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Impact analysis of JRC activities

Special report for the 100th meeting of the Board of Governors

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Table of content

BOX 1

The JRC Board of Governors

COMMISSION DECISION of 13 January 1971 on the reorganisation of the Joint Nuclear Research Centre (JRC) (71/57/Euratom) established a General Advisory Committee consisting of representatives appointed by the Governments of Member States to assist the Director General of the Joint Research Centre.

According to article 6 of the decision "the Director General, on his own responsibility and in consultation with the General Advisory Committee, shall prepare draft programmes for the various fields of activity of the JRC and the Committee shall give its opinion thereon". In 1982 this committee was transformed into a Governing Board.

In 1984 the European Community launched the first Framework Programme (FP), extending the Commission's actions beyond the "direct research" programmes of its own JRC, to promoting "indirect research" in the Member States. On 24 May of that year the Commission also issued Decision 84/339/Euratom amending its Decision 71/57/Euratom of 1971. This Decision instituted the Board of Governors as an organ of the JRC, at the time "*to establish more stability in the governance of the JRC and to create a closer link with the contemporary political and technological challenges*".

On 18 December 1984 the JRC organised the 1st meeting of its Board of Governors with representatives from each of the ten European Communities Member States.

On 20 and 21 June 2013 the JRC organises the 100th meeting of the Board with forty Governors from EU Member States, Candidate Countries and Associated Countries.

Foreword from the Board of Governors

On 20-21 June 2013 the JRC presented this special report at the occasion of the 100th Board of Governors meeting. It makes a retrospective analysis of the long-term impact of some selected policy-support activities and presents some recent statistics on immediate policy impact of JRC deliverables registered in 2012.

The JRC evolved considerably since the first meeting of the JRC Board of Governors in 1984. Its research work programme gradually shifted from a mainly nuclear orientation towards a diversified programme for scientific support to EU policies. Today around 75% of the JRC's activities are related to environment, food safety, health, chemical substances, security and crisis management while the other 25% concerns nuclear activities for Euratom.

During the same period, successive enlargements and the participation of Candidate Countries and Associated Countries increased the Board's membership from ten to forty Governors.

In light of these developments and by way of introduction to this report, the Board wishes to acknowledge the continued positive evolution of the JRC and its policy-support mission since 1984. This report gives a number of elaborated examples of the pan-European dimension of the JRC and its broad impact. That JRC's operational networks nowadays work with national laboratories or representatives from twenty-seven Member States, usually complemented with those from Candidate and Associated Countries, has also widened the scope of its actions.

The Board wishes to place on record the JRC's efforts to adapt its monitoring and evaluation procedures to focus more strongly on impact and efficiency. The report demonstrates that the JRC's internal review processes result in an evidence base fit for this purpose.

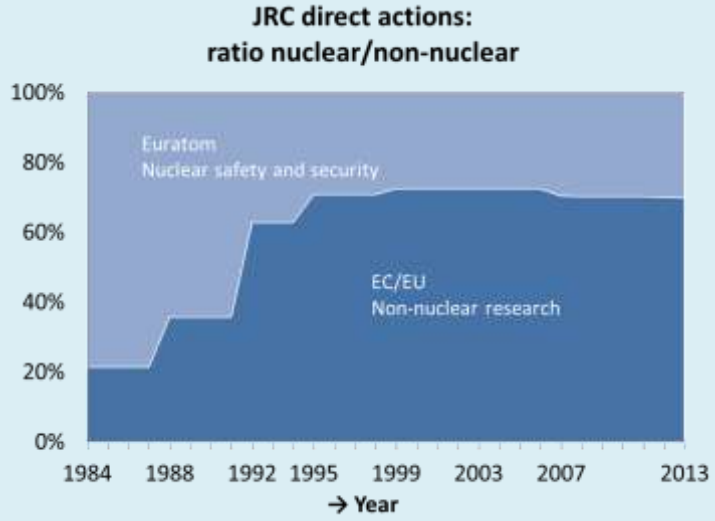
Therefore, the Board recommends this special report to be taken into account in the upcoming ex-post evaluation of the JRC's direct actions under the Seventh Framework Programme. Being on track with the preparations for this exercise, the JRC should continue developing its internal monitoring and evaluation procedures under Horizon 2020.

BOX 2

One hundred meetings of the JRC Board of Governors 1984-2013

At the time of the first meeting of the JRC's Board of Governors in 1984 the JRC programme was largely focussed on nuclear research for the European Atomic Energy Community (Euratom). The interest for nuclear research had been waning since the late 1960s and the JRC research activities gradually diversified since Council adopted the first JRC research programmes for the European Economic Community (EEC) in 1973 on "teledetection of earth resources", "protection of the environment" and "standards and reference substances".

By the time of the first Framework Programme (1984-1987) the JRC research programme included research action programmes on environmental research, non-nuclear energy sources (notably solar energy), application of remote-sensing techniques and materials research. It led to work on the effects of air pollution on citizens, effects of chemical substances on the environment, or developing the use of satellite data from space e.g. for monitoring agriculture and natural resources. By 1983 this non-nuclear research had grown just over 20% in terms of staff and budget allocations.



The picture shows the evolution of the relative budget allocated to nuclear and non-nuclear JRC activities in the period covered by the one hundred Board meetings.

The ratio nuclear/non-nuclear of 4:1 in the days of the First Framework Programme (1984-1987) almost inverted to 1:3 by the time of the Fifth Framework Programme (1998-2002), where it levelled off. In this further diversification the JRC strengthened its policy-support mission and developed activities related to food safety, health, chemical substances, security and crisis management.

1 Introduction

Ten years ago the JRC started systematic tracking of the policy impact of its work by recording immediate effects of its direct actions on the preparation and implementation of EU policies. In 2011 it also started to investigate cumulative effects of permanent support in certain areas, looking at longer-term impacts of specific ongoing policy-support activities. In light of this progressively built-up knowledge about impact of JRC work the Director General announced a special report on this at the occasion of the 100th meeting of the Board of Governors in Brussels.

Verifiable output, results and impact are also necessary elements for external evaluations of the direct actions of the JRC under the framework programmes. The next major evaluation under the legal provisions of the framework programme is the ex-post evaluation of JRC activities under FP7, which finishes at the end of 2013. Hence the JRC evaluation function prepared the current report for this 100th Board meeting also to underpin the JRC's ex-post FP7 evaluation, adding new impact analyses to the results from two earlier JRC impact reports[1,2].

The current report uses the methodology prepared with the help of a Steering Group of external experts for the earlier reports, looking at immediate and longer-term impact JRC activities in a differentiated view with:

- A statistical analysis of the immediate impact or so-called "policy-support impact" from all direct actions in the JRC programme;
- Qualitative analyses of the longer-term impacts from selected cases of ongoing policy support;

The report recalls the impact concept, the criteria and taxonomy that the JRC uses to verify immediate and long-term impacts, respectively in Chapter 2 and 3. It addresses impacts occurring mainly but not only under the Seventh Framework Programme (FP7). Text boxes in the report provide the historical perspective on the JRC and the growing importance of evaluation and impact over the one hundred meetings of the JRC Board of Governors. Chapter 4 summarises the main findings.

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1 *Impact analysis of the Joint Research Centre and its direct actions under the EU Research Framework Programmes*, 2011, EUR 24942, ISSN 1831-5593 (print), http://ec.europa.eu/dgs/jrc/downloads/jrc_eval_report_2011_08_impact_analysis.pdf

2 *Impact analysis of the Joint Research Centre's activities for the regulation of GMOs in the European Union,* 2013, EUR 25967, ISSN 1018-5593 (print), http://ec.europa.eu/dgs/jrc/downloads/eur_25967_en.pdf

BOX 3

From annual review to measuring impact in the JRC

Monitoring, evaluation and reporting have become essential elements of governmental policy and public sector expenditure programmes.

- In 1957 the Euratom Treaty enacts annual reporting duties on the JRC, soon expanded with a mandatory review of the four-year JRC research programmes[1] necessary to prepare a possible Council decision on a further four-year programme.
- In 1984 the first Framework Programme (FP) requires independent experts to make a critical analysis of the JRC programme for the European Council and the European Parliament.
- These first "formal" evaluations of the JRC have a peer-review character with advice to enhance scientific and technical achievements; common practice in the research sector.

Since 1984 all framework programmes ask for such "external evaluation" of the programmes.

Developments around the turn of the century encourage further advancements in monitoring and evaluation practices:

- The European Commission's administrative reform in the year 2000 leads to new internal evaluation standards for EU interventions, to be implemented systematically across the different services.
- The Fifth Framework Programme (1998-2002) introduces the JRC's mission with scientific support for EU policies, confirming a stronger focus on regulatory research and a need to adapt evaluation practices and criteria.

These developments lead to the introduction of an internal "periodic action review" (PAR), also to inform management on relative performance across projects and to build up a record of impacts and accomplishments for all JRC activities (see section 2.2).

In 2010 independent expert panels of the FP interim evaluations encourage the JRC to build up a public record of impacts from specific achievements for future evaluation purposes.

- By 2013 all of JRC's programme-monitoring and evaluation activities have an impact dimension with internal PAR reports and a series of published impact analyses.

Impact information imparts credibility to the JRC and its mission; informs the policy and budgetary processes; and shows where and how the JRC "is making the difference".

2 JRC impact with results from 2012

In an evaluative context "JRC impact" refers to effects resulting from JRC actions and deliverables. Impact evaluation looks at what happens because of these actions and deliverables, intended or unintended, direct or indirect and reviews the extent to which they make a difference for the EU in science and governance, and in policy and regulation. JRC impact evaluation concentrates on two levels. Firstly, it examines impact of individual actions in a specific area at regular time intervals. Secondly, it studies the impact of a sustained activity, aggregating the detailed impacts over a longer period and looking at the broader context to account for investments in JRC programmes or specific JRC activities.

2.1 A taxonomy for the various categories of impact

To achieve validated and verified impact records the JRC examines the impact of its activities on a yearly basis. This impact analysis at first level gives a fact-based view of how and where policy makers benefit directly from JRC's work in the conception, development or in the implementation phase of policies. This is represented in the upper left corner of the diagram in Figure 1 below – "policy impact".

