilitator or even chair in committees and working groups of standardisation organisations.

- **Measurement standards and references:** Reference materials play an important part in laying the foundations for a European reference measurement system. They are essential for the development of the internal market, trade, innovation, maintenance of healthcare standards, assuring quality and safety of food, protection against fraud, providing tools for enforcement of EU legislation and the application of documentary standards. Furthermore, they are crucial for the control of performance criteria laid down in standards. The JRC is one of the leading reference material producers in the world.

- **Formal attestations:** In special cases the JRC formally certifies that the performance requirements that are included in standards have been met (e.g. in the area of photovoltaics). To a larger extent the JRC is certifying property values of reference materials and the correctness of measurement data. Thereby, international standards are applied and disseminated in a materialised form to market actors and regulatory bodies for ensuring the proper implementation of EU legislation.




# 1 Environment

*Protecting the environment is crucial to the future of our planet and a healthy environment is one of the cornerstones of the European model of sustainable development. The JRC provides scientific support to EU and global standards in areas such as sustainable production and consumption, environmental monitoring, and is at the forefront of remote sensing and earth observation technologies.*

*Earth observation has become an essential component to deal with global challenges. It can provide synoptic overviews which can be used for situation assessment and change detection. The JRC has a longstanding expertise in the use of remote sensing technologies in support to many European policies, and undertakes pre-normative research to help develop internationally accepted harmonised methods and standards. Standardisation is required in order to produce accurate earth observation products that are capable of delivering reliable results and to allow for harmonisation worldwide, facilitating best practice across the board.*

*The JRC also produces certified reference materials for environmental analyses, ensuring the harmonisation of measurements not only within the EU, but globally as well. This is necessary to support EU legislation, and by using the reference materials for calibration and method validation, laboratories can demonstrate that their measurement results are traceable, or in other words that they are globally comparable.*

## 1.1 Interfaces, standards and data models for Digital Earth

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Directive 2007/2/EC establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)
- Commission Regulation (EC) No 1205/2008 regarding INSPIRE Metadata
- Commission Regulation (EC) No 976/2009 regarding INSPIRE Network Services (View and Discovery)
- Commission Regulation (EU) No 1088/2010 regarding INSPIRE Network Services (Download and Transformation)
- Commission Regulation (EU) No 1089/2010 regarding interoperability of INSPIRE Spatial Data Sets and Services
- Commission Communication Towards interoperability for European public services – COM(2010)744

Promoting sustainability requires an integrated assessment approach, and the development of next generation information infrastructure (Digital Earth) necessary to share observations, information, and analytical models and outcomes. Digital Earth is based on observations from heterogeneous networks of sensors, satellites and citizens that together contribute to measuring the state and response of the environment. Standardisation of the content (semantics), documentation on the quality, service interfaces and other aspects are important for sharing and understanding observations efficiently.

To address this issue, the Commission is working with EU countries and the European Environment Agency (EEA) to develop and implement an infrastructure for spatial information in Europe (INSPIRE). The JRC has led the development of more than 35 specifications for data and service interoperability for INSPIRE, which have been subject to formal consultations involving over four hundred organisations from more than 20 countries. These specifications are the basis for the INSPIRE Implementing Rules Legal Acts.

In advancing interoperability for Digital Earth, the JRC contributes to the interoperability pillar of the Digital Agenda for Europe by promoting the re-use of INSPIRE specifications and providing an EU-wide, cross-sector interoperability framework for the exchange and sharing of location information and location-based services. This framework is compatible with the European Interoperability Framework (EIF) based on the information infrastructures implemented through the INSPIRE Directive and the related legislation.

Information about location plays a pivotal role in all policy cycle stages, at all levels of government with regards to interactions with citizens and communities and in various policy areas. As of November 2011, the JRC chairs the Interoperability Solutions for European Public Administrations (ISA) Task Force on the Core Vocabulary for Location, a simplified, reusable and extensible data model that captures the fundamental characteristics of a location, represented as an address, a geographic name, or a geometry. The resulting specifications will be proposed for endorsement by EU member states in the context of the ISA programme, and promoted for adoption by the National Interoperability Frameworks.

Innovative solutions for interoperability of complex multi-disciplinary systems at the European and global levels are also being advanced through the development of a suite of brokering middleware components able to interface with multiple systems each adopting different specifications and standards. This brokered architecture has been adopted in 2001 by the Group on Earth Observation to develop further the Global Earth Observation System of Systems (GEOSS).

Article 15 of the INSPIRE Directive says that the Commission shall establish and operate an INSPIRE Geoportal at Community level and EU member states shall provide access to their services through it. The JRC is responsible for the development and operation of the INSPIRE Geoportal and underpinning infrastructure.

As the overall technical coordinator of INSPIRE, the JRC is also supporting the implementation of INSPIRE directly in collaboration with EU member states (through the Initial Operation Capability Task Force). This open, transparent and participatory process is necessary for the drafting and maintaining of technical guidelines, upgrading and developing the INSPIRE infrastructure and ensuring that its deployment is truly interoperable.

JRC has led the development of approximately 25 draft INSPIRE data standards. These have been subject to stakeholder consultation. The comments and test reports involved 160 organisations in 20 countries.

*The Global Earth Observation System of Systems, supported by the JRC's INSPIRE initiative, proactively links together existing and planned observing systems around the world and supports the development of new systems where gaps currently exist.*

## 1.2 Remote sensing geophysical products

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Commission Communication on the European Earth monitoring programme (GMES) and its operations (from 2014 onwards) – COM(2011)831
- Commission Communication Towards a space strategy for the European Union that benefits its citizens – COM(2011)152
- Commission Communication on GMES and its initial operations (2011 - 2013) – COM(2009)223
- GCOS-154 Systematic Observation Requirements for Satellite-based Products for Climate Supplemental details to the satellite-based component of the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC - 2011 Update, December 2011
- GCOS-138 Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (2010 Update), August 2010
- The Common Agricultural Policy (CAP) 'Control with Remote Sensing (CwRS)' programme, and the 'Land Parcel Identification System (LPIS)' quality assessment programme ; Article 20 of Council Regulation (EC) 73/2009 and article 33 to 35 of Commission Regulation (EC) 1122/2009, modified by by Commission Regulation (EC) 146/2010.

Satellite-derived information support studies on climate change, air and water quality, land use and vegetation monitoring. Accurate Earth Observation (EO) products are a pre-requisite for downstream applications – that use them – to deliver trustworthy results on the evolution of large-scale systems and the potential impacts and likely outcomes of environmental strategies and policies.

As such, standardisation in EO product quality assessments is required and the work plan of the Committee on Earth Observation Satellites (CEOS) reflects this by focusing on the development of improved traceability strategies, data and product comparison efforts to evaluate biases, as well as the identification of 'best practices' for field validation methodologies.

The JRC contributes to these efforts with pre-normative activities working toward the standardisation of: i) primary ocean colour measurements for the assessment of satellite geophysical products for climate change applications; ii) absolute calibration procedures for *in situ* optical radiometer systems applied for EO calibration and validation activities; iii) performance criteria for physically-based canopy radiative transfer models that serve in the development of retrieval algorithms for terrestrial EO products; and iv) methodologies to evaluate satellite retrieval algorithms and *in situ* validation protocols for terrestrial EO products.

At the same time the JRC also contributes to the Global Climate Observing System (GCOS) which periodically evaluates the state of the climate observing system (GCOS-138 and GCOS-154) to formulate monitoring priorities, minimum observational requirements (including standards for accuracy) and general recommendations for all EO data providers. In this way the JRC ensures high monitoring standards as well as relevant and reliable climate information for policy making.

Choosing metrology as a means of providing unambiguous criteria for standardisation efforts, the JRC is contributing to the Quality Assurance for Earth Observation (QA4EO) framework which has been endorsed by CEOS as a contribution to facilitate the Global Earth Observation (GEO) vision for a Global Earth Observation System of Systems (GEOSS). More specifically, for land remote sensing the JRC adopts a standardisation strategy based on validated 3-D models capable of certifying the compliance of field validation protocols and satellite retrieval algorithms with specified quality criteria. For the marine domain, the JRC is involved in standardisation of primary *in situ* measurements for the validation of satellite geophysical products. This effort has led to the implementation of a continuously expanding network of *in situ* autonomous instruments built in collaboration with the National Aeronautics and Space Administration (NASA).

The JRC is involved in the standardisation of absolute calibration procedures for in situ radiometers utilised for the collection of highly accurate in situ measurements supporting the indirect calibration of satellite ocean colour sensors and the validation of derived products.

It is actively involved in the development of community standards, best practices and harmonised methodologies suitable to assess the quality of models used in the interpretation of EO data over land, products derived from EO data over land, and protocols used in field validation campaigns of these quantities. It has also contributed to the definition and application of in situ and remote sensing standardised measurement methods in the generation of highly accurate Essential Climate Variables (ECVs) according to the requirements for the Global Climate Observing System (GCOS).

Within the framework of the Common Agricultural Policy checks programme, the JRC establishes guidelines for Member States on the use of remote sensing imagery for checking farmers' claims for CAP area-based subsidies. In particular, the area of claimed parcels is checked using Very High Resolution (VHR) imagery which imposes that this imagery should meet certain geometric quality standards. The JRC has recently tested Worldview-2 (Digital Globe, US), an example of a VHR sensor which offers a 0.5m ground sampling distance fitting the CAP checks accuracy needs. The JRC continuously benchmarks sensors ensuring that geometric accuracy thresholds are maintained, specifying which elevation angles and number of ground control points (GCPs) are used. The JRC is currently benchmarking Pleiades1a and SPOT6; both Astrium, produced in France.


*Within its earth observation research, the JRC maintains monitoring standards, and also provides trustworthy information in support of EU policy.*

## 1.3 Reference materials for environmental monitoring

A safe and healthy environment is the common goal of several EU directives and regulations, and to this end, water, air and soil have to be regularly monitored and assessed. Measurement standards and benchmarks are indispensable components of modern measurement systems for achieving reliable - and thus comparable - measurement results for environmental monitoring. Therefore, the JRC's activities on harmonisation of measurements and certified reference materials (CRMs) for environmental analysis are needed by testing laboratories for performance assessment and validation of analytical measurement methods required to implement EU environmental legislation.

Environmental samples represent a huge variety of different combinations of substances to be analysed and the matrices in which they are embedded.

### Water

The JRC's water-based reference materials are intended as quality control tools for laboratories carrying out measurements required under the Water Framework Directive (Directive 2000/60/EC). This legislation sets out a long-term perspective for the management and protection of EU inland and coastal waters, including mandatory monitoring of the so-called priority substances comprising a wide range of compounds and elements.

The JRC produces a number of fresh water, ground water and seawater reference materials certified for trace elements, nutrients and other parameters of interest. Moreover, tailored CRMs for environmental bioindicators, such as mussels or fish, ensure reliable measurements for monitoring aquatic ecosystems.

Recent examples of water-based CRMs include ERM®-CA615, which is a groundwater material certified for the mass concentrations of a range of trace metals. The mass concentrations of four metals were chosen to reach specific European environmental quality standards. Other examples are ERM®-CA616 and ERM®-CA408, which are groundwater and simulated rainwater materials, respectively, certified for the mass concentrations of the main components and for pH and conductivity.

In addition, the JRC accompanied the establishment of best-practices and guidance for monitoring the environmental quality standards set for priority substances and river-basin specific pollutants under the Water Framework Directive. Thus, JRC co-chaired during 2009-2012 together with Italy the expert group on Chemical Monitoring and Emerging Pollutants (CMEP) and supported the Common Implementation Strategy of the WFD in the prioritisation process leading to a proposal of 15 additional priority substances. During this period JRC laboratories generated targeted information on occurrence and levels of possible candidate substances and coordinated the drafting of the CIS Guidance Documents on Chemical Monitoring as well as on Sediment and Biota Monitoring. The activity is accompanied by continuous reporting and evaluation of the performance of existing international, European and national standard for the analyses of priority substances.

### Air quality

The Air Quality Framework Directive and its daughter directive (2008/50/EC and 2004/107/EC) require the monitoring of a range of parameters. The JRC contributes scientific knowledge on harmonised and validated measurement methods for implementation and development of EU air policy through organisation of inter-comparison exercises for national reference laboratories and participation to CEN working groups developing standard methods to measure air pollution. The JRC produces reference materials to match the testing requirements of European air quality legislation, in particular, the type of matrix (including the particle size) and the type and content of the certified analytes.

Recent examples include ERM®-CZ100 and ERM®-CZ120, which were produced from fine dust that was processed in such a way as to resemble particulate matter with an aerodynamic diameter below 10 microns (so-called PM10) as closely as possible. ERM®-CZ100 is certified for a range of polycyclic aromatic hydrocarbons and ERM®-CZ120 is certified for four trace elements (arsenic, cadmium, nickel and lead).

