Best Practice Recommendations

For the implementation of Guarantees of Origin and other tracking systems for disclosure in the electricity sector in Europe

Version 2.1, December 2012

1 Introduction

This document is meant to provide guidance to competent bodies and legislators which are implementing and managing systems of Guarantees of Origin (GO) and other tracking systems for purposes of electricity disclosure in Europe. The Best Practice Recommendation builds upon the findings and recommendations of the project "A European Tracking System for Electricity (E-TRACK)".[1] These have been developed further in the RE-DISS project[2] and were discussed in six workshops which involved representatives of Competent Bodies from 19 European countries. Comments received during and in between the workshops have been taken up in this version of the recommendation. It was not intended to ask the workshop participants for a formal approval of the Best Practice Recommendation. However the broad majority of participants supported the proposals and only very few reservations on single elements of the recommendation were made by some workshop participants.

The members of the RE-DISS project team recommend that competent bodies and legislators in Europe follow the proposals as specified in this document when implementing the details of GOs and disclosure systems in their countries. This will facilitate an advanced implementation of these instruments, which satisfies the requirements for GOs to be accurate, reliable and fraud-resistant (as set out in Directives 2009/28/EC and 2004/8/EC[3]) and for disclosure information to be reliable (as set out in Directive 2009/72/EC). The Best Practice Recommendation cannot be binding for any party, but we hope that it serves as a point for orientation for many countries and that it supports a truly reliable implementation of GOs and disclosure across Europe.

The term "Europe" used throughout this document refers to the EU member states and all other European countries which have implemented systems for Guarantees of Origin and electricity disclosure which are comparable to those stipulated by the EU directives mentioned above. We speak about "countries" and their competent bodies, but it should be noted here that in Belgium the competent bodies are working on a regional rather than a national level and that disclosure in Ireland comprises the Republic of Ireland as well as Northern Ireland.[4]

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1 See the website of the E-TRACK project, which ran until 2009 (http://www.e-track-project.org). The E-TRACK final report contains a lot of background information which might help in understanding this document, including a glossary.

2 For more information on the RE-DISS project, which runs until October 2012, please see the project website http://www.reliable-disclosure.org, which contains lots of useful information regarding GOs and disclosure.

3 Note that this Directive has been replaced recently by the new Energy Efficiency Directive 2012/27/EC, which must be implemented by member states by June 2014.

4 In order to make the text easier to read we have left out the term "domain" in this paper and are simply referring to "countries", but this is meant to include the regions in those cases in which this is applicable.

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As more experience is gained with the implementation of GOs and disclosure, the Best Practice Recommendation will be developed further. It will thus be a living document and new versions will be published after consultations with those competent bodies which have agreed to become participants of the RE-DISS project.

Any comments or questions regarding this document or the RE-DISS project should be directed to Ms. Anja Sachs at Öko-Institut (a.sachs@oeko.de), phone +49-761-45 295-226.

The following chapters address the most relevant items which have been identified for the Best Practice Recommendation by the project team and workshop participants. After a short introduction to each subject the actual recommendations are given in numbered paragraphs, which makes references easier. Details of the recommended methodology for residual mix calculations have been added as an annex to this document.

2 How to implement the "12 month lifetime rule" for GOs

Article 15 (3) of the Directive 2009/28/EC specifies:

> *"Any use of a guarantee of origin shall take place within 12 months of production of the corresponding energy unit. A guarantee of origin shall be cancelled once it has been used."*

The production of an energy unit can only be accounted for over a period of time (production period). Thus the term "production" in the text of the directive needs interpretation. The term "use" could be interpreted as the act of cancelling a GO or as the act of using the information contained in a GO for disclosure.

If the approach to the GO lifetime is not harmonised across Europe, then an option is created for arbitrage deals in the GO market, so that GOs could be moved from domains with stricter lifetime rules to those which allow for a longer lifetime. In the absence of specific incentives to do so this might not be relevant. However, if GO market prices vary from one year to another (for example due to natural variations in RES supply), then this might become an issue.