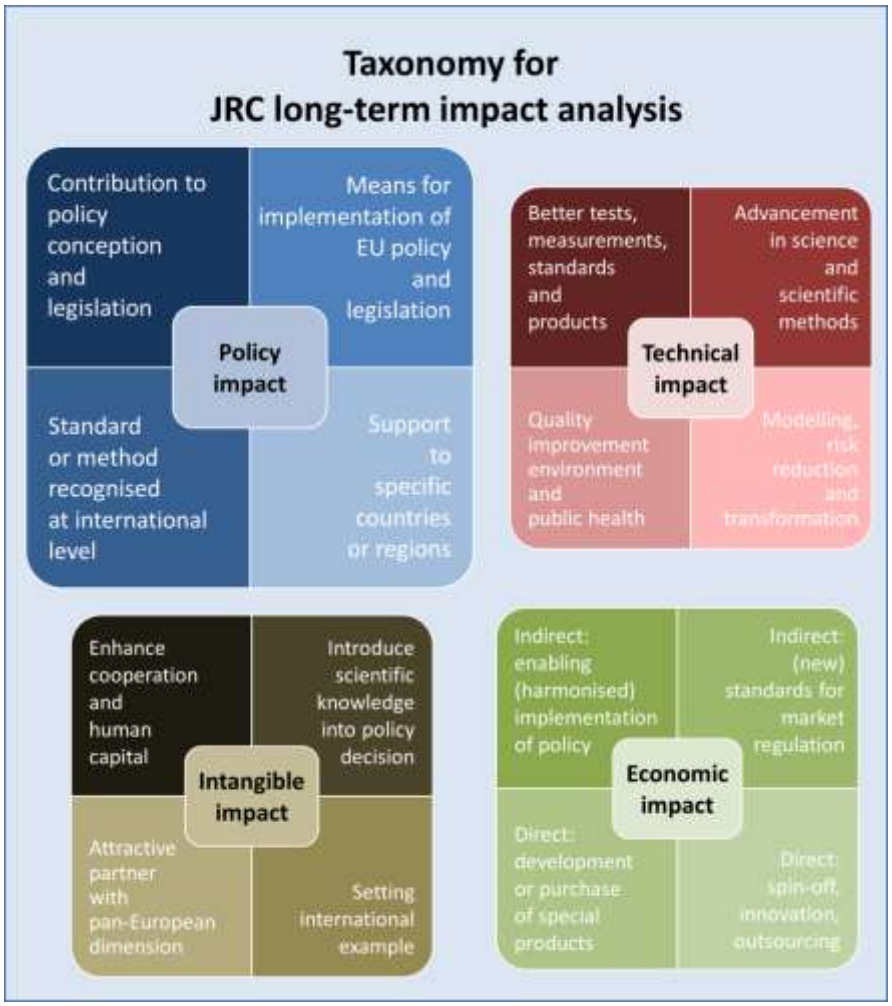

Figure 1 Impact-evaluation taxonomy for the JRC with four impact characters each with a number of impact categories

Policy impact from JRC work occurs in the day-to-day work of policy makers. In general regulatory-research results are verifiably used within some months after delivery. They generate immediate impact, unlike academic research or from legislation, which usually take much more time to transpire. The JRC monitors these immediate impacts for annual reporting purposes (see Chapter 2.2) and establishes an effective indicator for the mission alignment of actions (i.e. projects), for accountability purposes, and for analysing the JRC's effect on different customers (see Chapter 2.3).

Besides policy impact, the current analysis distinguishes three other types of impact: technical impacts (including scientific achievements), economic impacts and impacts on intangible assets referred to as "intangible impacts". They are indicated by smaller blocks in Figure 1 to show a difference: these impacts build up in time and are associated with a series of important deliverables. They can only be investigated with sufficient hindsight and their identification requires dedicated research and analysis with specific criteria and methods for each case.

The immediate policy impact from many JRC deliverables has an accumulative character. It builds up over time and generates impact that can be expressed at a higher level of abstraction. A series of contributions to impact assessments for a certain policy can be characterised as an impact on the scientific underpinning of this policy. Establishing such longer-term policy impact also needs sufficient hindsight, dedicated research and analysis as the other three longer-term impacts above.

The technical impact in this analysis focusses on improvements in measurements, tests, standards, modelling and the introduction of innovative technologies for policy implementation. It does include advancement in science and scientific methods, but the current analysis does not go further in detail. A preliminary analysis of Scopus, the largest available citations and abstracts data base of scientific literature, revealed 6557 peer-reviewed articles recorded from the JRC between 2005-2012 receiving approximately 9,5 citations per article. This purely "scientific impact" has been kept outside the scope of this analysis, but will be subject of further internal study.

Regarding the economic impacts, in previous analyses external experts advised against trying to quantify economic benefits or to convert JRC impacts into monetised values. Calculations of economic impact would require a sizeable research effort for the development of models and monetisation studies. Moreover, these models would have to be validated on a larger sample with similar organisations, of which there are few (if any) in view of the pan-European setting of the JRC within a European institution.

Intangible impact is e.g. an improved reputation from setting a world standard, creating a network, or sharing knowledge. Whereas there may be enough evidence for the improvement of an intangible asset like reputation or recognition, the impact as such has unquantifiable effects. Nevertheless these real but intangible impacts of JRC activities are important effects with public value. They include reassurance of the public, better

BOX 4

Impact via WEB 2.0

Google's ranking of a web page is correlated with keywords on that page, but also with the number of search queries that are used to find the page and with the number of new web pages that link to the page. It is common knowledge that the higher up a website appears on a search engine, the more visitors it is going to receive.

In March 2013 the JRC appeared on the first page of Google searches for almost one hundred S/T-related subjects. Regarding the merit of showing up on a first page of Google, some click-through rate (CTR) study results suggest that about 90% of the users click on a first page result and less than 10% ever clicks to the second page and selects a result displayed there.

Smartphones and tablet-computers open up new media for disseminating and sharing results. Indeed, the JRC developed some "mobile apps" to share data sets with special interest groups, for instance in the food-safety domain. Furthermore, scientific information also starts to appear via social media like Twitter or Google Plus.

The JRC also generates impact via these new Web 2.0 applications but existing evaluation mechanisms have not yet incorporated methods to include them. The identification and measurement of the impact from these complementary internet products is becoming a discipline in itself, to which the JRC is starting to connect.

understanding amongst policy makers and decision takers or even enhanced relations between various stakeholders.

In summary, JRC impact analyses take account of four neither exclusive, nor exhaustive types of impact which have proven useful in the past:

- policy impact, i.e. (i) immediate, from verifiable use of the policy-support product shortly after delivery and (ii) long-term, from sustained support to policy conception, monitoring, or implementation based on series of effects
- technical, economic and intangible impacts, i.e. long-term effects in science and society from sustained support efforts.

The following sections deal with immediate policy-support impact, while Chapter 3 presents long-term impacts in a number of narratives about JRC support to policies.

2.2 Immediate policy-support impact in 2012

Since 2003 working procedures at the JRC require action leaders to register the deliverables and the generated impact for their work systematically in an online data base. With this information the JRC can link output and impact information and, on an annual basis, it

verifies productivity in terms of deliverables for policy-support (e.g. reports, tests, methods) and for science (e.g. peer-reviewed publications, scientific reports). The information helps to build up knowledge on (i) how JRC activities have an impact on the conception, development, implementation and monitoring of policies, (ii) how the impact is distributed over EU-institutional, national, international or private customers.

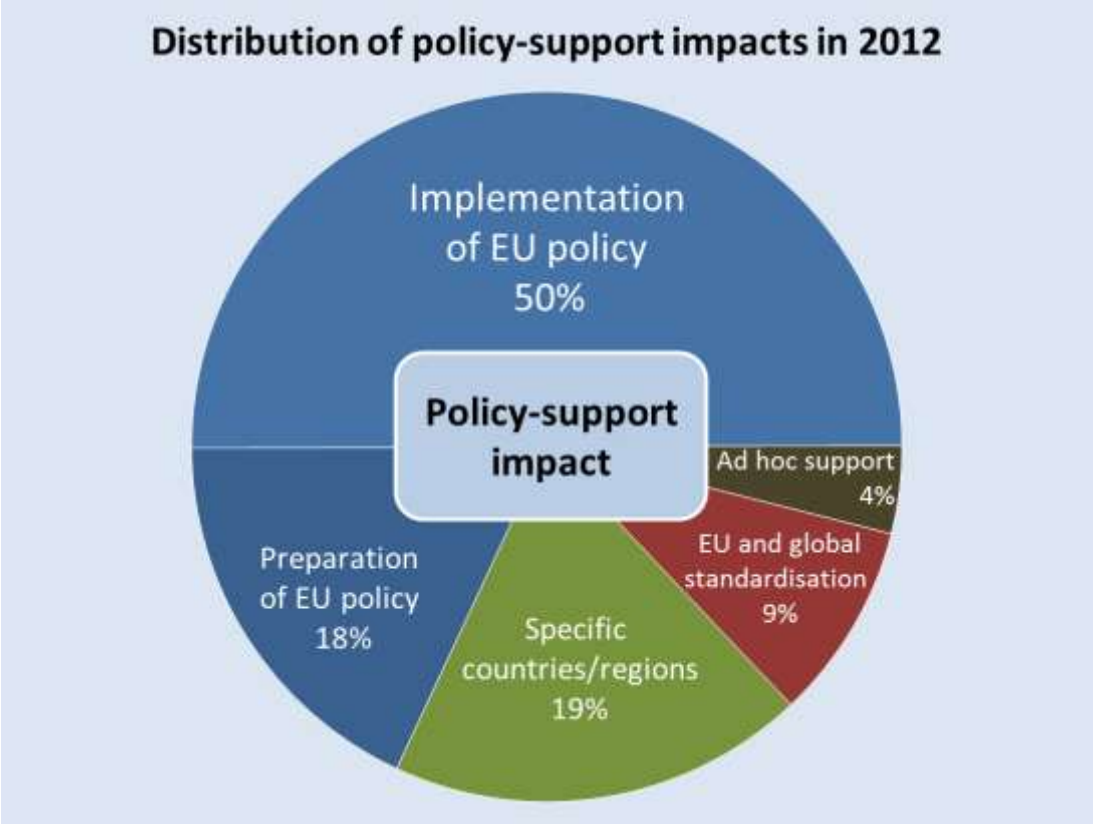

Figure 2 Distribution immediate impact of policy-support 2012

JRC scientists enter the outputs and impacts of their work according to a set of pre-described decision criteria with five empirically established impact categories. Subsequently a small internal evaluation team validates the registered outputs, impacts and the categorisation according to an internal ISO-certified peer-review process. For the calendar year 2012 the number of validated impacts is 269 and the distribution over the various categories is indicated in Figure 2.

- 50% of the impacts are directly linked with the implementation of EU policies, i.e. directives, regulations, recommendations (e.g. the JRC runs a bureau or a laboratory established by a Commission or EU decision)
- 18 % are directly linked with the preparation of EU policies in the conception phase of policy proposals (e.g. the Commission proposes an EU directive which incorporates scientific results from JRC research)
- 4 % concern *ad hoc* support (e.g. a situation assessment which is used for emergency response)

- 9 % concern EU and global standardisation (e.g. a JRC test method is adopted by an international standardisation body)
- 19 % of the impacts come from support to specific countries or regions (e.g. training of laboratory staff to enable a new Member State to enforce regulations)

The monitoring and reporting process itself is as important as the resulting statistics. It generates a complete record of achievements for further internal and external evaluation purposes. It allows further analysis of the corporate footprint, the nature of the work and its impact. Hence the JRC uses the "number of validated impacts" as an ex-post indicator to monitor its operations and to verify the alignment of its work with its policy-support mission. This indicator fully responds to the requirements of the Commission's internal Activity Based Management.

2.3 Policy-support impact: the recipients

Impact from policy support is distributed over the full range of JRC customers, beneficiaries and partners. Besides the Commission, other recipients of JRC deliverables are Member States (and Candidate Countries) authorities, EU agencies, international organisations and standardisation bodies, as displayed in Figure 3. In line with the JRC's mission most of the impacts happen within or through the Commission. This confirms a tight link of JRC work with EU policies and although there is no measure for the size of the collective impact, in the relevant EU policy processes it must represent a noticeable factor. Impacts purely outside the Commission largely come from work for Member States and Candidate Countries authorities.

