GRAGE
Grey and Green in Europe: elderly living in urban areas
This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 645706.

Scientific paper on economic model to assess different environmental policies impact on environmental innovation, to be presented to relevant scientific conference.

D2.4

GRAGE: *Grey and green in Europe: elderly living in urban areas*

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[1] **R**= Document, report; **DEM** =Demonstrator, pilot, prototype ; **DEC** Websites, patent fillings, videos, etc. **OTHER**
[2] **PU**= Public; **CO=** Confidential, only for members of the consortium (including the Commission Services)

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ECONOMIC MODEL TO ASSESS ENVIRONMENTAL POLICIES IMPACTS ON ENVIRONMENTAL INNOVATION

The aim of this paper is to propose a model for measuring the impact of European Union Environmental Policy (EU-EP) on Environment Innovations (EI).

The paper is developed within the framework of the EU funded project GRAGE on "Grey and green in Europe: elderly living in urban areas".

Specifically, the paper is the core part of Deliverable 2.2 related to Task 2.2 that is focused on the issue of "How to assure and enable supportive macro-environmental policies". The core idea of the task is the link between ageing population and sustainability/environment preservation. Indeed, demographic changes have serious implication on physical environment. Age-friendly environmental policies play an important role in achieving both inclusiveness of elderly people and national environmental (i.e. reducing stress and aiding memory), and green growth goals (e.g. lowering the long term costs to the economy of national environmental policies - Green Growth in Cities, OECD, 2013). Under this assumption, the issue of environmental measures becomes particular important: how to create an environment that is coherent with inclusion of elderly people and their life within the community?

The deliverable attached to this task aims to propose an economic model to assess environmental policies impacts on environmental innovation.

The models developed in the literature are limited by a lot of problems: the measure of Environmental Policy (EP) and Environment Innovations (EI), the general view of the impact, the time dimension and the availability of data. We suggest a dynamic panel model, which will be estimated by the General Method of Moment (GMM of Blundell and Bond 1998). The data are both macro data and survey.

1. INTRODUCTION

The world population continues to increase. It leads to increased pollution, climatic change, and the depletion of natural resources and biodiversity (Cawsey, 1996). In this context, Environment Innovations (EI) could help to maintain prosperity and a high quality of life now and in the long run "sustainable development".

EI also called eco-innovations are the best way to produce new products and processes which provide customer and business value and significantly reduce negative environmental impact of households and industries on environment (Fussler and James, 1996). Today, one of the most widely accepted definition of eco-innovations is that proposed by Kemp and Pearson (2007) as part of the MEI (Measuring Eco-Innovation) project. This definition[3] includes not only innovation aimed at reducing environmental impacts, but also cases where innovation leads to reduced impacts without this being an explicit aim. Eco-innovation is a broad concept, comprising innovation in pollution control, green products, cleaner process technologies, green energy technology and transport technologies and waste-reduction and handling techniques (Kemp and all, 2011).

The literature on determinants of eco-innovation accentuates the important role of regulation, cost savings and customer benefits. Environmental Policy (EP) has a strong impact on eco-innovation[4] because of regulation (taxation, subsidize and legislation) and public-good. Government can help and assists firms by providing grants, loans and other assistance to help bring new products and process to market. Alternatively, Government can directly brings EI.

Indeed, the European Union has taken lot of EP in order to propel EI. The EU Environment Action Programmes (EU-EAP) can be divided into seven items[5]. All these programmes (EU-EAP) have been implemented progressively. Since 1973, date of the first EAP, we can observe a gradual learning process. It starts with an ambitious programme to

[3] Assimilation or exploitation of a product, production process, service or management or business method that it is novel to the firm or user and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives (p. 3).
[4] Green et al. 1994; Porter and van der Linde 1995a, 1995b; Kemp, 1997; Hemmelskamp, 1997; Cleff and Rennings, 1998; Rennings 2000, Berman and Bui, 2001.
[5] We have done a summary of these seven EU-EAP in appendix 1.

resolve the environment problems in urgent, and gradually moves towards a more global and integrated approach, looking for synergies between business and environmental goals.

The development of the EU-EAP has been supported by a wide range of political parties as well as both NGOs and business interests. All the EU-EAP are focused around the polluter pays, sustainable development, high level of protection, prevention, proximity, benefit cost calculation, subsidiarity, proportionality…

Probably, the EU-EAP is one of the most developed set of measures and principles in any part of the world.