### Soil and sewage sludge

Sustainable production depends to a large extent on the natural fertility of soil. Contamination, soil erosion, the overall decline in soil quality and the sealing of soil (loss of soil resources due to the covering of land for housing, roads or other construction work) are major problems across the EU. The JRC offers soil-based reference materials for major and trace elements (cadmium, lead, mercury) as well as polychlorinated biphenyls, polychlorinated dibenzo-p-dioxins and -furanes in different types of soil and sewage sludge of domestic and industrial origin.

### New materials

Besides the more traditional analytes with ecotoxicological relevance, such as heavy metals and persistent organochlorine pollutants, there is increasing interest in the fate of substances such as endocrine disruptors, brominated flame retardants, chloroalkanes and drug residues in the environment. Accordingly, the JRC's development programme for certified reference materials is tailored to meet the new and emerging needs of European legislation.

*Certified reference materials allow for reliable and comparable environmental monitoring.*

## 1.4 Best available techniques for industrial emissions

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions (integrated pollution prevention and control)

Industrial activities play an important role in the economic well-being of Europe contributing to sustainable growth. However, they also account for a considerable share of the overall pollution in Europe.

Emissions from industrial installations to air, water and soil are subject to EU-wide legislation, and the main piece of legislation is the Directive on Industrial Emissions (IED) (2010/75/EU), the successor of the Integrated Pollution Prevention and Control (IPPC) Directive (2008/1/EC). It covers some 50 000 installations across the EU.

The IED is based on an integrated approach aiming to protect the environment as a whole. The installations covered by the Directive must be operated in accordance with a permit granted by the competent authorities in the EU member states. Permit conditions must be based on the use of the best available techniques (BAT), with the 'BAT conclusions' adopted by the Commission serving as the reference for setting those conditions. The JRC hosts and manages the European Integrated Pollution Prevention and Control Bureau (EIPPCB), set up to exchange information between the Commission, the EU member states, industry and environmental NGOs on Best Available Techniques.

This leads to the development of BAT reference documents, called BREFs, containing the 'BAT conclusions', as well as background information on the sectors concerned and techniques applied and information on emerging techniques that have the potential to evolve into future BAT.

'BAT conclusions' are implementing acts under the industrial emissions legislation. They are necessary for EU member states to update permit conditions and ensure compliance with the Directive. Without them, there is no legal regime to incorporate environmental performance levels into national legislation; they therefore constitute the environmental technical standards that European installations have to meet.

The role of BREFs and 'BAT conclusions' has been reinforced by the revised industrial emissions directive. Before the IED there were and there still are, consequently, important differences in EU member states with regards to the implementation of EU environmental standards. With the coming into force of the new directive, these differences will be reduced to benefit the environment and to also achieve a level playing field in the Union by aligning environmental performance requirements for industrial installations.

In 2012, the first two implementing decisions on the best available techniques (BAT) conclusions on industrial emissions were adopted by the Commission. They referred to the iron and steel production and glass manufacture. These conclusions define the reference for setting the permit conditions for these installations in Europe under the new Industrial Emissions Directive (IED) 2010/75/EU. Given the techno-economic and scientific nature of the BREFs as well as the very sensitive nature of their conclusions, they are elaborated by the JRC's European IPPC Bureau, which fulfils an obligation of the Commission (as laid down in Article 13(1) of the IED) to 'organise an exchange of information between EU member states, the industries concerned, non-governmental organisations promoting environmental protection and the Commission'. The objective is to draw up, review and, where necessary, update the BAT reference documents (BREFs). The European IPPC Bureau steers the work on determining BAT, guided by the principles of technical expertise, transparency and neutrality. Its work entails the independent verification and analysis of the information collected to derive BAT conclusions.

*The JRC plays a key role in supporting EU legislation, such as the Industrial Emissions Directive.*

## 1.5 Environmental criteria for water

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Directive 2000/60/EC of the European Parliament and of the Council to manage, protect, and restore surface water and groundwater resources of river basins in the European Union (The Water Framework Directive).
- Decision 2008/915/EC of the Commission establishing harmonised ecological objectives for all surface waters in the EU in compliance with Directive 2000/60/EC.
- Updated Commission Decision establishing harmonised ecological objectives for all surface waters in the EU in compliance with Directive 2000/60/EC (foreseen 2013).
- 2012 Blueprint to Safeguard Europe's Waters

The Water Framework Directive's innovative approach to water management includes the requirement to ensure the health of aquatic ecosystems. This is embodied in the objective to achieve "good ecological status" of all rivers, lakes, and coastal waters by 2015.

While EU member states have a great deal of experience in monitoring the chemical status of their waters, measuring good ecological status has brought new challenges. Given the wide range of ecosystems found across Europe, using a unique method to assess all water bodies was not pertinent. Instead, the directive establishes a common definition of good ecological status, which EU member states must use when developing their national assessment methods. The ecological status of European surface waters is assessed using biological indicators (phytoplankton, aquatic fauna including fish, aquatic flora) and five status classes for water quality: high, good, moderate, poor and bad. The JRC provided scientific and technical support to the development and harmonisation of these classification schemes.

To ensure that national assessment methods to measure good ecological status deliver consistent and comparable results, the directive requires an intercalibration exercise facilitated by the Commission. The JRC has played a pivotal role in this process by establishing and coordinating a pan-European intercalibration network composed of 50 expert groups. The class boundaries of national methods were compared and harmonised using data from thousands of rivers, lakes and coastal and transitional waters across Europe

First results were published in 2008 and further results were completed in 2013. EU member states are using the results of the intercalibration work to prepare and implement their river basin management plans. These plans identify waters that do not achieve the environmental objectives set out in the directive, along with the measures necessary to improve conditions and reach good status. Intercalibration thus plays a crucial role in identifying where action is needed to restore the quality of Europe's waters.

*The Water Framework Directive aims to classify all European surface water from high to bad quality, and harmonisation and standardisation research at the JRC actively supports this initiative.*

## 1.6 Environmental criteria for products

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Commission Communication on the Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan – COM 2008/397/EC
- 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
- Directive 2010/30/EU of the European Parliament and of the Council on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products
- Regulation (EC) No 66/2010 of the European Parliament and of the Council on the EU Ecolabel
- Commission Communication on Public procurement for a better environment – COM 2008/400/EC

The Communication on the Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan calls for the creation of a virtuous circle that includes "improving the overall environmental performance of products throughout their life-cycle, promoting and stimulating the demand for better products and production technologies and helping consumers to make better choices through a more coherent and simplified labelling system". Within this framework, several voluntary and regulatory product-related instruments exist: the Ecodesign (ErP) Directive establishes a framework for setting ecodesign requirements for energy-related products; the labelling schemes set by, for example the Energy Labelling Directive and the Ecolabel Regulation provide consumers with information on the environmental performance of products. Moreover, incentives and public procurement are being implemented to stimulate the better performance of products.

Several environmental aspects (in particular energy consumption during the use phase) are already well addressed by regulation and measurement standards. However, some material efficiency-related performances of products are still not very well covered, in particular due to the absence of standards for the assessment of the performances. As a member of the Technical Committee, the JRC provided scientific and technical support to the development of a method for the calculation of recoverability rate (per mass) of Electrical and Electronic Equipment. In particular, the JRC contributed to clarify how a recovery scenario should be defined and provided exemplary recyclability rates for numerous materials and components, based on recent publications.

JRC contributed to the development of the following IEC (International Electrotechnical Commission) standard:
* 111/252/DTR IEC/TR 62635 Ed. 1.0: «Guidelines for End of Life information provision from manufacturers and recyclers, and for recyclability rate calculation of Electrical and Electronic Equipment», published in October 2012.

***Work in Progress***

The JRC is currently expanding pre-normative research activities in the field when proposing methodologies to assess other material efficiency performances such as recoverability rates relative to environmental impacts, recycled content, durability and ability to disassemble components. The JRC is developing these methodologies with the aim of ensuring an interconnected, consistent and synergistic use of these assessment methods in various policy instruments.

Moreover, the JRC is supporting the Directorates-General for Energy, Enterprise and Industry, and Environment regarding the Eco-Design directive, through follow-up of the standardisation process of the following energy-related product categories: professional refrigerators, heaters and water heaters. The JRC has drafted specific mandates for the European Standards Organisations (ESO) and is closely monitoring the standardisation process needed for these products, attending European Committee for Standardisation (CEN) - European Committee for Electrotechnical Standardisation (CENELEC) working groups and technical committee meetings.

# 2 Health and consumer protection

*Standardisation related to health and consumer protection is important for consumers and producers alike. EU legislation sets standards to guarantee a high level of protection for human health and the environment. The standards reinforce consumers' confidence in the products they use daily, and also have the potential to encourage manufacturers and traders globally to conform to the best available practices. Without them, the free movement of goods and services within the EU would not be possible. Ultimately, the scientific and technical challenges encountered while developing a standard may themselves become a push forward to innovation in the disciplines they rely upon.*

*The rapidly developing field of nanotechnology illustrates well the need for standards in emerging technologies. Nanotechnologies have high potential to improve the daily life of EU citizens, in areas ranging from consumer products like cosmetics, paints and clothing, to food and medicine. However, there is also a strong need for methods to assess the potential risks of different uses of nanomaterials, and to detect, identify and quantify them. The development of standards in this area needs to strike the balance between justified societal expectations on the safety of consumer products and the need to manage risks in a way that does not impede innovation and economic development. This applies not only to nanotechnology, but also to the safety of applications created via synthetic biology, and the management and use of chemicals.*

*The JRC supports standardisation in health and consumer protection by providing validated harmonised methods, the operation of several EU reference laboratories, and reference materials for the calibration of measurement methods and performance assessments of methods and laboratories. It supports EU policy-making in a wide-range of areas such as chemicals, nanomaterials, food and feed (including food contact materials, food contaminants, food authenticity, additives, and genetically modified organisms), protection of animals used for scientific purposes, cosmetics and textiles. It also supports the Test Guideline Programme of the Organisation for Economic Cooperation and Development (OECD).*

## 2.1 Alternative test methods

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)
- Directive 2010/63/EU of the European Parliament and of the Council of 22 September 2010 on the protection of animals used for scientific purposes
- Regulation (EC) no 1223/2009 of the European Parliament and of the Council of 30 November 2009 on cosmetic products

Many substances widely used in Europe are harmful to human health and the environment if used in the wrong way. They can be poisonous, can cause allergies, can harm the aquatic environment, and can cause cancer and numerous other health or environmental problems. The EU system for safe use of chemicals (REACH) requires that substances be tested. To cut costs and limit animal testing, the legislation makes it mandatory for companies to share test results and it encourages the use of alternative test methods. EU cosmetics legislation goes further by gradually introducing a ban on the marketing of cosmetics containing ingredients tested on animals. This will not only impact EU cosmetics industry practices, but also international trade.

The JRC works actively to standardise and validate alternative test methods to refine, reduce and replace animal testing. This includes basic and applied research, as well as research for regulatory purposes, in particular through the standardisation of testing protocols and their validation.

Alternative methods are now available to fully replace animal testing on some health hazards such as corrosiveness of skin, skin irritation, dermal absorption, and phototoxicity. The biggest challenge lies in finding systems capable of replacing animal testing for complex (systemic) toxicological endpoints. This requires modelling the normal functioning of target biological systems and the disturbance that chemicals could imply. Particularly challenging is how to address human health effects.

JRC's activities focus on standardised toxicity test protocols, regulatory testing requirements and validation guidance, which is crucial for worldwide regulatory acceptance. The JRC hosts the European Union Reference Laboratory (EURL) for Alternative Methods to Animal Testing (EURL ECVAM). Through these facilities the JRC supports the regulatory acceptance process at both European Union level and internationally, the latter particularly through the Organisation for Economic Co-operation and Development (OECD). In vitro methods further developed and validated by EURL ECVAM have resulted in several adopted OECD Test Guidelines for alternatives.

Since 2009, EURL ECVAM has received 33 submissions of alternative test methods of which six are currently undergoing validation and one is in peer review. EURL ECVAM is currently (2013) involved in ten validation projects, including 14 testing methods, some of which address elements of the more complex adverse health outcomes[3].
In the framework of International Cooperation on Alternative Test Methods (ICATM), the JRC works with other validation organisations from other regions to accelerate the international acceptance process of validated and standardised methods. The ICATM partners seek to agree on harmonised recommendations to jointly support validated methods at the OECD, directly cooperating with the OECD's Test Guidelines Programme. Standard Operating Procedures (SOPs) and protocols, validated by ECVAM, have formed the basis for OECD Test Guidelines, as quasi standards. The mutual acceptance of data is based on these guidelines.