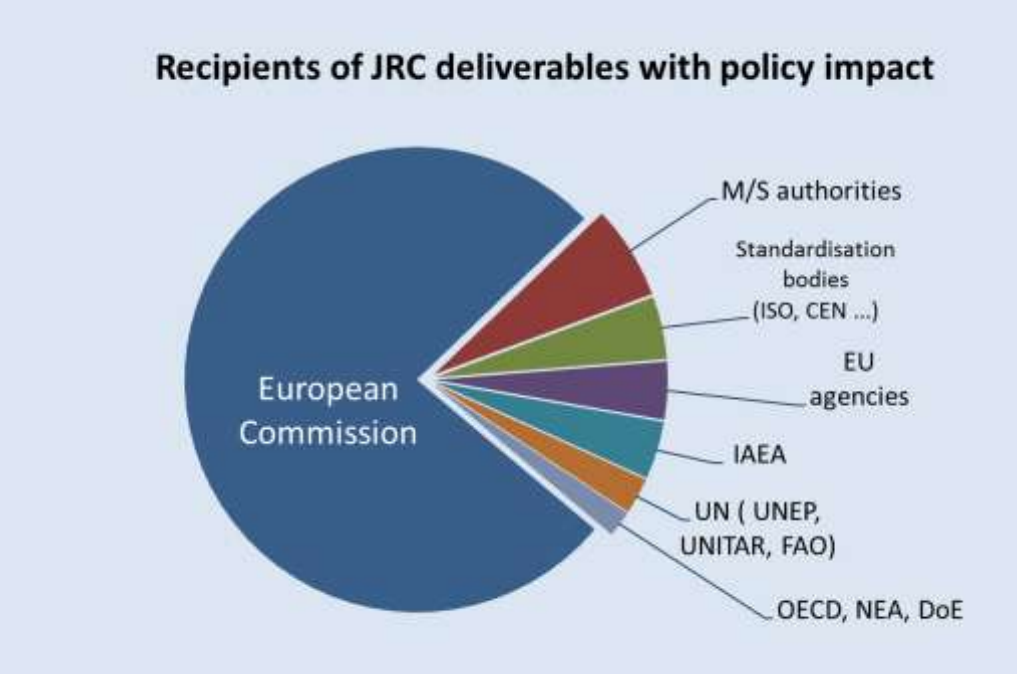

Figure 3. Pie chart showing the distribution of JRC deliverables with policy impact over the prime customer (source ref 1).

Figure 4 shows the registered impacts distributed over a large number of EU policies. The percentages are best-estimates for the relative share in impacts from the JRC work programme based on the statistical analysis, considering that some impacts relate to more than one policy. It is worth noting that impacts concentrate in policy areas where science plays an important role, i.e. with issues involving people's health, people's safety, security, the environment as well as the competitiveness of the European economy.

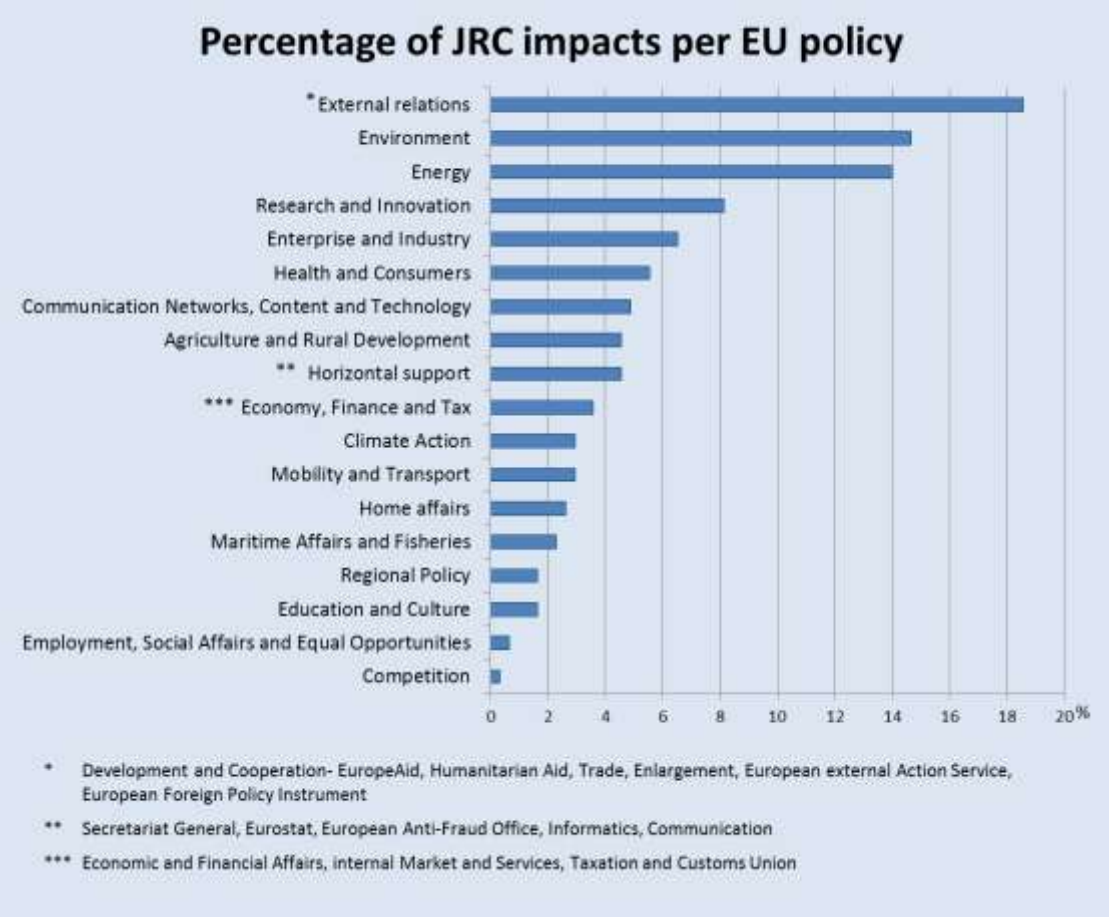

Figure 4. Customer policies of the EU and best-estimate percentage with which impacts occur in the respective areas in 2012

3 Long-term impact analysis of some JRC activities

This chapter presents a compilation of impact analyses of a selection of JRC activities covering different parts of the policy cycle (conception, development, implementation of EU policy or Euratom Treaty tasks) and with different impacts as in the taxonomy assumed in the previous Chapter, with policy-support impact, technical impact, direct/indirect economic impact, or intangible impact.

The selected activities are related to the following EU policy instruments:

- EU Reference Laboratories (EURL)
- Measures to restore financial stability
- Biofuels and Indirect Land Use Change (ILUC)
- The Euratom nuclear power plant stress test
- Euratom On site Laboratories[3]
- The EU Industrial Emissions Directive (IED)[3]
- An Infrastructure for Spatial Information in the European Community (INSPIRE) [3]

All activities reached a stage in which they have generated tangible impacts and with the exception of the nuclear stress test which as such is a completed task, all activities are ongoing.

3.1 European Union Reference Laboratories (EURL)

Every year hundreds of laboratories in the Member States perform millions of tests to monitor whether agro-food business operators respect the regulations adopted to protect human, animal and plant health across the European Union. These laboratory tests determine whether a product is allowed on the market or not. Therefore, they need to be reliable, accurate and the results should be independent of where the test is carried out.

For this purpose, as of the 1970s the Council and the Commission set up a range of control systems for feed and food safety in the Member States with EU reference laboratories (EURLs)[4] playing a central role in these control systems. An EU reference laboratory is a virtual structure within a larger existing public organisation. It uses laboratory facilities of the hosting institution where necessary and operates with a network of National Reference Laboratories (NRLs).

[3] Selected and presented earlier in JRC impact report 2011, full reference in footnote 1

[4] Previously referred to as Community Reference Laboratories (CRL)

In 2004 the Official Food and Feed Control Regulation (EC) No 882/2004[5] formalised the role of EURLs and assigned the following tasks:

- to ensure testing procedures and methods harmonised across the Member States;
- to develop specialised diagnostics and analytical detection methods; and
- to support standardisation activities.

Updated with the latest amendments in 2012, Regulation (EC) No 882/2004 has designated forty five EU reference laboratories[6] of which the JRC hosts the:

- EU reference laboratory for additives for use in animal nutrition (EURL-FA);
- EU reference laboratory for genetically modified organisms (EURL-GMO);
- EU reference laboratory for materials intended to come into contact with foodstuffs (EURL-FCM);
- EU reference laboratory for heavy metals in feed and food (EURL-HM)
- EU reference laboratory for Mycotoxins (EURL-MYC);
- EU reference laboratory for Polycyclic Aromatic Hydrocarbons (EURL-PAH);

In 2010 the Commission[7] also designated the European Centre for Validation of Alternative Methods (ECVAM) at the JRC as the:

- EU reference laboratory for alternatives to animal testing (ECVAM)

The nature of ECVAM's work is different from the EURLs for official food and feed control under Regulation (EC) No 882/2004; it does for instance not operate with a network of NRLs.

The Commission's approach to enlarge the designation of EURLs is corroborated in its recent proposal to replace Regulation No 882/2004 by a new Regulation[8], which extends the EURL concept to new sectors, rules for placing on the market and other aspects of the internal market like food fraud (misrepresentation, mislabelling). The new Regulation gives the Commission the authority to designate new EURLs by means of an implementing act.

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5 Regulation (EC) No 882/2004 of the European Parliament and Council of 29 April 2004 on official controls performed to ensure the verification of compliance with feed and food law, animal health and welfare rules.

6 There were 26 EURLs in 2004. From then until 2012 the number of EURLs for feed and food increased from 13 to 27 and the EURLs for animal health and live animals from 13 to 18.

7 Directive 2010/63/EU on the protection of animals used for scientific purposes, OJ L 276, 20.10.2010, p.33.

8 COM(2013)265, Proposal for a Regulation of the European Parliament and of the Council on official controls and other official activities performed to ensure the application of food and feed law, rules on animal health and welfare, plant health, plant reproductive material, plant protection products and amending Regulations (EC) No 999/2001, 1829/2003, 1831/2003, [….] and Directives 98/58/EC, 1999/74/EC, [….] and 2009/128/EC (Official controls Regulation)

EU reference laboratories typically employ between 2 and 10 (FTE) persons[9]. The number of staff depends on the nature of the task in the area, whether it includes substantial analytical work to be carried out in the hosting laboratory and for instance, some EURLs carry out additional tasks for other EU regulations.

Figure 5 shows the number of (FTE) staff of the different EURLs at the JRC. The six EURLs implementing Regulation (EC) No 882/2004 carry out tasks related to food and feed control in the market (indicated in blue). Two of them, i.e. the EURL Feed Additives and the EURL GMOs, also carry out test and evaluation tasks in the context of authorisation processes to allow products on the market described in other regulations (indicated in red). The number of staff in EURL-GMO is significantly higher than the average because of the labour-intensive research associated with the GMO authorisation process.