Lot of models has been proposed by researchers to measure the impact of Environmental Policy (EP) on Environment Innovations (EI). These models have been confronted with lot of difficulties. The first limit of these models is the measurement of EP and EI. It is difficult to find an index or a variable which takes into account all the EP and EI. The second problem of the models is that not all kind of variables are considered, only some specific EP and EI are considered. The third problem is the time dimension which is not taken into account in the models. After an EP, it takes lot of years to see the results on EI. The last problem we find with these models is the availability of data: most of times, surveys are not complete.

The goal of this paper is to propose a model to assess the impact of European Union Environment Action Programmes (EU-EAP) on Environment Innovations (EI).

The paper is structured as follows: Section 2 reviews the literature; Section 3 presents the model and the data; and Section 4 concludes with a discussion of the policy implications.

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2. LITERATURE REVIEW

Environmental innovation has only recently appeared in the economic literature. The seminal work is Porter and Van der Linde (1995b). In this part of the research, we will see the different kind of the model used in the literature to measure the impact of EP on the EI. It will allow us to see the limits of these models.

One of the last papers which summarizes the researches of EP impacts on EI is Kemp and all. (2011). They classify these studies in four groups: “(a) theoretical models of incentives for eco-innovation, (b) econometric studies about the effects of environmental policy instruments on technical change based on official statistical data (c) case studies of the effects of environmental policy instruments on innovation, and (d) surveys of firms seeking to distinguish the influence of different environmental policy instruments, amongst various other factors, on eco-innovation.” Kemp and all. (2011) find three particular problems in analyzing the impact of EP on EI. “The first problem has to do with the difficulty of measuring environmental policy“: it is very hard to incorporate design aspects of environmental policy instruments in the econometric analysis (strictness, enforcement, differentiation of standards or taxes with regard to type of polluter, and instrument combination where the effects depend on synergies). “The second methodological weakness concerns the measurement of innovation“: the majority of environmental innovations are not patented and thus missed, and data on environmental R&D is often not available. “The third limitation is that the econometric studies based on observed data cannot capture all relevant factors in the analysis” such as business expectations, the matrix of institutions which operates on companies and innovation capability of companies.

The majority of the studies, because of the availability of data, use some specific policy and specific EI.

Environmental policies may fall under the “command-and-control” or “market-based” types. Market-based instruments is also called economic instrument, price-based instruments… Market-based instrument can be pollution charges, subsidies, tradable permits, and some types of information programs which can encourage firms or individuals to undertake pollution control efforts. One of the most prominent examples of a market-based environmental policy

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of European Union is the trading of sulfur dioxide (SO2) allowances created by the 1990 Clean Air Act (CAA).

By contrast, command and control regulations tend to force firms to take on similar shares of the pollution burden, regardless of the cost (Jaffe et al., 2002). Command-and-control regulation can be technology-based controls, performance standards, reduction of pollution and energy use. Recycled waste, water, or materials.

All kind of EI (René Kemp and Peter Pearson (2007): environmental technologies, organizational innovation, product and service innovation offering environmental benefits, green system innovations are not covered by the studies. Each study analyses some parts or some kinds of EI. For example Johnstone and all (2008) examine the effect of environmental policies on technological innovation in the specific case of renewable energy. Kemp (1998) examines technical innovation.

As European Commission (2007) says, the type of approach and instrument retained will impact both the nature of innovation and the speed of its diffusion. In our model, we will take as many variables (EI and EP) as possible.

As underline by Ozusaglam (2012), diffusion of EI remains largely unexplored in the literature. Diffusion of EI is very important, how to bring innovation to the consumers, but it is prevented by lot of obstacles. We can divide the barriers to EI diffusion in two groups: the market barriers (it is costly to bring the EI from the industries to the customers; it is difficult to convince customers to adopt EI) and the regulation barriers. This aspect is not taken into account sufficiently in the literature. That’s why we use this variable in our model. Government must take care of drivers and barriers from the supply side (where technology push is supposed to occur) to the demand side (which exerts the market pull).

Porter and van der Linde, 1995, p. 99 confirm that environmentally and economically benign innovations are not realized because of incomplete information and of organizational and/or coordination problems.

Better explanations and increasing awareness about environmental issues may enable a more widespread adoption of eco-innovations. European Commission (2007) recommends that in order to stimulate both the private and public research effort, public policy may provide important organizational and information-related support as well. Effective policy for innovation depends crucially on the wider context parameters as well as the corresponding innovation barriers.

