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SUSTAINABLE DEVELOPMENT FOUNDATION
Fondazione per lo Sviluppo Sostenibile

ZEROCARBONRAILWAYS

Final Report

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This document is the Final Report of the "Zero Carbon" Project.

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Coordination: Veronica Aneris, UIC Senior Advisor Energy and Environment

Technical support: Sustainable Development Foundation (Team: Raimondo Orsini, Massimo Ciuffini, Daniele Arena)

Thanks in particular to Nick Craven (UIC), Edward Christie and Ethem Pekin (CER).

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The conclusions of this Report will be submitted for final approval to the UIC Expert Network meeting, to be held in Paris on September 10th/11th 2014.

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1.1. Legal framework: a quick view

The European Internal Markets Electricity (IEM) Directive 2009/72/EC of the European Parliament and of the Council (and its predecessors 1996/92/EC and 2003/54/EC) liberalises the electricity market across the member states of the EU, creating a framework for a common market for electricity.

The existence of a competitive internal market is a strategic instrument in terms both of giving European consumers a choice between different companies supplying electricity at reasonable prices, and of making the market accessible for all suppliers, especially the smallest and those investing in renewable forms of energy.

In liberalised electricity markets, consumers have a choice not only of their energy supplier, but also of the energy product they wish to buy. As a result, they can choose among different offers in terms of price, but also in terms of company profile and the sources of energy and technologies used for electricity production.

Electricity suppliers **must** disclose to their customers (Directive 2009/72/EC, art. 3):

the contribution of different energy sources to their supply portfolio in the preceding year;

related environmental impact indicators, which must include the CO_2 emissions and nuclear waste that have been produced.

On the other hand, it is necessary to keep in mind that the physical electricity that consumer A will use is indistinguishable from the physical electricity used by consumer B, even if A chooses a "greener" procurement. This is unavoidable, because everyone is served through the same transmission and distribution system: once the electricity produced by a production plant is put into the common transmission and distribution system, it is mixed with all electricity produced in other production plants and it is thus impossible to set the different sources physically apart anymore.

According to the Directive 2009/28/EC, Member States shall ensure that the origin of electricity produced from renewable energy sources can be guaranteed by a **Guarantee of Origin** (GO), defined in article 15 of the Directive.

The GO, a "certificate", provides a "track record" of the energy source.

A Guarantee of Origin shall specify at least:

- the energy source from which the energy was produced and the start and end dates of production;
- whether it relates to electricity;
- the identity, location, type and capacity of the installation where the energy was produced;
- whether and to what extent the installation has benefited from investment support;
- the date on which the installation became operational;
- the date and country of issue and a unique identification number.

Each unique certificate can be transferred from energy generator to electricity supplier to final consumer.

Guarantees of origin issued for the purpose of Directive 28/2009/EC have the sole function of proving to a **final customer** that a given share or quantity of electricity was produced from renewable sources. The guarantee of origin shall have no function in terms of a Member State's compliance with mandatory national overall targets and measures for the use of energy from renewable sources.

In this framework, Guarantees of Origin according to directive 2009/28/EC (or RECs) are *tracking* or *disclosure certificates* because they are used ("cancelled") by electricity suppliers to guarantee that the origin of electricity sold to their customers is of a specified origin, and by large electricity consumers to make claims of the origin of consumed energy.

With a view to ensuring that a unit of electricity from renewable energy sources is disclosed to a customer only once, **double counting** and **double disclosure** of guarantees of origin should be avoided. In particular:

1) The amount of energy from renewable sources corresponding to Guarantees of Origin transferred by an electricity supplier to a third party shall be deducted from the share of energy from renewable sources in its energy mix[1].
2) The energy origin of electricity, tracked through *tracking or disclosure certificates*, shall be removed from the energy origin of electricity disclosed to consumers who have purchased "general electricity" without a specified origin. This process is called the *residual mix calculation* and it is crucial for the reliability of the tracking system.

Energy certificates, as GO or Renewable Energy Certificates (REC), are created by an independent "issuing body", which guarantees their quality and credibility by means of various checks and controls. They can then be transferred between accounts held on a central registration database (otherwise known as a "registry") by market participants.

When the associated energy is sold to a final consumer, or perhaps used as evidence by a public body, then the certificate is made non-tradable and moved to a separate account from tradable certificates[2].

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[1] See also the notes in sections A.2.1 and A.2.2 in CEN document "Energy consumption and GHG emissions in relation to transport services" (CEN/TC 320/WG 10)

[2] It is essential to differentiate green certificates, called quota or support certificates, used for support schemes, from tracking or disclosure certificates as Guarantees of Origin or RECs. Support or quota certificate schemes are used for renewable energy support e.g. in Belgium, Great Britain (Renewable Obligation Certificate), India (REC), Italy (Certificati Verdi), Romania, as well as in Norway and Sweden (Elcertificate). According to the Directive 2009/28/EC (Art. 15), "Member States may provide that no support be granted to a producer when that producer receives a guarantee of origin for the same production of energy from renewable sources".

1.2. The certificates market

In parallel to the growth in renewable energy production, the voluntary use of renewable electricity by companies has also been growing.

Tracking or disclosure certificates such as RECs or GOs are currently used by some of the world's largest corporations, e.g. Ikea, Tetrapak, Kraft Foods, Carlsberg, Coca-Cola, Cisco, Starbucks, Sony, Philips etc.

In 2001 the Renewable Electricity Certificates System (RECS) was introduced. Almost at the same time the initial Renewables Directive 2001/77/EC brought about the introduction of the GO. The Association of Issuing Bodies (AIB) set up the European Energy Certificate System (the EECS System) to be able to handle both the REC certificate and the GO.

The main models for corporate use of renewable energy are:

a) Direct investment

A company directly **invests in on-site renewable energy assets** and consumes the energy generated. The assets are sometimes connected to the local grid for the sale of surplus power and for the purchase of any deficit. In order for the company to claim that the energy consumed is renewable, GO/RECs must be withdrawn by the company rather than sold. If applicable, surplus power and the associated GO/RECs may both be sold.

b) Power purchase agreement (PPA)

The company purchases electricity from a **specific renewable energy project** and the associated GO/RECs are produced. These are long-term bilateral agreements, which contain clear commercial terms for the transfer of electricity and the associated GO/RECs between the two parties. The assets are either hosted remotely (the renewable energy is then transported through the grid) or located at the site of the company (e.g., photovoltaic systems on an office roof).

c) Green power procurement

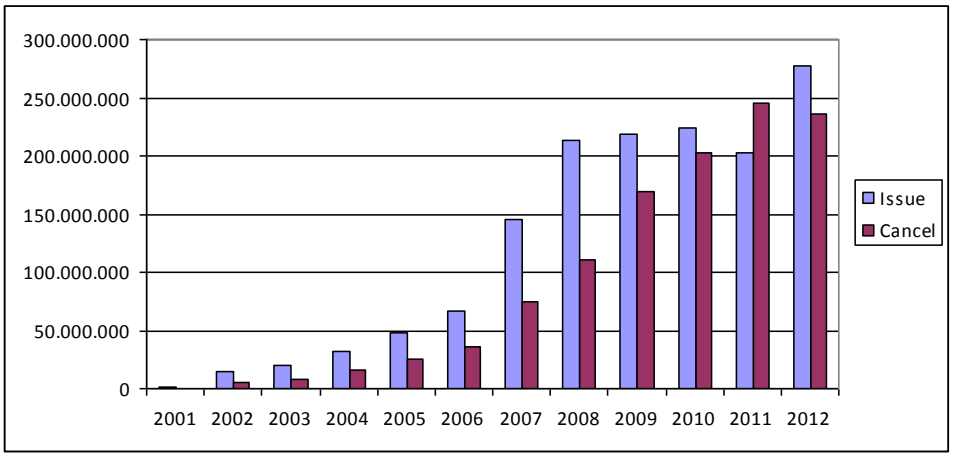
An energy supplier offers the purchasing company a guarantee with GO/RECs that its power has been produced using a certain percentage of renewable energy. Normally the supplier simply buys certificates as GO/RECs but **in some cases the supplier's own assets may be feeding power into the grid**. In either case, the recipient of the electricity can claim that they are purchasing renewable energy while the burden of assuring its origin is on the supplier.

d) Renewable energy certificate (GO/REC) procurement

Companies **procuring credits from the voluntary market** can claim, after certificates have been used (cancelled), that they have purchased a quantity of renewable energy corresponding to the number of GO/RECs. Traders may manage and withdraw the GO/RECs on the company's behalf, or the company may do this in-house.

The Renewable Energy Sources (RES) market is still evolving and growing: in the first year of trading (2001) only a few hundred GWh of electricity was delivered from production site to end-user. Since then growth has averaged 35% a year and in 2012 the market traded more than 250 TWh of electricity in Europe through the standardized EECS system (see Fig. 1). This quantity represents more than 30% of all European electricity produced from renewable sources in the same year.

Fig. 1: Transactions of EECS certificates during 2001 – 2012 (MWh)

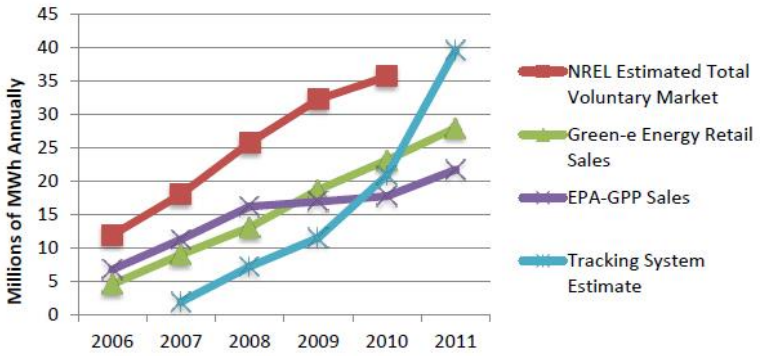


Source: AIB

GO prices are based on the same principles as all supply and demand markets. Under directive 2009/28/EC, Art.15, Guarantees of Origin must be used (and then cancelled) within 12 months from the production of the underlying energy or they become expired. However, not all countries have implemented this procedure yet, which enable cancellations to vastly exceed issuing during a specific year.