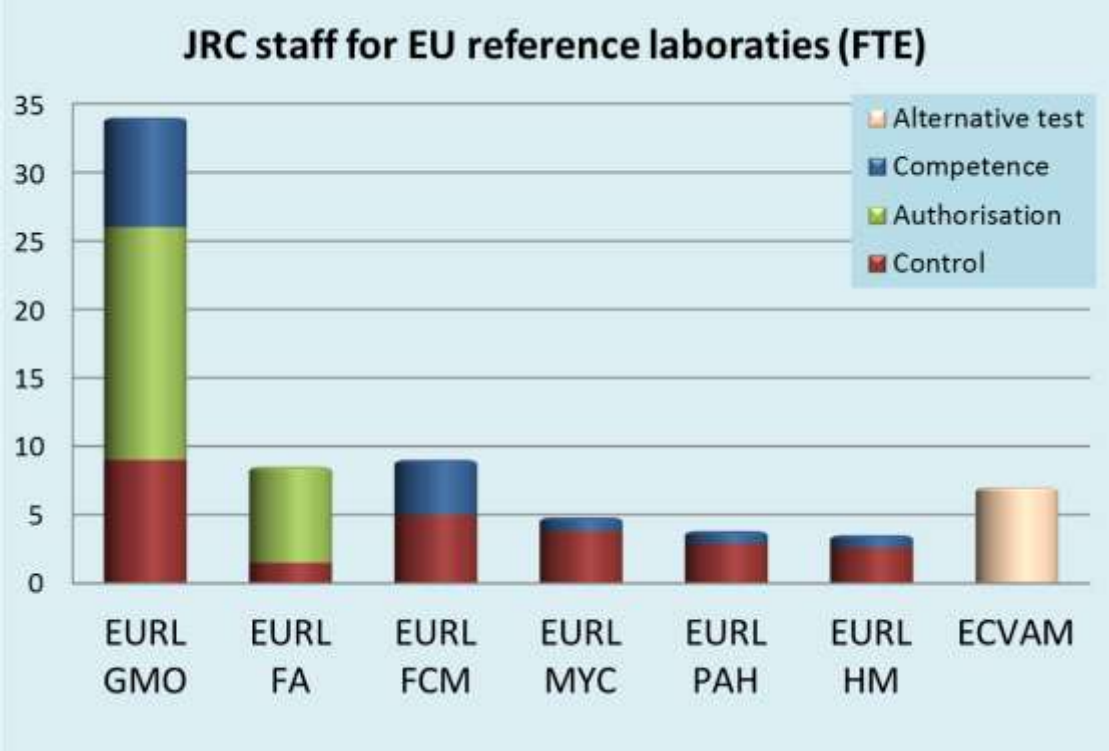

Figure 5 JRC Staff resources on EURLs

The seven EURLs together nominally employ 70 FTE persons, which is of the order of 3% of JRC staff. The JRC operates the EURLs at marginal costs: they work under administrative arrangements with the policy service, the Directorate General for Health and Consumers, and the EURLs working in the pre-market authorisation process receive a handling fee per validated test or verification of the notified test method. In terms of resources the JRC contributes its laboratory infrastructure for the EURLs in a well-equipped pan-European environment for standards and reference measurements.

[9] Number of full-time equivalent (FTE) persons, as distinguished from the (usually higher) number of persons assigned to the various actions (head counts)

3.1.1 The EURL for genetically modified organisms EURL-GMO)

Genetically modified organisms (GMOs) [10] are used in agriculture, in biological and medical research and for the production of chemicals, biofuels and pharmaceutical drugs.

Starting in the 1990s the European Union developed an extensive legislative framework for the regulation of GMOs in food and feed to pursue the global objective of protecting human life, health and welfare, environment and consumer interests, whilst ensuring that the internal market works effectively. The JRC assisted the development of this framework from the beginning, which led to two major EURL tasks:

- Coordinate and supervise all technical aspects in the **control on the presence** of GMOs in food and feed (implementation of Regulation (EC) 882/2004).
- Validate analytical methods for measuring the concentration of a GMO in food or feed; an essential element in the **authorisation process** for marketing in the EU (implementation of Regulation (EC) 1829/2003).

For these tasks the EURL-GMO is assisted by a consortium of around 100 national expert laboratories from the Member States in the European network of GMO laboratories (ENGL).

The long-term impact of all JRC activities for the regulation of GMOs has been analysed in a dedicated JRC evaluation report[11]. It presents seventy-two significant impacts with a policy, technical, or (socio-) economic character including, e.g., quality assurance for GMO analysis across the EU, certified reference materials, international standards, the effective protection of consumer's interest, as well as keeping complex legislation for international trade in food and feed manageable with a minimum of adverse effects. For this EURL the report concludes that the most characteristic impacts from the JRC's work are:

- The technical infrastructure in the EU that allows harmonised implementation of GMO legislation and regulations, including the availability of certified reference materials.
- The technical clarification of the EU zero-tolerance policy for GMOs, which are approved on a market outside the EU; the JRC's impact on the relevant recent regulation is subject of the case study in the evaluation report.

3.1.2 The EURL for feed additives (EURL-FA)

Feed additives are an integral part of modern animal husbandry which aims to improve animal production, performance and welfare. Their use is subject to a set of regulations adopted by the EU. There should be evidence for the efficacy of the additive and a safety assessment should demonstrate that the additive has no harmful effects on human and animal health and on the environment. Subsequently the European Commission can grant the authorisation for placement on the market (pre-market approval).

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[10] EU legislation defines a GMO as "an organism in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination".

[11] *Impact analysis of the Joint Research Centre's activities for the regulation of GMOs in the European Union,* 2013, EUR 25967, ISSN 1018-5593 (print);

The European Food Safety Authority (EFSA) is responsible for conducting the efficacy and safety assessment prior to authorisation. The EURL for additives for use in animal nutrition (or shortly: feed additives) at the JRC laboratories in Geel assists EFSA in this task with an evaluation of the analytical method for detection and quantification as proposed by the applicant for authorisation.

Examples of verified impacts from the EURL for feed additives are:

- The EURL for feed additives issued more than 300 evaluation reports, each of which is included as reference in as many Commission Implementing Regulations authorising the placing on the market of the feed additive.
- Throughout the EU, industry as well as feed control authorities use commonly agreed testing methods for feed additives, because of the EURL's supervision on harmonisation.
- The number of disputes over deviating analytical results is very low. This benefits Member States control authorities as well as the feed and feed additives industries.

3.1.3 The EURL for food contact materials (EURL-FCM)

The formal name of this EU reference laboratory "for materials intended to come into contact with foodstuffs" makes clear that its field of operation concerns materials like for packaging, kitchenware, cutlery, and processing machines. Because molecules from these materials can migrate into the food, the EU has adopted strict regulations[12] to ensure that the actual migration is below any level of health risk.

Since 2004 the JRC hosts this EU reference laboratory in its laboratories in Ispra (Italy). The EURL-FCM provides analytical methods and reference substances to test compliance with the EU regulation. This includes laboratory training on migration measurement, analytical testing, as well as maintaining a network of NRLs and other national expert laboratories for the exchange of information and expertise issues related to food contact materials.

Impact examples for the EURL-FCM are:

- An increased participation in interlaboratory comparison (ILC) tests: 66 NRLs submitted their results in the latest ILC in an area that started with 22 NRLs.
- A higher performance level of laboratories participating in ILC tests, demonstrated by ILC test results in the period 2008-2012.
- As a typical impact from EURL-FCM guidelines and training work, during the year 2012 the non-compliance for polyamide kitchen articles went down from 10% to 1%.

[12] Regulation (EC) No 1935/2004 of the European Parliament and of the Council on materials and articles intended to come into contact with food (repealing Directives 80/590/EEC and 89/109/EEC)

3.1.4 The EURL for heavy metals in feed and food (EURL-HM)

To reduce the health risk from certain toxic elements (heavy metals) contained in food and feed coming from environmental or industrial contamination, European legislation specifies maximum limits in several commodities. The task of the EURL for heavy metals in feed and food is to facilitate the implementation of Regulation (EC) No 1881/2006 and Directive 2001/22/EC establishing the maximum levels of heavy metals such as lead, mercury and cadmium.

Recently, the European Food Safety Authority (EFSA) has published scientific opinions assessing the risks to human health related to the presence of cadmium, lead, mercury, methylmercury, and arsenic in food. In this respect the authority highlighted the need for reliable analytical methods for generating the occurrence data that are necessary to estimate dietary exposure.

This EURL for heavy metals assessed the current analytical capabilities in Member States laboratories for the quantification of cadmium, lead, mercury, methylmercury and inorganic arsenic in a series of commodities to inform the risk managers in the Directorate General for Health and Consumers. The EURL thus validated a method for the determination of inorganic arsenic, the most toxic form of arsenic, in feed, which has become a European Standard, published by the European Committee for Standardization (CEN).

3.1.5 The EURL for mycotoxins (EURL-MYC)

Mycotoxins are poisonous substances produced by moulds (fungi) in food and animal feed. When food is stored in open air, particularly at relatively high temperature and humidity, moulds can proliferate fast and produce mycotoxins in such quantities that they become a health risk. Around 25 % of crop food products is contaminated with mycotoxins usually at acceptably low quantities. European legislation sets maximum limits to protect the consumers and ensure that the control measures meet established and accepted performance criteria[13].

The EURL for mycotoxins at the JRC in Geel (BE) coordinates activities related to the development and improvement of methods of analysis for the official control of the maximum levels. For this purpose it regularly organises interlaboratory comparisons to benchmark the testing capabilities of national reference laboratories and official control laboratories in the Member States. It also provides training in advanced analytical technologies to Member States laboratories and third countries.

Regulation (EC) No 882/2004 requires that official controls methods shall comply, *inter alia*, with internationally recognised rules or protocols, for example those that CEN has accepted. CEN issued eight European Standards for mycotoxin based on methods validated the EURL for mycotoxins. Besides a number of new notifications each year, the EURL currently also has

[13] Commission Regulation (EC) No 401/2006 of 23 February 2006 laying down the methods of sampling and analysis for the official control of the levels of mycotoxins in foodstuffs

to renew the validation of analytical methods for the official control of the maximum levels for 400 mycotoxins, a workload that can be spread over 5 years.

3.1.6 The EURL for polycyclic aromatic hydrocarbons (EURL-PAH)

Polycyclic aromatic hydrocarbons (PAHs) are chemical compounds that can result from combustion processes of organic substances or from heat processing and smoking of food – some of them are of particular concern for human health. The EURL for PAHs assists the national laboratories of the Member States by developing and validating analytical methods to detect these chemicals, and by harmonising official controls.

In 2002 the Scientific Committee on Food issued an opinion on the risks to human health of PAHs leading to a Commission Recommendation to monitor the occurrence of 16 PAHs in food[14]. The EURL organised 13 interlaboratory comparison tests for PAHs in various matrices, which is a major contribution to the development and standardisation of the testing, necessary for the implementation of the Recommendation.

3.1.7 The EURL for alternatives to animal testing (ECVAM)

In the early 1990s the EU decided to end the use of animals for demonstrating the safety of cosmetics. The Commission founded the European Centre for the Validation of Alternative Methods (ECVAM) at the JRC in Ispra and Council Directive 93/35/EEC[15] introduced a marketing ban on cosmetics containing ingredients tested on animals. The application date of this ban was 5 years later in 1998, but there was no science-based assessment of whether alternative methods would be available by that date. Hence the directive had a built-in option for the Commission to propose a postponement of the ban, as it did for several years. Eventually animal testing for cosmetic products became prohibited in the Union as of 2004 and for cosmetic ingredients as of 2009, but still with some exceptions.