The following regulations are thus recommended not only for RES-GOs but for any type of GOs.

Best Practice Recommendation:

[1] The metered production periods for purposes of issuing GOs should not be longer than a calendar month and where possible should not run across the start and end dates of the disclosure periods (see item [33]). Longer intervals up to one year are acceptable for very small plants, for example.

[2] If possible, the issuing of GOs should be done without delay after the end of each production period.

[3] The lifetime of GOs should be limited to 12 months after the end of the production period. GOs which have reached this lifetime should be collected into the Residual Mix (see chapter 5).

[4] An extension to this lifetime can be granted if a GO could not be issued for more than six months after the end of the production period for reasons which were not fully under the control of the plant operator. In this case, the lifetime of the GO might be extended to six months after issuing of the GO.

[5] Cancellations of GOs relating to production periods in a given year X which occur by 31 March of year X+1 should be counted in disclosure for year X. Later cancellations should be counted in disclo-

sure for year X+1. (If disclosure periods differ from the calendar year (see item [33]), the deadline should be defined accordingly.)

[6] The disclosure information from expired GOs (see item [3]) can be allocated either to the production year of the corresponding energy unit or to the year when the GOs have expired, depending on the methodology used for Residual Mix calculation in the respective domain. (Note that in the RE-DISS calculation of Residual Mixes, the production year of the expired GOs determines the year for which the disclosure information is allocated.)

3 Further Recommendations on GOs

Usage of the European Energy Certificate System

The European Energy Certificate System (EECS) is a ready-to-use standard for the implementation of electronic GO systems in Europe which reflects the requirements of European Directives and coordinates the details of GO systems, including the electronic interfaces for transferring GOs between registries in different countries. The Association of Issuing Bodies (AIB) which governs EECS is a membership-based non-profit organisation with high expertise and currently has members from 14 EU member states plus Norway and Switzerland.

Further guidance for implementing GOs will be given by a CEN standard for Guarantees of Origin for electricity, which will be published in summer 2013, and which is expected to reflect the achievements of EECS.

Best Practice Recommendation:

[7] The implementation of GOs in all countries in Europe should be based on the European Energy Certificate System (EECS) operated by the Association of Issuing Bodies (AIB). If national GO systems are established outside of EECS, then EECS should at least be used for transfers between registries.

[8] If not all European countries are members of EECS, appropriate connections between the EECS system and non-EECS members as well as in between different non-EECS members will need to be established. These include inter alia procedures for assessing the reliability and accuracy of the GOs issued in a certain country and interfaces for the electronic transfer of GOs. The AIB is developing procedures for allowing non-members of EECS to connect their GO registries to the EECS Hub. This option should be used by all countries which have decided not to become members of EECS.

[9] So-called ex-domain cancellations of GOs, where a GO is cancelled in one registry and a proof of cancellation is then transferred to another country in order to be used there for disclosure purposes, should only be used if a secure electronic transfer is not possible and if there is an agreement on such ex-domain cancellations between the competent bodies involved. Statistical information on all ex-domain cancellations relating to a disclosure year should be made available differentiated by energy source[5] in order to support Residual Mix calculations.

The implications of a coexistence of electronic GO transfers within EECS and outside of EECS are not fully clear yet and require further assessments.

5 This information should be provided using a structure for energy sources which corresponds to the highest hierarchy level of fuel codes in the EECS Fact Sheet 5 (see http://www.aib-net.org/portal/page/portal/AIB_HOME/EECS/Fact_Sheets)

Issuing of Guarantees of Origin for different energy sources and generation technologies

European Directives require the establishment of GOs for electricity from renewable energy sources and from high-efficiency cogeneration. However, in order to support differentiation also between other forms of electricity generation it is advisable to extend the system of GOs to other forms of electricity generation.