As shown in Fig. 2, the United States Voluntary REC markets also continue to exhibit growth.

Fig. 2: Estimated annual voluntary sales in U.S. by market sector, 2006–2011



Source: U.S. Department of Energy

In both markets – European and American – there is a **large spread of costs** depending on technology (hydro, wind, bio or geothermal), maturity (e.g. age of the installation), size, documentation of the products and point of delivery (wholesale or final customer).

To give some examples (prices for 2013 in the wholesale market) in Euro per certificate (1 MWh):

- GO based on hydro installation older than 12 years without any further specification (commodity product): 0.16-0.20 €
- GO based on hydro installation less than 6 years old: 1.8 €
- GO from Norwegian wind power: 0.6-0.7 €

Prices in the end customer market are significantly higher, **up to 4-6 Euro** for specific products/ecolabels with thorough documentation. There is in fact a tendency in the market to pay more attention to the "quality" of electric power, guaranteed by disclosure certificates.

Some sophisticated products are emerging in the market, with specific characteristics such as:

- Direct contribution to new energy production. Some certificates cover up to 15 % of the total project costs.
- Exclusion of "mature" renewable technologies
- Guaranteed minimum project allocation. Some certificates are based on a firm investment allocation guarantee and a predefined share of the total will be directly allocated to a named project
- Third party verification on investment flows and project development

As a comparison, the current average **gross prices** of electric power in Europe for non-household use are considerably higher: they go from a maximum of 227.9 Euro/MWh (consumption up to 20 MWh) to a minimum of 103.7 Euro/MWh (consumption between 70-150 GWh)[3].

1.3. A supplementary system to foster RES

It is important to understand that the function of RECs and GOs goes beyond allowing individual consumers to purchase certified electricity to express environmental values, or enabling large consumers to increase the share of renewables in their electricity mix for carbon accounting or as an instrument of green marketing.

RECs and GOs are not just an indirect support to renewable energies, operating on the demand side: they can be also a supply-side instrument, supporting renewable energy producers with the influx of new capital.

Fig. 3 describes the flow of money and electricity connecting the different market players, showing how renewable energy producers gain extra revenue from selling energy certificates in the certificate markets:

The electricity producer is issued 1 energy certificate for each MWh of production. It can sell the electricity in the electricity markets and the certificate in the certificate markets for extra revenue

The energy certificate, representing the generation attributes of the underlying MWh, can be traded in the certificate markets regardless of the trading of the related electricity

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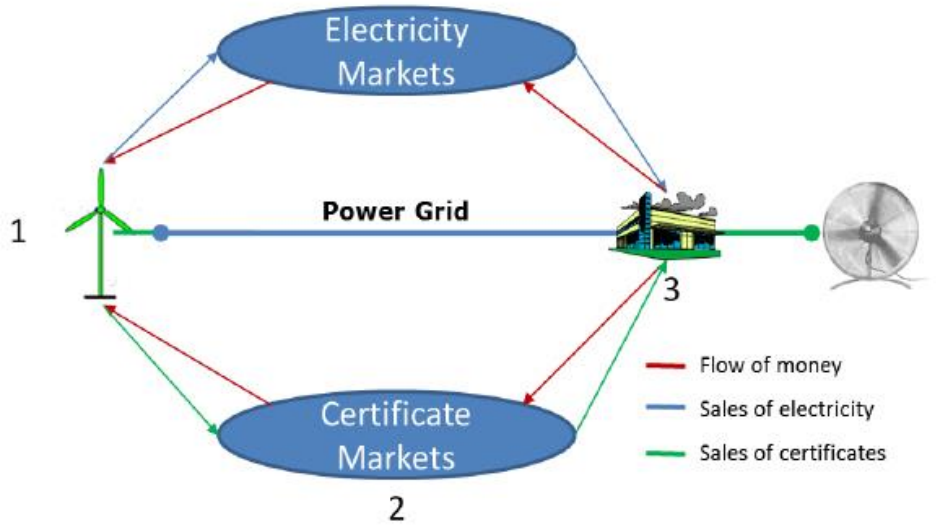
[3] (*Source: Eurostat, year 2012*): please note that the above mentioned numbers are the average *final prices* to the general customers in Europe, including all forms of taxes, contributions, etc. The European Railway companies may pay in some cases a significantly different price, due to many reasons (subsidies, exemptions, specific agreements with national government, etc.)

Electricity suppliers or large electricity consumers (e.g. railway companies) purchase tracking certificates, paying a premium price for electricity which is guaranteed to originate from renewable energy sources

The system of GO financing will most probably not replace national support schemes, but it can provide a valuable **supplement to other sources of financing**. The consolidation of the voluntary certificates market increases the incentive to the production of renewable energy: as the demand for tracking or disclosure certificates (RECs or GOs) grows, so does their price and therefore the extra revenue for the energy producer.

Fig. 3: Renewable producers gain extra revenue from selling energy certificates in the certificate markets



Source: Grexell

2. The use of GO and RECs by European railways

UIC and the Sustainable Development Foundation sent in May 2013 a questionnaire to UIC/CER members with the goal of understanding what electricity mix is used by railway companies to calculate their CO_2 emissions and whether railway companies are currently using RECs or GOs. The questionnaire was sent to 37 members: of those, **21 railway companies replied**.

The survey asked the following questions:

- Is there a difference in your country between national production mix and national consumption mix? If so, what is your national consumption mix?
- Is the railway using a specific electricity mix, different from the National production or National consumption?
- Does your railway include in the "specific railway mix" any voluntary instruments such as green certificates or RECs? If so, could you please explain us in detail the type of instrument used?
- Does your railway have a decarbonisation strategy for electricity with targets for the next years (2020/2030/2050)? Could you please send us some details (e.g. case studies, scenarios, best practices)?

Table 1: Questionnaire report

Railway	National Production Mix	National Consumption Mix	Railway Mix	Use of RECs or GOs
ATOC				
CP			x	no
DB			x	yes
DSB				yes
FS		x		no
Greencargo			x	yes
HZ		x		no
LDZ	x			no
LG	x			no
MAV		x		no
NS			x	yes
NSB			x	yes
OBB			x	yes
PKP			x	yes
RENFE			x	yes
SBB			x	no

Railway	National Production Mix	National Consumption Mix	Railway Mix	Use of RECs or GOs
SJ			x	yes
SNCB			x	no
SNCF		x		no
SZ			x	no
Trafikverket			x	yes
VR			x	yes

Source: SUSDEF 2013

As can be seen from

Table 1 the picture is quite diversified. For the most, the railway companies that answered the questionnaire use the mix of their electricity providers. This option is in fact recommended by the methodology developed by UIC (in the context of the *Environment Strategy Reporting System* or ESRS) and by the CEN Standard.

It has to be noted that most of the companies that use the mix of their provider also make use of some form of certificate such as REC or GO in order to ensure that they can declare a share of renewables higher than their provider mix or the national production mix (or rather the national residual mix).

The following railways used in 2013 RECs or GO certificates and include them into their calculation of CO_2 emissions generated by traction: **VR, SJ, Greencargo, NSB, DSB, PKP, OBB, NS, DB and RENFE**.

The total electricity consumed by these 10 railway companies (in 2012) corresponds to 18.6 TWh, meaning the 42% of the total electricity consumed by the European railway sector.

These results have been generally confirmed by a new questionnaire sent to UIC/CER member railways by UIC and the Sustainable Development Foundation in March 2014, which included questions on the use of Green Electricity Certificates by railways. The answers showed that some railways (VR, DSB, NSB, GreenCargo) are purchasing 100% of electricity from renewable sources with green certificates.

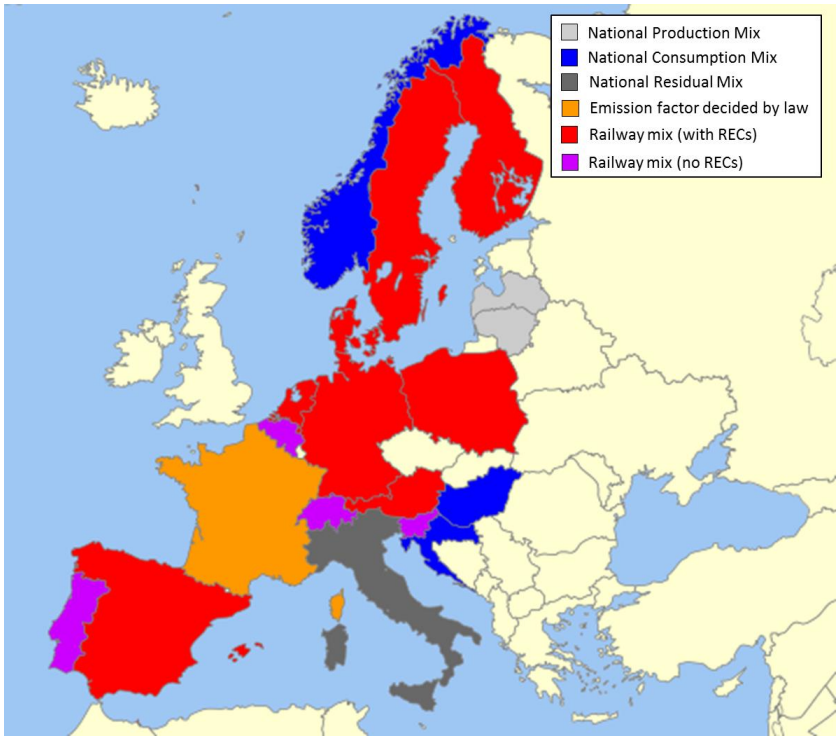
2.1. The UIC Zero-Carbon Workshop

In May 2014, UIC organized in Paris a workshop- open to all member railways- to discuss the issues related to the Zero Carbon project. In this workshop, participating railways had the possibility to show their practices to the workshop attendees and share suggestions and vision. 16 Railway companies were present. The opening presentations are available at http://www.uic.org/spip.php?article3250 . Here follows a very brief description:

- RENFE sent a written input describing the situation in Spain, where on a year-by-year basis the contract with energy suppliers are renegotiated and suppliers are changed, giving rise to a completely different electricity mix every year.

