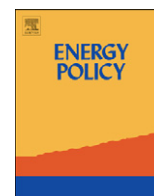




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Tax incentives to promote green electricity: An overview of EU-27 countries

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ABSTRACT

This paper provides a comprehensive overview of the main tax incentives used in the EU-27 member states (MSs) to promote green electricity. Sixteen MSs use tax incentives to promote green electricity simultaneously with other promotion measures, especially quota obligations and price regulation. However, not all available technologies are promoted. For example, six MSs (Germany, Romania, Slovak Republic, Denmark, Sweden and Poland) have included an exemption on the payments of excise duties for electricity when the electricity is generated from renewable energy sources (RES). This tax incentive is the most widely used. Limited tax incentives in personal income tax are available in Belgium, France, Czech Republic and Luxembourg. In corporate tax, tax incentives consist mainly of a deduction in the taxable profit (Belgium, Greece, Czech Republic and Spain). Lower tax rates in VAT are applied in three MSs, France, Italy and Portugal. Only Spain and Italy use effective tax incentives in property tax. As a great diversity of tax incentives has been used to promote green electricity, this adds another difficulty to the EU objective of providing a renewable energy policy framework, but also it offers a useful set of case studies which can be used to inform EU policy development.

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1. Introduction

From its present global levels, electricity production is expected to almost double by 2020. Compared with existing electricity generation, observers have pointed out that the global electricity industry should reduce its carbon emissions¹ (the superscript numbers refer to endnotes, not footnotes) more than 30% by 2020 together with reduced costs. Therefore, the electricity sector is likely to become a prime target in any future world where greenhouse gas (GHG) emission controls are implemented and GHG mitigation is valued.

Following Sims et al. (2003), several broad methods for mitigation of carbon dioxide emissions exist: (a) more efficient conversion of fossil fuels, (b) switching to low-carbon fossil fuels and suppressing emissions, (c) decarbonisation of fuels and flue gases, and carbon dioxide sequestration, (d) increasing the use of nuclear power and (e) increasing the use of renewable energy sources.

As the International Energy Agency (2009a) acknowledges, energy sourced from modern renewable technologies is increasing

more rapidly than gas and will constitute the second-largest source of electricity, behind coal,² soon after 2010. Excluding biomass, non-hydro renewable energy sources – wind, solar, geothermal, tidal and wave energy – together grow faster than any other source worldwide, at an average rate of 7.2% per year. Most of the increase occurs in the power generation sector. The percentage of non-hydro renewable energy as a function of total power generation is expected to grow from 1% in 2006 to 4% in 2030. Hydropower output has increased, but its share of electricity has dropped two percentage points to 14%.³ During this period, in the OECD, the increase in the renewable-based power generation exceeds that of fossil-based and nuclear power generation combined (an annual average rate of 2.4% versus 1.9%, respectively).⁴ As International Energy Agency (2009a) has recently pointed out, part of renewable energies' growth is due

² In relation to actual world electricity production, coal continues to have the largest percentage of total production, 38%, followed by renewable (principally hydro power) at 20%, nuclear at 17%, natural gas at 16% and oil at 9%. In the renewable area, hydropower is projected to grow by around 60%, mainly in China and other Asian countries. New renewable energies have expanded substantially throughout the 1990s in absolute terms, including wind by 21% per year and solar photovoltaic (PV) by 30% per year. Biomass and geothermal projects are also experiencing good growth.

³ Although the average cost of large-scale hydro power makes this type of RES a competitive one compared with plants powered by fossil fuels or nuclear materials, for the world as a whole, the construction of large hydro plants has stagnated due to environmental concerns. Canada and Turkey are the main exceptions. See International Energy Agency (2006) and Brower (1992).

⁴ See International Energy Agency (2009b).

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¹ Determined to combat climate change, the EU is committed to reducing its own emissions by at least 20% by 2020. It also calls for the conclusion of an international agreement which will oblige developed countries to reduce their greenhouse gas emissions by 30% by 2020. In the framework of this agreement, the EU would set itself a new objective of reducing its own emissions by 30% compared with 1990 levels.

to strong policy support, so the proliferation of renewable energy sources should be primarily a political issue.

The European Commission (EC) Green Paper on renewable energy sources (RES; EU 1996 (European Commission (EC), 1996)) set a target to double the contribution of those energy sources to the national gross energy consumption in fifteen years. Since then until the most recent Renewable Energy Directive, included in the 2008 European Union Climate and Energy Package, has been developed and implemented an important activity around the production of RES (EP&C, 2001; EC, 2006, 2007). This Directive confirmed its commitment of cutting GHG emissions by at least 20%, reducing energy consumption by 20% through improving energy efficiency and by increasing the share of RES in EU final energy to 20% by the end of 2020.

Focussing on renewable electricity consumption, the last European Directive of 2001 on this subject stated that all MSs must reach a target whereby renewable electricity accounts for 21% of total electricity consumption by the end of 2010. Although this was the common target, each country had a different target depending on that country's capacities and real production levels in 1997 (reference year). In 2007, the EU-27 MSs achieved a 14.93% contribution of renewable energy to gross electricity consumption (Euroserv'ER, 2008).