Best Practice Recommendation:

[10] GOs should generally be issued only for the net generation of a power plant, i.e. gross generation minus the consumption of all auxiliaries related to the process of power production. For hydro power plants involving pumped storage this means that GOs should be issued only for the net generation which can be attributed to natural inflow into the reservoir.

[11] The GO system should be extended beyond RES & cogeneration to all types of electricity generation.

[12] All types of GOs should be handled in one comprehensive registry system per country. (For an exception from this recommendation see the coexistence of national GO systems and EECS in item [7]).

[13] All GOs should be linked to disclosure.

[14] There should be no issuing of more than one GO for the same unit of electricity. If multiple certificates are to be issued, for example, a GO for disclosure and a support certificate for management of a support system, then these should be legally separated.

[15] This also applies to cogeneration plants which are using RES as the energy source: Only one GO should be issued per unit of electricity, which should combine the functionalities of a RES-GO and a cogeneration GO.

Note that linking cogeneration GOs to disclosure means that there should be a use of the information content of cogeneration GOs in disclosure statements. For example, suppliers might be encouraged or even required to disclose the share of electricity from high-efficiency cogeneration in their company or product mix.

The GO as the unique "tracking certificate"

Currently, other tracking mechanisms are also being used which are very similar to GOs, but do not have the same status. This includes RECS certificates and some "green power" quality labels.

In some domains, GOs may not only be used by suppliers of final consumers, but also by (typically large) consumers who purchase energy and GOs separately and cancel the GOs for their own purpose. In this case, the related energy might be associated with generation attributes two times (once by the supplier of the energy and once by the consumer itself through the cancellation of GOs).

Best Practice Recommendation:

[16] GOs should be the only "tracking certificate" used. Any other tracking systems of a similar purpose and function as GOs should be converted to GOs.

[17] Besides GOs, only Reliable Tracking Systems (which may include contract-based tracking, see chapter 6) and the Residual Mix should be available for usage for disclosure. No other tracking mechanisms should be accepted.

[18] Green power quality labels should use GOs as the unique tracking mechanism.

[19] European countries should clarify whether and under which conditions the use of GOs by end consumers is allowed. Such GO use should not be based on ex-domain cancellations performed in other countries. If consumers are allowed to use GOs themselves, a correction should be implemented in the disclosure scheme which compensates for any "double disclosure" of energy consumed.

Note that item [18] requires a cooperation between competent bodies and the operators of "green power" quality labels. For example, the GO systems need to become capable to convey label information as part of their data content.

Recognition of GOs imported from other countries

Directive 2009/28/EC allows member states to reject the recognition of a RES-GO for disclosure only if they have "well-founded doubts about its accuracy, reliability or veracity". Similar rules apply for co-generation GOs under Directive 2004/8/EC, which has now been replaced by the new Energy Efficiency Directive 2012/27/EC, to be implemented by member states by June 2014.

Best Practice Recommendation:

[20] Any such rejection should only relate to the actual use of cancelled GOs for disclosure purposes in the respective country and should not restrict the transfers of GOs between the registries of different countries. This means that the decision about the recognition of a GO should not hinder its import into a specific country.

[21] Within the rules set by the respective Directives, European countries should consider their criteria for the acceptance of imported GOs for purposes of disclosure.

- *These criteria should address imports at least from all EU member states, other members of the European Economic Area (EEA) and Switzerland. The parties to the Energy Community Treaty should be considered as well, as soon as GO imports from these countries become relevant.*
- *The criteria should specify the electronic interfaces, specifying data format and contents of GOs to be imported, which the respective country accepts for imports of GOs (such as the EECS Hub and any other interfaces accepted).*
- *Conditions for the recognition of GOs from other countries should be that they were issued based on Art. 15 of Directive 2009/28/EC or compatible national legislation, and that they meet the explicit requirements set in Art. 15, for example, regarding the information content of the GOs.*
- *The recognition of GOs from other countries should be rejected if these countries have not implemented an electricity disclosure system.*
- *The recognition of GOs from other countries should be rejected if the country which has issued the GOs or the country which is exporting the GOs have not implemented appropriate measures which effectively avoid double counting of the attributes represented by the GOs. Such appropriate measures should ensure the exclusivity of the GOs for representing the attributes of the underlying electricity generation, implement clear rules for disclosure, establish a proper Residual Mix (see chapter 5) or equivalent measures, and ensure their actual use. Furthermore, the appropriate measures should ensure that attributes of exported GOs are*

