

The European Commission's  
science and knowledge service

Joint Research Centre



The Joint Research Centre  
Supporting the EU Energy Union  
and Climate Policy

Antonio Soria

Head of Unit JRC.C.6 Economics of Climate  
Change, Energy and Transport

# JRC sites

Headquarters in Brussels  
and research facilities located  
in **5 Member States**:

- Belgium (Geel)
- Germany (Karlsruhe)
- Italy (Ispra)
- The Netherlands (Petten)
- Spain (Seville)



# JRC Role: facts & figures

€ **386** million Budget annually,  
plus € **62** million earned income

**6** locations in 5 Member States: Italy,  
Belgium, Germany, The Netherlands, Spain

**Independent** of private,  
commercial or national  
interests



**Policy neutral:**  
has no policy agenda of its own

**42** large scale research facilities,  
more than 110 online databases

**30%** of activities in policy  
preparation, **70%** in  
implementation



More than **3000** people  
**83%** of core research staff  
with PhD's

**125** instances of support  
to the EU policy-maker annually

More than **100** economic,  
bio-physical and nuclear models



**Over 1,400**  
scientific publications per  
year



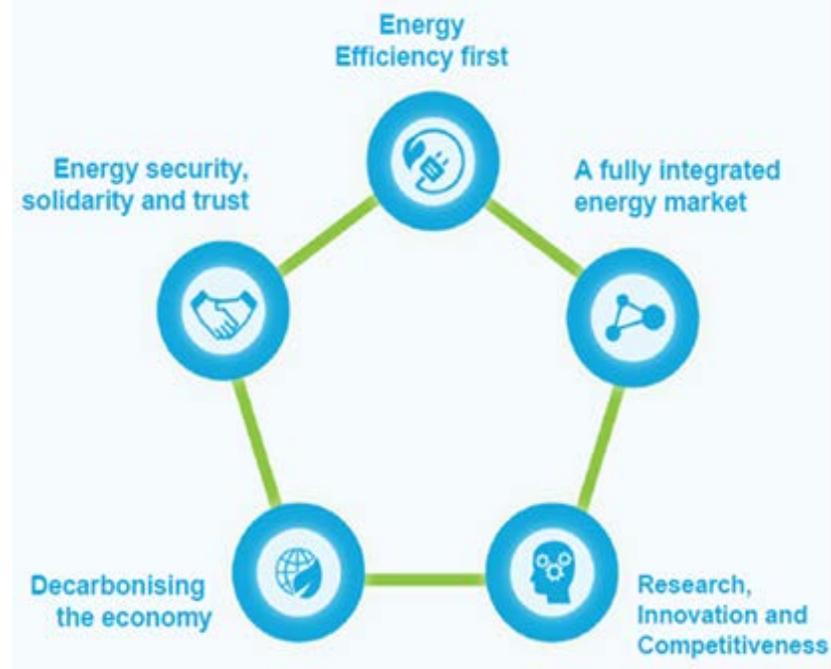
# JRC in Energy, Transport and Climate

The mission of the JRC's Directorate for Energy, Transport and Climate is to provide support to Community policies and technology innovation related to:

**energy** – to support the deployment of sustainable, safe, secure and efficient energy production, distribution and use

**transport** – to foster sustainable and efficient mobility in Europe

**climate** – to provide scientific and technical analyses in support of integrated air quality, climate and related policies



# *Policy support with and for key partners*

## **Within the Commission**

- SG, ENER, CLIMA, ENV, GROW, MOVE, REGIO, RTD, DEVCO, NEAR, MARE, JUST, COMP, EPSC,...

## **Other EU Institutions and Member States**

- EU Parliament
- MS authorities: national (Cyprus, Greece), regional and local authorities..

## **External partners**

- VECC China, NCSC China, AIST Japan, US DoE, Fraunhofer Society, Universities, standardisation & regulation bodies (UNECE, ISO, CEN-CENELEC )...

# Policy support better reinforced by scientific excellence



ARTICLE  
OPEN

## Air quality co-benefits for human health and agriculture counterbalance costs to meet Paris Agreement pledges

Toon Vandyck<sup>1</sup>, Kimon Keramidas<sup>1</sup>, Alban Kloss<sup>2</sup>, Joseph V. Spataro<sup>3</sup>, Rita Ben Driegen<sup>4</sup>, Mike Holland<sup>5</sup> & Bert Stevens<sup>6</sup>

Local air quality co-benefits can provide complementary support for ambitious climate action and can make progress on related Sustainable Development Goals. Here we show that the transformation of the energy system implied by the emission reduction pledges brought forward in the context of the Paris Agreement on climate change (Nationally Determined Contributions or NDCs) substantially reduces local air pollution across the globe. The NDCs could reduce acid between 71 and 90 thousand premature deaths annually in 2030 compared to a reference case, depending on the stringency of direct air pollution controls. A more ambitious 2°C compatible pathway reduces the number of avoided premature deaths from air pollution to 170–346 thousand annually in 2030, and up to 0.7–1.5 billion in the year 2050. Air quality co-benefits on morbidity, mortality, and agriculture could globally offset the costs of climate policy. An integrated policy perspective is needed to maximize benefits for climate and health.