Apart from the problem of diffusion, it is a problem of environmental policy (incentive based instruments or regulatory approaches): Fiscal system (pricing of eco-innovative goods and services, subsidies); Institutional structure (political opportunities of environmentally oriented groups) and International agreements on environment. That's why in our model we introduce subsidize and tax variables.

EI can be imported directly from other countries because certain countries have some advances in the EI than Europe. Recently, China has become one of the global leaders in environmental innovation, for example in the fields of hydropower, solar energy, wind energy and electro-mobility (Urban et al., 2012; Lema and Lema, 2012).

For Johnstone et al. (2010), the stark juxtaposition between market-based instruments and direct forms of regulation is somewhat misleading. It is more helpful to think in terms of attributes of characteristics of different policies, and of what effect each of these characteristics has on innovation.

Relevant attributes would include at least the following (Ashford et al., 1985; Johnstone, 2007; Brunnermeier and Cohen, 2003):

- stringency, ie how ambitious is the environmental policy target, relative to the «baseline» emissions trajectory?;
- predictability, ie what effect does the policy measure have on investor uncertainty; is the signal consistent, foreseeable, and credible?;
- flexibility, ie does it let the innovator identify the best way to meet the objective (whatever that objective may be)?;
- incidence, ie does the policy target directly the externality, or is the point of incidence a «proxy» for the pollutant?;
- depth; ie are there incentives to innovate throughout the range of potential objectives (down to zero emissions)?.

To solve the problem of diversity of EP, it is better to take into account these attributes.

The limits of the data (table 2) in measuring the impacts of EP on EI bring researchers to use survey (Cassiman and Veugelers, 2004; Mairesse and Mohnen, 2010). Cainelli (2013) uses data from a firm survey (EU CIS2008 survey of manufacturing firms) and regional level waste related information obtained from Italian environmental agency waste reports.

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Community Innovation Survey (CIS) 2009 used by Horbach and Rennings (2012) and World Economic Forum's Executive Opinion Survey of 2008 are also used by researchers.

The long time series make patents unique among innovation indicators. Using patent data, it is possible for researchers to collect data in highly disaggregated forms and to subject this to statistical analysis. The cost of processing patent data is also lower than the cost of survey-based data. Patents are classified according to the International Patent Classification (IPC). In Europe, the European Patent Office (EPO) grants about 70% of the patent applications. We can find EPO patent applications by sector (Eurostat). One of the problems with patent data is that patent data capture a limited proportion of all innovations. Not all inventions are patented, and this may vary across time and countries.

MEI (Measuring Eco-Innovation) of Kemp and Pearson (2007) investigated the usefulness of 3 methods for measuring eco-innovation:

- Survey analysis.
- Patent analysis (an exclusive right to exploit (make, use, sell, or import) an invention over a limited period of time (20 years from filing) within the country where the application is made).
- Digital and documentary source analysis.

To avoid the problem of patents not take into account, we use also survey of firms and household.

Survey data are also used with the aim of extending the scope and finding more robust ways to tackle endogeneity[6] in the model measuring the impact of EP on EI. Among others, Veugelers (2012), Borghesi et al. (2015), while not specifically focusing on resource efficiency oriented innovations, present single countries evidence and do not treat endogeneity. Cainelli et al. (2015) and Managi et al. (2014) attempt to treat endogeneity and focus on resource efficiency, but again offer only single country based evidence.

Other contributions focus on the EU (Ghisetti et al., 2015), but again with a general aim of analyzing all environmental innovations, without addressing the endogeneity issue. The present paper instead exploits EU data, measure the impact of EP on EI so we will use a model where we will resolve the problem of endogeneity which typically characterize firm's survey data.

[6] When we use micro data (survey data), the problem of endogeneity can come from an error in the measurement of the independent variables or from the fact that two independent variables are codetermined. When there is a problem of endogeneity, the parameters estimated are biased (over or under estimated).

Mairesse and Mohnen (2010) discuss in detail the intrinsic endogeneity issue in survey data. To overcome this problem of endogeneity, in our model, we construct a dynamic model and panel data. This modelling will provide more robust knowledge.

The probit model is also estimated to study the impact of EP on EI (Horbach, 2008; Cainelli et al., 2015; Veugelers, 2012; Cleff and Rennings, 1999; Horbach, 2008; Rehfeld et al., 2007; Wagner, 2008). The probit model is focused on the following equation:

$$P_r(Y_i = 1/X) = \Phi(X, \beta)$$

Φ is the cumulative distribution function of the standard normal distribution.

Y_i is a dummy variable that takes the value 1 if a firm i introduces an EI and 0 otherwise.