- Deutsche Bahn presented the company's green energy strategy, which contains a goal of 35% renewables in the traction electricity mix by 2020. DB assigns different energy mixes to different business units and different categories of passengers, which took the share of renewables of long-distance traffic to 75%. For this, DB acquires 1.2 TWh of green power annually.
- NS showed how they are stimulating new wind farm projects for 1.2 TWh (the total amount of electricity consumed by the railways) by buying GOs from them, aiming at carbon-free traction in 2018.
- SNCF explained how they are not buying green certificates, as the emission factor for electric transport in France is determined by law (French Decree n. 2011-1336) as 53 gCO_2/kWh.
- FS described how they are not buying green certificates, but using for CO_2 calculation the *national residual mix instead*, which is gradually getting "dirtier", since more and more electricity from renewables is sold through green certificates; this process is worsening FS traction emissions.
- NSB showed that Norway country is selling a huge amount of certificates, and NSB is buying GO for 100% of its electric consumption; however, GOs are not taken into account in the NSB emissions calculator. They explained why in their opinion GOs should not be included in the calculation: risks of double counting, lack of stimuli for reducing energy efficiency and renovating power plants, and risks of ineffective communication.
- CER outlined the necessity for railways to use those indicators that would fit better in describing the sector's efforts towards the targets in a European context and to compare the data with other transport modes, taking into consideration that the "physical" mix approach is the only one accepted by EUROSTAT and EU Commission for official member states and sector targets. International bodies including EEA, IEA and Eurostat never include GOs and RECs in their calculations. Reporting of the European railway sector should follow the EU legislation (Article 15 of Directive 2009/28/EC) thus aggregated sector data should not include the GOs so that discrepancies between the sector statistics and other official data sources are minimised.

Fig. 4: Electricity mix used by European railways



3. Inclusion of RECs/GOs in the UIC/CER 2020-2030 CO_2 reduction strategy?

In 2008, CER members agreed on a CO_2 reduction target for the whole European railway sector: 30% specific emissions reduction in 2020 compared to 1990 baseline year.

UIC and CER General Assemblies voted in December 2010 the "*European Rail Sector Sustainable Mobility Strategy"* that envisages specific targets for energy efficiency, CO_2 emissions reduction, PM/NOx emissions reduction and noise reduction to be met by the EU railway sector in 2030 and 2050.

By 2030 the European railways will reduce their specific average CO_2 emissions from train operation by 50% compared to base year 1990. In addition, by 2030 the European railways will not exceed the total CO_2 emission level from train operation in absolute terms even with projected traffic growth compared to base year 1990.

In order to monitor the environmental performance of the European Railway Sector towards the four targets set by the UIC/CER Sustainable Mobility Strategy 2030 and beyond, the UIC Environmental Strategy Reporting System (ESRS) has been created as a comprehensive instrument which allows the overall procedure of construction of indicators, data collection, analysis, reporting and data sharing to be regulated in a clear and transparent structure.

The ESRS is an evolution of the UIC Energy & CO_2 Database, which was started in 2005 to collect and analyse the railway sector's energy and CO_2 performance values, and has been updated on an annual basis. The database takes into account figures regarding both passenger and freight service, and has been used to show the picture of full energy/CO_2 performance data from the year 1990.

Further aims of the ESRS are the following:

- Collect, analyse and verify the consistency of key environmental performance data from all European member railway operators;
- Provide correct information about the environmental performance of railways, internally and externally, to all stakeholders such as institutions, customers, media etc.;
- Understand the trend of the sector for comprehension, improvement and benchmarking purposes;
- Provide data to the on-line environmental calculators *Ecopassenger* and *EcoTransIT World*

The ESRS **is ruled by a specific methodology**[4] as a guideline to collect, account and report the environmental Key Performance Indicators (KPI) of UIC/CER railway members.

To calculate specific CO_2 emissions linked to the corresponding energy consumption the electricity mix (described as "*the mix of energy sources used to generate electricity for the railway*") is needed.

[4] that can be requested via e-mail at the address: co2-data@uic.org

According to the ESRS methodological rules, "the electricity mix provided should be the one corresponding to the electricity **purchased by the railway operator** or **distributed by the infrastructure manager to the operator"**.

The ESRS methodology underlines that this electricity mix "may be different from the national electricity mix (for instance when an operator or an infrastructure manager purchases electricity from a specific energy provider guaranteeing a "greener" mix)".

If the railway specific mix is not available, the methodology allows to use the national electricity mix but "what should be reported is not the electricity mix produced nationally (national electricity production mix) but rather the electricity mix consumed nationally (national electricity consumption mix), which might be significantly different, due to energy imports and exports".

For the ESRS methodology the use of "*Renewable Energy Certificates*", as well as other "*CO_2-free procurement*" in general is regulated as decided by the UIC Green Certificates Workshop of January 26th, 2011.

The 2011 Workshop conclusions (*Golden Rules*) were:

- Green Electricity direct procurement by contract is preferable;
- Carbon offsetting will not be included in the UIC CO_2 reduction database;
- RECs and GOs can be used, but need regulations, UIC/CER guidelines and open consensus by NGOs.

The methodology on this last point notes that "The subject is a dynamic topic, therefore further analysis is necessary" and in the footnotes remarks that "UIC is currently carrying out the **Zero-carbon energy project** which will provide shared and common guidelines related to the accountability and reporting of CO_2-free energy products and this guideline will constitute an integral part of this methodological book, when the project will be completed".

This document is the first step of the Zero-carbon energy project.

3.1. Accountability of green electricity procurement

There are discordant opinions on the benefit that green electricity procurement can bring to the development of renewable energy sources.

Several NGOs are sceptical on whether consumers can actually influence the energy market towards sustainability by choosing their energy provider in function of how "green" the electricity mix of the power provided is. They claim that currently, the renewable energy share is only transferred from one consumer to another without impacting the global balance; and this will happen until the GO/REC demand is lower than the renewable energy production, in particular from recent installations (and not from decades-old installations). Doubts are also raised on the possibility of having a certificate exchange system which is strongly accurate, reliable and fraud-resistant.

The sceptic NGOs' view is that the green certificates system is purely a "mind game" potentially generating contradictory messages, without creating "additionality" (i.e. new renewable energy installations). They see as "wishful thinking" the possibility of extra revenue coming from certificate sales being invested in the installation of plants for renewable energy production.

Railways need to increase the use of renewable energy and at the same time keep their environmental credibility: a greening strategy must be credible and widely accepted.

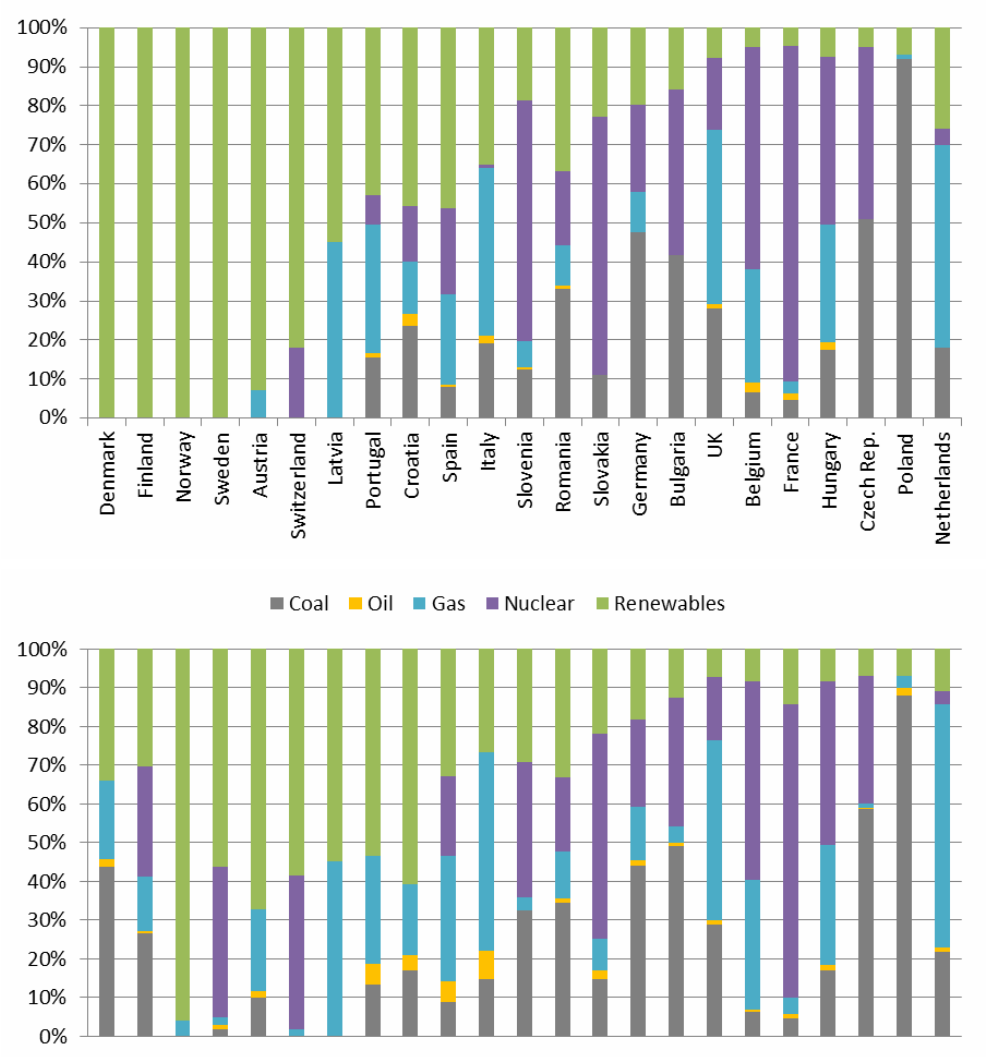
Possible threats to credibility could come by buying Renewable Energy Certificates (REC) or Guarantees of Origin (GO) which, as seen above, suffer from mixed reviews from third parties.