In order to increase the percentage of the renewable electricity as a function of total consumption, the promotion of green electricity in the EU has been essentially based on three instruments: (i) quota regulations in terms of quota obligations, which are linked to the trade of certificates, (ii) statutory entitlement of RES electricity plants to connection to, and usage of, the grid in many countries, and (iii) price regulation.⁵ The third instrument can be implemented in terms of feed-in tariffs, quota obligations/green certificates or bidding systems.⁶

Apart from these promotion instruments, subsidies, financial incentives, green funds and tax incentives are also used. Some of these measures are applied simultaneously but the same generic scheme may show different design features in each country. In fact, a large range of initiatives in tax incentives exist in several MSs.

The tax initiatives in EU countries to promote the implementation and use of renewable energies have been justified as a source of environmental benefits due to the reduction of GHG emissions. In relation to environmental benefits, the EC has estimated that by switching to renewable energies, the EU could cut consumption of fossil fuels by 200–300 m tonnes per year and reduce CO₂ emissions by 600–900 m tonnes a year. The promotion of renewable energies can also have other benefits such as contributing to net employment.⁷ In fact, the use of environmental taxes produces two types of benefits, known as the double dividend (Goulder, 1995). The first and most direct benefit, called the green dividend, is to preserve the environment. The second, called the blue dividend, can be obtained in several ways, including the positive impact on employment levels, due to the tax reform associated with the environmental taxes that reduce labor taxes (De Mooij, 1999). In that sense, most OECD countries have established environmental taxes to encourage energy conservation and to preserve the environment, being aware that the reforms also produce additional positive effects.

This paper provides a comprehensive overview of the main tax incentives used in the MSs to promote green electricity. Preceding works, e.g., Del Río and Gual (2004) and Uyterlinde et al. (2003)⁸

referred to the UE-15. The initiative of the German Federal Ministry for the Environment, named 'Legal sources on renewable Energy' must also be mentioned as an interesting source. This paper contributes to the specialized literature on renewable energies by analyzing the main tax incentives that are used in EU-27 countries to promote green electricity. This offers a useful set of case studies which can be used to inform EU policy development.

The paper is structured as follows. Section 2 shows the European regulation of tax incentives for green electricity and the actual share of RES in gross electricity consumption in the UE-27 area. In Section 3, the main tax incentives considered in direct taxes are presented. Section 4 shows how tax incentives have been introduced in indirect taxes and Section 5 focuses on pigouvian and other taxes. Section 6 concludes the paper.

2. Regulation of tax incentives and actual share of RES in gross electricity consumption in the UE-27 area

The Green Paper (European Commission (EC) 1996), which was the first attempt at establishing a common policy on renewable energies in the European Union, set down the goal of doubling the contribution of RES to the gross domestic energy consumption in 15 years. This would mean that the RES will increase to 12% in 2012. In this document, the Commission committed itself to mobilize all the instruments and policies of the States and the Community that affect the development of RES and, specifically, fiscal, agrarian, environmental, energy and innovation policies. In the same year, the Directive (European Parliament and the Council (EP&C), 1996) about common rules for the internal electricity market declared that electricity generation based on renewable energies is a high priority. This Directive is based on the security of electricity supply and environmental protection.⁹

From 1996 until the present, the European Union has developed an intense activity involving regulations around the promotion of RES. This activity has always taken into account the three objectives established in the White Paper (European Commission (EC), 1997) that sets down a strategy and a community action plan for RES,¹⁰ with special reference to the exemption from, or reduction in, the taxation of energy products resulting from RES.

In addition, the community guidelines about state aid to benefit the environment (European Commission (EC), 2001) recognize the necessity of public aid to promote RES and the necessity of internalizing external costs of electricity generation.¹¹ Fossil fuels and nuclear generation enjoy a competitive advantage over RES, because these sectors have lower marginal costs than new renewable technologies and are able to cope better with downward price pressure. As a consequence, electricity price in Europe reflects the marginal costs of production from existing capacity, but does not include the capital cost of the capacity used or the cost necessary for replacing the existing capacity as a consequence of depreciation.¹² Price volatility and

⁹ See article 3.2 from the Directive 96/92/CE of the European Parliament and Council of 19 December 1996 concerning common rules for the internal market in electricity (DO nOL027, 30 January 1997, pp. 20–29).

¹⁰ Three basic objectives are established in this plan: reducing dependency on energy imports, which would lead to an increase in the security of supply; protecting the environment, by reducing CO₂ emissions to the atmosphere; and the economic and social cohesion related to the development of national industry and the promotion of employment in the renewable energy sector.

¹¹ An interesting report in this area is contained in 'New Energy Externalities Development for Sustainability' published in 2008 on www.needs-project.org

¹² Nevertheless, in relation with the diversity of costs, it should take into account that for example the cost of R&D is a significant additional expense for

⁵ See Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (2008).

⁶ See Del Río and Gual (2004).

⁷ See Caldés et al. (2009).

⁸ Uyterlinde et al. (2003) refers also to Norway.

considerations regarding marginal costs have created a barrier to private investment in new capacity and this, of course, also affects renewable energy investments (Di Domenico, 2006). Because of these factors, taxation and policy measures are important for reducing costs of the RES sector in order that these costs are not reflected in the marginal price of electricity as it occurred with the extraordinarily high R&D costs of nuclear.