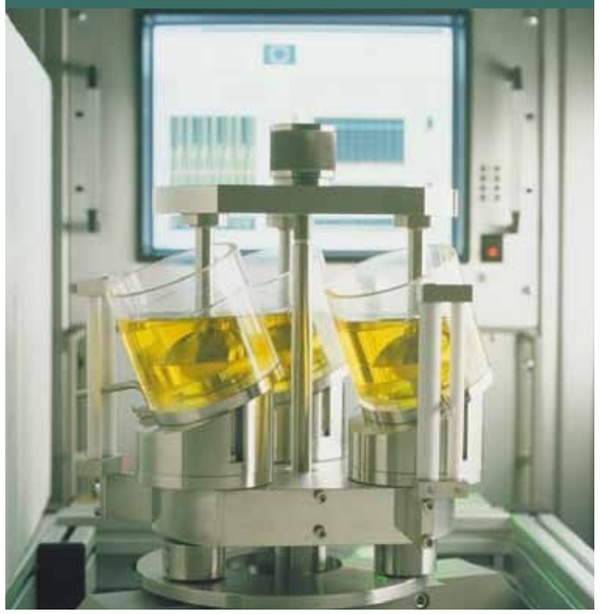
***Work in progress***

In March 2012 EURL ECVAM issued a recommendation on three assays for carcinogenicity testing and forwarded the results to the OECD for potential inclusion into the OECD Test Guidelines and subsequent international regulatory acceptance. It provides recommendations on two assays addressing skin sensitisation in the course of the year. In addition, work is on-going together with the OECD for integrated testing strategies for skin irritation and corrosion, which would set another standard. EURL ECVAM has launched new validation studies, based on a priority setting exercise amongst test submissions that are ready to enter validation. On the international cooperation side, it will carry out the peer review of an assay validated by the Japanese validation body member of ICATM. Reciprocally reviewing of assay validations by ICATM members is in fact a potentially highly effective way to facilitate and speed-up the international acceptance of new standardised methods for assessing the toxicological characteristics of chemicals. It is therefore planned to intensify this form of international cooperation, aiming at harmonising recommendations internationally to the greatest possible extent.

**Accelerating the validation of in vitro methods using a high throughput screening platform**

Animal-free testing strategies for determining toxicological hazard of chemicals rely heavily on data derived from in vitro assays. Although many new in vitro methods are becoming available, either from commercial developers or as output from Commission funded research projects, the validation of these methods for use in regulatory safety assessment poses a significant challenge. Typically it can take many months or even years to generate a sufficient dataset on enough reference chemicals on which to base a decision as to whether a particular assay is reliable and fit-for-purpose.

Applying a novel approach, the EURL ECVAM has demonstrated for the first time how an automated robotic in vitro testing platform can be used to generate the data needed for the purposes of validation, in a rapid and precise manner. This "high throughput" validation approach is expected to expedite the screening of promising assays to identify the high-performers that should be taken forward for further assessment.



*The European Union Reference Laboratory for Alternative Methods to Animal Testing (EURL ECVAM) helps to validate and standardise alternative methods.*

3 A full overview of validated and internationally accepted methods is available at the following website: http://tsar.jrc.ec.europa.eu

## 2.2 Food and Feed

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Regulation (EC) No 882/2004 of the European Parliament and of the Council on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules
- Regulation (EC) No 1831/2003 of the European Parliament and of the Council on additives for use in animal nutrition
- Commission Regulation (EC) No 1881/2006 setting maximum levels for certain contaminants in foodstuffs
- Commission Regulation (EC) No 401/2006 laying down the methods of sampling and analysis for the official control of the levels of mycotoxins in foodstuffs
- Commission Regulation (EC) No 333/2007 laying down the methods of sampling and analysis for the official control of the levels of lead, cadmium, mercury, inorganic tin, 3-MCPD and benzo(a)pyrene in foodstuffs
- Regulation (EC) No 1935/2004 of the European Parliament and of the Council on materials and articles intended to come into contact with food
- Commission Regulation (EU) No 10/2011 on plastic materials and articles intended to come into contact with food
- Commission Regulation (EU) No 284/2011 laying down specific conditions and detailed procedures for the import of polyamide and melamine plastic kitchenware originating in or consigned from the People's Republic of China and Hong Kong Special Administrative Region, China
- Commission Regulation (EU) No 142/2011, Implementing Regulation (EC) No 1069/2009 of the European Parliament and of the Council laying down health rules as regards animal by-products and derived products not intended for human consumption and implementing Council Directive 97/78/EC as regards certain samples and items exempt from veterinary checks at the border under that Directive

EU legislation is in place to ensure that the products we buy and the food we eat are safe. The EU's food and feed control legislation[4] requires official control laboratories in the EU member states to use standardised methods, e.g. those issued by the European Committee for Standardisation (CEN), whenever available. When preparing documentary standards for food safety and quality, the JRC focuses on submitting collaboratively validated methods and providing technical expertise for the detection and determination of regulated substances in food and feed. Examples of standardised methods of analysis developed and validated by the JRC are methods for the analysis of several mycotoxins in feed and food, food additives (sweeteners), heavy metals, coccidiostats, animal-by products, and foreign fats in chocolate. The validated methods submitted to the various standard developing organisations (ISO, CEN, AOAC International) are in part the result of pre-normative research activities linked to the operation of the EU reference laboratories (EURLs) hosted by the JRC.

This legislation relies upon the scientific support of the JRC to ensure it is properly implemented. Provision of tools for testing is a key part of the process and JRC scientists are engaged in developing and harmonising analytical methods to ensure the chemical safety of food and consumer products.

The JRC hosts the EURLs for GMO food and feed, mycotoxins, polycyclic aromatic hydrocarbons, heavy metals, food contact materials and feed additives. These contribute to a high quality and uniformity of analytical results, in particular in those areas where there is a need for precise analytical and diagnostic data. The EURLs provide national Reference Laboratories in EU member states with validated and harmonised analytical methods, ensure that reference materials are available, and organise comparative testing. As European centres of excellence, the EURLs operated by the JRC supply scientific and technical support to the European Commission in the formulation, development, implementation, and monitoring of EU legislation related to the safety of the food chain. The JRC's scientific expertise in this area serves also the interests of the European Food Safety Agency (EFSA), the European Committee for Standardisation (CEN), the International Organisation for Standardisation (ISO), and national reference laboratories of EU member states.

Some of the EURLs (food contact materials, GMO, feed additives) maintain a collection of reference substances that can be used as calibrants for controls under the EU food legislation.

4 (Regulation (EC) No 882/2004

The JRC, as part of the EU delegation, supports standardisation activities also in the Codex Committee on Methods of Analysis and Sampling of the Codex Alimentarius Commission (CAC), a joint undertaking of the Food and Agricultural Organisation of the United Nations and the World Health Organisation. The main mission of CAC is to develop food standards, guidelines and related texts to protect the health of the consumers and ensure fair trade practices. Furthermore, the World Trade Organisation's Sanitary and Phytosanitary Measures (SPS) Agreement mandates CAC as the relevant global standard-setting organisation for food safety.

***Work in progress***

The JRC is expanding pre-normative research activities to cover areas of high societal relevance, such as detection of food allergens using advanced analytical technologies such as genomics and proteomics to protect the well-being of vulnerable consumers, as well as metabolomics to detect fraud related to high value agricultural products such as European wine and olive oil. The JRC's work on food safety and quality contributes to enhancing the quality of EU products and giving them a positive image, inside and outside the EU. It is a vital tool to preserve and promote the image of the European agricultural sector and to protect and inform consumers. The European Office for Wine, Alcohol and Spirit Drinks (BEVABS), operated by the JRC, will play a prominent role to support those standardisation/harmonisation activities.

**The following international standards are based on methods developed and validated by JRC:**

- EN 16278:2012 Animal feeding stuffs - Determination of inorganic arsenic by hydride generation atomic absorption spectrometry (HG-AAS) after microwave extraction and separation by solid phase extraction (SPE)
- EN 16158:2012 Animal feeding stuffs - Determination of semduramicin content - Liquid chromatographic method using a "tree" analytical approach
- EN 16006:2011 Animal feeding stuffs - Determination of the sum of fumonisin B1 & B2 in compound animal feed with immunoaffinity clean-up and reversed phase high performance liquid chromatography (RP-HPLC) with fluorescence detection after pre- or post-column derivatisation
- EN 16007:2011 Animal feeding stuffs - Determination of ochratoxin A in animal feed by immunoaffinity column clean-up and HPLC with fluorescence detection
- EN 15850:2010 Foodstuffs - Determination of zearalenone in maize based baby food, barley flour, maize flour, polenta, wheat flour and cereal based foods for infants and young children - HPLC method with immunoaffinity column clean-up and fluorescence detection
- EN 15890:2010 Foodstuffs - Determination of patulin in fruit juice and fruit based purée for infants and young children - HPLC method with liquid/liquid partition clean-up and solid phase extraction and UV detection
- EN 15891:2010 Foodstuffs - Determination of deoxynivalenol in cereals, cereal products and cereal based foods for infants and young children - HPLC method with immunoaffinity column clean-up and UV detection
- EN 15911:2010 Foodstuffs - Simultaneous determination of nine sweeteners by high performance liquid chromatography and evaporative light scattering detection
- EN 15791:2009 Animal feeding stuffs - Determination of deoxynivalenol in animal feed - HPLC method with UV detection and immunoaffinity column clean-up
- EN 15792:2009 Animal feeding stuffs - Determination of zearalenone in animal feed - High performance liquid chromatographic method with fluorescence detection and immunoaffinity column clean-up
- EN 14123:2007 Foodstuffs - Determination of aflatoxin B1 and the sum of aflatoxin B1, B2, G1 and G2 in hazelnuts, peanuts, pistachios, figs, and paprika powder - High performance liquid chromatographic method with post-column derivatisation and immunoaffinity column clean-up
- ISO 11206:2011 Water Quality - Determination of dissolved bromate - Method using ion chromatography (IC) and post-column reaction (PCR)
- ISO 11053 Animal and vegetable fats and oils - Determination of cocoa butter equivalents in milk chocolate, 2009
- ISO 23275-1. Animal and vegetable fats and oils - Cocoa butter equivalents in cocoa butter and plain chocolate - Part 1: Determination of the presence of cocoa butter equivalents, 2006
- ISO 23275-2. Animal and vegetable fats and oils - Cocoa butter equivalents in cocoa butter and plain chocolate - Part 2: Quantification of cocoa butter equivalents, 2006

*The European Union Reference Laboratories standardise method of analysis to ensure that the food we eat is safe.*

**JRC method to detect chocolate fraud becomes international standard**

A method developed by the JRC to measure vegetable fats in milk chocolate has become the first such method to be adopted as an international standard by the International Organisation for Standardisation (ISO). It was developed to enable the enforcement of the so-called Chocolate Directive.

The Chocolate Directive (Directive 2000/36/EC) allows the addition of up to 5% of vegetable fats other than cocoa butter in chocolate products. When these fats are added to chocolate, European legislation requires that consumers be informed by appropriate labelling of the product. The threshold of 5% is also an essential requirement for these products to move freely within the internal market.

Prior to the development of the JRC method, no validated methodology existed in this field. It was therefore not straightforward to check whether manufacturers were correctly reporting the amount of vegetable fats other than cocoa butter in milk chocolate, as their chemical composition and physical properties resemble those of cocoa butter very closely, thus making them extremely difficult to quantify or even detect. This left the door open for disputes and uncertainty as to whether or not milk chocolate products fulfilled legal requirements.

The JRC worked on the problem since the entry into force of the Chocolate Directive in 2003, in close contact with the European Commission's Directorate-General for Agriculture and Rural Development. As a result, reliable analytical methods were successfully developed to detect and quantify so-called cocoa-butter equivalents (CBEs) in milk chocolate.

The JRC method was adopted by the ISO as standard ISO 11053:2009. Two other JRC methods to determine foreign fats in dark chocolate were previously adopted as international standards in 2007. This new method for milk chocolate took longer to develop because of the increased complexity of the measurement, as milk fats in milk chocolate interfere with vegetable fats.