X is a set of the covariates.

The β parameters reflect the impact of changes in x on the probability (Greene, 2008).

The dependent variables that capture EI are ECOMAT (Environmental benefits from the production of goods or services within the enterprise – reduced material use per unit of output), ECOREC (Environmental benefits from the production of goods or services within your enterprise - Recycled waste, water, or materials) and ECOREA (Environmental benefits from the after sales use of a good or service by the end user - Improved recycling of product after use).

Four different methodologies are used for the estimation: (i) a probit model; (ii) an ivprobit model (probit model with instrumental variables); (iii) a linear probability model (LPM) with instrumental variables and finally (iv) a special regressor method (SRM), 2SLS (Two-Stage Least Square Estimation) for example.

Horbach and all. (2012) add a second step where they restrict the analysis to firms with eco innovations in order to analyze the differences between our environmental impact areas separated by process and product innovations.

Veugelers and all. (2012) investigate the direct government policy instruments which survive as significant drivers for clean innovations, controlling for other motives: demand push (ENDEM) and voluntary agreements (ENAGR) and controlling for firm and industry characteristics (firm size & age, sector dummies and innovative inputs of the firm).

We will not use this model because we want to measure all the aspects of the impacts of EP on EI.

Another way to measure the impact of EP on EI is to create indicators which depict the influence of instruments (cf. Cottica 1994:36). In a panel study, for example, Jaffe Palmer (1996) use the rate of investment expenditure and running costs for the branch as an indicator of the pressure exerted on companies by environmental regulations. Another measure of regulatory intensity is the size and number of environmental laws and regulations passed (Hemmelskamp, 1999).

Kemp (1998) develops indicators that can assist public policy makers to implement programs that can encourage the development, adoption and use of environmental innovations. For Kemp (1998) two main challenges relate to the development of indicators for environmental innovation. The first challenge is that every aspect of manufacturing can affect the environment: the choice of materials, the characteristics of the production process, and the characteristics of manufactured products. In addition, environmental effects can occur not only during the production phase but during the entire life-time of a product. The second challenge is that many innovations that are beneficial to the environment are not readily recognizable as such.

It is therefore very difficult to find a good indicator.

The development of environment technology, its adoption and its diffusion take lot of times. “The process by which an innovation is communicated through certain channels over time among the members of a social system” (Rogers, 1962). The widespread diffusion of new technologies can take anywhere from between five to fifty years, depending on the innovation (Mansfield, 1968). The direct benefits are relevant in the short term while, the indirect benefits are more relevant in the long run.

That’s why, we must study the impact in the long run. So we include the period *p* in our model. In our model, p is in year. Requate (2005) also observed that some relevant aspects like the innovation output market and the conflicts between short and long term incentives provided by environmental policy instruments are missing in traditional models and they should be brought into the analysis.

We want to have a general view of the impact of EP on EI, and take into account as possible the maximum information on the impact of EP on EI. All the variables we take and the methodology will help us to correct lot of the limits of the models used in the previous research.

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3. METHODOLOGY

The methodology we suggest for measuring the impact of Environmental Policies on Environmental Innovation in European Union is an econometric analysis. To take into account all the aspects of the impacts of EP on EI, we use a mixed-method (macro data and surveys data).

a) The model

The model is a linear model where the dependent variable is the Environmental Innovation and the independent variables are variables of Environmental Policy.

$$\begin{aligned} ENV\_INOV_{ijt} = \alpha &+ FACTORS_{ik(t-p)} + EXPENDIT\_R\&D_{i(t-p)} \\ &+ TRANS_{TECH_{it}} + DIFFUSION_{i(t-p)} + ENV_{TAX_{i(t-p)}} \\ &+ ENV\_SUB_{i(t-p)} + d_{i(t-p)} + \varepsilon_{ijt} \end{aligned}$$

Table 1

Variable	Description
ENV_INOV_{ijt}	Environmental Innovation. j = 1 : all patents. j = 2 : environmental technologies patents. j = 3 : organizational innovation patents. j = 4 : product and service innovation patents. j = 5 : green system innovations patents. j = 6 : environmental technologies accumulation.
$FACTORS_{ik(t-p)}$	k = 1 : flexible. k = 2 : middle. k = 3 : strict.
$EXPENDIT\_R\&D_{i(t-p)}$	National public sector expenditures on R&D.
$TRANS\_TECH_{it}$	Transfer of environmental technology.
$DIFFUSION_{i(t-p)}$	Diffusion of EI.
$ENV\_TAX_{i(t-p)}$	The revenues from environmental taxes in percentage of GDP.
$ENV\_SUB_{i(t-p)}$	The subsidies for environmental innovation in percentage of GDP.
$d_{i(t-p)}$	Dummies variables to catch the impact of the introduction of the EU-EAP.
p = period.	
ε_{ijt} = the error term.	
i = European countries.	
t = time.	