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ARTICLES  
nature climate change

## Residual fossil CO<sub>2</sub> emissions in 1.5–2°C pathways

Gunnar Luderer<sup>1,2</sup>, Zoi Vrontos<sup>3,4</sup>, Christoph Bertram<sup>5</sup>, Okeane Y. Edelbladt<sup>6,7</sup>, Robert C. Pietzcker<sup>8,9</sup>, Joeri Rogelj<sup>10,11,12</sup>, Harmen Syze de Boer<sup>13</sup>, Laurent Desoust<sup>14</sup>, Johannes Emmerling<sup>15</sup>, Oliver Fricko<sup>16</sup>, Shichiro Fujita<sup>17</sup>, Peter Havlik<sup>18</sup>, Gøsta Hoff<sup>19</sup>, Kimon Keramidas<sup>20</sup>, Alban Kloss<sup>21</sup>, Michaja Pehl<sup>22</sup>, Volker Kreyer<sup>23</sup>, Keywan Riahi<sup>24</sup>, Bert Stevens<sup>25</sup>, Massimo Tavanti<sup>26</sup>, Detlef P. Van Vuuren<sup>27</sup> & Einar Klöpper<sup>28</sup>

The Paris Agreement—which is aimed at holding global warming well below 2°C while pursuing efforts to limit it below 1.5°C—includes a bottom-up process of iteratively updating nationally determined contributions to reach these long-term goals. Achieving these goals implies a tight limit on cumulative net CO<sub>2</sub> emissions, of which residual CO<sub>2</sub> emissions from fossil fuels are the greatest impediment. Here, using an ensemble of seven integrated assessment models (IAMs), we explore the determination of these residual emissions, focusing on sector-level contributions. Even when strengthened pre-2030 mitigation actions is combined with very stringent long-term policies, cumulative residual CO<sub>2</sub> emissions from fossil fuels amount to 850–1,900 GtCO<sub>2</sub> during 2016–2050, after an average peak of 100,000–200 MtCO<sub>2</sub> per year. By 2030, these 640–900 GtCO<sub>2</sub> represent a steady decline of burning and of carbon remaining in the atmosphere of strengthened pre-2030 pledges. Long-term CO<sub>2</sub> commitments are increased by 160–210 GtCO<sub>2</sub>, further postponing achievement of the 1.5°C and increasing dependence on CO<sub>2</sub> removal.

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ARTICLES  
nature energy

## Energy investment needs for fulfilling the Paris Agreement and achieving the Sustainable Development Goals

David L. McCallum<sup>1,2</sup>, Wenzhi Zhou<sup>3</sup>, Christoph Bertram<sup>4</sup>, Harmen-Syze de Boer<sup>5</sup>, Valentina Boettler<sup>6</sup>, Sebastian Busch<sup>7</sup>, Jacques Després<sup>8</sup>, Laurent Drouot<sup>9</sup>, Johannes Emmerling<sup>10</sup>, Marianne Fay<sup>11</sup>, Oliver Fricko<sup>12</sup>, Shichiro Fujita<sup>13</sup>, Matthew Gooder<sup>14</sup>, Matthijs Harmsen<sup>15</sup>, Daniel Huppmann<sup>16</sup>, Gøsta Hoff<sup>17</sup>, Volker Kreyer<sup>18</sup>, Elmar Kriegler<sup>19</sup>, Claire Nicolau<sup>20</sup>, Shonali Pachauri<sup>21</sup>, Simon Parkinson<sup>22</sup>, Miguel Poblete-Caceres<sup>23</sup>, Peter Rataj<sup>24</sup>, Narasimha Rao<sup>25</sup>, Julie Ribesbeck<sup>26</sup>, Andreas Schmitz<sup>27</sup>, Wolfgang Schoppert<sup>28</sup>, Detlef van Vuuren<sup>29</sup> & Keywan Riahi<sup>30</sup>

Low-carbon investments are necessary for driving the energy system transformation that is called for by both the Paris Agreement and Sustainable Development Goals. Improving understanding of the scale and nature of these investments under diverging technology and policy futures is therefore of great importance to decision makers. Here, using six global modelling frameworks, we show that the pronounced reallocation of the investment portfolio required to transform the energy system will be initiated by the current scales of countries' Nationally Determined Contributions. Charting a course toward 'well below 2°C' instead of low-carbon investment scenarios based on investment pledges by 2020 is not sufficient to ensure that the Paris Agreement's 1.5°C target demands a marked escalation in low-carbon capital beyond that of a 2°C-compliance future even combined with an energy transformation would increase the costs of achieving the goals of energy security and fast security, but reduce the costs of achieving air-quality goals.