The taxation measures (i.e. exemptions, reductions and accelerated depreciations) will always occur in accordance with European Commission competition and environmental rules for the energy sector, which will look after the compatibility between environmental protection and competition rules in the energy sector. These guidelines point out in an unequivocal way the duality of taxation measures as instruments of promotion of RES in general, and green electricity in particular. Firstly, it is recommended that the price of polluting energies reflects their global cost, based on the “polluter pays principle”.¹³ Moreover, tax incentives, such as reductions, exemptions, deductions or tax allowances have been established by reducing the tributary invoice for both consumers and suppliers of clean energy.

An important step forward in the construction of the Community framework was the passing of the Directive (European Commission (EC), 2003) that restructures the community regime concerning taxation on energy products and electricity. The 24th statement of the preamble, based on articles 15 and 16 of this Directive, allows MSs to apply, under Community control, total or partial exemptions on, or reductions in, the level of taxation on electricity generated by RES.

The last step forward in the construction of the Community framework has been the passing, in the European Parliament, of the Proposal Directive (European Parliament and the Council (EP&C), 2007) which refers to the promotion of the use of energy coming from renewable sources. This is the first time that a binding objective has been established. Until now, all goals concerning this issue had been merely indicative. The new target established that 20% of the energy consumed in the EU by 2020 should come from renewable sources. The proposal leaves MSs the discretion to promote the development of the renewable energies sector depending on their internal potential and circumstances. This choice includes the possibility of achieving the objective by boosting the development of renewable energies in other MSs.

Tax incentives to promote renewable energies are part of a specific policy of the European Union to favour non-polluting energy sources. In order to be absolutely effective, this policy requires a regulatory framework that provides the sector with the necessary stability to take reasonable decisions about the investments required to take the EU on the path towards a future with a cleaner, safer and more competitive energy.

The regulation of electricity tax incentives¹⁴ aims to contribute to the increasing of the renewable energy production and to reduce the GHG emissions and thus to reach the 2010 objectives of electricity consumption.

Table 1 shows the share of RES in gross electricity consumption of EU MSs and the national targets. The EU common target of 21% of gross electricity consumption is different according to each country's potential and its production level reached in 1997,

considered as the reference year.¹⁵ In 2007, the EU-27 MSs achieved a 14.93% contribution of renewable energy to gross electricity consumption (Eurobserv'er, 2008) compared with 13.1% in 1997. Table 1 also shows that the EU-27 has achieved a growth of green electricity primary production of 45.50% between 1997 and 2007. The eight countries that have achieved the highest increases of green electricity production are Czech Republic, Germany, Hungary, Slovakia, Ireland, United Kingdom, Belgium and Denmark.

3. Direct taxes

Electricity from RES is subject to different fiscal tax privileges. One privilege is rewarded in a direct way through tax deductibility or a tax exemption of the investment costs for systems generating electricity that come from RES either in terms of personal income tax or in corporate tax.

3.1. Personal income tax

A personal income tax incentive is used to promote electricity consumption from RES by some MSs. These tax measures are becoming more common as it allows either tax deductions or exemptions depending on the source of income and the capacity installed.

The Czech Republic uses personal income tax incentives to promote the generation of green electric power. The persons entitled are operators of renewable energy systems who gain income subject to Czech tax. The method allows total exemption of the tax on revenues that the taxpayer obtains from the sale of this type of energy to national grid. The personal income tax rate is 15% in the Czech Republic. To avoid problems due to a different system for personal and corporate taxpayers, a similar exemption is implemented in corporate tax law. The cost of tax exemption in the Czech Republic is borne by the state.¹⁶

The personal income tax is used in Belgium as an instrument to promote the use of solar photovoltaic energy (PV), solar-thermal energy and geothermal energy. Expenses for the installation of these energy systems may be offset against income tax. The amount of reduction is 40% of the actual costs of the building project. A limit of € 2600 is applied for apartments, although under certain conditions the amount of investments that may be offset against income may increase by 780 Euros.

In the French case, the exemption not only covers the cost of the investment in the PV system, but also investments in the systems where wind energy, hydroelectricity or biomass are used, although the capacity of the systems is limited to 3 kWp (kW peak) (except in certain circumstances).¹⁷ Persons that install these renewable energy systems at their principal residence may deduce 50% of the net costs of hardware from income tax.

¹⁵ These objectives do not take into consideration hydroelectric production by pumped-storage plants that store water in dams using electricity already being produced.

¹⁶ An amendment to the 1992 Income Tax Act in 2005 allows for owners of renewable energy equipment producing energy for their own use to be exempt from income tax payments. The devices promoted are: small hydro plants with maximum output of 1 MW, wind plants, photovoltaic systems, heating pumps, biogas and biomass devices; and geothermal power. Owners are exempt from paying income taxes for five years, plus the year in which the device or devices were put into operation.

¹⁷ Systems that generate more than 3 kWp are eligible only if the electricity consumption of the building is more than half of the nominal system capacity installed. Besides Belgium and France, two Spanish regions allow similar deductions although these have not been considered due to their very limited application.