## 2.3 Genetically modified organisms

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Regulation (EC) No 1829/2003 of the European Parliament and of the Council on genetically modified food and feed
- Regulation (EC) No 882/2004 of the European Parliament and of the Council on official controls performed to ensure the verification of compliance with feed and food law, animal health and animal welfare rules
- Commission Regulation (EU) No 619/2011 laying down the methods of sampling and analysis for the official control of feed as regards presence of genetically modified material for which an authorisation procedure is pending or the authorisation of which has expired

The number of genetically modified crops is steadily increasing worldwide. Opinion as to their safety is still divided. In the EU, products derived from genetically modified organisms (GMOs) are strictly controlled by EU legislation. GMO derived food and feed can be commercialised within the EU only when it successfully passed through an authorisation procedure and with appropriate labelling provisions. To ensure that authorised GMOs can be traced, and, that no unauthorised GMOs enter the European market, it is critical to have an effective and reliable means of detecting them in, for example, shipments of imported food, feed, seeds and end products. Therefore, European legislation explicitly relies on validated methods and reference materials.

The detection of GMOs requires standardised methods that are specifically tailored for each GMO and are applied in a standardised way within all EU control laboratories. The JRC has been working for more than ten years on the development and provision of appropriate tools for this task including the design and production of tailored certified reference materials. They are required as measurement standards for carrying out the standardised measurement methods. Through its the JRC validates analytical European Union Reference Laboratory for Genetically Modified Food and Feed (EURL-GMFF), the JRC validates analytical methods for the detection and quantification of GMOs in food and feed.

The JRC's work on green biotechnology includes development of harmonised methods to detect genetically modified organisms in food and feed, the provision of certified reference materials, input to draft documentary standards at ISO level for GMO analysis.

***Work in progress***

The JRC is currently (2013) developing certified reference materials for independent calibration and quality control for the monitoring of GMOs in food and feed supplies. It leads discussions with biotech industry associations (EuropaBio and CropLife) to agree on a joint protocol defining the procedure for submission of validated methods to ISO for inclusion as international documentary standards. It is continuously working on the validation of GMO detection methods, in particular for the implementation of the new low-level presence legislation. New material standards were established in 2011 for sound reference measurement systems for GMO quantification, for example, in genetically modified potatoes. Guidance is also being developed for the harmonised implementation of the accreditation standard ISO/IEC 17025 for GMO control laboratories in the EU in cooperation with expert laboratories and the European co-operation for Accreditation (EA).

**Fostering harmonisation of GMO detection and analysis worldwide**

The Project "Towards Global Harmonisation of GMO Analysis by Creating and Supporting Regional Networks of Excellence" and related initiatives help fulfilling the principles of the European Commission Directorate-General for Health and Consumer Protection "Better Training for Safer Food" programme according to the mandate defined by Regulation (EC) 882/2004 on food controls.

The specific objective is to facilitate worldwide understanding of the EU legal frame and of the requirements in relation to control and safety, thereby enabling non-EU operators in their task of checking compliance with EU requirements.
In this context, the JRC organised in June 2012 the 1st international workshop on Harmonisation of GMO detection and Analysis in the Middle East and North Africa Region, in the Dead Sea area, Jordan.

*The European Union Reference Laboratories standardise method of analysis to ensure that the food we eat is safe.*

## 2.4 In vitro diagnostics

Decisions about the health status of citizens, potential treatments of patients and their success monitoring relies on diagnostic findings, which are largely based on measurement results which have to be reliable, of proven medical relevance and globally comparable. The latter gains increased importance because of globalisation, both regarding mobility of people and industrial activities in medical diagnostics.

Since the beginning of the 1990s, the JRC is working in the area of healthcare, mainly on globally harmonised measurement systems and standards for in-vitro diagnostics. The JRC provides policy advice and support for enabling the implementation of the In vitro Diagnostics Medical Device Directive (IVDD) 98/79/EC.

The JRC is developing and providing crucial measurement standards for health status markers required for implementing the IVDD. Many of the collaborative projects that JRC coordinates are based on the Cooperation Agreement for the production, certification and distribution of biomedical certified reference material (CRM) between the European Commission and the International Federation for Clinical Chemistry and Laboratory Medicine (IFCC). An important aspect for unlocking the full potential of in-vitro diagnostics consists in the global acceptance of newly established and reliable diagnostic systems by all stakeholders, namely regulators, professional organisations, in-vitro diagnostics industry, standardisation and accreditation bodies.

***Work in progress***

Currently JRC's pre-normative research and standardisation activities are directed towards new standards for the diagnosis and monitoring of selected cardiovascular diseases, chronic diseases, neurodegenerative diseases (e.g., Alzheimer) and autoimmune diseases. In parallel, the JRC facilitates the international harmonisation and global acceptance of reliable measurement systems via professional organisations (such as IFCC, collaboration with NIST) and standardisation bodies (ISO, CEN).

*The JRC's research on in-vitro diagnostics provides policy advice and support to the In vitro Diagnostics Medical Device Directive (IVDD).*

## 2.5 Nanomaterials

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Commission Communication to the European Parliament, the Council and the European Economic and Social Committee on Regulatory Aspects of Nanomaterials – COM(2008)366
- Commission Recommendation 2011/696/EU on the definition of nanomaterial
- Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)
- Council Regulation (EC) No 440/2008 of 30 May 2008 laying down test methods pursuant to Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

Nanotechnology as an enabling technology holds great potential to solve approaching challenges, such as energy supply, healthcare or clean water. Furthermore, nanotechnology applications are also possible in a number of products which EU consumers use daily, such as cosmetics, textiles, food packaging and food.

However, this new technology and manufactured nanomaterials also raise considerable concerns, as nanoparticles of substances might interact differently with our bodies and the environment than the same substance would do if used in other ways. The European Parliament has expressed the need to address nanomaterials explicitly in relation to various EU policies (for example in relation to chemicals, food, air and water quality, workers' protection and waste). It has also called for legislation requiring the mandatory labelling of nanomaterials when incorporated into consumer products. It is important, therefore, that the EU's legislative processes concerning nanotechnology proceed from the basis of sound scientific judgment and knowledge.

The JRC provides guidance on how to assess nanomaterials within the EU regulatory context. This entails, among other things, the development of validated measurement methods for physico-chemical properties of nanomaterials, the development of dedicated reference materials, the establishment of corresponding sets of reference data on physico-chemical properties and the provision of guidance on how to present and report measurement results (including quality assurance). This allows the JRC to develop harmonised data templates as a contribution to international standardisation activities regarding the physico-chemical properties, and to provide a harmonised dynamic standard database of nanomaterials' properties for international use by identified user communities and stakeholders.

The JRC also supports international standardisation within the context of the OECD. It contributes to the harmonisation of toxicological and ecotoxicological tests for hazard identification, and represents the European Commission in the OECD Test Guidelines Programme. It co-chaired various steering groups of the OECD Working Party on Manufactured Nanomaterials, for example, 'Safety Testing of a Representative Set of Manufactured Nanomaterials' or 'Role of Alternative Methods in Nanotoxicology'.

The JRC coordinates input from authorities in the EU countries and publishes test methods. Furthermore, it seeks to develop harmonised and validated toxicological in vitro test methods for the identification of potential hazards linked to nanomaterials, and to establish corresponding performance standards.

***Work in progress***

The current work focuses on providing the scientific basis for adapting existing EU legislation to cover various aspects of nanotechnology, while at the same time making sure that the legislative framework remains innovation-friendly.

The JRC is developing and validating methods for the characterisation of nanomaterials, including their detection and identification in consumer products (sunscreens, food and food contact materials). By participating in the activities of the technical committees of both CEN and ISO, the JRC can facilitate coordination between the two standardisation organisations, for instance on the issue of a "Guide to labelling of manufactured nanoparticles and products containing manufactured nanoparticles".

Finally, in response to an essential need for transparency of information on nanomaterials and products containing nanomaterials, the JRC is expanding the NANOhub database and promoting its use as a central tool for the collection and exchange of nanomaterial information and data within the regulatory and research communities.

In January 2011, the JRC issued the first certified reference material from industry-sourced nanomaterials: ERM®-FD100 colloidal silica in water. In cooperation with other stakeholders, the JRC also studied several other representative nanomaterials of relevance for industry in view of their use in products and applications. Similarly, in October 2011, the Commission adopted Commission Recommendation 696/2011 on the Definition of Nanomaterial for regulatory purposes. The JRC has issued a reference report and contributed to the formulation of the recommendation. Meanwhile, another JRC reference report on requirements on measurements for the implementation of the European Commission definition of the term 'nanomaterial' is available.

*The JRC hosts the NANOHub database, facilitating the exchange and collection of information on nanomaterials and products containing nanomaterials.*

# 3 Energy and transport

*In 2009, EU member states set a target whereby 20% of the total EU energy mix should come from renewable energy sources by 2020. Scientific and technical support to EU and world-wide standards in energy and transport are key priorities at the JRC. In particular, standardisation in the automotive and power sectors aims to increase resources efficiency, interoperability and competitiveness.*

*Clean road transport and electromobility call for a high level of harmonisation and standardisation. A great variety of players are involved in the process, such as the automotive industry, electricity suppliers, telecommunications operators and the legislator at all levels. To reap the benefits of electromobility, it is necessary to harmonise vehicle technologies, electric grid operation and interconnections between electric vehicles, charging infrastructure and the grid. A major driver of standardisation is the need to reduce production costs and to increase safety. For example, performance and safety standards for batteries and other components, as well as electromagnetic compatibility of hybrid / electric vehicles, need to be carefully addressed.*

*At European level, standardisation helps to safeguard the best use of scarce resources and avoid the unnecessary diversification of production and fragmentation of markets. At a global level, standardisation efforts are strongly supported by vehicle manufacturers, power systems manufacturers and electronics and communications manufacturers that seek to maintain and stabilise their market position.*

## 3.1 Smart grids and electromobility

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Commission Communication on Clean Power for Transport: A European alternative fuels strategy – COM(2013)17
- Commission Communication on Research and innovation for Europe's future mobility – COM(2012)501
- Commission Communication on Investing in the Development of Low Carbon Technologies (SET-Plan) – COM(2009)519
- Commission Communication on Smart Grids: from innovation to deployment – COM(2011)202
- Standardisation Mandate to European Standardisation Organisations (ESOs) to support European Smart Grid deployment.
- Mandate M/490 for Smart Grids (March 2011), DG Enterprise and Industry
- Standardisation Mandate to CEN, CENELEC and ETSI in the field of measuring instruments for the development of an open architecture for utility meters involving communication protocols enabling interoperability. Mandate M/441 for Smart Meters (March 2009), DG Enterprise and Industry
- Standardisation Mandate to CEN, CENELEC and ETSI concerning the charging of Electric Vehicles. Mandate M/468 for Electric Vehicles (June 2010), DG Enterprise and Industry
- Commission Recommendation 2012/148/EU on preparations for the roll-out of smart metering systems

Clean and environmentally-friendly transport using electric vehicles is an innovative technology with large growth potential. These vehicles should interact with smart grids, the intelligent electricity systems of the future which should ensure economically efficient, sustainable power systems with low losses and high security of supply and safety. Standards ensuring the interoperability of smart grids and electric vehicles are becoming increasingly important as they enable innovators to bring their products to a wider market. Key to this market is the ability to guarantee electricity supply with intelligent metering and monitoring capacities, as well as two-way digital communication between supplier and consumer in order to predict and intelligently respond to the behaviour and actions of users.

The JRC works with European standardisation organisations to establish a European reference centre for energy security, including a smart grid simulation centre. Underpinning this is the JRC's work on various standardisation technical working groups, such as the European Commission Reference Group for Smart Grids Standards, responsible for validating the technical work.

In the area of transport, the JRC undertakes international efforts at the United Nations Economic Commission for Europe (UNECE) to forge a new world light vehicles testing procedure. This includes participation in the Development of the Test Procedure sub-group "Laboratory procedures for Electrical Vehicles", which provides specific testing procedures for full-electric cars and hybrids, as well as informal working groups on the safety, emissions and efficiency of vehicles with electric drive trains (batteries and fuel cells).

The JRC pays particular attention to the interplay between smart grids and the electrification of transport as several intrinsic advantages of e-vehicles can be fully exploited only if they are connected to smart grids. This includes two-way communication technology between the supplier and the user where flexible billing could become possible due to internationally standardised smart grid and information and communication technology (ICT). This will enable sustainable approaches to car-sharing, rail-and-drive, and electromobility. To support this, the JRC is undertaking pre-normative research to prepare methodologies and international standards. The focus is on components and batteries; smart electricity grids; electromagnetic compatibility and interference issues.

Recognising that technological integration and interconnection are key to the sustainable development of cities, the JRC also provides scientific support to the assessment of the environmental benefits of smart cities. It is specifically involved in the International Telecommunication Union (ITU) working group preparing recommendations for the definition of a methodology for the assessment of the environmental impact of ICT in cities.

In addition, the JRC engages directly with European industries and their representatives to optimise the impact and effectiveness of JRC's innovation activities. One example of this is JRC's liaison with the European Storage Battery Manufacturers Association (EUROBAT), which seeks to establish a mutually beneficial co-operation in European and international standards and regulations by ensuring a sound scientific and technical basis for robust legislation and policies on clean, efficient and safe electricity storage for transport.