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## A multi-model assessment of food security implications of climate change mitigation

Shinichiro Fujita<sup>1,2,3,4</sup>, Tomoko Hasegawa<sup>5,6,7</sup>, Volker Kreyer<sup>8,9</sup>, Keywan Riahi<sup>10</sup>, Christoph Bertram<sup>11</sup>, Benjamin Leon Bodirsky<sup>12</sup>, Valentina Boettler<sup>13</sup>, Jessica Celler<sup>14</sup>, Jacques Després<sup>15</sup>, Jonathan Dolman<sup>16</sup>, Laurent Drouot<sup>17</sup>, Johannes Emmerling<sup>18</sup>, Stefan Frank<sup>19</sup>, Oliver Fricko<sup>20</sup>, Peter Havlik<sup>21</sup>, Florian Humpfer<sup>22</sup>, Jason F. Keenan<sup>23</sup>, Hans van Meijl<sup>24</sup>, Yuki Ochi<sup>25</sup>, Alexander Popp<sup>26</sup>, Andreas Schmitz<sup>27</sup>, Keyichi Takahashi<sup>28</sup> and Detlef van Vuuren<sup>29</sup>

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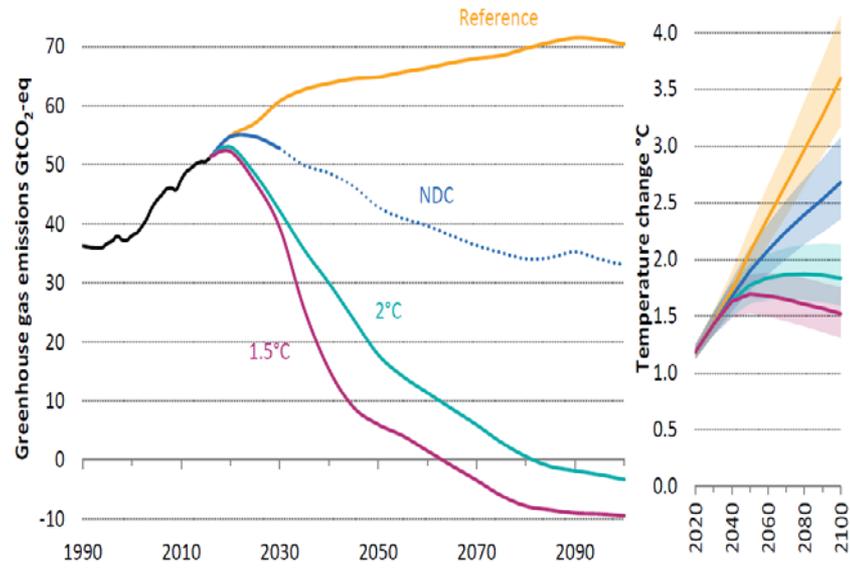
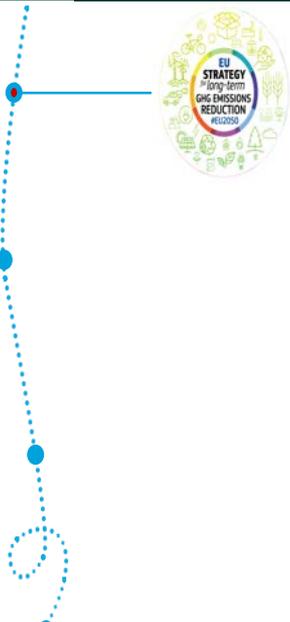
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# Long Term Vision - global context

## A Clean Planet for All



- Global/EU Macroeconomic Framework: JRC-GEM-E3
- Global Energy Scenarios: POLES-JRC
- Global Energy and Climate Outlook (GECO) Report Series

In-depth analysis supporting the Communication, Long Term Strategy, 393 pages

# The transition offers opportunities for growth & jobs

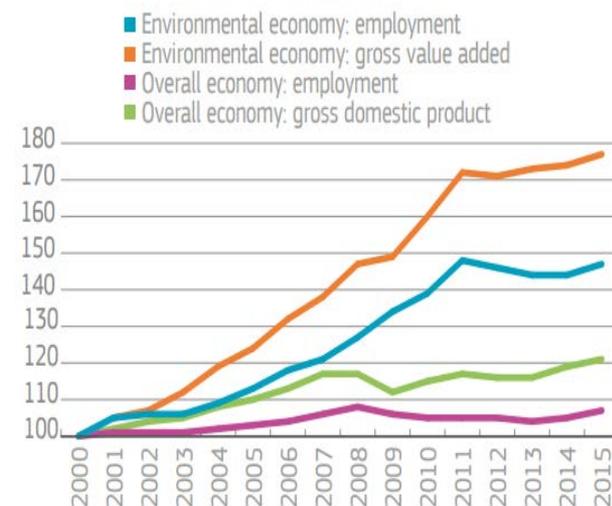
Sector	Share of total jobs in 2015	Range of change in jobs by 2050 compared to baseline
Construction		
Power generation		
Agriculture		
Services		
Manufacturing (energy-int)		
Other manufacturing		
Mining & extraction		