(footnote continued)

new renewable energy technologies as the R&D cost of nuclear for example were extraordinarily high but these sunk costs are not reflected in the marginal price of electricity from nuclear.

¹³ See article 174.2 of the EC Treaty.

¹⁴ European Council (EC) (2003). Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity, Brussels, Belgium.

Table 1

Share of RES in gross electricity consumption, national targets and green electricity production growth in EU Member States.
Source: Eurobserv'ER (2008) and Eurostat (2010).

	Effective share 1997 (%)	Effective share 2007 (%) ES	National target 2010 (%) NT	2007–2010 ratio ES/NT (%)	Green primary production growth 1997–2007 (%)
Austria	67.50	54.80	78.1	70.16	30.00
Sweden	49.13	52.09	60.0	86.81	10.08
Latvia	46.71	35.98	49.3	72.98	32.84
Portugal	38.30	29.14	39.0	74.71	23.46
Denmark	8.95	26.76	29.0	92.27	76.01
Romania	30.50	26.33	33.0	79.78	1.65
Finland	25.33	24.34	31.5	77.26	18.35
Slovenia	26.97	21.94	33.6	65.29	37.50
Spain	19.70	18.88	29.4	64.21	49.64
Slovakia	14.50	16.26	31.0	52.45	121.39
Germany	4.32	13.96	12.5	111.68	237.30
Italy	16.00	13.29	25.0	53.16	35.04
France	15.20	13.16	21.0	62.66	4.20
Ireland	3.80	8.56	13.2	64.84	93.50
Bulgaria	7.00	8.38	11.0	76.18	46.75
Greece	8.62	7.53	20.1	37.46	26.18
Netherlands	3.54	6.18	9.0	68.66	51.64
United Kingdom	1.90	4.86	10.0	48.6	90.24
Czech Rep.	3.50	4.65	8.0	58.12	269.84
Lithuania	2.63	4.5	7.0	64.28	32.84
Belgium	1.00	3.65	6.0	60.83	87.75
Hungary	0.86	3.59	3.6	99.72	190.68
Poland	1.80	3.48	7.5	46.4	29.22
Luxembourg	2.00	3.10	5.7	54.38	64.00
Estonia	0.12	1.5	5.1	29.41	45.50
Cyprus	0.00	0.04	6.0	0.66	51.16
Malta	0.00	0.0	5.0	0.00	na
Total EU-27	13.1	14.93	21.0	71.09	45.50

To obtain the exemption, the taxpayer has to prove the expense by means of invoices.

The tax credit results in lower state revenue, so the cost in France is borne by the federal budget and in Belgium by the national budget.

Luxembourg uses the personal income tax only to promote the electricity generated from solar photovoltaic. Income from the sale of electricity generated by small photovoltaic systems, whose capacity is 1–4 kWp, is deemed non-commercial. For this reason, it is not subject to tax.

3.2. Corporate tax

The exemptions included in corporate tax allow for the deduction from the net tax base of a percentage of the investment made in systems that generate green electricity. Belgium, Greece and Spain allow these deductions in corporate tax.

In Belgium and Greece, the corporate tax exemption is allowed for the company that has spent the funds to build systems that generate green electricity. In Greece, this investment incentive consists in a tax allowance for a percentage of the amount invested. It requires the creation of a provisional fund, as part of the benefits of the economic activity, related to the investment objective for tax benefit that specifically should be related to facilities for green power production, based on renewable resources. This fund cannot be distributed among the shareholders – this is the reason for the creation of a specific investment fund – since the established tax benefit is to encourage the productive activity in which such investment is involved, and in no way for the immediate dividend paid on the equity capital. In Belgium, the exemption is only allowed if the electricity is generated from the renewable energies that are included in a list published by the authority.

In Spain, the corporate tax Act permits deductions from the tax bill of a percentage of the investment that the company makes for the installation of green electricity systems. The company is required to include the investment on its balance-sheet for a specified minimum period. The allowable deductions are 6% (2008), 4% (2009), 2% (2010) and 0% (2011), so this scheme ceases for everyone in 2011. In all cases, the exemptions are not allowed to be combined with the system of grants.

As has been mentioned, revenues from the generation of green electricity are exempt from corporate tax in the Czech Republic, where the corporate tax rate is 21%.

3.3. Property tax

Two MSs, Italy and Spain, have adopted tax measures, using property taxes, to encourage the use of green electricity.

In Italy, ICI ('Imposta comunale sugli immobili') is a tax set by each municipality that may range between 0.4% and 0.7% of the value of construction of a property (DL 504/1992). In the 2008 Budget Law, however, it was established that municipalities may impose rates lower than 0.4% for taxpayers who install or have installed a system of renewable energy to produce electricity or heat for domestic use, with a maximum concessional period of three years for solar thermal installations and five years for all other types of renewable energy.

However, Decree Law number 93 of 2008 includes an exemption from ICI for the first home, so this measure is only applicable to second homes and luxury residences and its effect is small.