A number of NGOs and technical bodies have questioned the acceptability of some *green electricity procurement*, calculated as CO_2 savings by railway sector.

For example:

- Since 2012 **IFEU** (*Institut für Energie- und Umweltforschung* - Institute for Energy and Environmental Research) does not certify *EcoPassenger* and did not fully trust the *UIC energy/CO_2 database*, because of the inclusion of GO/RECs by some UIC members in their electricity mix.
- A warning from the **International Energy Agency** was also received. The IEA informally questioned in 2013 how it was possible (see Fig. 5) that the mix of energy sources used to generate electricity for the railways was so different from the national production mix.
- The **European Environment Agency** (EEA) publishes yearly data on Transport (TERM Report) excluding GOs and RECS from any calculation and referring only to the physical national electricity mixes, in line with EUROSTAT values.
- The Methodology Working Group of **EcoTransIt World**, the CO_2 emissions tool of which UIC, DB Schenker and other railway companies are members, decided in April 2014 that in the public version available on line (www.ecotransit.org) only the physical electricity mix will be used for calculations, while in the company business solution of the tool each company can include GOs and RECs in the carbon footprint company balance.

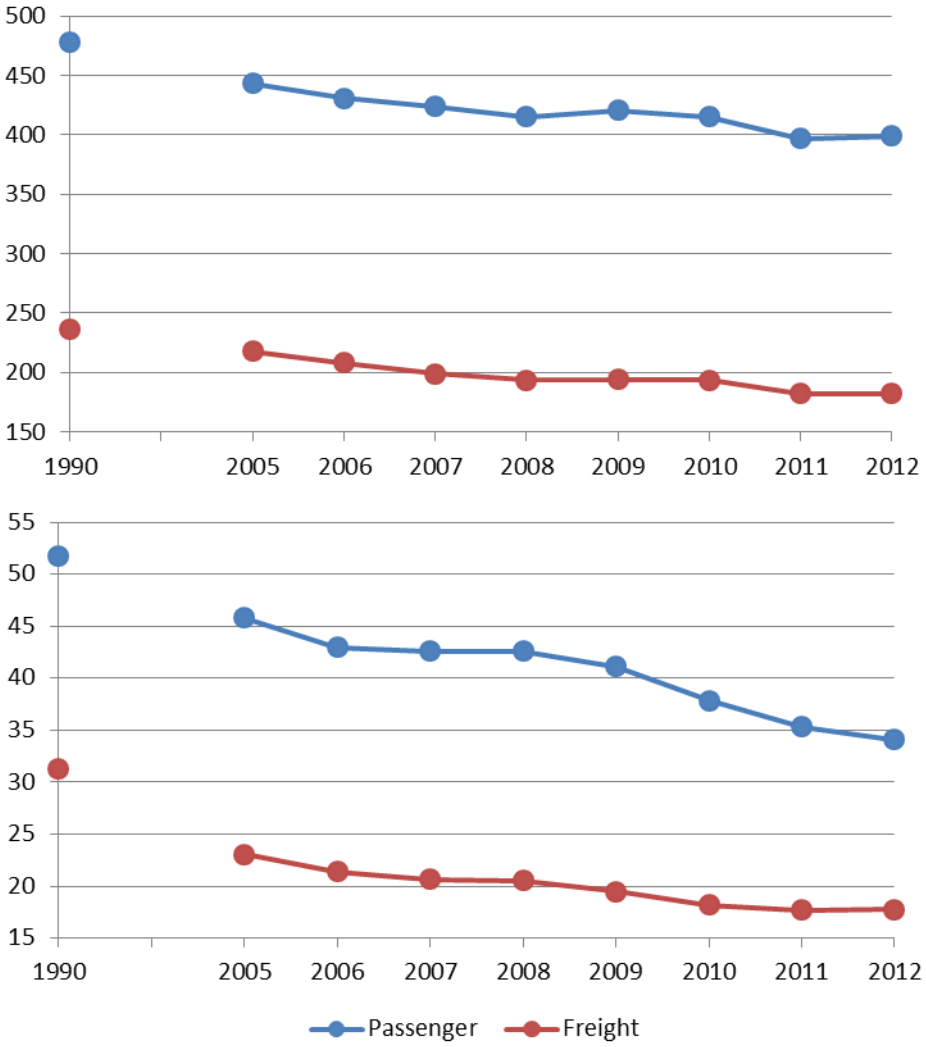
Fig. 5: Railway operator mix (ESRS) and national production mix



Source: IEA (2010 data)

The energy and CO_2 monitoring report to 2020-2030 UIC/CER strategy targets shows that the improvement in energy efficiency of the European railway sector is in line with the targets set in the European Rail Sector Sustainable Mobility Strategy, while for CO_2 emissions there is a much greater reduction (see Fig. 6).

Fig. 6: Specific energy consumption and average CO_2 emissions in railways 2012 (kJ/pkm-tkm, gCO_2/pkm-tkm)



Source: UIC ESRS Database

This excellent performance of the railway sector is in part due to specific policies implemented by the railway sector players (for example the increasing electrification of lines at the expense of diesel), but it is also in part the consequence of external factors such as the increase of renewable sources in the production of electricity in Europe: at European level renewables made 12% of the electricity mix in 1990, 15% in 2006 to finally reach 21% in 2010 (source: IEA).

The greening of the electricity mix has benefited the railway sector more than any other transport mode, as rail is the mode that uses electric traction the most: the total use of renewables in railways reaches 18% in 2010, compared to less than 5% in the transport sector as a whole (see Fig. 7).

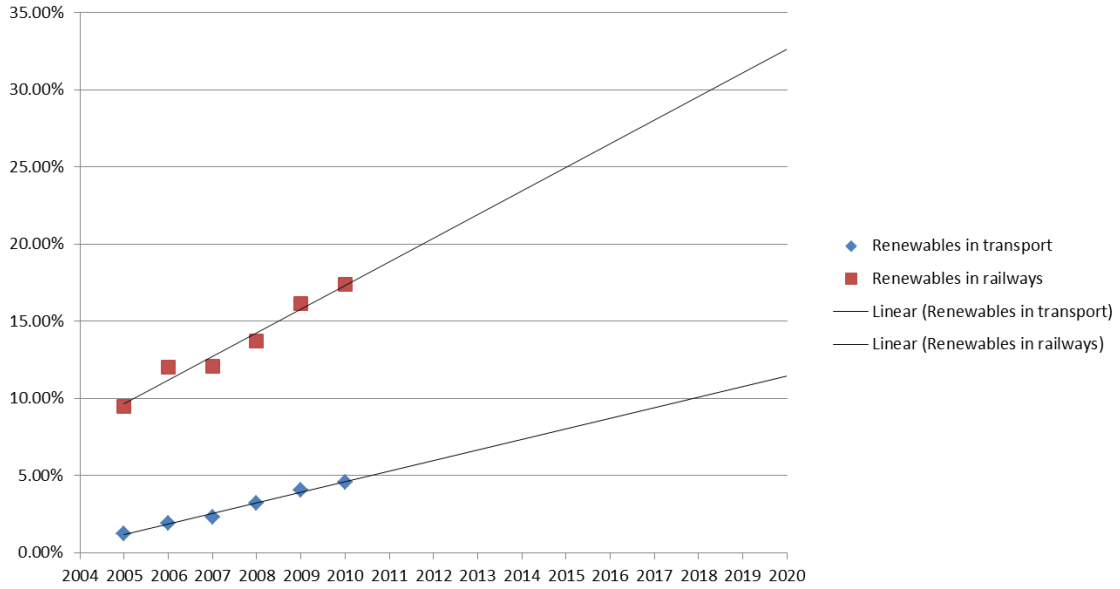
One of the advantages of the use of electricity is the possibility for railway undertakings to easily resort (in comparison with other transport modes) to the main forms of use of

renewable energy such as *Green power procurement* and *Renewable energy certificate (GO/REC) procurement*. Railway undertakings want to showcase their individual performance. At the same time, commonly accepted indicators that describe the sector's efforts and progress to-date for the sector targets are also needed.

The **two main issues** to be considered are:

- Should GOs and RECs be fully included in the calculation of UIC/CER European railway sector voluntary targets through the UIC Environmental Performance Database?
- Should GOs and RECs be included in the methodology of *Ecopassenger* ?

Fig. 7: Renewables in transport and railways in EU27 (%)



Source: Elaboration by Susdef based on IEA (2012b) and UIC (2012b)

3.2. The opinion of some key stakeholders

The Sustainable Development Foundation, on behalf of UIC and in cooperation with CER, has undertaken a series of *informal talks* between June 2013 and February 2014, with the following organizations:

1. EU commission – DG energy
2. EEA (European Environment Agency)
3. NTM (Scandinavian transport network)
4. ECOHZ (Norwegian provider of GO certificates)
5. ADEME (French environment authority)
6. GSE S.p.A (Italian state-owned company which promotes the use of renewables and – among other activities – purchases renewable electricity from producers and re-sells it in the market).

7. DB
8. IFEU (German institute for environment and energy research)
9. Transport and Environment (Brussel-based NGO)

As an introduction, in all meetings the UIC Environment Strategy Reporting System (ESRS) was presented. Afterwards, a number of questions have been asked to the stakeholders, taking their roles and objectives into account. The counterparts were asked how they viewed the use of REC and GO certificates, in general and specifically their use in the ESRS methodology.

The results showed conflicting positions on the use of REC and GO certificates as an instrument.

Some stakeholders, such as EEA and IFEU, give significant importance to the issues of "additionality" and "double accounting". They foresee the following risks:

- The extra revenue from certificate sales does not turn automatically into new investments on renewable sources, or just in a very small percentage: no additional renewable electricity is generated, or very little. This can communicate an ambiguous and potentially counter-productive message.
- The absence of a homogeneous and reliable system in the different certificate markets brings about a systematic, widespread double accounting of renewable energy[5].