Faster growth of EU **clean economy** than the overall economy

**Struggling** traditional, fossil fuel based industries

**Sector analysis** helps to identify growth opportunities and vulnerable groups to protect

## Environmental economy growing faster than overall economy

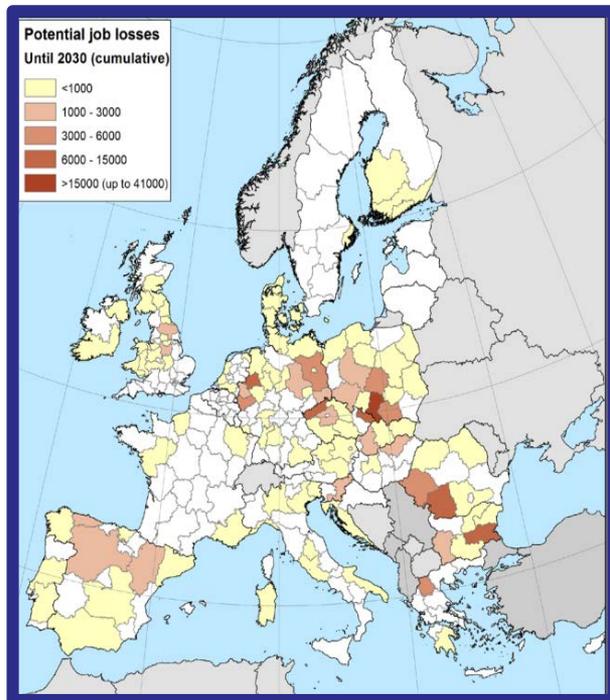


Source: Eurostat, European Commission

Based on JRC GEM-E3 model results

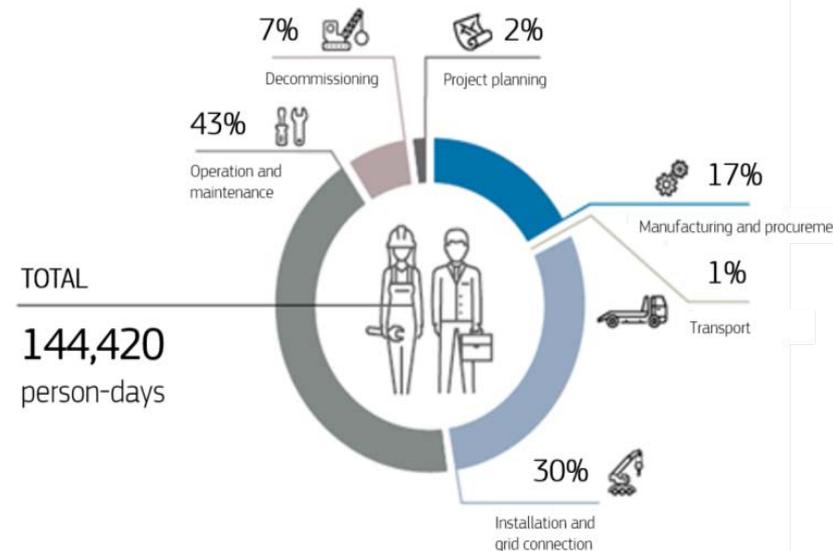
# A **fair** transition to a climate-neutral economy

## The European coal sector



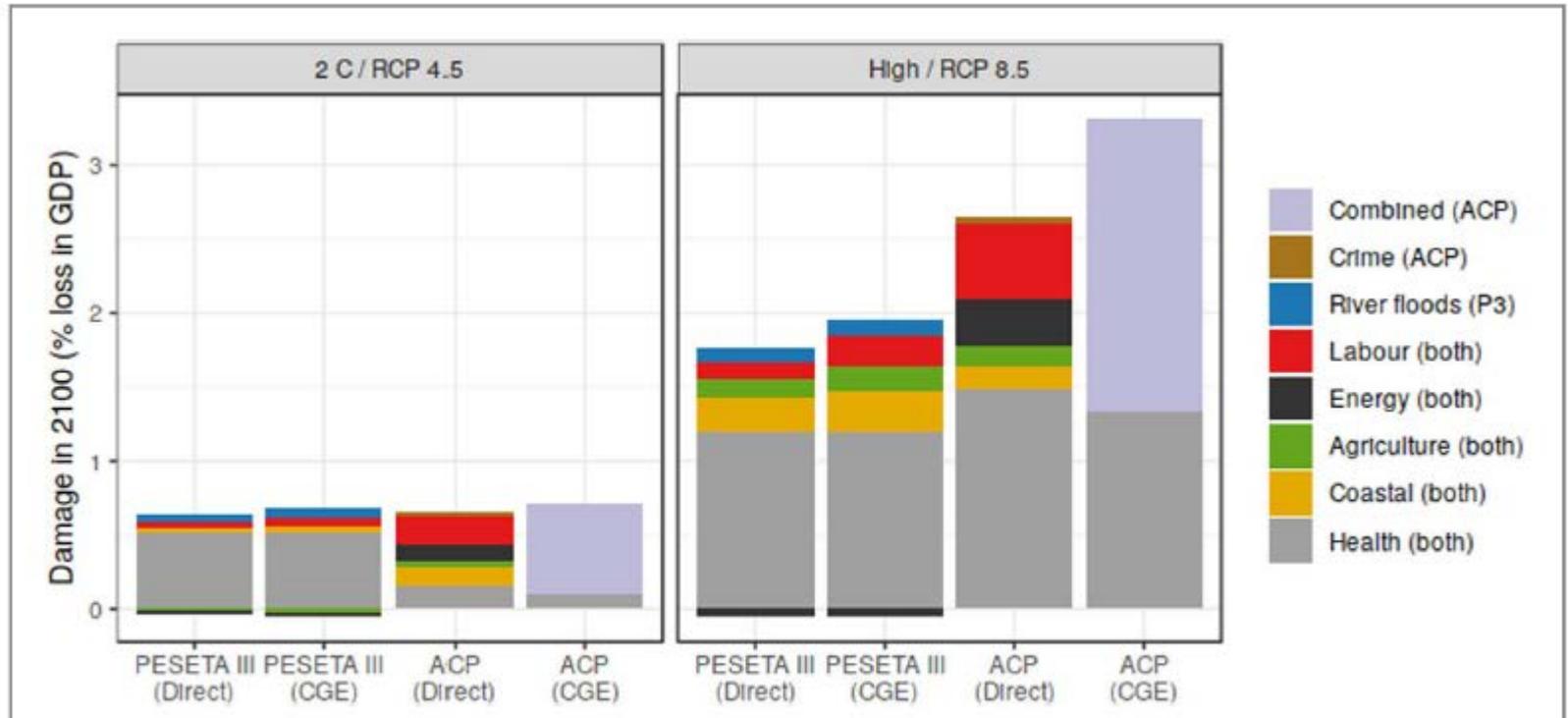
- **240 000 direct jobs**
  - 55 000 in power stations
  - 185 000 in mining
- **215 000 indirect jobs**