In Spain, the IBI ('Impuesto sobre bienes inmuebles') which is a similar tax to the ICI and is also set by municipalities, introduced tax measures to promote the establishment of solar energy systems. Royal Legislative Decree (RDL) 2/2004 states that those

Table 2
Tax incentives in direct taxes.
Source: Own elaboration.

	Personal income tax	Corporate tax	Property tax
Belgium	✓	✓	
Czech Rep.	✓	✓	
France	✓		
Greece		✓	
Italy			✓
Luxembourg	✓		
Spain		✓	✓

who have installed solar systems for the use of thermal or electrical energy may obtain a bonus of up to 50% of the full share of the tax on real estate, based on a municipal optional bonus. This bonus is applicable to solar systems which include heat collectors with appropriate approval by the competent authority. The tax, according to the RDL, is calculated at a rate that ranges between 0.4% and 1.10% on the value of the property if this is urban or between 0.3% and 0.9% if it is rural.

Tax incentive costs are borne by municipalities, and as the central government has not offered any general recommendation, this may explain why only 173 councils out of 8112 have adopted it.¹⁸

Table 2 summarizes this subsection. Table 2 also shows the MSs that have implemented tax incentives in direct taxes and the specific tax that is used.

4. Indirect taxes

The European Council Directive 2003/96 of 27 October (European Council (EC), 2003)¹⁹ restructures the community framework for the taxation of energy products and electricity and establishes in its preamble (statement 24) the possibility for MSs to apply exemptions or reduced tax levels, at their own discretion, to foster RES development. Nevertheless, as the European Directive affirms in this preamble, this cannot affect the smooth running of the internal market and cannot imply distortions of competition.

4.1. VAT

Value added tax (VAT), as a tax common to all EU MSs is, theoretically, one of the most suitable indirect taxes to promote renewable energies within the framework of the European policy of supporting electricity generated by RES. However, in practice, very few MSs have chosen this tax as an instrument to boost renewable energies in general, and green electricity in particular.

A reduction in the VAT rate levied on operations that benefit green electricity, as well as any other state aid that favours the environment, must follow European guidelines about state aid mechanisms that favour the environment (European Commission (EC), 2001). Apart from this, the reduction must receive authorization from the Commission, which will determine the size and conditions under which state aid may be necessary to guarantee environmental protection and sustainable development. This measure is implemented in order to prevent

disproportional effects over competition and economic growth. The exemptions are regulated by the 15th article of the Directive 2003/96 of 27 October (European Council (EC), 2003). Therefore, Community law allows this kind of reduction in VAT when it does not imply any distortion of competition. This danger does not seem to be imminent because of the relatively low participation of RES in the total energy supply in the EU.²⁰

Till now, only France, Italy and Portugal have introduced a reduction in the VAT rate for operations related to green electricity in their national regulations. Specifically, France²¹ allows a 5.5% reduction when buying basic products related to improvements, changes and installation in residential buildings that incorporate technology based on solar power, wind power, hydroelectric power and biomass. Italy²² charges a reduced tax rate (10%, rather than the usual 20%) on sales and services related to wind and solar power generation as well as on investments in green electricity distribution networks. In the Portuguese case,²³ buying systems which generate green electricity is taxed at a 12% rate, in contrast to the 21% general rate. In all three cases, the tax incentive has focused on reducing the tax rate, though the reduction in France is half that in the other two countries. This tax incentive cost is borne by the state.

4.2. Excise duty exemptions

At present six MSs use excise duty exemptions as a measure to encourage the use of renewable electricity. These are Germany, Denmark, Romania, Slovakia, Sweden and Poland.

In general, the justification used by these countries for excise duty exemptions is based on the consideration that this energy tax is an environmental one, and also on the fact that renewable energy does not cause environmental damage. This measure also helps with the aim of reducing the higher prices of production of this type of energy, as in the case of biofuels sales (Bomb et al., 2007; Van Beers et al., 2007).

In the case of Germany, the electricity duty in force since 1999²⁴ actually amounts to € 20.50/MWh²⁵ for non-business use and € 12.30/MWh for business use, but the law provides for exemptions to encourage the use of green sources of energy. Duty on electricity is waived if it is generated exclusively from renewable sources and taken from a power grid or a line supplied exclusively with electricity from such sources. RES are comprised of wind power, solar energy, geothermal energy, landfill gas, sewage gas, biomass and hydroelectric power from power stations with an installed capacity not exceeding 10 MW.

In the same sense, Romania has included an exemption from the payments of excises duties for energy products and electricity when the electricity is generated by RES. This tax, regulated by Law no. 571/2003, discriminates between electricity used for commercial purposes (€ 0.5/MWh) and electricity used for non-commercial purposes (€ 1/MWh). In the Slovak Republic, the use of renewable energy is promoted by exemption from the excise duty on electricity (Law No. 609/2007). The amount of subsidy

²⁰ According to the communication from the Commission to the Council and the European Parliament about the Renewable Energy Road Map: renewable energies in the 21st century. Building a more sustainable future (COM (2006) 848 final) is not very likely unless the contribution of renewable energy sources exceeds 10% in 2010, across the whole EU.

²¹ Renewable Energy Policy Review France (2008).

²² Renewable Energy Policy Review Italy (2008).

²³ Renewable Energy Policy Review Portugal (2008).