In general, these stakeholders consider the use of REC/GO in the calculation of UIC/CER targets as a "too easy" way to reach their decarbonisation objectives. In the precise wording of an EEA official, it would be "too little effort from the railways' side", leading to counterproductive effects for the environmental image of the railway sector.

Other counterparts, e.g. NTM, ECOHZ and GSE, are aware of the critical aspects mentioned above; however, they see those as the normal limits of a system in consolidation, which becomes more accurate and reliable the more it is used and widespread, as the success in Scandinavian countries shows. They note that:

- The presence in the market of GO and REC with specific clauses on additionality is growing;
- The awareness of market players is increasing, and so is the demand for quality;
- The electric and certificate markets in the different countries are starting to share a harmonized and reliable set of rules for certificates and tracking systems.

On this last point, GSE brings the example of EECS (the European Energy Certificate System)[6], governed by an independent non-profit organization, the Association of Issuing

[5] The RE-DISS project (Reliable Disclosure Systems for Europe) estimates the measureable error at 243 TWh/y of wrongly disclosed electricity at the time when the project was launched (2007). The figure includes about 105 TWh/y of electricity from renewable energy sources which were double-counted. This corresponds to 18% of all RES electricity generated in the countries covered by the project.

[6] The EECS Rules governs the European Energy Certificate System (EECS) – a commercially funded, integrated European framework for issuing, holding, transferring and otherwise processing

Bodies (AIB). EECS, together with the RE-DISS project in its second phase, aims to consolidate in the EU+EFTA area a single disclosure system with a single set of rules. Currently, the National Residual Electricity Mix of each participating country is available with the RE-DISS methodology.

The point of view of ADEME, the French environment authority, is peculiar as they specify that in France the quantity of carbon dioxide emitted during transport is established with the Decree n° 2011-1336 of 24 October 2011. This is the same for all other productive activities: the French system aims to "assign" CO_2 emissions to different sectors according to their seasonality. The underlying idea is that non-seasonal activities (e.g. transport or industry) which consume a constant, schedulable amount of energy throughout the year use low-carbon energy (typically nuclear and renewable). The excess electricity used typically in cold seasons (e.g. heating and lighting) "forces" the producers to fire up high-carbon plants (e.g. coal and gas), therefore seasonal activities are assigned the excess carbon emissions produced.

The EU Commission's DG Energy reported that the disclosure and the REC/GO market regulated by art. 15 of the Directive 2009/72/EC has been conceived as an incentive to the development of renewables; however, only the physical renewable energy (as reported by Eurostat and EEA) will be calculated in the objective of having 10% of renewables in the transport sector by 2020, while no "virtual" certificates and guarantees of origin will be taken into account.

Some stakeholders have suggested that the choice of including REC and GO in the ESRS would be "irreversible", i.e. it would be difficult to change the methodology in the future. This can represent a risk, for example in the following cases:

- The cost of certificates becomes much higher. In this case railways might buy less certificates, and there would be an increase in declared emissions that wouldn't be caused by real operational reasons.
- If competing sectors (e.g. electric cars) decide to adopt similar strategies, it would hinder the possibility of a reliable comparison of specific emissions between different modes of transport. In the extreme case, if all railways and all competitors using electric traction bought certificates to completely cover electricity consumption, then all those modes would be at "zero emissions" and no comparisons at all would be possible.

3.3. The need of homogeneity in the adoption of the electricity mix for the UIC Environmental Performance Database

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electronic records (EECS Certificates) certifying, in relation to specific quantities of output from production devices, attributes of its source and/or the method and quality of its production. The purpose of the EECS Rules is to secure, in a manner consistent with European Community law and relevant national laws, that systems operating within the EECS framework are reliable, secure and inter-operable. The implementation, under the EECS Rules, of harmonised standards for issuing and processing EECS Certificates enables the owners of EECS Certificates to transfer them to other Account Holders at both the domestic and international level. See http://www.aib-net.org/.

As seen in the answers to the questionnaire submitted by UIC and Susdef, the electricity mixes used by European railway companies are different in nature.

This heterogeneity in data collection can have a negative impact on the accuracy and reliability of the reports on CO_2 emissions of the European railway sector as a whole.

To better understand this technical aspect it is useful to summarise the characteristics of the different electricity mixes in question.

3.3.1. Short review of the different types of electricity mix that can be used in ESRS methodology

As reported in the introduction, the ESRS methodology indicates that the calculation of CO_2 emissions for transport operations be related to the *mix of energy sources used to generate electricity for the railway*, and thus:

the electricity purchased by the railway operator;

if that is not available, the national electricity mix (preferably the national electricity consumption mix).

Railway mix

The *railway mix* represents the mix of electricity purchased by the railway undertaking; the electricity is bought from a seller who is subject to the disclosure rules set by the European directives 2009/72/EC and 2009/28/EC.

Thus the railway mix is in fact the electricity mix of the supplier (or suppliers).

In order to certify the share of electricity produced from renewable sources, the seller has to use the so-called disclosure certificates (GO and REC), national or foreign.

National Production mix

The *national production mix* represents the share by fuel of the electricity **produced** in a given country and introduced in the network. The electricity produced can be gross or net, whether the electrical energy absorbed by the generating auxiliaries and the losses in the main generator transformers are considered or not.

In the Eurostat database it is indicated as *Gross or Net Electricity Generation by fuel* and it is available in aggregated form and per member country since 1990.

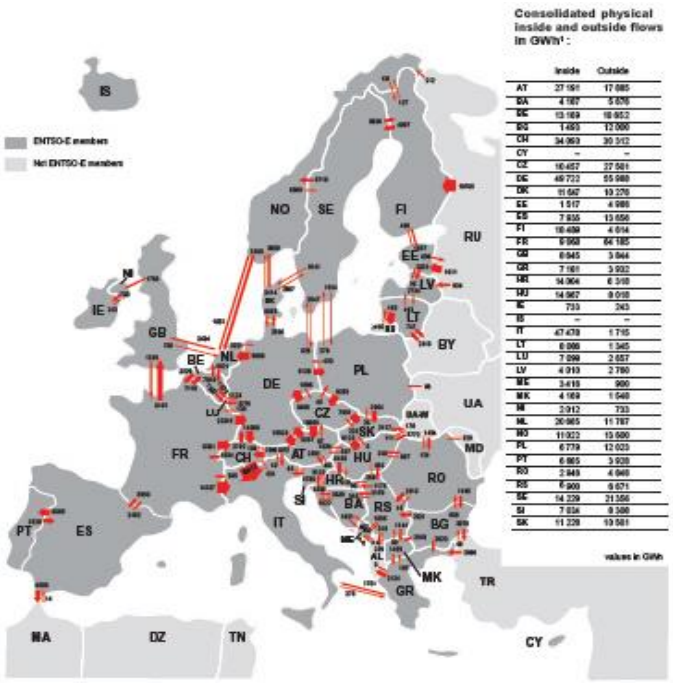
Because of technical reasons, electricity cannot be stocked, so in some contexts the national production mix has been made equal to the national consumption mix.

National Consumption mix

The national consumption mix represents the share by fuel of the electricity **consumed** in a given country. In the case of a national network, this is equal to the sum of the net electrical energy production supplied by all power stations within the country, reduced by the amount used simultaneously for pumping and reduced or increased by exports to or imports from abroad (IEA/UNIPEDE definition).

Both Eurostat and IEA provide the *Total National Consumption* per country and the international electricity flows for European countries, but not the associated electricity mix.

Fig. 8: Physical energy flows 2011 – Graphical overview in GWh

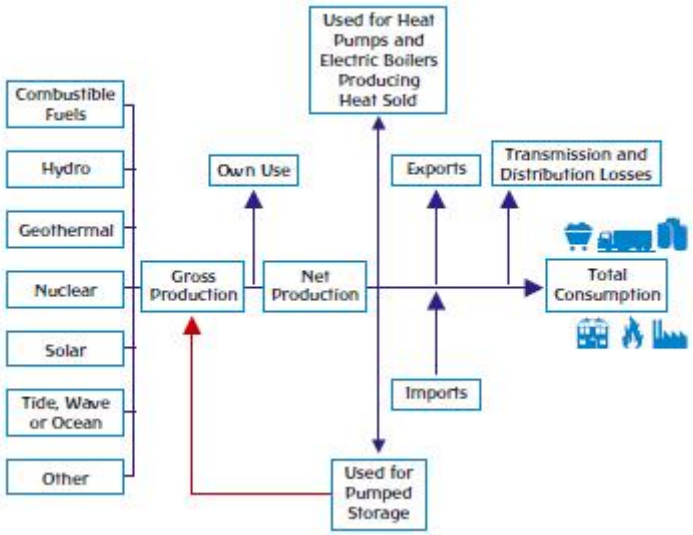


Source: ENTSO-E

As a matter of fact, it is impossible to physically identify the source of electricity exchanged between countries; the disaggregation per fuel should be calculated through a shared methodology[7] establishing how to statistically allocate the electricity exchanged by neighbouring countries.

[7] The IEA/OECD/EUROSTAT Statistic Manual mentions, when dealing with import/export electricity flows related to renewables for the "group 1" sources (wind, tide, wave, ocean, solar, photovoltaic and hydro), that "It is still very difficult (or impossible) to identify the source of traded electricity. However, the opening of green markets for the electricity might force statisticians to be in a position to break down imports and exports of electricity by source of production."

Fig. 9: Simplified Flow Chart for Electricity



Source: IEA

3.3.2. Accuracy and reliability of the calculation methodology

As seen above, there are significant exchanges of electricity between the systems of different European countries: these exchanges are both physical and virtual, i.e. through disclosure certificates. Therefore, to have accurate and reliable estimates of CO_2 emissions, the ESRS should narrow the use of electricity mixes to a single option, valid for all railway undertakings.

The fact that some companies use the railway mix, for example, means that the companies which use instead a national average have to use the national residual mix (see section 1.1), which is a mix where the REC and GO have been discounted, as they are already counted in other contexts (e.g. by the resellers).

Otherwise, some shares of renewable energy could be counted twice: once (with the production mix) in the mix of the country where they have been produced, and once in the railway mix where the related certificates have been purchased.