## Distribution of jobs in the production of a 50 MW wind farm



Source: JRC (2018). EU coal regions: opportunities and challenges ahead. Science for Policy report. (left map) and IRENA (right figure)

# Evaluating Climate Change Impacts and Adaptation

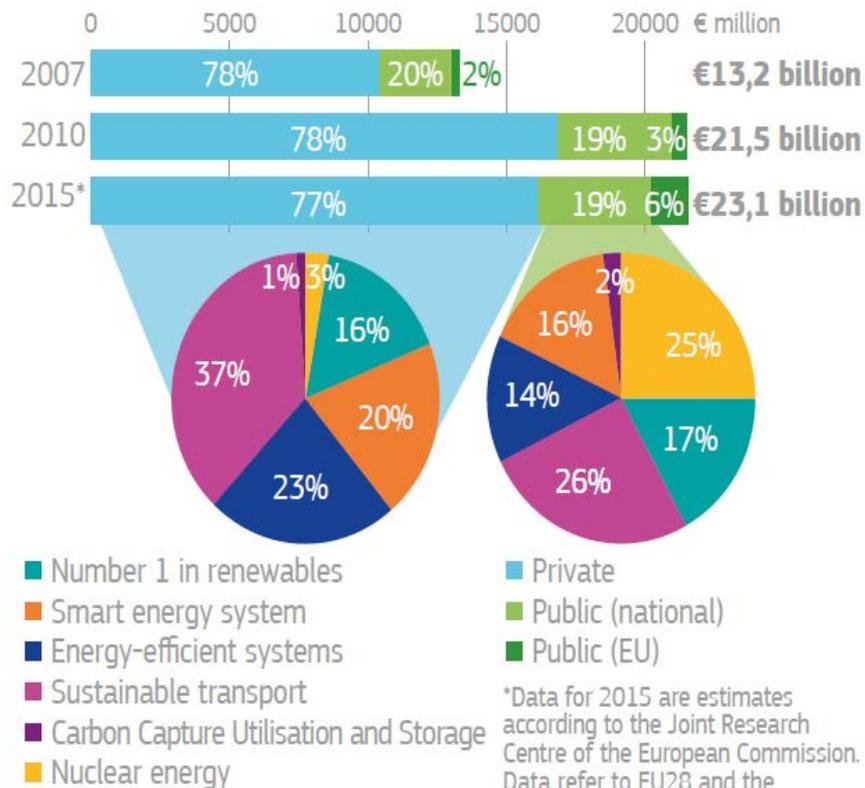


Impact Decomposition on EU and US Economies under 2 emission pathways

# The key role of innovation

## Monitoring energy R&I

### Private research spending on the up in Europe



### But the EU ranks last among major economies in terms of R&I investments as a share of GDP

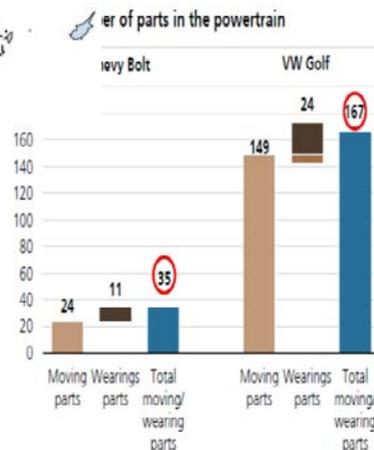
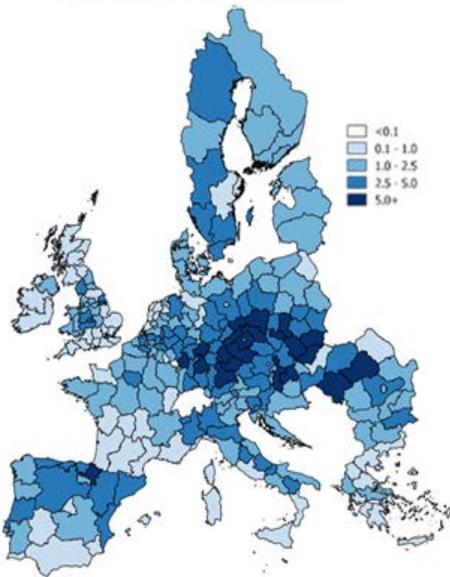


Source: Joint Research Centre

Source: Joint Research Centre

# Societal Implications of Mobility Transition

Share of employment  
Energy Intensive Industries &  
Automotive Manufacturing



Source: UBS 2017

## Future mobility scenarios

- Technology uptake, transport demand
- Impact on production, maintenance, infrastructure,...