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Table 2

Variable	Source of Data
$\boldsymbol{ENV\_INOV_{ijt}}$	European patent office PATSTAT database.
$\boldsymbol{FACTORS_{ik(t-p)}}$	World Economic Forum Survey on environmental policies EU CIS2008 survey of manufacturing
$\boldsymbol{EXPENDIT\_R\&D_{i(t-p)}}$	Gross domestic spending on R&D of OECD and R&D expenditure of EUROSTAT.
$\boldsymbol{TRANS\_TECH_{it}}$	OECD indicators of globalization
$\boldsymbol{DIFFUSION_{i(t-p)}}$	Survey
$\boldsymbol{ENV\_TAX_{i(t-p)}}$	Environmental taxation of OECD and environmental tax of EUROSTAT.
$\boldsymbol{ENV\_SUB_{i(t-p)}}$	PINE database.
$\boldsymbol{d_{i(t-p)}}$	EU Environmental Policy Handbook; EEA Report No 8/2013 https://ec.europa.eu/commission/priorities/energy-union-and-climate_en

For the variable diffusion ($DIFFUSION_{i(t-p)}$), we propose to do a survey which insists on the preference of household. We can ask the following questions: What are your criteria to take an environmental innovation? Which EI do you prefer? Which problems do you meet in to take an EI?

b) Estimation

We use the Generalized Method of Moment (GMM) to estimate our model.

The presence of a lagged dependent variable makes the Least Ordinary Squares (OLS) estimation biased. Although fixed effects estimation (FE) eliminates specific effects, it cannot eliminate the bias introduced by the lagged dependent variable. The lagged variable is correlated with the error term, although the error term is not serially correlated.

The OLS estimation of the dynamic panel data model leads to biased and non-convergent estimators when the number of periods is small or the lagged dependent variable is correlated with the individual effects. The Least Squares Dummy Variable Model (LSDV) produces poor quality results for a small panel and with individual effects, whether the effects are fixed or random (Nickell 1981, Hsiao 1982). For this reason, Anderson and Hsiao (1981) propose the use of instrumental variables.

Arellano and Bond (1991) show that the Anderson and Hsiao (1981) estimator with instrumental variables does not take into account all orthogonality conditions and does not use all the information available in the sample. It is to resolve this bias (correlation between the lagged variable and the error term) that Arellano and Bond (1991) propose the Generalized Method of Moments (GMM). They take the first differences of the original model. The transformation of the equation into a first difference removes both the constant term and the individual effect (it is the first difference estimate by the GMM): $\Delta y_{it} = \beta_j \Delta y_{it-1} + \delta \Delta X_{it} + \Delta u_{it}$. The GMM is based on the orthogonality conditions between the lagged variables and the error term.

Blundell and Bond (1998) prove, using Monte Carlo simulations, that the first difference estimation by the GMM of Arellano and Bond (1991) is biased when the number of periods is small and has a low precision in the simulation studies. This makes the autoregressive coefficient unusually high (see Blundell and Bond, 1998 and Bond, 2002).

To correct these problems, Blundell and Bond (1998) develop the system of GMM estimation that combines the first difference equations with the level equations: the estimation of the equation in level ($y_{it} = \beta_j y_{it-1} + \delta X_{it} + u_{it}$) with the following instrumental variables:

Z(-1), Z(-2), Z(-3),…, Z(-t), Δ(Z(-1)), Δ(Z(-2)), Δ(Z(-3)),…, Δ(Z(-1))

Z = all the exogenous variables.

The method of Blundell and Bond (1998) enable to provide solutions to the problems of endogeneity bias and any omitted variables; it also controls individual and temporal specific effects. In addition, it generates the instruments from the explanatory variables; it is not the case for other traditional methods of instrumental variables such as 2OLS and 3OLS. An additional benefit of Blundell and Bond (1998) is the possibility of including constants that are not correlated with u_{it}.

Given its superiority in terms of efficiency and the robustness of the results, we use the level estimation by the two-step Generalized Method of Moment (GMM) of Blundell and Bond (1998) to estimate our model. We limit our model to the results of this estimate without doing any tests (it is the method of Blundell and Bond (1998) who wants to do so).