Regarding the residual mix calculation, the RE-DISS project[8] has developed a detailed methodology, collected data and performed calculations whose results were published,

[8] The RE-DISS (Reliable disclosure for Europe) project aims at improving significantly the reliability and accuracy of the information given to consumers of electricity in Europe regarding the origin of the electricity they are consuming. The first phase of the RE-DISS project was launched in mid April 2010 and ended in October 2012. It resulted in important improvements in the electricity tracking systems (guarantees of origin and disclosure) in several member states. RE-DISS II, the second project phase, has been launched in April 2013 and aims at overcoming the still existing shortfalls in coordination and implementation

starting from 2010, ready to be used for the disclosure information in all major countries in Europe.

Similarly, if some undertakings use the national consumption mix, there would be a risk of double accounting if other railways use the national production mix, due to the import-export flows across neighbouring countries.

Another thing to be kept into consideration is that not all possible electricity mixes (e.g. residual mixes) are available since 1990.

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of related policies in the EU27, Croatia, Norway, Switzerland and Iceland. See http://www.reliable-disclosure.org/.

4. Possible methodological options

The use for all railway undertakings of a single type of electricity mix in the calculation of CO_2 emissions is a simple technical consequence of the evolutions of the European electricity market: increase of the share of renewables, certificates market, cross-border electricity flows, etc.

On the other hand, the choice of the appropriate electricity mix for the UIC/CER ESRS might not be so straightforward and widely accepted.

Two possible approaches to this issue have been selected: physical (*grid based*) and virtual (*market based*); in order to clarify the different scenarios originating from their adoption for each approach, a SWOT analysis has been undertaken.

4.1.1. Physical approach ("grid-based")

With this approach only physical flows of electricity will be taken into account.

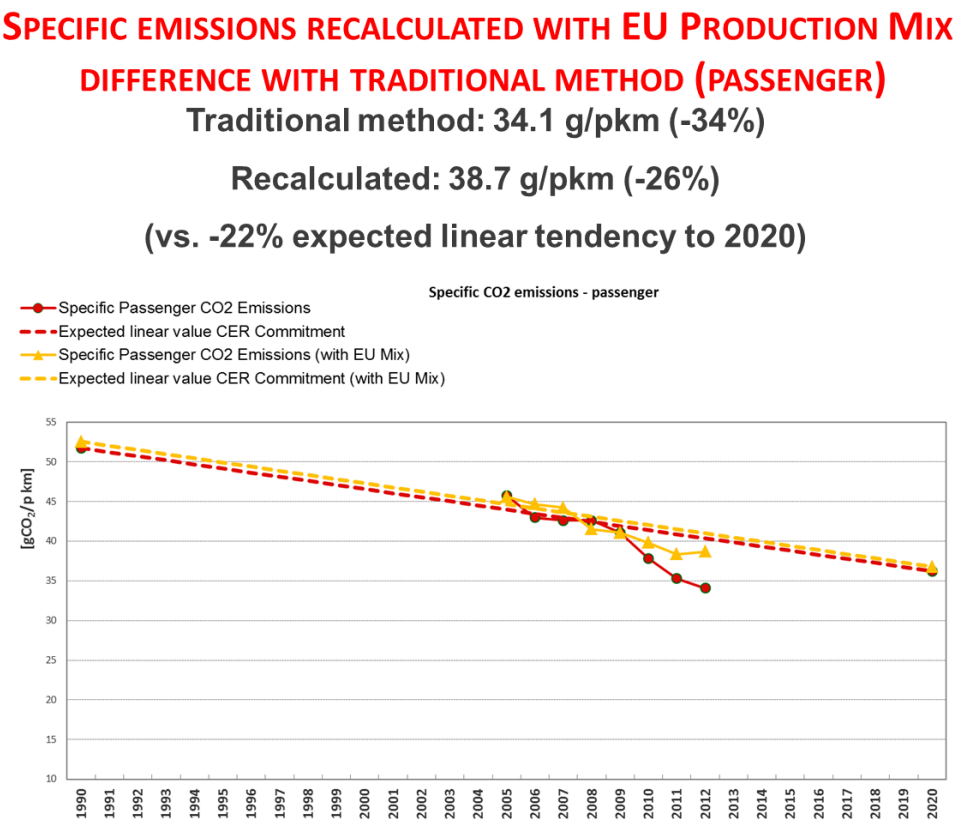
In CO_2 emissions calculation related to the European Railway Sector, a possible technical option ("**Option 1"**) would be to take into account for all railway undertakings one common physical mix: the European electricity production mix.

This Option is quite stringent: the UIC/CER target is at a European level and not for single countries. The European electricity production mix is calculated with a solid methodology and is readily available, giving rise to results that are clear and simple to communicate.

From an operational point of view, the use of European production mix is easy to be implemented and managed: the update of the emission estimates since 1990 can be done without needing the contribution of the railway companies. The railway companies would have a simplified task as they would only need to communicate to UIC their traffic and energy consumption data.

As visible in Fig. 10, in year 2012, using the European production mix for calculations, for passenger transport the railway sector performance would respect the trajectory of the UIC/CER targets. CO_2 reduction from baseline year 1990 to 2012, using the European electricity production mix, corresponds to- 26%, not too different from the values sent to UIC by single railway operators on the basis of "company mix".

Fig. 10: Specific emissions recalculated with EU Production Mix

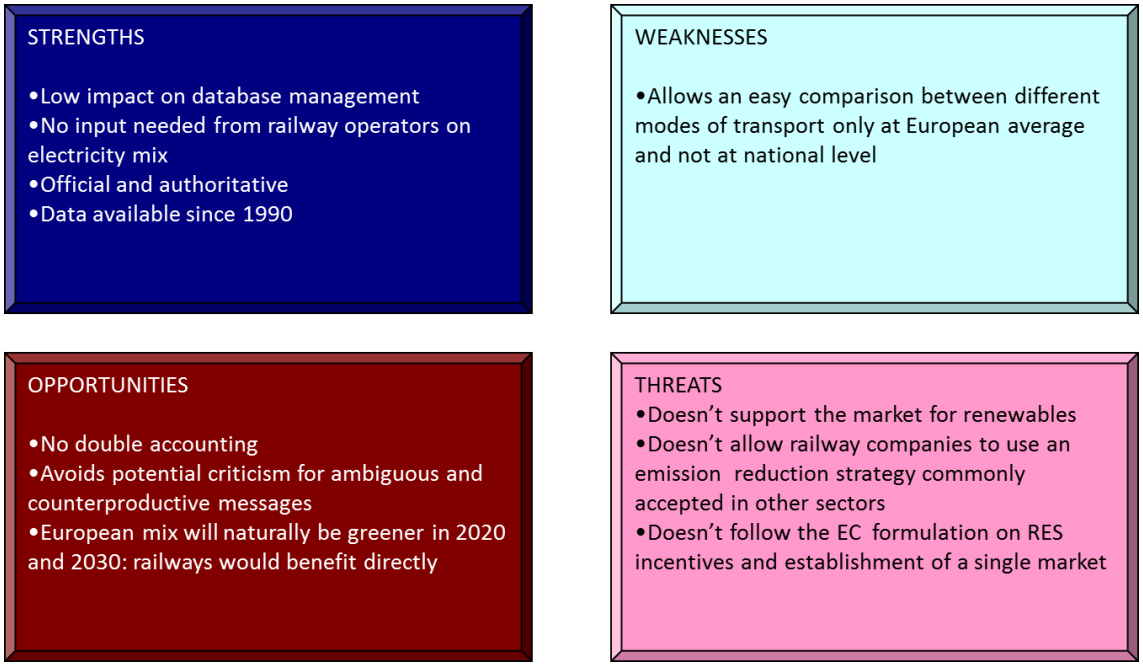


European production mixes will certainly improve towards higher share of renewables, due to the national targets of the "2020 EU package" and the 27% common target of EU "Framework 2030": this improvement scenario is quite advantageous for the railway sector.

The weakness of this option comes from the lack of detailed national mixes, which lowers the effectiveness of the comparison between modes for single trips (e.g. with tools such as Ecopassenger or EcoTransIT World).

The risks are mostly related to the possible disconnection between the targets of the European railway sector and the strategies of the single railway undertakings, which make use of different methodologies.

Fig. 11: Physical Approach SWOT analysis– Option 1

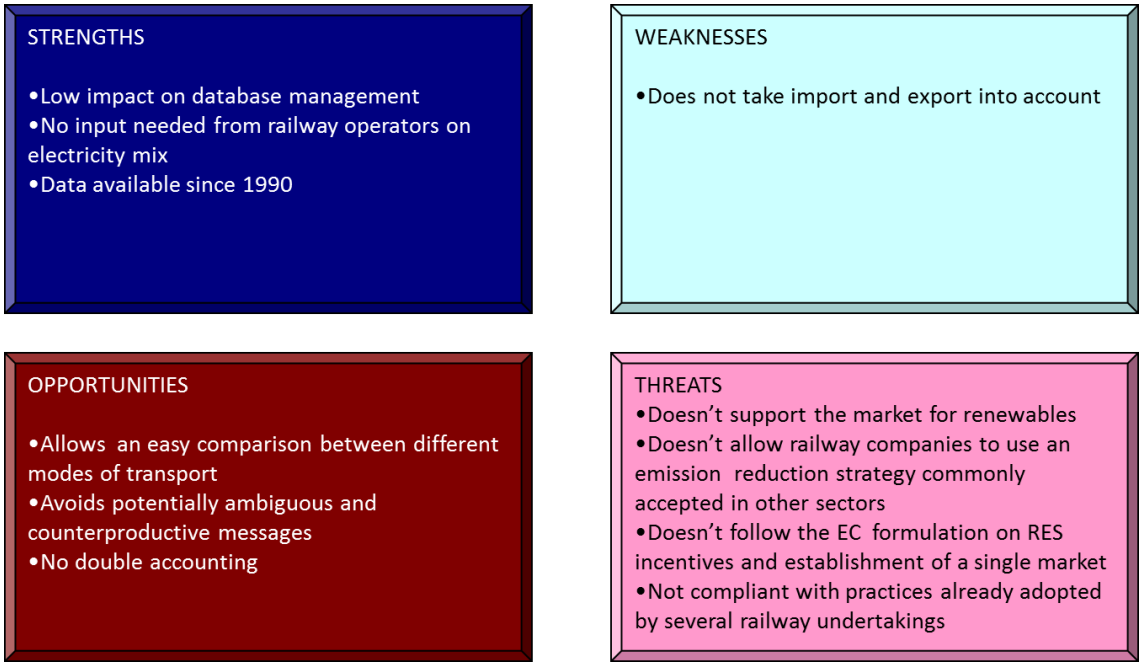


Within the same approach (Physical) it is possible also to use a different option (**Option 2**) that consists in using *national production mix for each country*, taking into consideration the production sources in the different countries.[9] This improved accuracy allows to conveniently monitor the targets both at a European level and for single countries, and to operate comparison on trip emissions with tools such as Ecopassenger and EcoTransIT World.