The “Cosmetics Directive” 76/768/EEC regulates the EU market for cosmetic products to ensure consumer safety and to secure the internal market. The marketing ban on cosmetics containing ingredients tested on animals, dates from 1993, but became fully effective only this year.

in 2010 the European Cosmetics and Toiletries industry had a turnover of the order of EUR 70 billion, almost half of the global market.

[14] Commission Recommendation of 4 February 2005 on the further investigation into the levels of polycyclic aromatic hydrocarbons in certain foods (2005/108/EC)

[15] Directive 93/35/EEC, OJ L 151, 23.06.1993, p. 0032-0037, also serving Council Directive 86/609/EEC regarding the protection of animals used for experimental and other scientific purposes OJ L 358, 18.12.1986, p. 1–28

BOX 5

Impacts associated with the EURLs

The main policy impacts of the JRC's work for the EURLs:

- Harmonised technical implementation of the underlying EU regulations
- Feasibility demonstration of a technologically advanced law-enforcement system with state-of-the-art instruments and methods
- Hundreds of standards and methods entered in EU regulations

The main technical impacts:

- Well-developed test and analytical capacities in Member States
- Higher accuracy and measurement precision (less false-positives and false-negatives)
- Newly developed analytical methods and international standards

Associated (indirect) socio-economic impacts:

- Protection of EU consumers' interest
- Proper functioning of the internal market
- Consistent implementation of regulation for international trade

Intangible impacts from operating the EURLs:

- International recognition for JRC expertise
- Stronger position as European (metrology) reference centre
- Impartiality as basis for trust between policy makers, industry and the public.

This year marked the last milestone for the complete phasing out of animal testing to prove the safety of cosmetic products in Europe. As of the 11 March 2013 the EU market is closed for cosmetics tested on animals and only allows products of which the safety has been established with alternative test methods. Exactly on that date the Commission published a Communication[16] confirming its commitment to respect these deadlines as well as its support for research and innovation in the area of alternative methods.

The EURL for alternatives for animal testing coordinates the validation of alternative approaches to animal testing in the European Union since 1991 as ECVAM. It guides the development of alternative methods, conducts validation studies, facilitates regulatory

[16] COM (2013)135, Communication on the animal testing and marketing ban and on the state of play in relation to alternative methods in the field of cosmetics

acceptance and promotes the use of alternative methods by end-users. Examples of impacts from this EURL are:

- Validated replacement test methods in the fields of skin irritation and corrosion, photo toxicity and skin penetration, all adopted as OECD test guidelines.
- Contributions to the Impact Assessment accompanying the Commission's recent Communication on animal testing.
- JRC technical reports are the basis for the yearly Commission reports, which present the state of play of the development, validation and regulatory acceptance of alternative methods in the field of cosmetics.

3.2 EU measures to restore financial stability

The financial crisis of 2008 and the more recent sovereign debt crisis severely tested the ability of national and international authorities to manage problems in banking institutions. A number of high-profile banking failures took place in this period (Lehman Brothers, Fortis, Icelandic banks, Anglo Irish Bank, Dexia). Existing arrangements for tackling bank failures fell short, leaving governments with little other choice than to bail out their banking sector with public money. Three years after the first crisis the European Commission had already approved EUR 4,5 trillion of state aid to financial institutions; an amount putting significant strain on national treasuries.

At an early stage of the crisis the G20 already called for better national and international arrangements that would "permit an orderly wind-down of large complex cross-border institutions". Following these international developments in 2010 the European Commission came with first proposals for crisis management in the financial sector as well as a roadmap for the preparation of prevention and resolution tools together with powers that enable timely intervention. Today there is a package of proposals for higher capital requirements for banks, harmonised deposit protection schemes, bank deposit guarantee schemes and the establishment of an EU framework for bank recovery and resolution[17]. The proposed framework sets out the necessary steps and powers to ensure that bank failures across the EU can be managed in a way that preserves essential functions of a bank, avoids financial instability and minimises costs for taxpayers with shareholders and creditors bearing the losses.

Once every element is adopted, this package offers governments and regulators an orderly wind-down of banks in trouble without presenting the bill to the taxpayer. It is consistent with international level work on the issue, responds to the crisis that challenged the EU financial integration project and allows the EU to play an important role in G20 efforts to find a global approach on bank resolution.

[17] EU framework for bank recovery and resolution proposal: http://ec.europa.eu/internal_market/bank/crisis_management/index_en.htm

3.2.1 The JRC and the EU policy for Economy, Finance and Tax

The JRC has contributed and continues to contribute to the assessment of many of the measures for banking, regulatory capital, deposit guarantee schemes, crisis management, and structural reform supporting the EU policy for Economy, Finance and Tax. The JRC became involved in monitoring aspects of the banking sector several years before the global financial crisis. Around 2005 it gradually started to deploy its expertise in statistics, econometrics and financial modelling to assist the policy makers with the development of internal market policies for financial services. It developed research on the impact of proposed revisions in the directive on deposit guarantee schemes (DGS) and of other measures in the Basel regulations for the banking sector and in the Solvency Directives for the insurance sector.

The JRC undertook these activities in close cooperation with the Directorate General for Internal Market and Services, originally to support the consolidation of the Financial Service Action Plan (FSAP, COM/99/0232) by establishing the (ex-post) impact of the new rules on the European financial sector. Because of the financial crises the JRC created a special task force and directed this support towards calculations of the impact from Commission regulatory proposals to enhance financial stability and prevent future crises (i.e. the Capital Requirement Directive, Bank and Financial Institutions Resolution Framework, and Financial Transactions Tax). While the JRC developed and runs several models to support Economics, Finance and Tax policy, the current impact analysis focuses on SYMBOL, the SYstemic Model of Banking Originated Losses.

Recent Commission policy proposals that made use of SYMBOL simulations:

- COM(2010)368 final - Directive on Deposit Guarantee Schemes [recast]
- COM(2011) 452 final - Regulation on prudential requirements for credit institutions and investment firms (CRD IV Package, 2011)
- COM(2011) 453 final - Directive on the access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms and amending Directive 2002/87/EC (CRD IV Package, 2011)
- COM(2011) 594 final – Directive on a common system of financial transaction tax, amending Directive 2008/7/EC
- COM/2012/280 final - An EU framework for Crisis Management and Bank Resolution

The JRC developed SYMBOL jointly with the Directorate General for Internal Market and Services and with academic experts, to calculate probabilities and magnitudes of economic losses in the banking sector, to simulate the onset and development of banking crises and to serve as the main tool in the assessment of the impact of regulatory changes. The model can simulate the impact of a single regulatory measure or the cumulated impact of a package of regulatory measures. This permits an assessment of the impact from complex and numerous legislative initiatives, and to calibrate regulatory changes accordingly. The features of the model allow it also to take potential losses arising from contagion effects in the interbank market into account.

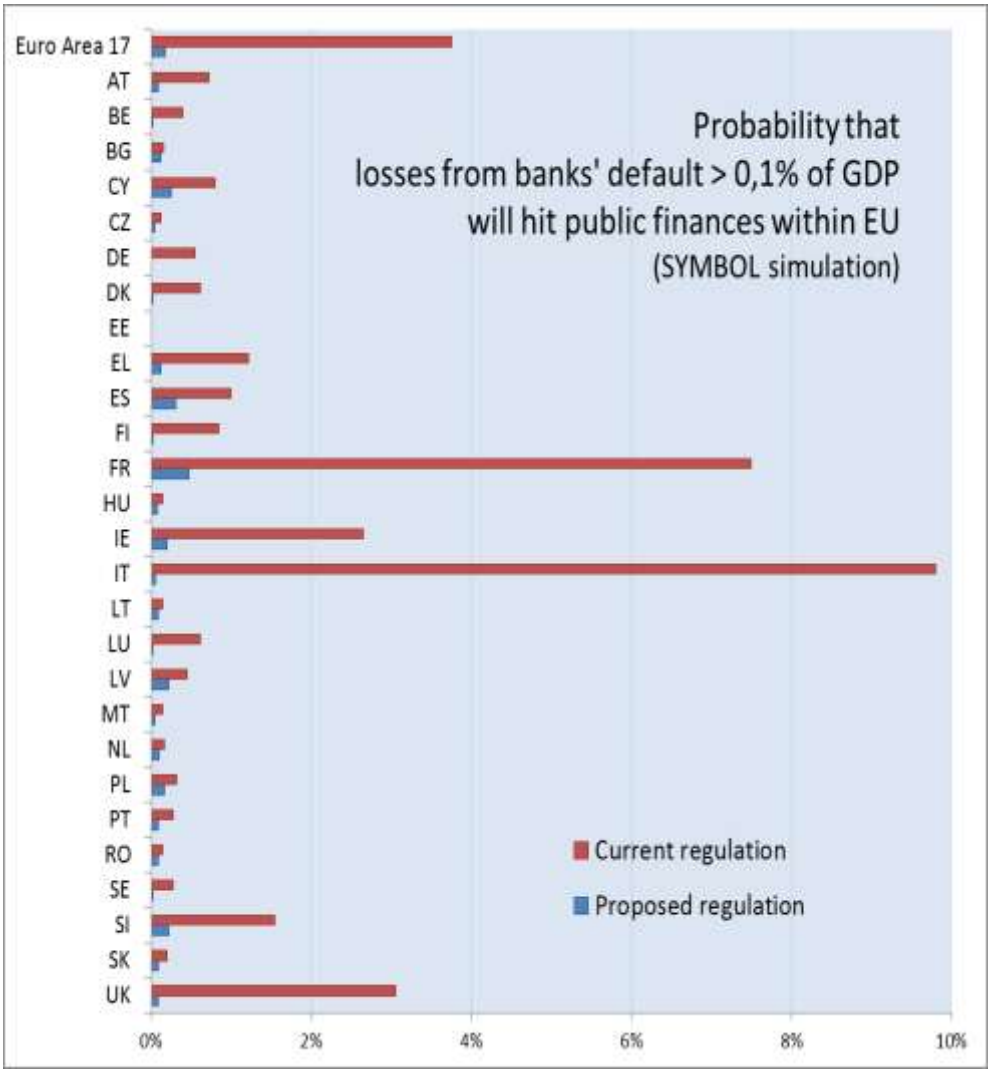

Figure 6 An example of a SYMBOL result showing the probability that public finances will be hit by bank-default losses higher than 0.1% of the GDP in various EU members states under two alternative regulatory scenarios.

Over the last few years the JRC used SYMBOL to simulate the financial consequences of bank failures in EU countries. This work allowed examining how different factors, such as higher capital requirements or the introduction of resolution funds, affect the probability and magnitude of economic losses and liquidity shortfalls due to bank defaults. Results help to investigate which combinations of regulatory changes are most effective for enhancing financial stability.

The JRC used SYMBOL also to analyse the consequences of various regulatory measures and changes, e.g., the Commission proposal for Capital Requirement Directive (CRD IV) and the proposed introduction of a Tax on Financial Activities in 2011, as well as the proposal for the introduction of an EU Framework for Bank Recovery and Resolution in 2012. SYMBOL calculations underpin positive effects or discover unforeseen negative effects of proposed measures. For instance calculations of the effect of the new rules for the CRD IV capital requirements showed that they would reduce the risk of a systemic banking crisis by at least 30% and up to 90% for some EU countries (see Figure 6).