In November 2011, the JRC and the United States Department of Energy (DOE) signed a Letter of Intent to establish two Scientific Interoperability Centres, one in Europe located at the JRC's sites in Ispra (Italy) and Petten (the Netherlands), and one in the US, at Argonne National Laboratories. These reference centres are working to ensure that hardware and software, including communications used in the EU and in the US, are interoperable, and aims to facilitate innovation, manufacturing and trade to support economic growth and job creation in the transatlantic context.

*:Smart grids are intelligent electricity systems enabling sustainable, economically viable and secure energy supplies.*

## 3.2 Photovoltaics

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Commission Communication on Investing in the Development of Low Carbon Technologies (SET-Plan) – COM(2009)519
- Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources
- Commission Delegated Regulation (EU) No 244/2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings
- Commission Communication on Smart Grids: from innovation to deployment – COM(2011)202
- Commission Communication on the Energy Roadmap 2050 – COM(2011)885
- Commission Communication on renewable energy: a major player in the European energy market – COM(2012)271

The Renewable Energy Directive requires each EU country to lay down specific renewable energy plans. Photovoltaic (PV) solar energy is expected to make a significant contribution to this, as well as to the EU's longer term goals for a low carbon energy system. The sector has been growing rapidly - the production has increased by approximately 50% per year over the last five years - and this growth is characterised by rapid technological development, not just scaling up existing systems. Against this background, international standards addressing the performance, reliability and safety of PV products ensure market transparency and are essential to help cut costs and strengthen investor confidence.

The JRC, through its European Solar Test Installation (ESTI) at its Ispra site, has had a central role in developing the existing body of international standards. The JRC currently chairs the International Electrotechnical Commission's Technical committee 82 and participates in several of its working groups (WG 2 Solar Cells and Modules, WG3 PV Systems and WG 7 PV Concentrators). The JRC also contributes extensively to CENELEC Technical Committee 82 on Solar Photovoltaic Energy Systems, and is convenor of Working Group 1 – Wafers, Cells and Module.

The JRC's aim in the field of PV technologies is to accelerate market introduction and innovation by the early development and harmonisation of standards. These address the EU single market objectives and renewable energy goals in the context of Directive 2009/28/EC on the promotion of the use of energy from renewable sources, as well as those of the European Strategic Energy Technology Plan (SET-Plan). Furthermore, PV product standards dovetail with the development of smart grids and the future development of low/zero net-energy buildings.

The JRC's European Solar Test Installation (ESTI) laboratory provides a European reference laboratory to validate electrical performance and lifetime of PV devices based on emerging technologies. In tandem, it performs pre-normative research to develop and improve traceable measurement techniques with reduced uncertainty levels, benefiting both manufacturers and investors.

The recent upgrading of equipment and laboratories puts ESTI in a strong position to address expected standardisation issues accompanying the rapid expansion of the PV market. These include, for example, power calibration standards for thin film, concentrated PV, organic PV and other emerging products; extension of life-time guarantees up to 40 years; standard procedures for energy output rating etc. Pre-normative research and development will also serve the need to address the integration of PV in smart grids as well as in advanced concepts for building energy saving, in line with the EU goals in these areas.

*The European Solar Test Installation (ESTI) laboratory provides support to EU policies that will help enable the EU to meet its target of increasing renewable energy use to 20% of total energy consumption by 2020.*

## 3.3 Clean transport

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Regulation (EC) No 715/2007 and Commission Regulation (EC) No 692/2008 on type-approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (Euro 5 and 6)
- Regulation (EC) No 595/2009 and Commission Regulation (EC) No 582/2011 on type-approval of motor vehicles and engines with respect to emissions from heavy-duty vehicles (Euro VI)
- Regulation (EC) No 443/2009 on CO2 emissions from cars
- Regulation (EC) No 510/2011 on CO2 emissions from vans
- Commission Implementing Regulation (EU) 725/2011 on innovative technologies for reducing CO2 emissions from passenger cars
- Commission Communication on Research and innovation for Europe's future mobility developing a European transport-technology strategy – COM(2012)501
- Commission Communication on Clean and Energy Efficient Vehicles – COM(2010)186
- Regulations (UN/ECE) No 49 and No 83 on light- and heavy-duty vehicles
- UNECE GRPE and GRSP working groups for the development of worldwide harmonised test cycle and test procedure for light-duty vehicles, including hydrogen, fuel cell, hybrid and battery electric vehicles.
- Directive 2006/40/EC of the European Parliament and of the Council on emissions from air-conditioning systems in motor vehicles
- Directive 98/70/EC on the quality of petrol and diesel fuels

Recent research results have shown a statistically significant difference between vehicle type-approval CO2 levels and real life CO2 emissions, with the latter being higher. A decision has therefore been taken at EU level to design a new type-approval procedure better able to represent real life situations.

The revision of the European procedure for type-approval of Light Duty Vehicles (LDV) began in 2010 as a component of the European strategy on $CO_2$ and energy efficiency in transport. The final goal is to adopt a new standard test cycle and standard test procedure for the approval of passenger cars that will promote cleaner vehicles and a more realistic representation of the CO2 emissions from transport.

The European Commission actively participates in a United Nations Economic Commission for Europe (UN-ECE) activities aimed at the development and adoption of a world-wide harmonised test procedure.

The activities include the development of a worldwide harmonised standard test cycle, based on newly acquired in-use driving data. The JRC has contributed by managing several new in-use driving data collection campaigns, and participated in the statistical analysis of the in-use driving data for the derivation of the new test cycle. Its Vehicle Emissions Laboratory (VELA) has contributed to the first part of the validation phase which addresses the drivability of the new test cycle, and has taken on a coordination role for the second part of the validation phase, which includes the feasibility of the new test procedure.

Such a new harmonised standard procedure will be complemented at the European level by additional measures, such as random cycle emissions and/or portable emissions measurement system testing that will be integrated in the new European type approval process.

Underpinning this work is the JRC's participation in the European Metrology Research Project (EMRP), a collaboration that aims to standardise the calibration procedures for instrumentation, targeting a number of emerging pollutants. It focuses on the development of a particle number standard but also on the accurate quantification of the platinum group element content of particulate matter. This EMRP work aims to establish traceable techniques for the calibration of particle measurement instrumentation.

The JRC also works with national metrology institutes across Europe, particularly in the framework of the Particulate Measurement Programme and the evaluation of techniques using the exhaust of late technology vehicles and engines.

***Work in progress***

In future, the VELA laboratory will participate in the experimental tests for assessing the feasibility of the new test procedure and will participate in wider laboratory tests. It is envisaged that the results of this work (standardised procedures and practical recommendations) will be incorporated in future amendments of the relevant regulations.

A JRC led working group comprised of industry stakeholders and Member State representatives was established following a report on on-road emissions testing with portable emissions measurement systems (PEMS). This method was judged to be a better method to cover the wide range of driving and ambient conditions than random laboratory test cycles, and the group will conduct an extensive test campaign in cooperation with car manufacturers and European technical services throughout 2013.

*Portable emissions measurement systems (PEMS) offer a modern and innovative way to check the impact of emissions from combustion engines upon the environment, as the vehicle or equipment is being used.*

## 3.4 Hydrogen and fuel cell technologies

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Regulation (EC) No 79/2009 and Commission Regulation (EU) No 406/2010 on type-approval of hydrogen-powered motor vehicles, and amending Directive 2007/46/EC
- Revised Draft Global Technical Regulation (UN/ECE) WP.29/GRSP/2012/23 on hydrogen fuel cell
- Commission Communication on Clean Power for Transport: A European alternative fuels strategy – COM(2013)17
- Directive 2009/142/EC of the European Parliament and of the Council relating to appliances burning gaseous fuels
- Commission legislative proposal on Alternative Fuels Infrastructure Development (2012)
- Council Regulation (EU) No 1183/2011 amending Regulation (EC) No 521/2008 setting up the Fuel Cells and Hydrogen Joint Undertaking
- Commission Communication on Investing in the Development of Low Carbon Technologies (SET-Plan) – COM(2009)519
- Commission Communication on the European strategy on clean and energy efficient vehicles – COM(2010)186
- Commission Communication on Energy 2020: A strategy for competitive, sustainable and secure energy – COM(2010)639
- Commission Communication on Energy infrastructure priorities for 2020 and beyond -A Blueprint for an integrated European energy network – COM(2010)677
- Commission Communication on the Roadmap for moving to a competitive low carbon economy in 2050 – COM(2011)112
- Commission Communication on the Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system – COM(2011)144
- Commission Communication on the Energy Roadmap 2050 – COM (2011)885
- Commission Communication on the Research and innovation for Europe's future mobility – Developing a European transport technology strategy – COM(2012)501
- Proposal for a Directive on the deployment of alternative fuels infrastructure (Clean Power for Transport Package) – COM (2013)18

Hydrogen and fuel cells are critical technologies in the transition towards a low-carbon economy. The absence of harmonised, globally accepted performance characterisation methods is a barrier to the market deployment of hydrogen and fuel cell technologies in transportation, stationary and early market applications.

The JRC plays a key role in the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) which was set up in 2008 as a public-private partnership to enable widespread market introduction of hydrogen and fuel cell technologies in the EU by 2015-2020. The JRC assists the Joint Undertaking in identifying regulation, codes and standards gaps and priorities. The JRC performs pre-normative research that aims to harmonise regulation, codes and standards at European and international level, and participates in international standards organisations. On the regulatory front, the JRC contributes to the European type-approval regulation on hydrogen powered vehicles and to the international homologation activities in UN-ECE.

When the JRC performs pre-normative research, the aim is not to develop material or product standards, but to address harmonisation and subsequent validation. These include performance characterisation methods for hydrogen detectors, hydrogen storage, reformers, fuel cell stacks and systems (e.g. forklift trucks, uninterruptible power systems, auxiliary power units), plus the safety assessment of hydrogen use in storage, distribution and transport. Performance is assessed in terms of safety, efficiency, emissions, reliability, durability and sensitivity to fuel contaminants.





The pre-normative research results in harmonised and validated measurement techniques, test protocols and safety assessment procedures that serve as input to regulatory and standardisation activities at European and international level, covering vehicles, stationary applications and the hydrogen infrastructure. The European Parliament has expressed its wish that EU type-approval be extended to not only include the vehicles, but also the hydrogen refuelling infrastructure.

Pre-normative research is carried out in the framework of international collaboration, particularly with European and US National Laboratories, either through bilateral agreements or in the framework of international organisations such as the International Energy Agency (IEA) and the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE). In this context, the JRC carries out international inter-laboratory comparison exercises on performance characterisation of fuel cell stacks, hydrogen sensors and hydrogen solid state storage capacity and kinetics. In a similar effort, numerical simulations of accident scenarios have been compared against each other and validated through experiments.

***Work in progress***

The JRC will continue pre-normative research in the development and improvement of testing methodologies, to address identified gaps. The JRC will also look into expanding its area of expertise to include pre-normative research on related subjects such as hydrogen-based storage as an enabler of smart grids, on the potential of fuel cells to concentrate and capture carbon dioxide without energy loss, and on reversible energy storage devices such as flow batteries. In the current drive towards electromobility, the JRC will concentrate its activities on the safety and performance assessment of flow batteries for vehicle propulsion.

Together with US Department of Energy, JRC co-chairs the Regulations, Codes and Standards Working Group of the International Partnership for Hydrogen in the Economy (IPHE). Within this working group, JRC and Sandia National Labs collaborate to assess the feasibility of a number of requirements that will be included in the forthcoming UN Global Technical Regulation on hydrogen fuelled vehicles. This feasibility evaluation covers specifically testing of on-board composite tanks for storing hydrogen under pressures up to 700 bar, as well as the performance criteria that testing infrastructure (hardware, control and measurement equipment) has to meet to ensure worldwide consistency and comparability of hydrogen high-pressure testing in type-approval schemes.

*A fuel cell vehicle undergoing testing at the JRC's Vehicle Emissions Laboratory*

# 4 Nuclear safety and security

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Council Decision 2010/212/CFSP to strengthen the Non Proliferation Treaty as the cornerstone of the international nuclear non-proliferation regime
- Council Decision 87/600/EURATOM on urgent information exchange in case of a radiological emergency
- Commission Recommendation 2000/473/ Euratom on the application of Article 36 of the Euratom Treaty concerning the monitoring of the levels of radioactivity in the environment for the purpose of assessing the exposure of the population as a whole
- Council Directive 98/83/EC on the quality of water intended for human consumption
- Council Regulation (Euratom) No 3954/87 laying down maximum permitted levels of radioactive contamination of foodstuffs and of feeding stuffs following a nuclear accident or any other case of radiological emergency
- Commission Communication proposing a Council Directive laying down requirements for the protection of the health of the general public with regard to radioactive substances in water intended for human consumption – COM(2012)147
- Council Directive 2009/71/EURATOM establishing a Community framework for the nuclear safety of nuclear installations
- Council Directive 2011/70/EURATOM establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste
- Council Conclusion EUCO 10/1/11 on the implementation and continuous improvement of highest standards for nuclear safety,

The JRC provides independent and reliable scientific and technological assessment on nuclear safety of present and future generations of nuclear reactors, on the safety of the nuclear fuel cycle, and nuclear safeguards, non-proliferation and nuclear security issues.