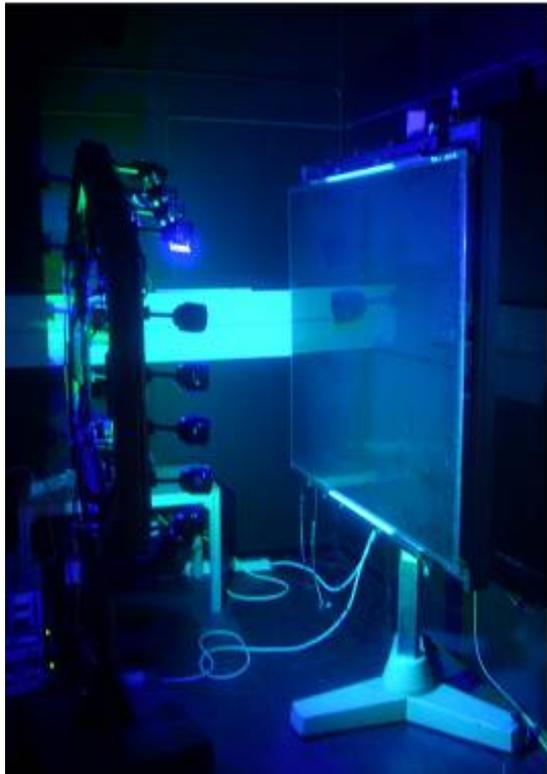
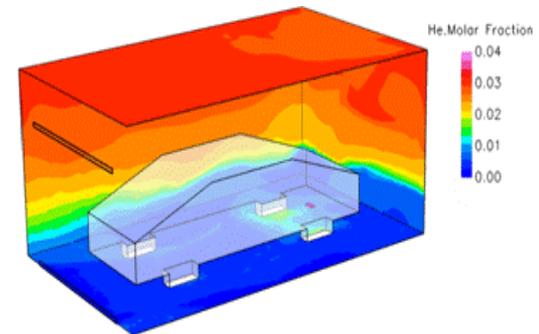
## Macro-Economic modelling JRC GEM-E3

- Impact on economy, energy, environment, employment



## Impact on skills/jobs/trade/GDP

# Contribution to Regulations, Codes & Standards



# JRC Living Lab Future Mobility Solutions

**JRC Ispra**

**167 ha**

of fenced-in  
land

**36 km**

of internal  
roads

**2200+**

intl. staff and  
visitors



# *Innovation in Green Batteries*

*Sustainability and circular economy*

## EU Battery Initiative

Coordinating  
R&I efforts on  
green batteries

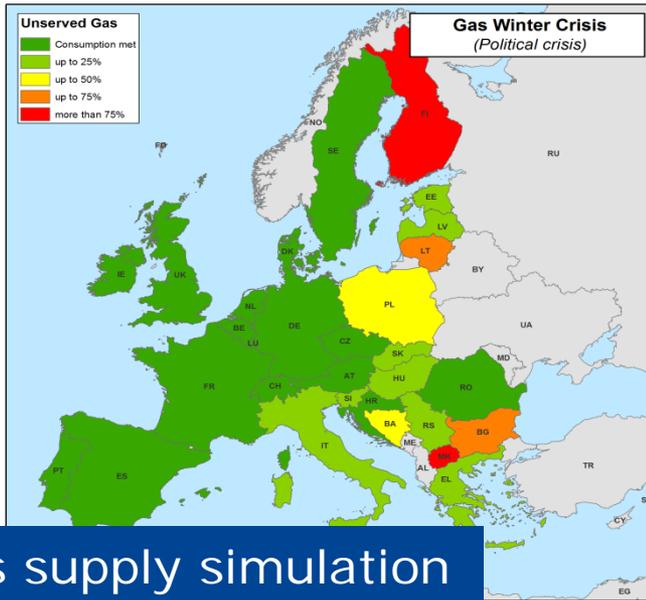
**BatteRIes Europe**  
**European**  
**Technology and**  
**Innovation**  
**Platform**