In this case as well, data update would be technically feasible with a relative simplicity, and the result would be clear and extremely simple to communicate.

Fig. 12: Physical Approach SWOT Analysis – Option 2

[9] In order to fully evaluate the physical electrical mix used in each country, this solution could be even improved by using the *national consumption mix* (that takes into account not only the electricity produced in the country but also the physical fluxes of import and export). Unfortunately, Europe is still lacking an official methodology that could provide certain electricity mixes to the import and export physical fluxes.



4.1.2. Market approach ("electricity-tracking" based)

With this approach, the electricity fluxes taken into account are the ones associated with the contractual instruments, *including certificates and guarantees of origins*, independently by the physical flux.

The main advantage of this approach is linked to the fact that, taking into account the CO_2 reduction obtained from green electricity procurement and renewable energy certificate procurement, railway undertakings can make visible their efforts towards a more responsible business. This visibility gives them higher motivation to proceed with their commitment, using also the marketing drivers to target more responsible customers.

It is fundamental that the principles would have to be defined through a shared process involving all railway companies participating in the data collection. In order to make the approach credible and reliable, it should be adopted by all railway companies participating to the ESRS.

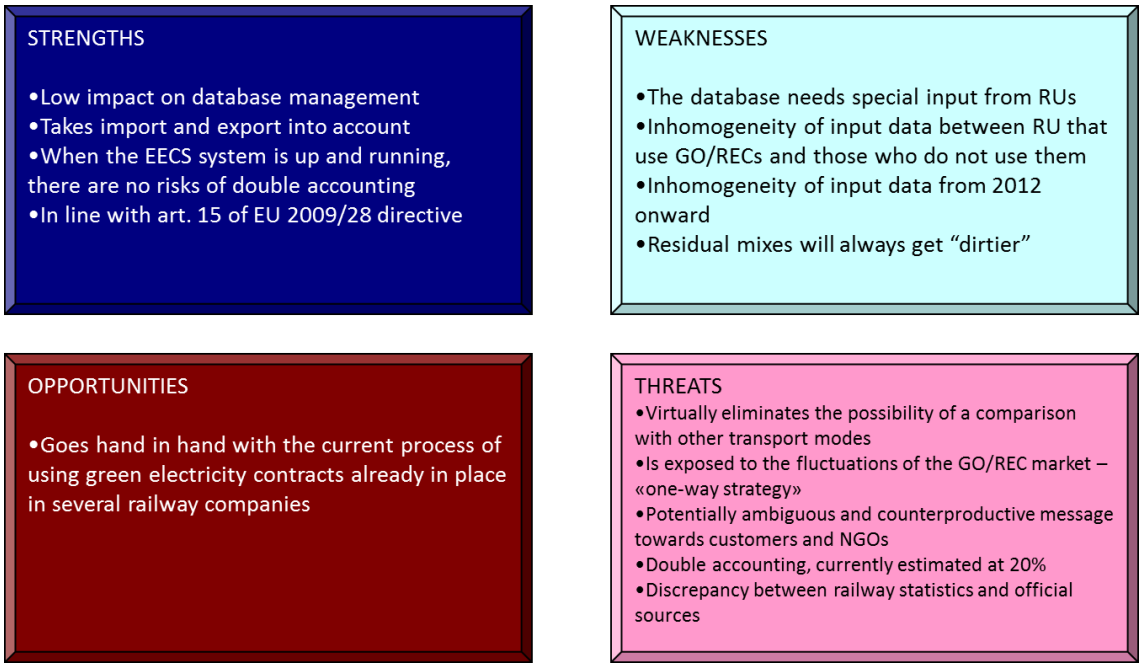
This means that all railway undertakings not using GO or REC should consistently use the national "residual mix" that will become every year less "green". Another issue with that is that not all national residual mixes are official or calculated with commonly accepted rules; furthermore, the residual mixes are not consistently available for all countries since 1990. Lastly, the adoption of this approach basically implies a strategy with no return, where the railway companies would be subject to the price fluctuations of the GO/REC markets.

Another risk is that it will be much harder to compare the sector emissions (both global and specific) with other sectors. While the comparison is currently to the advantage of railways, the situation might be different when other modes of transport (e.g. electric cars) will be able to declare that they travel with zero emissions, through the use of carbon offsetting or of the same REC and GO certificates used by railways.

The highest risk is linked to a potentially ambiguous and counterproductive message towards customers, NGOs and institutions of losing credibility in front of the public (for example due to a hostile press campaign by some NGOs).

Last, but not least, the risk of an evident discrepancy between railway "self-produced" statistics and official sources (Eurostat, IEA, EEA, etc.) is very high.

Fig. 13: Market Approach SWOT ANALYSIS- Option 1



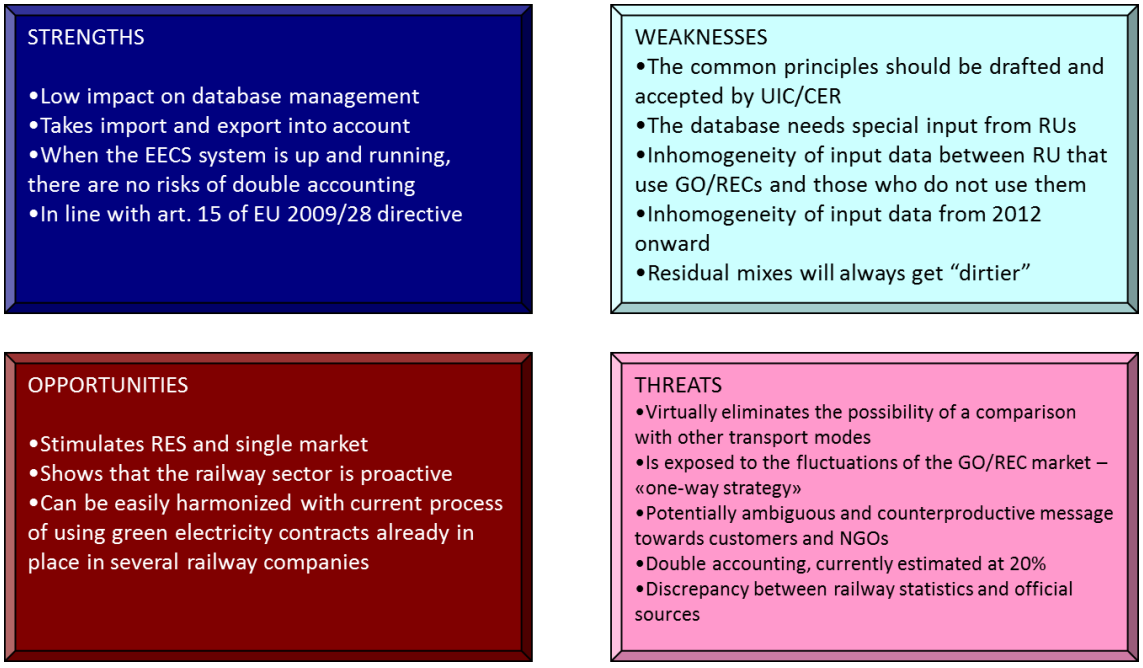
It is possible to reduce these risks by using **an Option 2**: calculation taking into account green electricity procurement and renewable energy certificate procurement/GOs with some "minimum requirements" of the quality of certificates.

This option would be associated with a set of common acceptable principles dealing with the characteristics of the GO or REC certificates used. The approach has already been adopted by some railway companies. For example, it would be possible to define a threshold limit to the *age* of the electricity plant, to the "location" of the plant, a required quantity of investment actually going to *additional* green electricity, a *maximum limit of use* by a single railway (ex. 30% of the total energy consumption), or other parameters.

On the other hand, increasing the "quality" of certificates with a set of principles to show the willingness of reducing the risk of "greenwashing", can result in increased electricity costs, as the certificates which respect restrictive requirements will be more expensive than basic ones.

The workshop in Antwerp has shown anyway that the European market offers already some new products/GOs with an "additionality" sound approach, at reasonable prices.

Fig. 14: Market approach SWOT ANALYSIS -Option 2



4.2. The findings from Green electricity and Carbon Disclosure workshop

As a part of the UIC "Energy efficiency days" Conference held in Antwerp in June 2014, a dedicated workshop has been held with 30 participants, and opening presentations given by the Sustainable development Foundation, IFEU, Carbon Disclosure Project, GHG Protocol, CER and RECS International. A thorough debate between participants followed[10].

In particular, during the workshop a very interesting possible methodological solution has been presented by the GHG Protocol, the most-used international standard for carbon calculation at a global level, developed by the World Resources Institute and the World Council for Business Development that conveyed a multi-stakeholders partnership of businesses, NGOs and governments.

In March 2014 the supplement to the GHG Protocol Corporate Standard has been released ("GHG Protocol Scope 2 Guidance"), dedicated to the question of electricity and certificates/guarantees of origin.

This international new standard, taking in consideration all possible methodological options, adopts the principle of "**Dual Reporting"**:

[10] Opening presentations are available at http://www.energy-efficiency-days.org/.