An international initiative on a holistic safety, security and safeguards ("3S") concept for nuclear energy was launched with the Nuclear Safety and Security Group (NSSG) at the G8 summit in 2008. The European Union is supportive of internationally binding security and safety standards. The JRC contributes to all associated standardisation processes. A large part of the JRC's work in the nuclear domain is related to harmonisation and standardisation, mainly in support to Commission services. This work can be grouped in three main categories: nuclear safety, nuclear security and safeguards, and radiological monitoring. Activities include:

- European and/or international documentary standards;
- International expert documents on harmonisation or target performance criteria;
- Material standards;
- European or international guidelines;
- Membership of relevant working groups and/or technical committees (CEN, ISO etc);
- Workshops/meetings on standardisation/ harmonisation.

Among the examples of the JRC's work for standardisation and harmonisation in the area of nuclear safety are determination of reference safety relevant data for nuclear oxide fuels; comparison and assessment of instrumentation and control standards for nuclear installations; design and construction codes; and interoperability of engineering materials data.

In the domain of nuclear security and safeguards, examples of on-going projects are the illicit trafficking radiation assessment programme and sealing systems for the Canada Deuterium Uranium reactor spent fuel bundles.

Within radiological monitoring, examples include the radiological / nuclear information exchange platform in Europe and inter-laboratory comparisons among Member State laboratories monitoring environmental radioactivity.

The JRC is represented in numerous standards committees internationally e.g. in the Joint Evaluation Fusion and Fission File (JEFF) and in numerous expert working groups, e.g. the International Atomic Energy Agency's (IAEA) International Neutron Cross Section Standards Committee. It is also central to providing training and education in nuclear safety and security, including standardisation processes, via international platforms (such as the European Safeguards Research and Development Association and the European Nuclear Engineering Network) but also towards an internationalisation of higher education in the field through EC initiatives (e.g. the JRC European Nuclear Safety and Security School, EN3S). This involves providing direct support to inspectors, other policy customers and young professionals in the field.

## 4.1 Neutron Cross Section Standards

Neutron data standards are basic data sets needed for experiments related to the assessment of reactor safety and nuclear waste minimisation. Since the majority of measurements in neutron physics are made relative to neutron data standards, the quality of experimental data is a key issue for improved safety of present day reactor systems. The data files used by industry and research laboratories have to be complete, accurate and validated by well-defined quality assurance procedures.

This process of validation requires high-quality neutron data measurements using advanced facilities and equipment, based on well-defined neutron sources and cross section standards. The data need to be analysed using state-of-the-art data analysis techniques, using improved codes. Whenever experiments are not feasible, extensive theoretical work is carried out to complement the experimental nuclear data with calculated values. JRC works in close co-operation with other research institutes to optimise the use of resources and participates in international data evaluation exercises and cooperation with industry for the definition of priorities of the work programme.

The objectives of this project are to provide improved and high quality reference neutron data sets to be incorporated in the evaluation process to generate new evaluated neutron data files like JEFF (in Europe) and Evaluated Nuclear Data File (ENDF/B) in the US. Dedicated and unique installations for neutron data measurements are available at the JRC for this purpose.

Results have been incorporated within a Coordinated Research Project of the IAEA. Industry partners in France (AREVA, EDF) have already adopted the new evaluations and it is planned in the UK (SERCO).

The JRC operates two large facilities for neutron data measurements, namely a 150 MeV linear electron accelerator (GELINA) and a 7 MV light-ion Van de Graaff accelerator. The JRC's two accelerators are used to obtain neutron reaction data and standards. They are complementary in their experimental conditions and among the best such installations in the world.

The JRC's facilities play an key role in the measurement of nuclear data standards. Reference measurements at both facilities substantially contribu-ted to the successful new evaluation of the unique neutron cross section standards file lead by the IAEA. This standard file is used by all international nuclear data evaluation projects, e.g. the evaluated nuclear data file (ENDF) used in the USA, the European joint evaluated fusion and fission (JEFF) file, and the Japanese evaluated nuclear data (JENDL) to name a few. A new nuclear data development project has recently been approved by the IAEA. It is focused on neutron cross-section standards that will be up-to-date when they are needed by the various nuclear data evaluation projects.

*A JRC scientist sets up an experiment for measuring neutron cross sections*

## 4.2 Radionuclide metrology for primary standardisation

There is international consent for the need to develop and implement the highest standards for nuclear safety and security in order to ensure optimum safety of the population. For example, as a pre-requisite for safe mid- and long-term management of waste, reliable and accurate decay data are required for the implementation of sound nuclear waste management strategies. Beyond the strict limitation of possible risks to the safety of the food chain, monitoring of radioactivity levels in the environment and foodstuffs serve to assess the exposure of the population to ionising radiation (radiological protection).

The priorities for new measurements are determined in co-operation with international organisations, in particular the Nuclear Data Section of the International Atomic Energy Agency (IAEA), the Consultative Committee for Ionising Radiation (CCRI) of the International Committee for Weights and Measures (CIPM), and the decay data evaluation project (DDEP).

The main objectives of this activity are to provide technical support in monitoring radioactivity in the environment and in foodstuffs as regulated both by the Euratom Treaty, and by secondary legislation; to provide a regular international comparison scheme in support of nuclear safety; to develop material standards and proficiency test materials in support of nuclear safety; to standardise calibration instrumentation and testing methods for security-relevant equipment; to provide high-quality reference data in support of nuclear safety, waste management and nuclear medicine; to give scientific-technical and policy advice; and to provide knowledge transfer and training.

With the organisation of interlaboratory comparisons, the JRC evaluates the comparability of regularly reported monitoring data, while providing EU monitoring laboratories with a tool to benchmark their performance (e.g. activity concentrations of natural radium and uranium isotopes in water, anthropogenic radionuclide activity in air filters) and to improve their measurement capability. The JRC has also ensured high quality and reliability of radioactivity measurements by developing matrix reference materials, characterised for radioactive components by traceable reference measurements. Finally, it has provided a technical solution (irradiation equipment) to standardise calibration instrumentation and testing methods for security-relevant equipment.

The JRC has provided technical support in monitoring radioactivity in the environment and in foodstuffs as regulated both by the Euratom Treaty, and by secondary legislation. It regularly evaluates the performance of Member States' laboratories with a tool to benchmark their performance, and to initiate improvement of their measurement capability.

The JRC operates radionuclide measurement facilities which serve to harmonise the radioactivity measurement system in the EU and globally, at all levels from the basic realisation of the unit for activity (Becquerel) to safety- and security-relevant applications in nuclear decommissioning, environmental monitoring or surveillance of foodstuffs.

*Target preparation for nuclear data measurements, used in research that helps support the Euratom Treaty.*

## 4.3 Design and Construction Code for mechanical equipment of innovative nuclear installations

New nuclear reactors types with improved safety features are currently been developed as an evolution of the current nuclear 3rd Generation type (called Gen III+) within the frame of even more innovative designs within the Generation IV International Forum (GIF). Codes for design and construction of nuclear components for current Light Water reactors are judged not completely adequate for innovative reactors. This is because geometries, materials, structure environment, loadings and in-service conditions differ sensibly. Design codes that cover the more severe requirements and new materials of the innovative systems need to be developed.

In response, a European Committee for Standardisation (CEN) workshop has been established on design and construction code for mechanical equipment of innovative nuclear installations to this scope. Project partners represent different organisations from industry, code developers and research from across the EU. The objective of this European Committee for Standardisation Workshop is to develop a European design code that can be used for different innovative nuclear installations. The aim of the code is to unify standards, to complement them when it is necessary and to improve the options in order to optimise the quality of components.

Several proposed and approved modifications to design and construction rules for mechanical components of nuclear installations applicable to high temperature structures and to the ITER (RCC-MRx code) have already been achieved. The European Commission has commissioned the Association Française de Normalisation (AFNOR) as project leader to investigate the feasibility to develop standardised rules for the design and construction of Generation IV nuclear reactors.

This will contribute to developing, and help to reinforce, a common European approach for innovative nuclear prototypes in the field of structural integrity; reinforcing the links between European mechanical engineering standards and the nuclear industry.

The European Committee for Standardisation (CEN), European Committee for Electrotechnical Standardisation (CENELEC), and the JRC will work together with the aim to promote a cost-effective way of taking into account the CLC/TC45AX standards in European Union countries.

*Reference instruments used to record data in parallel to instruments under testing as part of ITRAP+10.*

## 4.4 Nuclear Safety and Security - Illicit Trafficking Radiation Assessment Programme

The Illicit Trafficking Radiological Assessment Program +10 (ITRAP+10) is an effort initiated by the JRC under a contract with the Commission's Directorate-General for Home Affairs to evaluate and compare the performance of commercially-available radiation detection equipment. The final results will provide an independent assessment of the available radiation monitoring equipment which will serve as a reference for regulatory and other EU member state authorities to identify such equipment and/or families of equipment help to ensure common standards at a European level. The JRC invited also the U.S. government and the International Atomic Energy Agency to participate in ITRAP+10 to expand this testing to other globally-available systems.

Collectively, the European and their international partners will have access to nearly 100 devices across nine different categories of detection equipment. As of 2013, devices have been proposed for testing by 27 vendors from eleven different countries.

ITRAP+10 provides the opportunity to ensure that standards for radiological and nuclear detection devices are clearly defined, comprehensive and realistic. This programme's internationally collaborative features may also help achieve greater homogeneity in European and international detection standards. In addition, ITRAP+10 will enable a better understanding of the performance of commercially available detection equipment and drive industry to technological advances, ultimately ensuring nuclear security success.

The certification of border monitoring instruments (e.g. fixed radiation portal monitors, personal radiation detectors, gamma and neutron search detectors, radioisotope identifiers, and mobile equipment) is not part of the project goals. However, the project's results will help the European Commission to establish a network of European laboratories able to perform a variety of tests included in the referenced standards.

The Joint Research Centre is in the process of implementing a joint programme for the Commission's Home Affairs DG: the Illicit Trafficking Radiation Assessment Program+10 (ITRAP+10), which is carried out with the US Department of Homeland Security (DHS), Domestic Nuclear Detection Office (DNDO), Systems Engineering and Evaluation (SE&E). The purpose of ITRAP+10 is to conduct an evaluation and comparison of the performance of available radiation detection equipment relevant to nuclear security. The US Department of Homeland Security Domestic Nuclear Detection Office is mandated by Congress to set Technical Capability Standards, and implement a Test and Evaluation program, to provide performance, suitability, and survivability information, and related testing, for preventive radiological/nuclear detection equipment in the United States.

*The Illicit Trafficking Radiological Assessment Program +10 (ITRAP+10), inaugurated by the JRC, tests commercially-available radiation detection equipment.*

## 4.5 Radiological Monitoring - Radiological / Nuclear Information Exchange Platform in Europe

The European Radiological Data Exchange Platform (EURDEP) and the European Community Urgent Radiological Information Exchange (ECURIE) allow for harmonised exchange of data and information in the event of a radiological and/or nuclear emergency between the European Commission and national authorities in Europe.

The ECURIE system is the official system for exchange of information between the EU member states and the European Commission, which is activated in case of a nuclear/radiological emergency. It is activated whenever a competent authority decides or plans to take countermeasures to protect its population against the dangers of ionising radiation. The system was developed by the JRC more than 20 years ago and is continually being updated to respond to evolving needs.

Exchange of environmental radiation monitoring data has been automated through the EURDEP system. EURDEP is both a standard data-format for radiological data and a network. Currently 34 European countries participate to it by exchanging the data from their national radiological monitoring networks (4500 stations) in almost real-time. The data exchange is mostly done on an hourly basis and in continuous mode, i.e. both during routine and emergency operation.

The participation of the EU member states to EURDEP is regulated by Council Decision 87/600. The participation of non-EU countries is on a voluntary basis. Countries sending their national data have access to the data of all the other participating countries. In addition EU member states participating to EURDEP automatically fulfil their ECURIE duty for sending environmental monitoring data.