subtracted from the Residual Mix of the exporting country and cannot be used for disclosure at any time in the issuing or the exporting country by explicit mechanisms, unless the GOs are re-imported and cancelled there.

European countries should establish a register of their decisions taken regarding the acceptance of imported GOs, which gives guidance to other competent bodies and also provides transparency for market actors.

4 Disclosure Schemes and other Reliable Tracking Systems

European Directives require EU and EEA member states to implement full disclosure systems. However, the analysis undertaken in the course of the E-TRACK project showed that as of 2009 not all countries had fully implemented these requirements yet. As of 2012 there are still some hints of incomplete compliance regarding disclosure schemes.

In order to set up a full disclosure system, GOs and a Residual Mix should be implemented (see the following chapter 5 on the Residual Mix). As a third element, other Reliable Tracking Systems may be implemented where appropriate, but these should fulfil certain criteria.

Best Practice Recommendation:

[22] Full disclosure schemes should be implemented, including the disclosure of CO_2 emissions and radioactive waste.

[23] (Other) Reliable Tracking Systems (RTS) should be defined where appropriate based on criteria of added value, reliability and transparency.[6]

[24] RTS can comprise, where applicable:

- *Homogenous disclosure mixes for non-competitive market segments where no choice of supplier or different products exists,*
- *Support systems whose interaction with disclosure requires a certain allocation of the attributes of supported generation (for example, a pro-rata allocation to all consumers in a country in which RES electricity is supported by a feed-in tariff),*
- *Contract-based tracking (see chapter 6 below).*

5 Calculations of residual mixes

The use of uncorrected generation statistics for purposes of disclosure should be avoided, because this leads to double counting in relation to GOs (and other Reliable Tracking Systems, if applicable).[7] A Residual Mix should be provided for disclosure of electricity of unknown origin, based on the methodology developed in the RE-DISS project. For details of the recommended methodology for residual mix calculations see the methodology paper in the annex to this document.

Best Practice Recommendation:

[25] All countries should provide a Residual Mix as a default set of data for disclosure of energy volumes for which no attributes are available based on cancelled GOs or based on other Reliable Track-

6 For more details on the criteria for Reliable Tracking Systems please see the final report of the E-TRACK project.

7 For more details on this issue please see the final report of the E-TRACK project.

ing Systems (RTS, see item [23]). The use of uncorrected generation statistics (for example on national or UCTE, Nordel etc. levels) should be avoided.

[26] The calculation of the Residual Mix should follow the methodology developed in the RE-DISS project. As part of this methodology, competent bodies should ensure that double counting between GOs they have issued, other Reliable Tracking Systems in use in their country and the Residual Mix is excluded.

[27] Competent bodies from all countries in Europe should cooperate in order to adjust their Residual Mixes in reflection of cross border transfers of physical energy, GOs and RTS. For this purpose, competent bodies should use data provided by RE-DISS.[8] They should also support the collection of input data for the related calculations by the RE-DISS project team.

[28] As a default, the Residual Mix should be calculated on a national level.[9] However, if the electricity markets of several countries are closely integrated (for example in the Nordic region), a regional approach to the Residual Mix may be taken. This should only be done after an agreement has been concluded between all countries in this region which ensures a coordinated usage of the regional Residual Mix.