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CONCLUSION

Lot of models are proposed in literature to assess the impact of Environment Policy impact on Environmental Innovation in European Union. These models present some limitations. In this paper, we suggest to use a panel dynamic model estimated by the General Method of Moment (GMM) of Blundell and Bond (1998).

The fundamental fault in an environmental economic approach is its failure to note the complexity of existing structures influencing environmental innovation.

Looking at the influence of environmental policy from the perspective of innovation research, it becomes clear that the use of environmental policy instruments must be considered as a part of a system of interdependent structures influencing innovative behavior.

Other variables can be added to the model to see also the impact of cost savings and customer benefits on EI.

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APENDIX [7]

First EU-EAP : 1973-1976

1973: First Protection of the Environment' Research Programme (1973-1975).
1975: Directive on the quality of bathing water.
1976: Second Environment Research Programme (1976-1980).

Second EU-EAP : 1977-1981

1978: Directive on fresh waters and fish life.
1979: Directive on the conservation of wild birds.
1980: Directive laying down minimum drinking water standards.
1981: Environment, Nuclear Safety and Civil Protection DG founded and launch of Environmental Protection and Climatology research programme.

Third EU-EAP: 1982-1986

1984: First EU Framework Programme for research (1984-1987).
1986: Environment Research Programme (1986-1990).
1987: Single European Act incorporates environmental policy in Treaty of Rome.

Fourth EU-EAP: 1987-1991

1987: Second EU Framework Programme for research (1987-1991).
1988: Directive limiting pollution emission from large combustion plants.
1989: Launch of EU's Marine Science and Technology programme (MAST).
1990: Directive limiting use and deliberate release of GMOs.
1991: Third EU Framework Programme for research (1991-1994).
1991: Directive protecting waters against nitrate pollution caused by agricultural run-off.
1992: Directive establishing the Natura 2000 network to protect wild fauna and flora.

Fifth EU-EAP: 1992-2000

1993: Maastricht Treaty gives environmental action full EU policy status.
1994: Fourth EU Framework Programme for research with specific 'Marine science and technology' and 'Environment and climate' programmes (1994-1998).
1996: Directive on ambient air-quality assessment and management.
1997: EU adopts Kyoto Protocol.
1998: Fifth EU Framework Programme for research with specific 'Environment and sustainable development' programme (1998-2002).

[7] EU Environmental Policy Handbook; EEA Report No 8/2013; https://ec.europa.eu/commission/priorities/energy-union-and-climate_en

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1998: Directive to increase minimum quality standards of drinking water.
1998: Directive introducing new environmental specifications for petrol and diesel fuels.
1999: EU project clusters on urban mobility and biodiversity set up.
1999: Amsterdam Treaty makes environmental policy a key EU political aim.
2000: Directive establishing framework for EC action in relation to water policy.
2001: Commission publishes Biodiversity Action Plan for Conserving Natural Resources.

Sixth EU-EAP: 2002

2002: Sixth EU Framework Programme for research with specific 'Sustainable development, global change and ecosystems' programme (2002-2006).[8]
2005: Launch of the REACH Proposal on chemicals.
2006: Reshaping of the EU Sustainability Strategy.

Seventh EU-EAP: 2013-2020[9]

The slogan is "Living well, within the limits of our planet".
Environmental challenges from the 2008 OECD's Environmental Outlook to 2030 report that presents the key environmental challenges over the coming twenty years: Climate Change, Biodiversity & renewable natural resources, Water, Air quality, Waste & hazardous chemicals, reducing greenhouse gases emissions by at least 40% compared to the 1990 levels, increasing renewable energy to make up at least 27% of final energy consumption and a minimum 27% reduction in energy consumption compared to business-as-usual.
The current projections for 2030, however, indicate that further efforts are required at national and EU level to keep the EU on track towards its new 2030 targets, as well as its longer term objectives to decarbonize the European energy system and cut EU's greenhouse gas emissions by 80 to 95% by 2050.

[8] The European Union's Emission Trading Scheme (EU ETS) is the world's biggest tradable permit scheme and the main instrument of climate policy in the EU. It is now fully operational in 27 Member States.
[9] The introduction of the EU Emission Trading Scheme (ETS) (Directive 2003/87/EC)2 and the directives of the 2020 Climate and Energy Package on CO2 emission reduction (2009/29/EC, 2009) and renewable energy (2009/28/EC, 2009) are two of the most significant EU policy interventions (Costa-i-Font and all., 2015).

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