The information technology development and operation of EURDEP is performed by the JRC. Two mirror-sites have been set up in Germany and Luxembourg. The data is transmitted via national ftp-servers to which the JRC has read-access. At the JRC, all data-files are checked and loaded in a database. Participating public authorities have full access to all data on a protected website. The general public can view parts of the data on a public website , where data is published immediately or in some cases with a certain delay. The development of EURDEP has been so successful that the IAEA has decided to use the same technology to exchange monitoring data outside of Europe (share of best practice, international standardisation of exchange data). It is anticipated that further countries will join.





# 5 Safety of the citizen

*Protecting the citizen is of the utmost importance, including mitigation of natural and man-made hazards. It is unfortunately not possible to predict the location and intensity of future earthquakes for example, but most of the human casualties are due to the collapse of inadequate construction. Therefore, effective prevention has to be based mainly on adequate design, construction and maintenance of civil engineering structures.*

*To mitigate the effects of earthquakes, the JRC studies the structural behaviour of buildings and other infrastructures under earthquake scenarios, develops methodologies to increase the safety of buildings and contributes to the creation of European standards for the construction sector. The research carried out at the JRC contributes to the development of the EUROCODES, a set of European standards for the construction sector. They are the recommended means of giving a presumption of conformity with the essential requirements of the Construction Products Directive for construction works and products that bear the CE Marking, as well as the preferred reference for technical specifications in public contracts.*

## 5.1 Building sector safety, energy efficiency and sustainability

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Commission Communication on the Strategy for the sustainable competitiveness of the construction sector and its enterprises – COM(2012)433
- Commission Communication on Reinforcing the Union's Disaster Response Capacity – COM(2008)130
- Commission Communication on An Integrated Industrial Policy for the Globalisation Era Putting Competitiveness and Sustainability at Centre Stage – COM(2010)614
- Commission Communication on A resource-efficient Europe Flagship initiative under the Europe 2020 Strategy – COM(2011)21

The construction and construction products sector represents approximately 10% of the EU GDP and shares almost 30% of industrial employment. Construction also represents a key component in the quality of life of the citizen as people spend an important part of their time in various buildings and other built infrastructures. When natural and man-made hazards occur, our welfare depends on the performance of the structures that surround us.

The availability of advanced European standards for construction, known as the EUROCODES, is a starting condition for risk reduction and harmonisation in construction. The research and standardisation agenda in the field of construction is defined according to the evolution of the construction sector, innovative materials and emerging needs. It should also respond to EU policy objectives in terms of competitiveness (innovation, harmonisation), sustainability (energy consumption, reduction of waste) and rational use and optimisation of resources.

The JRC, through its scientific and technical knowledge and expertise, has actively supported the development of the EUROCODES. In this context, the JRC carries out pre-normative research, prepares design guidelines, contributes to the development of harmonised methods and pro-actively supports and promotes the internationalisation of standards for the construction and building sector.

The JRC plays a key role in maintaining and strengthening the EUROCODES by supporting and facilitating their full implementation in co-operation with EU member states, the European Committee for Standardisation (CEN) and the Commission's Enterprise and Industry DG. The JRC collects and analyses the Nationally Determined Parameters (NDPs, related to country safety classes, geographical distribution, and deviation from recommended values), periodically reports on their status of upload in the JRC-NDPs database and analyses the available data in view of further harmonisation.

The JRC is promoting and supporting the development of interoperable European standards, extending from the field of safety into other fields such as health, energy efficiency and sustainability.

The JRC equally undertakes pre-normative research in support of the development of safety standards taking into account sustainability and energy efficiency aspects.

The JRC activities involve key stakeholders and strategic partners. The JRC organises training workshops on the EUROCODES in collaboration with CEN and European experts, covering topics such as the design of reinforced concrete structures, seismic design of buildings and bridge design to the EUROCODES. Further, the JRC facilitates and fosters training activities related to the use of the EUROCODES outside of Europe. Workshops on the application of the EUROCODES in Georgia, Montenegro and the Russian Federation have been organised with the technical support of the JRC.

At its European Laboratory for Structural Assessment (ELSA), the JRC recently tested a full-scale four-storey reinforced concrete building designed for gravity loads and achieved a fivefold increase in seismic load capacity after retrofitting, by infilling the central bay with a reinforced concrete wall. This cost-effective technique is commonly used in southern Mediterranean European countries exposed to seismic risk for the upgrading of existing, highly vulnerable buildings designed in the 1960s and 1970s with insufficient seismic capacity. The methodology for enhancing capacity was developed by the Cyprus University of Technology through an FP7 integrated project SERIES. The application of such techniques for seismic rehabilitation provides a significant contribution to sustainability, as it avoids demolition and waste disposal, extending the life of existing buildings with a direct impact on reducing the consumption of energy and natural resources. The results from the test campaign carried out at the JRC will result in design guidelines for their future incorporation in the EUROCODES.

*The European Laboratory for Structural Assessment (ELSA) is capable of testing the behaviour of buildings of up to five storeys high when exposed to earthquakes.*

## 5.2 Critical Infrastructure Protection (CIP)

The JRC set up the European Reference Network for Critical Infrastructure Protection (ERNCIP) project in 2009. This took place under the mandate of the Directorate General for Home Affairs (DG HOME), in the context of the European Programme for Critical Infrastructure Protection (EPCIP), and with the agreement of Member States.

ERNCIP is a European effort with the mission to "foster the emergence of innovative, qualified, efficient and competitive security solutions, through networking of European experimental capabilities" and the three strategic goals are:

- Improve the protection of critical infrastructure in the EU
- Support the development of the EU's single market for security
- Identify gaps in EU security product testing capabilities

In order to achieve this ERNCIP puts its efforts in maintaining an online inventory of experimental capabilities in Europe ("The ERNCIP Inventory") and in developing a network of experts to identify and promote good test practices to form the basis of common European testing standards, aiming at harmonisation of test methodologies and test protocols, where practical. Currently ERNCIP brings together over 250 voluntary stakeholders in this network.

The ERNCIP Inventory is a free-to-use search tool for information on European security experimental and testing facilities. It helps all types of critical infrastructure stakeholders to identify and make contact with CIP related experimental expertise located in the EU. For the laboratories that are registered in the ERNCIP Inventory it provides greater visibility and increased business potential.

Member States and the Commission have so far identified nine Thematic Areas (TA) of concern for ERNCIP to address at the EU level, including: Aviation Security Detection Equipment (AVSEC), Explosives Detection Equipment - non-Aviation (DEMON), Industrial Automatic Control Systems and Smart Grids (IASC&SG), Structural Resistance against Seismic Risks (SERIES), Resistance of Structures against Explosion Effects, Chemical & Biological Risks in the Water Sector, Video Analytics and Surveillance, Applied Biometrics for CIP, and Radiological Threats to Critical Infrastructure. Once a TA is identified by the Member States, ERNCIP launches a Thematic Group (TG) to address this area. A TA consists of nominated experts, representing experimental facilities and laboratories, and also other stakeholders such as manufacturers and vendors of security solutions, government authorities, academia, and operators of critical infrastructures. Each group is led by an appointed Coordinator, who is in charge of developing a work programme for the TG to deliver against in order to achieve the goals of that specific TG.

***Work in progress***

In the recently started Knowledge Exploitation Phase, the ERNCIP's Thematic Areas will continue to develop and deliver on their approved work programs. However, the emphasis from now onwards will be on intensifying the collaboration within ERNCIP of the academic community and the CI operators community. Their structured involvement in ERNCIP is expected to create a pool of scientific and technological push and pull and provide a mechanism for ensuring that the results from ERNCIP are relevant and useful.

The TA deliverables will consist of a series of Testing Guidelines and recommendations for how to improve security testing in Europe, and these deliverables will be made openly available (as far as possible) from the ERNCIP website and build a basis for the development of security testing standards and eventually EU wide certifications, if needed.

ERNCIP's efforts in Europe are very similar to the work provided by the National Institute for Standards and Technologies (NIST) in the US, therefore collaboration has already started with the scope to improve transatlantic trade conditions for security solution.

# 6 Innovation and future directions

*Innovation provides real benefits for all citizens, consumers, and workers. It speeds up and improves the way products and services are conceived, developed and produced. As the European Commission's in-house science service, the JRC needs to remain at the cutting edge of scientific research, and does so by constantly striving for excellence through innovative practices.*

*Standards for security products and services are essential in this process, as is harmonisation and standardisation in the fields of smart infrastructures, digital broadband and global navigation systems.*

## 6.1 European security label

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Commission Communication on Security Industrial Policy - Action Plan for an innovative and competitive Security Industry - COM(2012)417
- Commission Communication on More Product Safety and better Market Surveillance in the Single Market for Products - COM(2013)74

Security products and services are put on the market just like any other goods and services. Citizens and companies need to know that the various security measures are compliant with European law and that they meet the highest safety standards.

The introduction of a European Security Label (ESL) addresses this issue and constitutes a common reference point for suppliers, end users, customers and society in general. The purpose of the European Security Label is not to replace existing national or international standards or certification schemes or existing labels. The purpose is to provide a common framework for existing standards and schemes for security-related applications and services.

The JRC supports the European Commission's service responsible for enterprise and industry in the implementation of the European Security Label. It analyses segments of the security market with respect to the completion of a European Security Label. For example, aviation security; space based services particularly positioning, time and navigation; supply chain security; identification of travellers etc. The JRC undertakes pre-normative research to fill the gaps in the European Security Label for those selected market segments and it then supports the European Standards Organisations (ESO) in the preparation of documentary standards.

The proposed European Security Label is a certificate within the context of security. Based upon a public consultation which highlighted the fragmentation of the current security market, the European Commission has defined a step by step approach as the most realistic path to a harmonised certification system in the EU. The JRC collaborates with other Commission services in developing this approach further. The goal is to develop certificates for selected subjects such as aviation security. Other initiatives are equally underway in the fields of maritime security, global navigation systems and security cameras.

In parallel, the European Standards Organisations the European Committee for Standardisation (CEN) and the European Telecommunications Standards Institute (ETSI) have beenhave been given a programming mandate for standardisation in the context of security. The JRC has been requested to provide active support to this initiative.

*The European Security Label subjects security products and services to certain standards – in aviation security for example – that allow for greater protection of the citizen.*

## 6.2 Reconfigurable radio systems, wireless interference and co-existence

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Council and Parliament Decision 2012/243/EU establishing a multiannual radio spectrum policy programme
- Regulation (EU) No 1025/2012 on European standardisation
- ETSI Reconfigurable Radio Systems: Status and Future Directions on Software Defined Radio and Cognitive Radio Standards
- Parliament Resolution 2009/C 286 E/04 on stepping up the European Union's disaster response capacity
- Council Decision 2007/124/EC on Security and Safeguarding Liberties and Prevention, Preparedness and Consequence Management of Terrorism and other Security related risks

Radio spectrum is the key enabler for innovative wireless services including digital broadband and smart infrastructures (future internet, smart cities, smart grid, smart homes, intelligent transport systems, etc). As a limited natural resource, radio spectrum must be managed efficiently and exploited effectively. This requires development of new wireless communications technologies and standards for secure, efficient and flexible use of the radio spectrum.

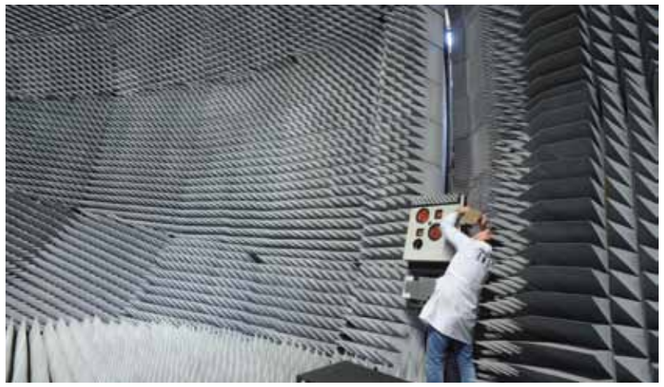
Software defined radio (SDR) and cognitive radio (CR) are promising technologies that will allow flexible use of radio spectrum, along with associated equipment and services. These technologies are not only important for citizens, but also for public safety users (police forces, fire brigades, etc.) and military users. Currently, no European standards cover reconfigurable and cognitive radio technologies. The JRC is contributing to the development of this technology by preparing the technical input to new standards in wireless communications.

The emergence of new wireless applications and devices has dramatically increased the demand for radio spectrum, with the ensuing risk of causing harmful interference to primary radio services. There is the need to develop advanced modelling tools and conduct measurement campaigns to test new technologies against the risk of interference and to ensure the coexistence of new and existing wireless services.