²⁴ Electricity Duty Law (StromStG) of 24 March 1999 (BGBl I, p. 378; 2000 I, p. 147).

²⁵ Minimum excise duty adopted by the council on 2003 was € 0.5/MWh for business use and € 1.00/MWh for non-business use. (Dir. 2003/96/EEC). Present values of the excise duties for the relevant countries are taken from European Commission. Directorate General Taxation and Customs Union Tax Policy (2010) document, Ref. 1.030.

¹⁸ See Dirección General del Catastro (2009).

¹⁹ It replaces, with effect from January 1st 2004, Council Directive 92/81/EEC (on the harmonization of the structures of excise duties on mineral oils) and Council Directive 92/82/EEC (on the approximation of the rates of excise duties on mineral oils).

equals the amounts of tax that entitled persons are exempt from. The rate is € 0.66/MWh to 31 December 2009, but from first January 2010 a new rate equivalent to € 1.32/MWh has become effective to meet the requirements of the Directive 2003/96/EC. Finally, the new Polish legislation on the taxation of electricity and energy products, in force since 1 January 2009, which has brought its law in line with the EU Energy Directive and replaces the Excise Act of 23 January 2004, continues to exempt RES electricity from excise duty. The exemption is granted on submission of a written statement by the business that the President of the Energy Regulatory Office has accepted the certificates of energy origin as confirmation that the energy comes from renewable sources. The excise rate remains at PLN 20 per MWh (equivalent to € 4.71/MWh).

On the other hand, some countries have introduced electricity excise exemptions for renewable electricity only if they are generated using a particular technology. In Denmark, the law on tax on electricity²⁶ establishes that exemption from excise duty applies to electricity produced in small plants (less than 150 kW), or by wind, hydropower or solar cell systems. The tax rate is DKK 530/MWh (€ 71.04/MWh) if electricity consumption is above 4 MWh per year in permanent residences registered as being supplied by electricity from these sources, and DKK 598/MWh (€ 80.16/MWh) for electricity generated by other means.

Finally, Sweden decreed that electricity is not taxable if it is produced in a wind power station by a producer who does not produce electricity in the normal course of business (Energy Tax Act – SFS 1994:1776). The reduction is (1) SEK 5 (€ 0.49) per MWh for consumption by the manufacturing industry and commercial greenhouse cultivation, (2) SEK 185 (€ 18.16) per MWh for consumption other than as specified in (1) in certain areas mainly in the northern parts of Sweden, and (3) SEK 280 (€ 27.48) per MWh for other consumption specified in point (1) in areas other than those specified in point (2).

Wind energy production has also been entitled to a tax reduction (environmental bonus). This bonus has, however, been applied only during a transition period some years after the electricity certificates were introduced. The bonus has been gradually decreased and has ended at SEK 20/MWh (€ 2.05) in 2008 for onshore wind energy and SEK 120/MWh (€ 12.34) in 2009 for offshore wind energy.²⁷

5. Pigouvian and other taxes

5.1. Pigouvian taxes

In the United Kingdom, the 'Climate Change Levy – CCL' is also used to promote electricity production from RES. The CCL is a climate protection tax which we can characterize as a typical pigouvian tax²⁸ and was set out in the Finance Act 2000. It was introduced on 1 April 2001 and effectively replaced the Fossil Fuel Levy. The CCL was implemented as a tax reform inspired by a recycling tax.²⁹ The Government is returning the money raised from the Levy to businesses, mainly through a cut in the rate of

employers' National Insurance by 0.3%. However, the 2002 Finance Act subsequently increased that offset to 1%, reversing the reduction. Due to the CCL is relatively unusual in MSs, so a broad consideration of the Levy is needed.

The CCL is in effect borne by agents that generate carbon emissions and hence could be replaced by a real carbon tax.³⁰

The absence of efficient markets is due to externalities, and does not permit one of the necessary conditions to raise the social welfare to a maximum level. In this scenario, public intervention can be considered to restore the efficiency conditions either through implementing Coase solutions³¹ – when these are feasible – or by pigouvian taxes.

All the pigouvian taxes attempt to reduce negative externalities which come from human activities.³² The CCL was forecast to cut annual GHG emissions by 2.5 million tonnes by 2010, and forms part of the UK's Climate Change Program.³³

The CCL has to be paid by the electricity suppliers, who pass the costs to the industrial and commercial final consumers. The CCL³⁴ per MWh amounted to € 6.12 from 1 April 2007 onwards and to € 5.04 from 1 April 2008 onwards.

Electricity from RES is promoted in terms of an exemption from the tax.