- Companies **shall** report scope 2 in two ways: one total based on the location-based method, and one total based on the market-based method where applicable and Quality Criteria are met.

- Companies **shall** ensure that contractual instruments used in the market-based method meet the Quality Criteria outlined in this Guidance. A statement shall be made by a 3rd party ensuring that these Criteria have been met, or a reference given to the certification program which has verified conformance with the Quality Criteria

- Companies **shall** disclose the relationship between energy attribute certificates used in the market-based method and compliance instruments present in the same market.

- Companies **shall** identify which scope 2 total – location-based method or market-based method – serves as the basis for goal setting and for scope 3 data uses.

- Companies **should** disclose key features about their contractual instruments for added transparency about the context of the procurement choices

- Companies **may** report avoided emissions from projects or actions separately from the scopes using project-level methodology.

It is also important to say that the principle of transparent dual reporting had already been used with success by other European industrial sectors in sectoral targets carbon calculation.

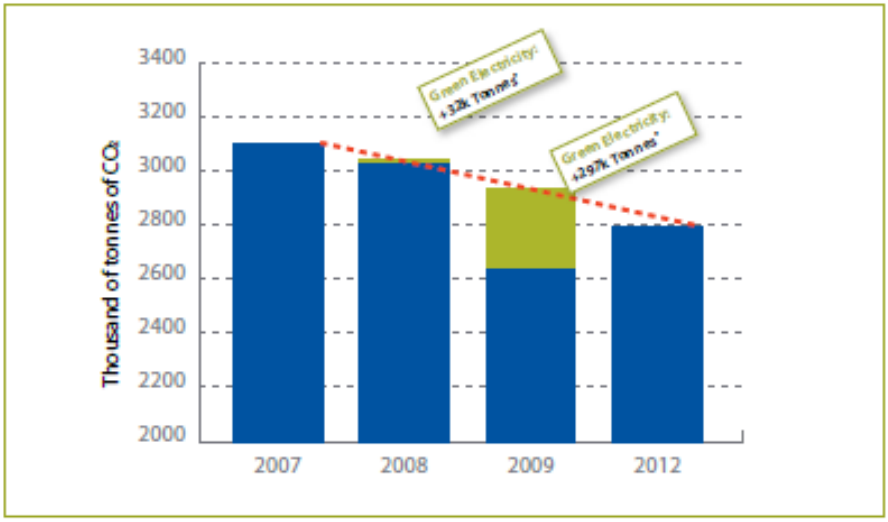
As example, PostEurop, the European association of postal companies, published in 2010 the monitoring Report of the sectoral CO_2 reduction targets (similar to the UIC-CER targets) showing both the reduction calculated with the physical approach and the reduction calculated with the market approach:

Evolution of Target

Following the PostEurop recalculation on historical data, it shows that members are on the right track to reach the reduction target in 2012.

From 2007 to 2009, a **reduction by 465 thousand of tonnes of CO_2** was accounted for, meaning a collective reduction of 15%. However, green electricity with a low emission factor was major contribution in achieving this result. Consequently, without considering the reduction obtained thanks to green electricity*, the result will be a lower reduction, that will require further alternative efforts in order to reach the target in 2012.

Evolution of Target (SCOPE 1 and 2 only)



Source: PostEurop 2010

5. Conclusions

After the analysis of all possible methodological options shown in precedent chapters, following the conclusions of debates and workshops, having evaluated also the CER position and the valuable inputs by key stakeholders, it seems clear that:

- The physical approach (grid based) can be in principle the most appropriate for the UIC evaluation and monitoring of the UIC-CER CO_2 reduction targets, as this approach provides with the only technical possibility, so far, to harmonize under a common methodology the different calculation methods used by each company in each country, and avoid taking the risks of double accounting, lack of additionality, lack of consistency throughout Europe, etc..
- On the other hand, many European railway companies are investing (technically, economically and financially) in acquiring always higher quantities of green electricity for their train traction. The use of *Guarantees of Origin* (together with direct investment in new production from renewable sources) is the only way to do this legally and properly, and to make the carbon disclosure technically feasible. This practice is also an effective way of supporting renewable energy producers with the influx of new capital. Therefore it should be taken into account in the calculations as well.

For these reasons:

- The UIC Environment Strategy Reporting System Methodology, for the exercise of monitoring the performance of the European Railway Sector reduction targets 2020-2030-2050, in harmony with latest international standards and similar practices by other sectors, will adopt for calculation **both** the physical approach (*by using the national production mix in each country*) **and** the market approach (*by using the increased amount of green electricity purchased through Guarantees of Origin*). For the sake of the highest level of transparency, both values will be shown and reported each year in the Final European Report[11].
- The Ecopassenger UIC tool will be updated, so that the visible output of a single query (example Milan-Zurich) will show the CO_2 emissions related to both the national production mix **and** the greener electricity mix used by the railway company, if present.
- UIC may consider to establish in the future, in accordance with its members, some common "Quality criteria" for Guarantees of Origin that will be accepted in the ESRS Methodology and Ecopassenger, similar to the ones recently adopted by the GHG Protocol International Standard.

[11] The Report shows only aggregated European data for the whole railway sector and not single company's data.

References

ADEME Evaluation du contenu en dioxyde de carbone (CO_2) des différents usages de l'électricité distribuée en France métropolitaine entre 2008 et 2010, Rapport méthodologique Présentant les hypothèses et choix du Comité de Gouvernance de la Base Carbone (Actualisation du contenu CO_2 par usage calculé en 2005 par l'ADEME et EDF)

AIB *Annual Report 2011*, Brussels 2011

AIB EECS RULES Principles & Rules of Operation, Brussels 2013

BLOOMBERG New Energy Finance/UNEP Collaborating Centre Frankfurt School of Finance & Management *Global trends in renewable energy investment 2013,* Frankfurt 2013

BLOOMBERG New Energy Finance/VESTAS *Global Corporate Renewable Energy Index (CREX) 2012*, Copenhagen, 2012

CER (Commission for Energy Regulations in Ireland)/UTILITY REGULATOR *Single Electricity Market Fuel-Mix Disclosure in the Single Electricity Market:Calculation Methodology*, Decision Paper 18 November 2011

CDP (Carbon Disclosure project) Accounting of Scope 2 emissions Technical notes for companies reporting on climate change on behalf of investors & supply chain members 2013, 2013

Directive 2009/28/ec of the European Parliament and of the Council of 23 april 2009

Directive 2009/72/ec of the European Parliament and of the Council of 13 july

Decree n° 2011-1336 of 24 October 2011 Ministère de l'Écologie, du Développement durable, des Transports et du Logement (FRANCE) - *Information on the quantity of carbon dioxide emitted during transport*

ECOFYS/BUSINESS INSIGHTS The Outlook for Green Certificate Markets in Europe:A strategic analysis of EU and national policies and the role of GoOs, www.globalbusiness insights.com, London, 2012

ECOHZ ECOHZ's response to the European Commission's public consultation on a 2030 framework for climate and energy policies, Brussels 2013

ECOHZ *ECOHZ GO2: the renewable energy opportunity*, www.ecohz.com

ECN/ITPower/OKO Institut/IDAE Guarrantees of Origin and multiple counting of electricity from renewable source, 2004

ECN/ITPower/OKO Institut/IDAE Guarantees of Origin as a tool for renewable energy policy formulation, 2004

EN 16325:2013 Guarantees of Origin related to energy - Guarantees of Origin for Electricity

EN 16258:2012 Methodology for calculation and declaration of energy consumption and GHG emissions of transport services (freight and passengers)

ENTSO-E Statistical Yearbook 2011

Eurelectric, Key Statistics Edition 2013

EPA's Green Power Partnership, *Renewable Energy Certificates,* Washington 2008

IEA, OECD, EUROSTAT, *Energy Satistic manual*, Paris 2005

IEA Electricity information 2013 - Edition documentation for beyond 2020 files

IEA/OECD Tracking Clean Energy Progress 2013 - IEA Input to the Clean Energy Ministerial, Paris 2013

IEA/UIC Railway Handbook 2013 - Energy Consumption and CO_2 Emissions - Focus on Energy Mix

GAIA (Gaia Consulting Oy) Guarantees of origin and eco-labeling of electricity in the Nordic countries, Final Report, Helsinky 2011

GREENHOUSE GAS PROTOCOL/WORLD RESOURCES INSTITUTE *Ghg protocol Scope 2 Guidance (Draft for pubblic comment)* March 2014

GSE Procedura per la determinazione del mix energetico complementare dell'energia elettrica immessa in rete del produttore per l'anno 2012, Rev_03/01/2013, Rome 2013

GSE Procedura per la determinazione del mix energetico utilizzato per la produzione dell'energia elettrica venduta dall'impresa di vendita per l'anno 2012 procedura per la determinazione del mix energetico utilizzato per la produzione dell'energia elettrica venduta dall'impresa di vendita per l'anno 2012, Rev_03/01/2013, Rome 2013

GSE (N. Falcucci) The Italian Implementation of Disclosure: The Green Supply Perspective on the light of the EU LegislativeFramework, Rome 2009

GREXEL, Energy Certificates – Markets and Systems in Europe, http://www.grexel.com

OKO Institut/V. Burger Green Power Labelling An Instrument to enhance Transparency and Sustainability on the Voluntary Green Power Market, 2007

POSTEUROP, Environment Report, 2010

RE-DISS (Reliable Disclosure Systems for Europe) European Residual Mixes 2012 Results of the calculation of Residual Mixes for purposes of electricity disclosure in Europe for the calendar year 2012 Version 1.0, 2013

RE-DISS (Reliable Disclosure Systems for Europe) Reliable Disclosure Information for European Electricity Consumers - *Final Report from the project "Reliable Disclosure Systems for Europe (RE-DISS)*", 2012

Regulation (EC) n° 1099/2008 of the European Parliament and of the Council of 22 october 2008 on energy statistics

H. Schwarz *Why is this issue strategic? Objectives of the workshop*, UIC Green energy procurement workshop, UIC January 25th 2010

UIC CER 1990-2030 Environment Strategy - Reporting System Methodology and Policy, 2013