Based upon tests and measurement in the radio-frequency and microwave domains, as well as in digital signal processing, the JRC aims to develop and validate suitable algorithms to evaluate the impact of emerging wireless communication technologies on existing wireless infrastructures. It also supports the development and testing of technologies to ensure the availability of efficient communications systems for the identified security applications. On this basis, the JRC technically supports the European Telecommunications Standards Institute (ETSI) in the development of new standards for public safety communication and smart infrastructures with high bandwidth capability in Europe.

Central to the scientific and technical work is the European Microwave Signature Laboratory (EMSL), which permits repeatable tests and measurements in a controlled environment. The work in the EMSL addresses the need to conduct measurement campaigns to assess the risk of interference and ensure the coexistence of wireless services.

The JRC is assessing compatibility and harmful interference between diverse technologies for wireless communications. In the area of intelligent transport systems, the JRC is carrying out a series of measurement campaigns to establish the radar cross sections of pedestrians, two-wheelers and cars for automatic collision avoidance. Concerning road-tolling applications, a number of measurement campaigns have been conducted to assess the risk of interference between dedicated short range communication and intelligent transport systems. JRC research has generated the newly proposed intelligent transport systems signals and analysed their impact on the dedicated short range communication system. Finally, in railway transportation the JRC has evaluated the impact of new wireless technologies on the existing global system for mobile communications used for hi-speed European railways.



*The European Microwave Signature Laboratory (EMSL) is a multi-purpose facility that can be used to carry out reference measurements of wireless communications systems, Global Navigation Satellite System (GNSS) navigation and timing receivers, and active/passive microwave sensors (i.e. radar).*

## 6.3 Galileo infrastructure security – global coexistence and interoperability

**The JRC's activities in this area provide scientific support to the following policy initiatives:**

- Commission Communication Towards a space strategy for the European Union that benefits its citizens - COM(2011)152

The Galileo programme is Europe's initiative for state-of-the-art Global Navigation Satellite Systems (GNSS), providing a highly accurate, guaranteed global positioning service under civilian control. The fully deployed system will consist of 30 satellites plus the associated ground infrastructure. To be successful, Galileo needs to be interoperable with the other two operating GNSS: the American Global Positioning System (GPS) and the Russian system, GLONASS. This will equally apply to the planned Chinese contribution to GNSS, COMPASS. The minimum requirement is coexistence with other GNSS systems without harmful interference. This requires mutual agreements on the GNSS signal design and independent tools and laboratory-based measurements to verify compatibility with different GNSS systems as well as with terrestrial communications services such as 4G broadband.

The JRC performs simulations and measurements in GNSS and is developing a simulation tool to perform compatibility studies on Galileo/EGNOS and GLONASS, Compass and GPS. It will crosscheck the results with those obtained by other independently developed tools.

To-date, the radio-frequency compatibility tool has been developed and tested by the JRC. This has been followed by the first analysis on the interference between Galileo and GLONASS. The results have been verified against those obtained at ESA and UniBW. Simulation results have also been obtained for the GPS and COMPASS systems, and are currently being analysed and compared with the EGNOS and GLONASS results. Verification of simulation results is carried out through measurements in the JRC's EMSL laboratory.

*The JRC has conducted a study on the impact of a number of Global Navigation Satellite Systems (GNSS) on Galileo and vice versa, helping to guarantee radio frequency compatibility across the globe.*

The JRC conducted a study on the impact of the various GNSS systems on Galileo and vice versa. The JRC is contributing to international efforts to ensure radio frequency compatibility between Galileo and the European Geostationary Navigation Overlay Service (EGNOS) and other international Global Navigation Satellite Systems. Coordination between the various European bodies involved in this work takes place through the European Commission's 'Compatibility, Signal and Interoperability' Working Group. The underpinning analyses are being performed by the European Space Agency (ESA) and the University of the German Federal Armed Forces (UniBW). The JRC verifies the analytical results. This work adheres to the recommendations of the International Telecommunications Union (ITU), adopted by the United Nations Office for Outer Space International Committee on GNSS.

The JRC has developed and tested a radio-frequency compatibility tool. This has been followed by the first analysis on the interference between Galileo and GLONASS. The results have been verified against those obtained at ESA and UniBW. Simulation results have also been obtained for the GPS and COMPASS systems, and are currently being analysed and compared with the EGNOS and GLONASS results.

JRC carried out compatibility tests between the Galileo signals and the proposed 4G broadband service LightSquared, proposed in the USA. Results were provided to DG Enterprise and Industry to secure global availability of Galileo signals.

## 6.4 Data exchange standardisation for maritime surveillance

**JRC's activities in this area provide scientific support to the following policy initiatives:**

- Commission Communication towards An Integrated Maritime Policy for the European Union – COM(2007)575
- Commission Communication towards the integration of maritime surveillance – COM(2009)538
- Council Conclusions on integration of maritime surveillance
- Commission Communication on a Draft Roadmap towards establishing the Common Information Sharing Environment (CISE) for the surveillance of the EU maritime domain – COM (2010)584

Currently, EU and national authorities responsible for different aspects of maritime surveillance – e.g. border control, safety and security, fisheries control, customs, environment or defence – collect data separately and often do not share them. In order to provide these authorities with ways to exchange information and data, a Common Information Sharing Environment (CISE) is currently being developed jointly by the European Commission and EU/EEA member states. It will integrate existing surveillance systems and networks and give all concerned authorities access to the information they need for their missions at sea.

The added value of integrating maritime surveillance is to enhance the present maritime awareness pictures of the various authorities of EU member states and EEA States, with additional relevant cross-sector and cross-border surveillance data on a need-to-know and, a need-and-responsibility-to-share basis. The requirement to share information, particularly in case of an imminent threat, should be balanced by its owner against the risk of not sharing it. Such enhanced pictures will increase the efficiency of EU member states' authorities and improve cost effectiveness.

The JRC is providing technical support to the Directorate-General for Maritime Affairs and Fisheries in paving the way to the definition of a standard set of data elements to be used in the framework of CISE hence allowing the ICT systems of more than 400 different European authorities involved to exchange meaningful data, while ensuring a tight control over the management of the access rights.

Namely, in its role as Technical Advisory Group Secretariat, the JRC will play a relevant role in the definition of the standard semantic related to the data exchanged within CISE and in the establishment of a suitable methodology for the maintenance of such standards to ensure the cross sector interoperability of the CISE over time.


*Data exchange standardisation for maritime surveillance is facilitated by the JRC, helping to improve cost effectiveness and maximise efficiency.*

# 7 Useful tools

1. Environment
   - INSPIRE Geoportal: http://inspire-geoportal.ec.europa.eu/
   - Global Earth Observation System of Systems: http://www.earthobservations.org/geoss.shtml
   - European Integrated Pollution Prevention and Control Bureau (EIPPCB): http://eippcb.jrc.es/

2. Health and consumer protection
   - European Union Reference Laboratory for Alternative Methods to Animal Testing (EURL ECVAM): http://ihcp.jrc.ec.europa.eu/our_labs/eurl-ecvam
   - European Union Reference Laboratory for Genetically Modified Food and Feed (EURL GMFF): http://gmo-crl.jrc.ec.europa.eu/default.htm
   - European Union Reference Laboratory for Mycotoxins: http://irmm.jrc.ec.europa.eu/EURLS/EURL_MYCOTOXINS/Pages/index.aspx
   - European Union Reference Laboratory for Polycyclic Aromatic Hydrocarbons (EURL PAHs): http://irmm.jrc.ec.europa.eu/EURLS/EURL_PAHS/Pages/index.aspx
   - European Union Reference Laboratory for Heavy Metals in Feed and Food: http://irmm.jrc.ec.europa.eu/EURLS/EURL_HEAVY_METALS/Pages/index.aspx
   - European Union Reference Laboratory for Food Contact Materials (EURL FCM): http://ihcp.jrc.ec.europa.eu/our_labs/eurl_food_c_m
   - European Union Reference Laboratory for Feed Additives (EURL FA): http://irmm.jrc.ec.europa.eu/EURLs/EURL_feed_additives/Pages/index.aspx
   - JRC's IHCP Safety of nanomaterials webpage: http://ihcp.jrc.ec.europa.eu/our_activities/nanotechnology/safety_nanomaterials

3. Energy and transport
   - Project Maps: http://iet7-dev.jrc.nl/ses/?q=project-maps
   - Smart Grid Projects in Europe: http://www.smartgridsprojects.eu/map.html
   - Smart Grid Interactive Tool: http://iet7-dev.jrc.nl/ses/node/40
   - JRC's Photovoltaic Geographical Information System (PVGIS): http://re.jrc.ec.europa.eu/pvgis
   - European Solar Test Installation: http://re.jrc.ec.europa.eu/esti
   - JRC's Photovoltaic Power Calculator: http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php
   - JRC's IET Clean and Efficient Vehicles (CLEEVE) webpage: http://iet.jrc.ec.europa.eu/clean-and-efficient-vehicles-cleeve

4. Nuclear safety and security
   - European Radiological Data Exchange Platform (EURDEP): http://eurdep.jrc.ec.europa.eu/Basic/Pages/Public/Home/Default.aspx
   - European Community Urgent Radiological Information Exchange Platform (ECURIE): http://rem.jrc.ec.europa.eu/RemWeb/activities/Ecurie.aspx

5. Safety of the citizen
   - EUROCODES: http://eurocodes.jrc.ec.europa.eu/home.php
   - European Reference Network for Critical Infrastructure Protection (ERNCIP): http://ipsc.jrc.ec.europa.eu/index.php/ERNCIP/688/0/

6. Innovation and future directions
   - EU Ecolabel and Green Public Procurement for Buildings: http://susproc.jrc.ec.europa.eu/buildings/
   - European Microwave Signature Laboratory (EMSL): http://sta.jrc.ec.europa.eu/index.php/emsl



# Partners

The JRC works in close contact with a vast array of institutions, research networks and science-led public and private partners and is continuously strengthening co-operations on global issues with international partners and organisations.
In the area of standards, cooperation is developed world-wide, with close collaboration with universities, international agencies, standardisation authorities, and research bodies. A representative sample of these partners can be found on this page.

American National Standards Institute (ANSI), Association for Emissions Control by Catalyst (AECC), Association of Analytical Communities International (AOAC), Codex Alimentarius Commission, Conference of European Posts and Telecommunications Administrations (CEPT), European Association of Automotive Suppliers (CLEPA), European Association of National Metrology Institutes (EURAMET), European Authority for Food Safety (EFSA), European Automobile Manufacturers' Association (ACEA), European Chemicals Agency (ECHA), European Committee for Electrotechnical standardisation (CENELEC), European Committee for Standardisation (CEN), European Medicines Agency (EMEA), European Network of GMO Laboratories (ENGL), European Network of Reference Laboratories for Food Contact Materials, European Radiological Data Exchange Platform (EURDEP), European Safeguards Research and Development Association (ESARDA), European Space Agency (ESA), European Storage Battery Manufacturers Association (EUROBAT), European Telecommunications Standards Institute (ETSI) , Food and Agriculture Organization of the United Nations (FAO), Fuel Cells and Hydrogen Joint Undertaking (FCH JU), Health Canada, Institute for Nuclear Materials and Management (INMM) (USA), International Association of Hydrogen Safety (IAHySafe), International Atomic Energy Agency (IAEA), (South) Korean Centre for the Validation of Alternative Methods (KoCVAM), International Committee for Radionuclide Metrology (ICRM), International Committee for Weights and Measures Consultative Committee for Ionizing Radiation (CIPM-CCRI), International Cooperation on Alternative Test Methods (ICATM), International Electrotechnical Commission (IEC), International Energy Agency (IEA), International Organisation for Standardisation (ISO), International Organisation of Motor Vehicle Manufacturers (OICA), International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE), International Renewable Energy Agency (IRENA), Japanese Centre for the Validation of Alternative Methods (JaCVAM), National Aeronautics and Space Administration (NASA) (USA), National Institute for Standards and Technology (NIST) (USA), National Oceanic and Atmospheric Administration (NOAA) (USA), National Physical Laboratory on the quality assurance of Earth Observation products (UK), Nuclear Reaction Data Centre, Open Geospatial Consortium, Organisation for Economic Cooperation and Development - Nuclear Energy Agency (OECD-NEA), Organisation for Economic Cooperation and Development (OECD), United Nations Economic Commission for Europe (UNECE), United States Department of Energy (DOE), University of the German Federal Armed Forces (UniBW), US Department of Homeland Security – Domestic Nuclear Detection Office (DHS-DNDO), US Interagency Coordinating Committee on the Validation of Alternative Methods (ICCVAM), World Health Organisation (WHO), World Wide Web Consortium (W3C)

## JRC Mission

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

***Serving society***
***Stimulating innovation***
***Supporting legislation***

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