Symbol has become a reference tool that allows assessing the impact of legislative initiatives of the Commission for stronger economic governance, including prudential regulation both at micro and macro level.

3.2.2 Associated impacts

The JRC makes key contributions to the preparation and the accomplishment of the package of financial crisis management tools and powers, by carrying out the necessary inquiries in the Member States, collecting the relevant data from various official sources and subsequently simulating various scenarios with the help of SYMBOL. Results find their way in many impact assessments accompanying Commission proposals in this field. The JRC can achieve this result through its financial and econometric competence, but at least as important is its capacity to operate independent of national interests, here for instance in a partnership constellation with national and European banking authorities.

- The policy impact of the development and use of SYMBOL is widespread. A range of Commission proposals used SYMBOL results to evaluate the impact of new regulatory tools. It has also been used for the assessment of the riskiness of a country's government debt.
- SYMBOL created significant technical impact as an additional new tool for financial and economic modelling. It meets the political need for enhanced possibilities in financial research.
- An important intangible impact from the success of SYMBOL and in general from JRC's research contributions in this area, is credibility in financial research and recognition because of a serious contribution in this field amongst key players.

This acceptance in the field of EU policy on Economics, Finance and Tax enabled the JRC also to make proactive moves in support of financial research at EU level. In 2011 and 2012 the JRC organised a series of round table discussions on financial stability between prominent financial experts, researchers, economists and EU policy makers from European banks and supervisory authorities. The high-level attendance and the profound discussions on financial stability raised the awareness that:

- Policymakers need to be able to understand the functioning of the entire financial system. To respond appropriately in similar situations in the future it should be possible
    - to assess and monitor threats to financial stability;
    - to appreciate how threats propagate from one institution to many others, or from one market to others; and
    - to evaluate mitigating measures to address the different risks.
- There is a general need for well-organised financial research, worldwide as well as in the EU which requires in particular achieving a better understanding of the relationship between financial stability and financial integration.
- There is a lack of high-quality data and weaknesses in data standards as a critical potential source of risks to the financial system.

Sometimes policy support is associated with a reactive approach responding to political developments, but having opened this - for the JRC - new line of activity several years before the outbreak of the Global Financial Crisis is a prime example of proactivity, which today enables the authorities to act quickly in defence of EU citizens' interest.

3.3 Biofuels and Indirect Land Use Change (ILUC)

Biofuels play a role in a range of EU policies, where they are expected to:

- Help dealing with the transport sector's strong dependence of oil and the need to decarbonise transport, two fundamental challenges in energy policy;
- Contribute to employment in rural areas in the EU and in developing countries;
- Offer scope for technological development, for example in second-generation biofuels;
- Contribute significantly to the reduction of greenhouse gas (GHG) emissions agreed under the Kyoto Protocol[18] and included as an EU 2020 goal and part of the EU's climate strategy.

To achieve the maximum benefit from biofuels, the EU Renewable Energy Directive[19] and the Fuel Quality Directive[20] include a comprehensive sustainability assessment scheme. The directives impose a number of sustainability criteria that economic operators need to satisfy before they may count their biofuels for the legislative targets and qualify for support schemes. These criteria aim at preventing the conversion of areas of high carbon stock and high biodiversity into areas for the production of raw materials for biofuels.

Indeed, if biofuel material is cultivated on existing agricultural land, it may displace crop production to another place, where land is converted into agricultural land. Through this route, extra biofuel demand can lead *indirectly* to land-use change, from which the term indirect land-use change (ILUC) is derived. The newly cultivated land generally has a lower carbon content, a reduced carbon sink potential and a lower degree of biodiversity. This indirect effect also changes the demand for and the price of agricultural commodities in global markets, which incentivises an increased use of land with associated destruction of carbon sinks and hence increased GHG emissions.

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18 Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) is an international treaty to reduce GHG adopted by Parties to the UNFCCC in 1997 and entered into force in 2005

19 Directive 2009/28/EC of the European Parliament and of the Council, on the promotion of the use of energy from renewable sources

20 Directive 2009/30/EC of the European Parliament and of the Council amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC

3.3.1 The JRC and the ILUC

With its Well-to-Wheel analysis[21] in 2003 the JRC was amongst the first to point out the importance of considering land-use change in the GHG-saving balance. A dedicated report on biofuels[22] in 2008 again noted that indirect land-use change can lead to the release of enough GHG to cancel the gross GHG savings from conventional biofuels. As a direct consequence from this scientific discussion on ILUC the Commission included in both energy and fuel directives the need to review the impact of ILUC on greenhouse gas emissions and to address ways to minimise that impact. The review should be accompanied by a proposal, based on the best available scientific evidence, containing a concrete methodology for emissions from carbon stock changes caused by indirect land-use change.

The JRC is helping to develop the method for taking account of ILUC with different models being used in Europe as well as in the United States. In collaboration with the international research community, the JRC is comparing the ILUC estimates from the most widely used agro-economic models for different feed stocks under biofuels-policy scenarios. Recently the JRC also started complementing the model calculations with historical ILUC data covering global trends over a 10-year period. Results from the historical data are broadly similar to those from future projection-based models.

3.3.2 Associated impacts

The JRC provides scientific support to the Commission for the establishment and the review of EU policy in this field with the best scientific evidence on ILUC. This policy is in full development with contributions from the JRC continuously feeding into the process. Although it is too early to assess the full extent of impacts generated by this work, a qualitative appraisal of the immediate impact of the JRC's work can already be made today.

- JRC study results foster the Commission's internal debate on how to address ILUC emissions in legislation.
    - The JRC report on biofuels in 2008 generated tangible impact by drawing attention to the actual extent of ILUC effects.
    - The conclusion from the projection of ILUC model predictions into the next decade (2020^{+}) is that feedstock-based biofuels will indirectly cause net (above zero) greenhouse gas emissions.

  This assisted EU policy makers in taking account of ILUC effects in the preparations of the relevant policies.
- JRC scientists provide the Commission with quantified knowledge to propose appropriate measures regarding the production and use of biofuels.

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[21] Well-to-Wheels Analysis of Future Automotive and Powertrains in the European Context, JRC version 1 first published on the web in November 2003. The Joint Research Centre, EUCAR and CONCAWE [JEC research partners] published the latest version 3C of their joint evaluation in 2011, EUR 24952 EN, ISBN 978-92-79-21395-3

[22] Biofuels in the European context: Facts and Uncertainties (2008), http://ec.europa.eu/dgs/jrc/downloads/jrc_biofuels_report.pdf

- The previously mentioned first comparison with historical data confirms the trend in the estimates based on a synthetic analysis of the various models.
- JRC results are used in a range of official EU policy documents on the assessment of ILUC effects[23].

- The obtained knowledge about the size of the effects enabled the Commission in its latest Communication[24] to include differentiated policy proposals seeking to minimise ILUC effects of biofuels, by:
  - Limiting the contribution from conventional biofuels in the efforts to achieve the Renewable Energy Directive targets;
  - Promoting a greater market penetration of advanced biofuels[25] by allowing them to contribute more to the Renewable Energy Directive targets than conventional biofuels, which bear a risk of ILUC emissions;
  - Introducing Member States obligation to report estimated indirect land-use change emissions, based on the best available scientific evidence, for the purposes of calculating the life cycle GHG emission savings from biofuels.

Biofuels and ILUC policy support requires transdisciplinary expertise with knowledge in areas like energy, transport, agriculture, climate change, environment and economy. With a limited number of staff it covers a variety of subjects like biofuels production and life cycle, global land use, GHG emissions, well-to-wheels analysis, modelling and sustainability assessment. It is not feasible to identify an FTE staff number for such a complex transdisciplinary team, but some key numbers for this effort are that the original JRC biofuels task force gathered around 40 persons and that today still around 10 persons support the biofuels policy more or less full time.

3.4 Euratom: The Nuclear Stress Test 2011 - 2012

The safety record of the nuclear reactors in operation in the EU is such that, although incidents have occurred and continue to occur, no major accidents have ever taken place. While the overall safety record is therefore good, EU citizens' confidence in Europe's nuclear industry hinges on continuous improvements of the EU nuclear safety and security framework, to ensure that it remains the most effective in the world, based on the highest safety standards.

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[23] Key example is Impact Assessment, SWD(2012)343, accompanying the Commission's recent proposal for amending the fuel quality directive (footnote 24), with many references to results of JRC's modelling, calculations, analyses and expert consultations

[24] Directive of the European Parliament and of the Council amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources, COM(2012) 595, 17.10.2012

[25] The term "advanced biofuels" typically refers to biofuels produced by advanced processes from non-food feedstock offering higher levels of GHG reduction without competing with food crops for land use.

The accident at the Fukushima reactors in Japan in March 2011 demonstrated the world that nuclear reactors must be protected also against accidents that have been assessed as highly improbable. Worldwide it resulted in unprecedented efforts for the safety of nuclear installations. Days after the accident the European Council concluded that "the safety of all nuclear plants in the EU should be reviewed through a comprehensive and transparent risk and safety assessment ("stress tests"), including a peer review of the assessments.

The Commission developed the scope and modalities of these tests together with the European Nuclear Safety Regulatory Group (ENSREG), gathering the nuclear safety authorities of the 27 Euratom Member States and the support of the Western European Nuclear Regulators' Association (WENRA). The tests assessed the resistance of nuclear power plants to external events, similar to those at the accident in Japan. Nuclear operators and national regulators participated in the stress tests on a voluntary basis, aware that the safety of nuclear power plants is their responsibility.

In April 2012 the national European regulators and the European Commission as European Nuclear Safety Regulators Group (ENSREG) endorsed the peer-review board report on the stress tests, with 17 country-specific reports attached to it. All reports and the ENSREG Action Plan are publicly available on the ENSREG webpage[26]. They identify a number of good practices, give recommendations for further progress and highlight improvements already implemented or planned. The stress tests thus contributed to strengthening the EU's commitment to promote nuclear safety at world level

The JRC provided the technical secretariat for the stress test, which implied organising the exercise and participating in all technical discussion and peer-review missions. It provided most of the technical analysis for the Commission's Staff Working Paper[27] and was involved in the preparation of the ENSREG Action Plan. The chair of the stress-test peer-review board commended the JRC for outstanding support to the whole peer-review process. The stress tests covered all nuclear power plants in operation in the EU, 13 reactors that were phased out since the beginning of the stress tests, as well as 15 reactors in Ukraine, and 5 reactors in Switzerland.

Through its support the JRC helped implementing a European exercise for the safety of nuclear power plants at an unprecedented scale in terms of extent, collaboration and commitment of all parties involved. The public availability of all safety-related reports and the participation of non-nuclear countries bring the transparency that creates an intangible impact of public reassurance.

[26] http://www.ensreg.eu/EU-Stress-Tests

[27] Technical Summary of the national progress reports on the implementation of comprehensive risk and safety assessments of the EU nuclear power plants, SEC(2011) 1395

BOX 5

The JRC and Euratom

Around 25% of the JRC's resources come through the Euratom Framework Programme and are dedicated to the safety and security of the use of nuclear energy in the EU. The tasks concern: promoting research through an in-house nuclear research programme, ensuring the dissemination of technical information and contributing to a comprehensive and strict system of nuclear safeguards to prevent that nuclear materials are diverted from their intended use.