To be tax-exempt, an authorization is required, which may be given under the following conditions which involve consumers, suppliers and electricity producers:

1. Requirements in the contract involve the electricity consumer and the electricity supplier. Exemption from the CCL is granted if the supply contract includes a standardized declaration (called 'Renewable Source Declaration') by the electricity supplier. This ensures that the electricity supplied does not exceed the quota of electricity from RES produced by the supplier himself or received from other producers.
2. Necessary agreement involves the electricity supplier and the electricity producer. In order to be able to conclude a contract including a 'Renewable Source Declaration' with the consumers, the electricity suppliers must reach a New Electricity Trading Agreement (NETA) with the electricity producers they receive electricity from.
3. Obligation of the electricity producer to the Office of Gas and Electricity Markets. In order to be able to reach a NETA with the electricity suppliers, producers of electricity from RES must

³⁰ In the south of Spain, the regional authority of Extremadura implemented a similar tax from 1 January 2007. In this case, the tax on facilities that affect the environment is in effect borne by the electricity supplier and the electricity producer, and the 2/2006 regional Act (named 'Texto Refundido de las disposiciones legales de la Comunidad Autónoma de Extremadura en materia de Tributos Propios') prohibits them to pass the tax on to final consumers. Its revenue is projected to rise to € 27.5 M in 2009.

³¹ Compared with the pigouvian taxes, the markets for emission rights represent an alternative way to solve the negative externalities of the emission of CO₂. This solution – more recent than the previous one – is based on the Coase Theorem (Coase, 1960) and on the later work of Dales (1968), Montgomery (1972), Atkinson and Tietenberg (1987) and McGartland and Oates (1985a, 1985b). Coase solutions are the theoretical framework of the current EU Emissions Trading Scheme (see Cornes and Sandler, 1996).

³² Viladrich (2004).

³³ Climate Change Act (2008) established new targets on GEI. The Climate Change Bill was introduced into Parliament on 14 November 2007 and became law on 26 November 2008. A key provision of the Act established a legally binding target of at least an 80% cut in greenhouse gas emissions by 2050, to be achieved through action in the UK and abroad. Also a reduction in emissions of at least 34% should be achieved by 2020. Both these targets are against a 1990 baseline.

³⁴ From when it was introduced, the levy was frozen at £ 0.0043/kWh on electricity, £ 0.0015/kWh on coal and £ 0.0015/kWh on gas. In the 2006 budget it was announced that the levy would in future rise annually in line with inflation, starting from 1 April 2007. To read more, see OECD (2005) and Pearce (2006). More information can be obtained by visiting <http://www.cclevery.com/>

²⁶ Afgift af elektricitet. Law on tax on electricity, see Statutory Notice No. 689 of 17 September 1998.

²⁷ See Björck (2005).

²⁸ The name is due to A.C. Pigou (1932) who proposed this type of taxes in "The Economics of welfare" published in 1932, although Alfred Marshall had referred to externalities previously in his "Principles of Economics" in 1890. A pigouvian tax can reduce or eliminate negative externalities, by equating the private polluter's cost to the social cost. The modern development of Pigou taxes is due to Meade (1952), Scitovsky (1954), and Baumol (1972).

²⁹ See http://www.decc.gov.uk/en/content/cms/what_we_do/change_energy/tackling_clima/ccas/cc_levy/cc_levy.aspx

present certificates (named 'Levy Exemption Certificates') issued by the Office of Gas and Electricity Markets.

5.2. Other taxes

The Regular energy tax (REB or the ecotax) is an energy levy on electricity and gas consumption by small- and medium-size customers that was introduced in the Netherlands from 1997. Energy from renewable sources was exempt from the tax. The aim of REB was to stimulate green electricity consumption, while production support was also given to green suppliers. In 2001, with the liberalization of the electricity market, a voluntary trade of green certificates replaced the green label system of 1998. This green certificate was used for the validation and monitoring of the production and sale of green electricity under the REB.³⁵

The REB system was modified and in July 2003 a new policy titled "environmental quality of electricity production (MEP)" was introduced. Since then, electricity from renewable energy sources is granted a tax reduction if it is produced within or outside the Netherlands but with the condition that it has to be supplied back to this country. All technologies used for the generation of electricity from renewable energy sources are permitted.³⁶

Although very effective, the MEP was more expensive than the government had estimated. As a result of that the MEP was cancelled in September 2006. The MEP was the forerunner of the Support scheme to stimulate the production of renewable electricity (SDE). This support scheme for renewable electricity came into force on 1 April 2008. The SDE consists of a variable allowance per megawatt-hour produced. The allowance is based on predetermined base prices and corrections. Depending on the type of production device, the support scheme may entitle its owner to receive support for twelve to fifteen years. The national government aims to provide lasting security to help investors recover their costs.

Finally, it is worth commenting on the system developed in Finland.³⁷ The excise duty on electricity is graded into lower (II) and higher (I) categories. The lower duty is charged on electricity which is used in the mining of minerals, in industrial manufacturing or professional greenhouse cultivation and measured separately. This duty is € 2.63/MWh. All other cases fall under category I and the duty is € 8.83/MWh. In general, the consumption of electricity from RES is also taxable; nevertheless all operators of plants generating electricity from RES (wind energy, recycled fuels, biogas and small hydroelectric power stations having a nominal power of 1MVA max., and forest chips) are entitled to a subsidy by statutory law in order to offset the tax they must pay annually to electricity producers, who normally transfer it to the consumer. Thus, the subsidy is used to reduce the price of renewable energies. The subsidy is € 4.2/MWh except for electricity generated by wind power and forest chips, for which the subsidy is € 6.9/MWh, and electricity generated by recycled fuels, for which the subsidy is € 2.5/MWh. The application for the subsidy has to be lodged with the Customs District of the area of the domicile of the power plant and no subsidy is paid when the volume of electricity referred to in the application is less than 100 MWh. This subsidy is established also to reduce the price of the renewable electricity.