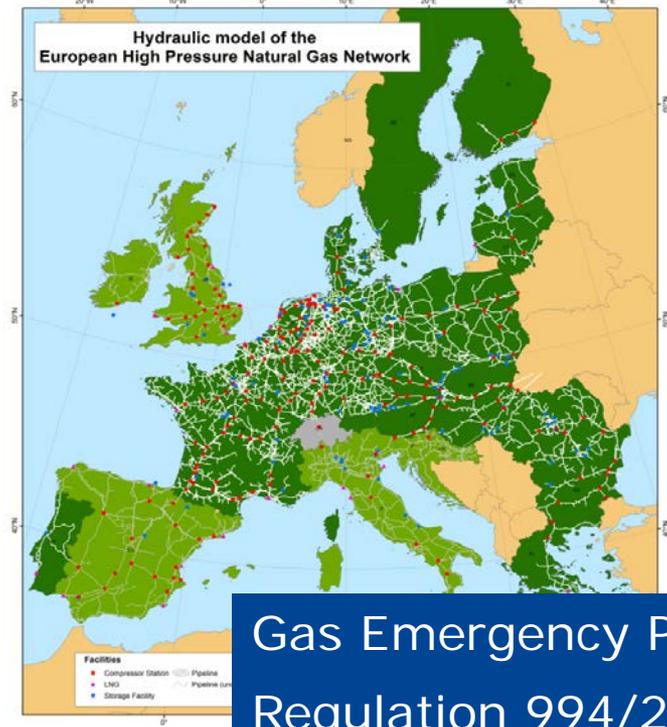
## JRC activities

- EC-coordinator in SET-Plan Action 7
- Will be involved throughout ETIP Batteries
- Life Cycle Assessment of **Second Life** of vehicles batteries
- Circular Economy perspectives for the management of Batteries used in Electric Vehicles – **Ecodesign** regulation on batteries
- Waste and recycling: contribution to the new **Batteries Waste Directive**

# Security of Supply



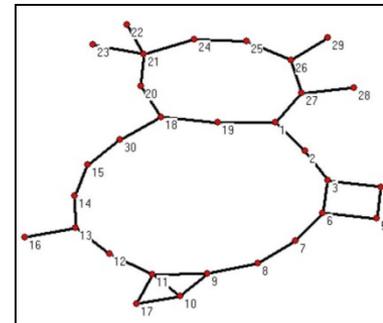
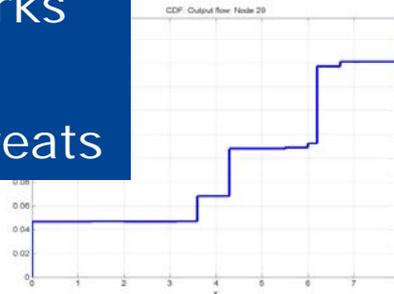
Gas supply simulation  
Stress tests



Gas Emergency Plans  
Regulation 994/2010

Reliability of gas networks

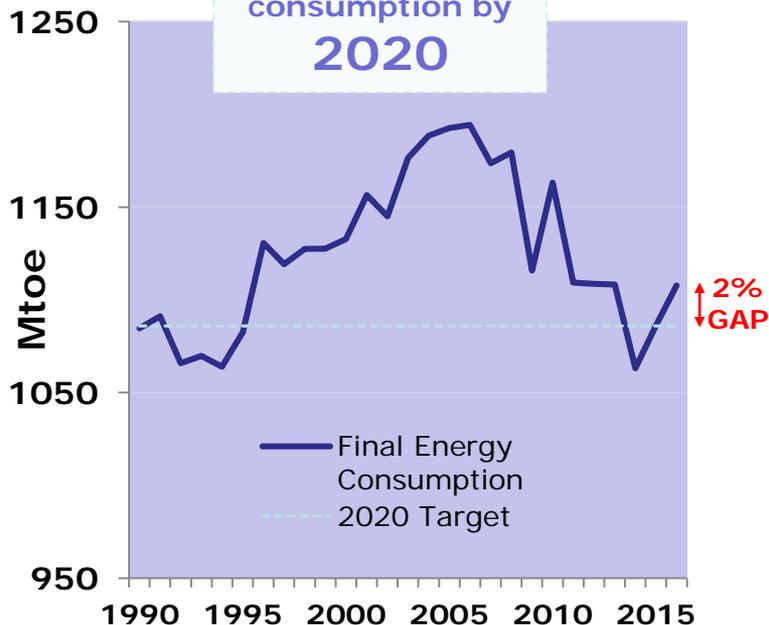
Disruptions from intentional/accidental threats



# Energy Efficiency

## Progress towards 2020 EU energy efficiency targets

**Target of 20%**  
reduction in EU  
energy  
consumption by  
**2020**



**Is it all due to efficiency?**

- Examination of drivers behind EU energy consumption trends
- Assessment of National Energy Efficiency Action Plans
- Assessment of Annual Progress Reports

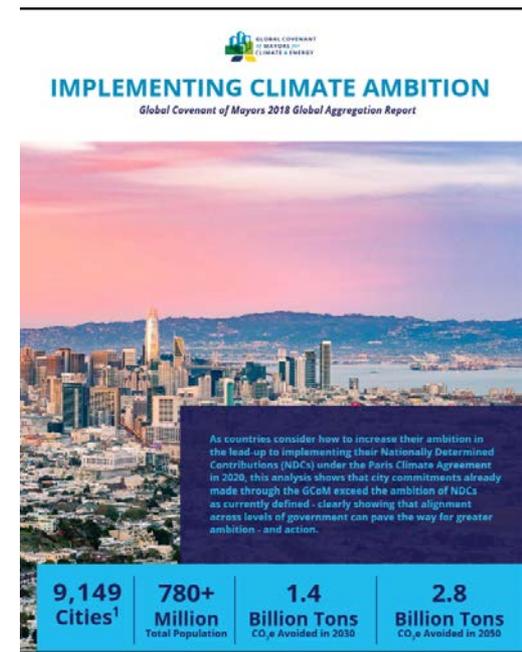
### JRC analysis feeds into:

- State of Energy Union Report
- Energy Efficiency Progress Report by DG ENER
- Guidelines on National Energy Efficiency Action Plans

Our contribution continues under new **Energy Union Governance Regulation**

# Global Covenant of Mayors: Impact assessment

- Common data reporting framework for city and local governments' greenhouse gas emission inventories, climate risks and vulnerabilities is being developed
- Aggregated **collective potential** of Global CoM 2018: 9149 cities (85% EU), from 120 countries (covering 780+ million inhabitants, 10.5% of the global population),  
if fully implemented, could achieve annual reductions of
  - ✓ **1.4 GtCO<sub>2</sub>-eq in 2030**
  - ✓ **2.8 GtCO<sub>2</sub>-eq in 2050** from BAU.



# Air Quality

JRC chairs

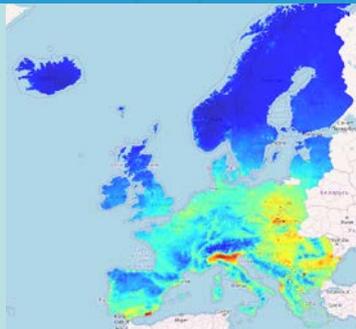
Harmonising  
monitoring

JRC European Reference  
Laboratory for Air Pollution



Harmonising  
models

**FAIRMODE**  
Forum for air quality modelling in Europe



**SHERPA**  
Screening for High Emission  
Reduction Potential on Air

Designing  
action plans



SHERPA city

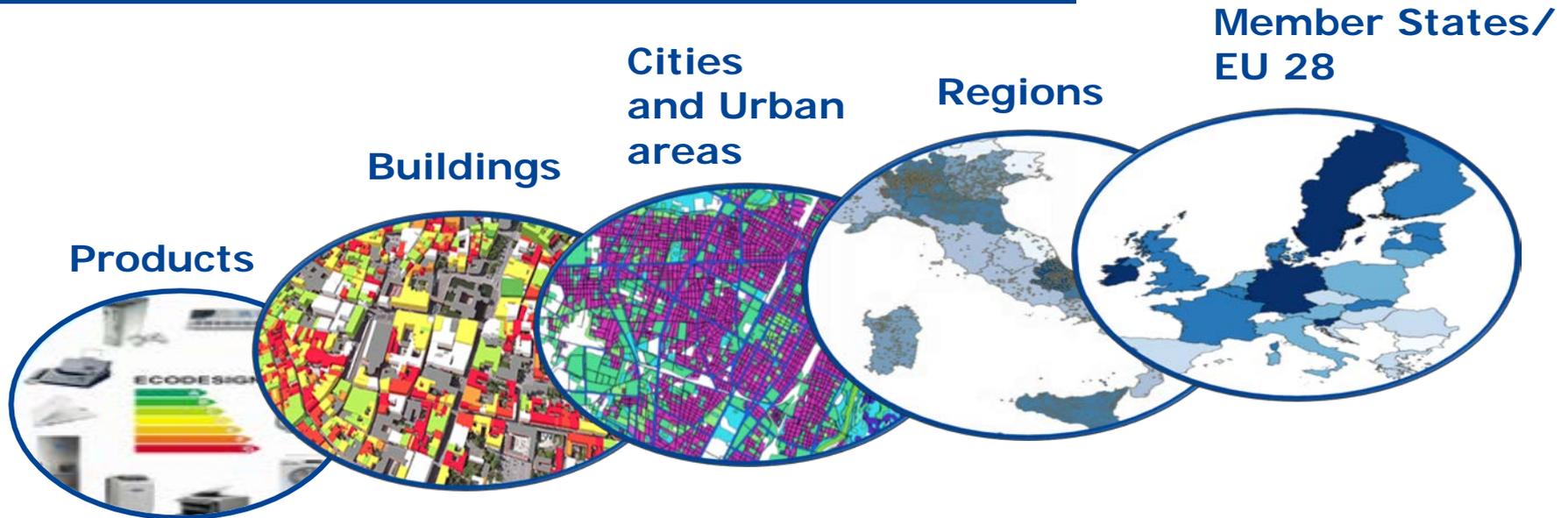


European Committee for Standardization

# JRC DIR C in a nutshell

Supporting energy, transport and climate policies at different scales

- Coherent and integrated assessment
- Geographical Information Systems
- Regional gap



Energy label  
Ecolabel  
Directives

Energy Performance of  
**Buildings** Directive

Covenant of  
Mayors (**Cities**)

Smart  
Specialisation  
(**Regions**)

Global Scenarios, EU  
Energy Projections,  
Energy Efficiency –  
Renewable Energy  
Directives



# Thank you for your attention



JRC Science Hub  
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