These tasks date back to the creation of the JRC under the Euratom Treaty of 1957 and have not lost any of their significance today, when 132 nuclear reactors in the EU provide about 14% of the total primary energy needs. They account for roughly 30% of the total electricity production in the EU (Eurostat Statistical Books - Energy, Edition 2010).

The final report recommends significant and tangible improvements to nuclear power plants, which are being implemented or planned in all participating countries. Furthermore, it identifies weaknesses in procedure and gaps in the legal arrangements. Proposals to improve these are in preparation. The Commission Communication[28] on risks and safety of nuclear power plants in the EU uses these results as a basis. The JRC will continue to support the stress test follow-up process as necessary in the future.

The stress tests are not supposed to be a one-off exercise, but as an on-going process to improve nuclear safety, in close collaboration with national regulatory authorities in the context of ENSREG and the IAEA. The EU is seeking a comprehensive approach to safety, which includes a revision of nuclear safety specific Euratom legislation, complemented by legislative or non-legislative instruments on nuclear liability, on emergency preparedness and response, and by pursuing actions in the area of nuclear security.

The JRC's role in this highly visible case of policy support focuses on the implementation of EU policy once the Council decided on the stress test. Long-term impact of this work can be evaluated in a number of years, but the immediate impact has a policy character, because of the predominant policy implementation aspect in this task. The transparency of the stress test and the public availability of all safety-related reports are the basis for the key impact, which is that the citizens can be confident that nuclear power plants in their EU are subject to the most stringent safety conditions in the world.

[28] Communication from the Commission to the Council and the European Parliament on the comprehensive risk and safety assessments ("stress tests") of nuclear power plants in the European Union and related activities, (COM/2012/571)

3.5 Euratom: On site laboratories

The principal risks of nuclear proliferation come from the nuclear fuel cycle[29], especially at the very sensitive step of reprocessing irradiated fuel. Here it has to be made absolutely sure that no nuclear material is diverted from its intended use. This is done through a strict system of nuclear material accounting and control (safeguards) at reprocessing plants. By accurately determining the quantities of uranium and plutonium the verification measures can identify in a timely fashion when there is a high probability that nuclear material is missing.

The two largest plants for the reprocessing of nuclear material from irradiated reactors are located at La Hague in France and Sellafield in the United Kingdom. They process around 2000 tonnes of nuclear material per year, which represents 80% of the world's reprocessed spent nuclear fuel.

3.5.1 JRC laboratories to verify flow of nuclear material

To perform nuclear material accountancy at reprocessing plants requires the sampling of material from the process streams. However, to transport the samples for analysis to a central Euratom laboratory brings additional costs in terms of time, money and a higher risk. It would be more effective to verify the flow of nuclear material at the plants[30]. To achieve this, the JRC opened On-Site Laboratories (OSL) respectively in Sellafield (1999) and La Hague (2000) on behalf of the Commission's Safeguards Directorate in Luxembourg.

JRC analysts are present at the On-Site Laboratories for more than 40 weeks per year, making on average 800 sample analyses per year, based on which inspectors from the Safeguards Directorate do their nuclear accountancy. The analyses performed allow the inspectors to check, independently of the plant operator, the fissile material chain and inventory of these facilities to assure that the nuclear material is only used for declared and intended purposes.

3.5.2 Impact and benefits

Literature on the impact of nuclear safeguards is scarce. However, safeguards approaches for the once-through fuel cycle are well-known and generally considered effective. Safeguarding spent-fuel reprocessing is relatively expensive and technically challenging[31]. The JRC's On-Site Laboratories have proved to be an essential part of the safeguards measures at both reprocessing plants.

The International Atomic Energy Agency (IAEA) and the Japanese Nuclear Material Control Centre have followed this technology demonstration by the JRC. They installed a similar On-

[29] The nuclear fuel cycle is formed by the various activities associated with the production of electricity from nuclear reactions. It starts with the mining of uranium and ends with the disposal of nuclear waste. With the reprocessing of used fuel, the stages form a true cycle.

[30] The Euratom Safeguards On-Site Laboratories at the Reprocessing Plants of La Hague and Sellafield, JRC reference report 2010, EUR 24602 EN, ISBN 978-92-79-18647-9

[31] Non-proliferation Impact Assessment (NPIA), US National Nuclear Security Administration http://nnsa.energy.gov/sites/default/files/nnsa/inlinefiles/GNEP_NPIA.pdf

Site Laboratory as an important part of safeguards at the Rokkashomura reprocessing plant in Japan with the help of the JRC.

Besides the technical impact of developing the On-Site Laboratory, through the laboratory the JRC makes a strong contribution to nuclear safeguards and facilitates the establishment of a detailed account of the nuclear materials operations of the reprocessing plants. By giving assurance to governments and the public the On Site Laboratories generate policy impact as well as an intangible impact. The substance of the assurance is that the European nuclear industry, the European Union and its Member States comply with their legal duties under the Euratom Treaty and their commitments to the Non-Proliferation Treaty.

3.6 Directive for an Infrastructure for Spatial Information in the EU (INSPIRE)

The INSPIRE Directive 2007/2/EC is a key piece of legislation in European environmental policies. It provides the framework to collect, harmonise or organise the dissemination or use of spatial information in the EU and it facilitates national and EU level initiatives to become interoperable. INSPIRE is also linked to the Directives 2003/4/EC on the public access to environmental information and Directive 2003/98/EC on the re-use of public sector information by their complementary objectives regarding the efficient public data use, the transparency in decision making and the open access to public information.

The origin of INSPIRE goes back to the early 1990s, when public and private services started to use Geographic Information Systems (GIS) with digitised topological maps with various layers of information. This development opened up huge possibilities to combine geographical data and maps into Spatial Data Infrastructures (SDI) for urban planning; resource management, environmental impact assessment, location planning, or crisis interventions, just to mention a few. However, there were problems with the quality, organisation, accessibility and sharing of the data because the lack of agreement on standards at the time made it cumbersome and sometimes impossible to combine data sets across borders.

The EU has solved many of these standardisation issues through INSPIRE's legal framework for harmonised spatial data. It created the appropriate conditions for having harmonised and high-quality spatial (geographic) information readily available across the different public authorities and the different sectors in the EU at local, regional, national and European level.

3.6.1 The JRC and INSPIRE

With its experience as a pioneering user and producer of GIS and geospatial data, the JRC has been on top of spatial data since the mid-1980s when earth observation satellites created a rapid increase of geospatial data and digitised maps. Major initiatives to harmonise spatial data in the United States and Europe go back to 1994 when the US announced a National Spatial Data Infrastructure (NSDI) and the European Commission launched the development of a policy framework for Geographic Information in Europe (the GI-2000 initiative) a few months later.

The GI-2000 initiative evolved into INSPIRE in close contact with JRC scientists, from anticipation and conception in FP5, to development in FP6 and implementation in FP7. Whilst the Environment DG is the policy maker behind the INSPIRE Directive, the JRC takes the central role of overall technical coordinator and Eurostat is the Commission service that will take over the operations of the infrastructure including the European Geoportal[32], once it has been developed.

In 2005 the JRC formalised tri-lateral collaboration with Natural Resources Canada and the US Federal Geographic Data Committee, which respectively have the responsibility for the technical coordination of the spatial data infrastructures in Canada and the USA. This work has developed further in the context of the Group of Earth Observation Systems of Systems (GEOSS), an initiative supported by eighty-six governments, the European Commission, and sixty-one intergovernmental and international organisations with a mandate in earth observation.

The JRC is responsible for the development of the INSPIRE technical specifications (Implementing Rules) and the European Geoportal. It also initiates and monitors the work with international standardisation bodies[33]. The development of the INSPIRE Implementing Rules requires coordinating the work of hundreds of experts from the Member States to ensure that the technical specifications are not only technically sound but also organisationally and financially feasible, and that they can be accepted and implemented successfully by the Member States.

The development of the Implementing Rules for INSPIRE in the EU requires a high level of technical expertise and independence of national and industrial interests. The JRC possesses the neutrality needed and the relevant expertise, which has taken it to the point where it drafts the text of the regulations submitted to the Regulatory Committee.

3.6.2 Impacts and benefits

The JRC is strongly associated with achievements of INSPIRE as it has pushed the standardisation of geospatial data from the early days of the new technologies. Hence JRC impacts related to INSPIRE accumulate over twenty years.

At the level of policy impact there are many examples of JRC references and results in the INSPIRE legislation for which it closely collaborates with the policy DGs of the Commission. This occurred at all stages of the policy cycle and INSPIRE provides another example of JRC's permanent support for certain pieces of legislation. The longer-term impact of the JRC is the effective implementation of legislation that touches many different sectors of society.

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[32] The European Geoportal is a web portal to find and access geographic information (geospatial information) and associated geographic services via the Internet. In general, geoportals are the gateways to geographic information systems (GIS) and a key element for the use of Spatial Data Infrastructure (SDI).

[33] ISO TC 211, CEN TC 287, Open Geospatial Consortium (OGC)

The technical impact is most significant at the level of standardisation. The major long-term impact is having achieved the major purpose of INSPIRE, which is the availability of harmonised, high-quality spatial information across the different public authorities and the different sectors in the EU at local, regional, national and European level. The JRC played a key enabling role in this achievement which is the result of a joint effort with national authorities, legislators and private sector operators.

Part of the economic impact from INSPIRE can be attributed to the JRC as indirect effect. Cost estimates for INSPIRE calculate with an annual investment around EUR 3 million per year from the Commission (JRC, Eurostat, Environment DG) and around EUR 100 million per year from Member States in local, regional and national spatial data infrastructures. The extended impact assessment[34] of the INSPIRE proposal in 2004 estimated the total benefits in the European Union at EUR 700 - 1100 million per year[35], without counting important qualitative improvements in terms of data availability, accuracy and speed of delivery, which have a positive impact on the functioning of public services and benefit the citizens. Local public administrations benefit increased internal efficiency (time saved in internal queries by technical staff, time saved in attending queries by the public, time saved in internal processes) and effectiveness (time saved by the public and by companies in dealing with public administration). Outside the public sector there are considerable benefits for private sector firms active in the field of environmental impact assessment and strategic environmental assessment.

3.7 The Industrial Emissions Directive (IED)

The emissions from a wide range of industrial and agricultural activities in the EU are subject to one overarching Industrial Emissions Directive[36] (IED), which evolved from merging the original IPPC Directive[37] of 1996 with other pieces of legislation. The Directive concerns about 50 000 installations in the EU, such as large combustion plants, waste incinerators, refineries, production and processing of metals, mineral industry, intensive rearing of poultry and pigs, other activities (e.g. pulp and paper, textiles, slaughterhouses, tanning, food industry). Key atmospheric pollutants may have other sources like transport or domestic combustion, not covered by the Directive. The percentage of the pollutant covered by the IED is indicated in Figure 7.

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34 http://inspire.jrc.ec.europa.eu/reports/inspire_extended_impact_assessment.pdf

35 The first JRC impact analysis from 2011 (ref. 1) gives more recent numbers from fragmented assessments confirming the order of magnitude.