Table 3

Tax incentives in indirect, pigouvian and others taxes.
Source: Own elaboration.

	VAT	Excise duty exemptions	CCL	Other taxes
Denmark		✓		
Finland				✓
France	✓			
Germany		✓		
Italy	✓			
Netherlands				✓
Poland		✓		
Portugal	✓			
Romania		✓		
Slovakia		✓		
Sweden		✓		
United Kingdom			✓	

Table 3 summarizes this subsection, and shows the MSs that implement tax incentives in indirect taxes and the specific tax that is used.

6. Remarks

Proliferation of RES in the power sector is primarily a political decision which can be implemented by using a large range of promotion instruments.

In promoting green electricity, there are probably no "perfect" tax incentives that should be widely applied in all situations and countries.

Tax incentives used to promote green electricity in UE-27 are mainly designed as tax exemptions, rebates on taxes, tax refunds and by applying lower tax rates on activities promoted. Not all available technologies are promoted because their choice depends on national priorities.

Sixteen MSs have used tax incentives to promote green electricity simultaneously with other promotion measures, especially quota obligations and price regulation. Therefore, the effectiveness of the tax incentives cannot be assessed independently of the other measures. However, it can be argued that in recent years six countries of the eight that have had the greatest increases in green electricity production have some kind of tax incentive. Only three countries of those that have some sort of tax incentives have had slight growth in green electricity, which can be related to other difficulties, such as legislative changes or high administrative barriers. Therefore many welcome the establishment of such tax measures, even though other complementary measures may also be important.

Based on the number of MSs which use the tax incentives, we can draw the following conclusions:

Six MSs have included an exemption from the payments of excises duties for electricity when the electricity is generated from RES: Germany, Romania, Slovak Republic, Denmark, Sweden and Poland. In some of these countries, tax exemption is allowed only if green electricity is generated using specific technologies. This is the tax incentive most widely used.

Tax incentives in personal income tax are offered in two different ways: (i) as a deduction on the taxable income, which is calculated as a percentage of investment cost of the PV system installed at home (Belgium and France use this tax incentive with a limit per home) and (ii) as a tax exemption on the taxpayers income that comes from generated green electricity (Czech Republic) and to electricity producers that produce electricity exclusively for their own use (Luxembourg, with a capacity limit).

³⁵ Gan et al. (2007).

³⁶ The burden of the MEP levy on final energy consumers is compensated by an equivalent reduction in annual ecotax charges. The MEP is therefore financially neutral to electricity customers. The cost of the tax exemption is borne by the public budget of the Netherlands.

³⁷ See National Board of Customs (2008) and Ericsson et al. (2004).

In corporate tax, incentives consist mainly of a deduction in the taxable profit (Belgium, Greece and Spain). These are designed as a tax exemption on the profit generated by exploiting RES (Belgium), and a tax exemption on corporate annual contributions to funds that will finance plants for green electricity (Greece). In Spain, tax incentives allow for the deduction from the corporate profit of a percentage of the cost of investment for installing RES systems. Finally, in the Czech Republic, income from generating green electricity is exempted from corporate tax.

Lower VAT rates are applied in three MSs – France, Italy and Portugal.

Only Spain and Italy effectively use tax incentives in property tax as a tax exemption.

Tax incentives in CCL are implemented only in one MS (the United Kingdom) which has this levy.

A great diversity of tax incentives has been introduced by the MSs in order to promote green electricity. That diversity could be related to the objective of each specific measure, and the different potentials to increase production of green electricity. It seems that income tax incentives for individuals or on their property are related to the promotion of the non-commercial production of electricity, while indirect tax incentives are intended primarily to reduce commercial prices in order to make them competitive. On the other hand, incentives in corporate tax are linked mainly to the reduction of investment costs in new plants.

This diversity of policies offers a useful set of case studies which can be used to inform EU policy development.

From the energy policy perspective, the implementation of these incentives in a larger context might be considered. In a wider EU-27 level, the implementation of some of the tax incentives discussed in this paper might have some pros and cons. The main advantage would be the promotion of renewable energy in a wider area, e.g. OECD, thus might cause the reduction of the demand stress of non RES. On the other hand, the different national commitment in the GEI abatement would be a disadvantage for extending these tax incentives.

The different weight that each RES technology has in the EU-27 is a disadvantage to the application of standard electricity tax incentives green in the EU-27 (e.g. MSs as Spain might be more interested in solar energy while other countries such as Denmark would prefer wind energy). In the present context, MSs can promote technologies which can improve their self-sufficiency and therefore their optimal energy mix.

However, from the investor's point of view, although taxes are only one part of the investment decision could be decisive. If the tax incentives are considered, they could affect positively to the investment's return rate and thus to its promotion.

Moreover, if common politics ensures the permanence of tax incentives in the medium and large term, taking into account the lifetime of the plants, the investment decisions in the green power generation sector can also be improved (e.g. *Caldés et al. (2009)* for the thermo solar electricity case).

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