36 Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recast)

37 Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control, followed by Codified version, Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control

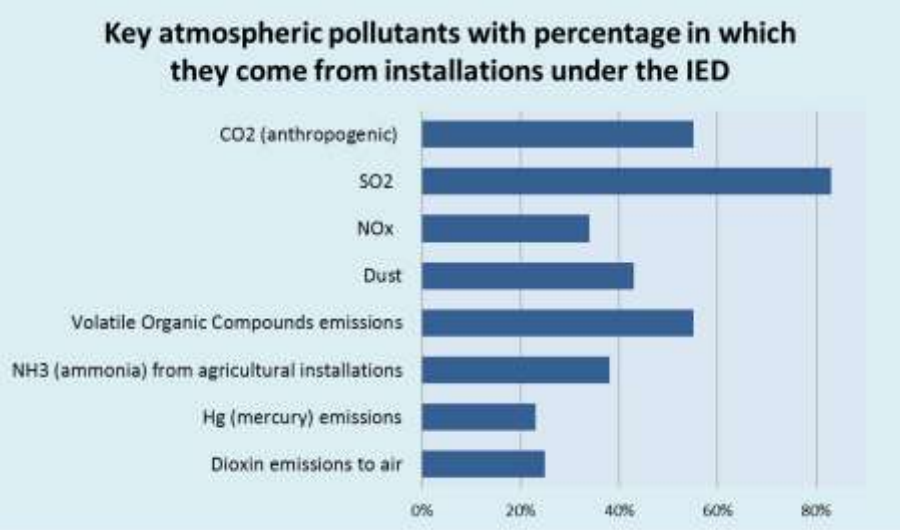

Figure 7 Key atmospheric pollutants and the percentage[38] coming from installations under the Industrial Emissions Directive

The Directive envisages an integrated prevention and control of the consumption of energy, water, raw materials and chemical substances, as well as the prevention and control of pollution to water, air and soil, also by minimising the generation of waste. By aligning the environmental performance requirements for industrial installations the Directive also creates a level playing field for industries.

Under the terms of the Directive, the Commission has to "organise an exchange of information between Member States, the industries concerned, non-governmental organisations promoting environmental protection and the Commission".

3.7.1 The JRC and the IED

In 1997 the JRC set up the European Integrated Pollution Prevention and Control (IPPC) Bureau in Seville to implement the Directive, organising the so-called "Sevilla process" with exchange of information between the stakeholders, i.e. Member States, the industries concerned, relevant non-governmental organisations and the Commission.

The European IPPC Bureau defines the technical standards for each sector covered by the Directive (the so-called BAT, Best Available Techniques[39]) and formalises this in the BAT reference documents (BREFs). In practice this means that the JRC drafts, reviews and updates the BREFs in consultation with Member States, industry representatives, environmental NGOs and other Commission services. In a final step the competent authorities in the Member States grant operating permits to plant operators based on the content of the BREFs, especially the part laying down the BAT conclusions.

[38] The remaining percentage of the pollutant is coming from other sources like e.g. transport, domestic combustion

[39] "Techniques" in BAT refers to both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned

Estimates for the global market for eco-technologies are between EUR 500 billion and EUR 1000 billion with a prediction of global market of EUR 2200 billion by 2020.
Europe is considered a strong eco-innovation player in the world, accounting for approximately 30% of world turnover in eco-related technologies and services.
The EU accounts for 50% of the recycling industry turnover and 40% of the renewable energy sector turnover globally. (Source: Executive Agency for Competitiveness and Innovation (EACI) - 2011)

Each BREF is the outcome of a three to four years process steered by the Bureau and involves up to 170 experts, including the formal representatives from all Member States. The BREF documents are formally adopted by the IED Article-75 Committee upon proposals prepared by the Commission according to the legal provisions of the IED.

The JRC carries out this work in support of the Environment DG because of the techno-economic and scientific nature of the BREFs. The work includes support in the legal adoption process, in the consultation process within the Commission, in the Committee established by Article 75 of the IED as well as in Council and Parliament.

The impact assessment for the Directive estimated that the implementation of the directive for the large combustion plant (LCP) sector alone leads to the prevention of 13 000 premature deaths, equivalent to annually saving 125 000 life years.

Reduced industrial emissions bring many other benefits, e.g. for the preservation of (materials of) buildings, for crops and for ecosystems in the environment.

The European IPPC Bureau has completed thirty three BREFs and the latest revision of the Directive requires at least two new BREFs bringing the total up to thirty five. Since the concept of “Best Available Techniques” is a dynamic one, these BREFs are documents in permanent revision; new techniques may emerge, technologies develop further, or industry may introduce itself more-resource-efficient or less-polluting processes. The Directive stipulates that the Commission should aim at reviewing the whole series of BREFs every eight years.

The Bureau derives its authority largely from the neutrality of JRC staff. Yet, the Bureau would not work without the involvement of more than 1200 experts in the technical working groups coming from the Member States, from other European countries (EFTA and Candidate and Accession Countries), from different services of the European Commission, industrial associations and environmental NGOs, all giving life to the Sevilla process.

3.7.2 Impacts and benefits

The permanent support for the implementation of the Industrial Emissions Directive generates long-term impact of different kinds.

- Policy impact: The European IPPC Bureau fulfils the Commission’s implementing powers to adopt guidance on data collection and to draft BAT reference documents

in a politically neutral and efficient way. Staffed with around 20 FTE persons, the Bureau is the enabling factor for reaping the economic, environmental and societal benefits associated with the Industrial Emissions Directive.

- Technical impact: The BAT standards have led to a higher uptake of technologies with state-of-the-art economic and environmental performance, in areas known for their slow integration of new technologies. This positively affects the development and employment of eco-industry in the EU. Using the best available techniques as prescribed in documents prepared by the JRC, will make it possible to achieve the EU targets for the SO_2 and NO_x emissions from large combustion plants by 2020. Full-scale implementation of the Industrial Emissions Directive for LCP can bridge the current serious gap with respect to the agreed objectives for reducing air pollution in the EU[40].

- Economic impact: The impact of the JRC's work on the BREFs is most noticeable in the Member States, the ultimate beneficiaries of the reference documents from the "Sevilla process". In the counterfactual situation, every Member State would have to elaborate BREFs individually. The Commission's impact assessment estimates savings of EUR 105 - 255 million per year, due to a net reduction in administrative burden in the Member States.

- Intangible impact: third countries take an example in how the JRC shaped the IPPC-Bureau and the "Sevilla process". Israel and Brazil have incorporated the BAT concept in their legislation. The permitting authorities in Russia, China, India, and Ukraine use the BREFs as a reference for their industries and for industries which have emissions with transboundary effects. Third countries solicit the JRC for technical advice to settle cases in industrial emissions. Inside the Commission, the model of the IPPC Bureau has served as example for similar implementing structures for EU legislation in the field of sustainable production and consumption (Eco-label, Eco-design, Energy Efficiency, Waste and Recycling, Eco-management and Audit Schemes etc.). The World Bank makes extensive use of the BREFs in the elaboration of their Environmental, Health and Safety (EHS) guidelines which are used to grant financial assistance in developing countries.

[40] Thematic Strategy on Air Pollution, COM(2005) 446

4 Summary

This special report makes an impact analysis of the direct actions of the JRC to investigate where and how JRC deliverables make a difference for science and governance in EU policy and regulation. A statistical analysis of the immediate impact of JRC activities during 2012 shows the footprint of the collective impact for that year. Screening of a dozen of specific activities over a longer period allowed for a qualitative longer-term impact analysis, distinguishing policy impact, technical impacts (including scientific achievements), economic impacts and intangible impacts. The report has been prepared at the occasion of the 100th meeting of the JRC's Board of Governors.

The statistical analysis totals 269 validated immediate policy impacts in 2012, confirming that the JRC produces this number of impacts with real annual regularity. They are distributed over the various policy-impact categories as follows:

- 50% of the impacts are directly linked with the implementation of EU policies, i.e. directives, regulations, recommendations (e.g. an EURL or a JRC bureau)
- 18 % are directly linked with the preparation of EU policies in the conception phase of policy proposals (e.g. JRC research incorporated in Commission proposals)
- 4 % concern *ad hoc* support (e.g. a situation assessment, which is used for emergency response, aid, assistance)
- 9 % concern EU and global standardisation (e.g. a JRC test method is adopted by an international standardisation body)
- 19 % of the impacts come from support to specific countries or regions (e.g. training of laboratory staff to enable a new Member State to enforce regulations)

JRC deliverables serve a full range of customers, beneficiaries and partners: Member States authorities, EU agencies, international organisations and standardisation bodies, but most of them go to the Commission. Deliverables outside the Commission largely come from work for Member States and Candidate Countries authorities.

The impact from these deliverables is distributed over a large number of policies with a concentration of impacts in policy areas where science plays an important role for issues involving people's health, people's safety, security, the environment as well as the competitiveness of the European economy.

The analysis studied longer-term impact on some selected JRC activities related to the following EU instruments:

- Seven EU Reference Laboratories (EURL)
- Measures to restore financial stability
- Biofuels and Indirect Land Use Change (ILUC)
- The EU nuclear power plant stress test
- Euratom On site Laboratories

- An Infrastructure for Spatial Information in the European Community (INSPIRE)
- The Industrial Emissions Directive (IED)

These cases cover thirteen actions, representing 5 - 10% of the JRC's work programme in terms of combined financial and human resources. Some cases concern mainly policy preparation; others are in the stage of policy implementation including technological support for international treaty verification. In cases of policy implementation the JRC has usually also been involved in the policy-preparation phase (INSPIRE, IED, EURLs notably for GMOs) and provided the Commission at the time with the scientific knowledge necessary to conceive a comprehensive proposal within responsible technical specifications. The JRC acquired experience and built up expertise years before the EU adopted the relevant legislation, which is characteristic of the JRC's proactive approach in these cases.

Following the taxonomy of the report the main features of the various impacts can be summarised as follows:

Policy impact over a longer period:

- Technical implementation of the relevant EU legislation and decisions. Where necessary this includes harmonisation amongst the Member States in networks with implementing national authorities and making available certified reference materials.
- Actual verification of compliance with legislation and international treaties.
- Scientific and technical clarification and specification, data and modelling results in a range of official EU policy documents (directives, regulations, recommendations, impact assessment, Commission reports).
- Hundreds of standards and methods in Commission Implementing Regulations and EU regulations, many of which also became adopted later by CEN and ISO.
- Raising awareness in the policy-preparation phase, allowing the Commission to prepare proper proposals and EU decision makers to take informed decisions based on up-to-date and comprehensive scientific knowledge.

The technical impacts:

- Validated tests and a well-developed test and analytical capacity in Member States and Candidate Countries (through interlaboratory comparisons).
- Development of new analytical methods, models, modelling tools and international standards.
- Higher accuracy and precision with less false-positive and false-negative decisions because of regular benchmarking tests (external quality assurance).
- International replications of JRC technology demonstration.

Associated (socio-) economic impacts:

- Consistent implementation of regulation for efficient international trade.
- Proper functioning of the internal market with reduced number of disputes over deviating analytical results. This benefits Member States control authorities as well as industries.
- A net reduction in administrative burden in the Member States.
- Protection of EU consumers' interest.

Intangible impacts:

- International recognition and credibility amongst key players in the relevant field.
- Stronger position as European (metrology) reference centre.
- Confirmation of impartiality.
- Foster the Commission's internal debate on scientific aspects of policy proposals.
- Assurance that safety and security requirements for nuclear energy are respected.
- Third countries take an example and solicit the JRC for technical advice.

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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 standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

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