6 Contract-based tracking

Currently, producers and suppliers in most countries are using an implicit allocation method for disclosure attributes which follows the bilateral contracts which are concluded in the electricity market. In most cases, market participants simply assume that they are receiving a certain set of attributes from their contractual counterparts in the electricity market. In most of these countries, this tracking mechanism is not clearly regulated, its relation to GO systems and RTS is not clarified and there are no reliable statistics about the volumes and types of electricity attributes which are tracked through this mechanism. This makes it impossible to generate a reliable Residual Mix and inevitably leads to double counting of generation attributes, including those represented by GOs. In order to establish reliable tracking systems, contract-based tracking should either be banned or the related practices need to be improved significantly by clear regulation and statistics.

Best Practice Recommendation:

[29] If contract-based tracking is allowed in a country, it should be regulated clearly.

[30] Such regulations should ensure that

- *The rules of the tracking system are transparent and comprehensive and are clearly understood by all participants in the system.*
- *Double counting of attributes and loss of disclosure information is minimised within the contract-based tracking scheme and also in the interaction of the contract-based tracking scheme to GOs and other RTS (if applicable). As a precondition for this, the contract-based*

8 An appropriate replacement for the RE-DISS project in providing this information to Competent Bodies will have to be determined for the time after the project has terminated. Currently, the project team has applied for funding of a second phase of the RE-DISS project. During this second phase, options for a long-lasting organisational structure for this task will be assessed.

9 Exceptions may apply when the domestic market is separated into two or more regions. In this case, regional mixes can be determined. See also the introduction of this document on the usage of the term “country”.

tracking scheme should be able to provide comprehensive statistics about the volumes and types of electricity attributes which are tracked through it.

- *The relevant information for disclosure purposes should be available in time to meet the timing requirements set out in chapter 7.*

[31] If suppliers of electricity intend to use contract-based tracking in order to fulfil claims made towards consumers regarding the origin of a certain electricity product (for example a "green" energy product), GOs should be used in addition to the contract (see also item [38]).

[32] If a country implements a system in which generation attributes are allocated to suppliers and consumers of electricity "ex post" based on the contracts concluded in the electricity market, then such a system should fulfil the requirements mentioned above in order to qualify as a Reliable Tracking System (see item [23]). This includes the need to produce reliable statistics about the attributes allocated by this system.

7 Timing of Disclosure

It is necessary to coordinate the timing of the most relevant steps for calculating disclosure data across Europe. This helps to avoid market distortions and possibilities for arbitrage deals between different countries with different deadlines and is a precondition for the recommended cooperation of European competent bodies regarding the calculation of their Residual Mixes (see item [26]).

Best Practice Recommendation:

[33] Electricity disclosure should be based on calendar years.

[34] The deadline for cancelling GOs for purposes of disclosure in a given year X should be 31 March of year X+1 (see item [5]).

[35] The timing of the calculation of the Residual Mix should be coordinated across Europe:[10]

- *By 30 April X+1 all countries should determine their preliminary domestic Residual Mix and whether they have a surplus or deficit of attributes.*
- *By 15 May X+1, the European Attribute Mix should be determined.*
- *By 31 May X+1, the final national Residual Mixes should be published.*
- *As of 1 July X+1 the disclosure figures relating to year X can be published by suppliers.*

It must be noted here that some countries are already using diverging disclosure periods: Austria, the United Kingdom and Estonia are using financial years which are different from calendar years. In Portugal suppliers are disclosing based on rolling 12 month invoicing periods and therefore disclosure figures are determined on a monthly basis. In order to avoid market distortions and possibilities for arbitrage deals between countries with different deadlines and in order to support the cooperation of competent bodies regarding the calculation of their Residual Mixes, these countries should move to a calendar year disclosure period whenever possible.

[10] For details of the recommended methodology for residual mix calculations see the methodology paper in the annex to this document. See item [28] on the regional scope of the Residual Mixes.

8 Further Recommendations on Disclosure

The following additional items have been identified as recommendations for disclosure systems. For details on the background of these items please refer to the E-TRACK final report.

Best Practice Recommendation:

[36] All countries should clarify the relation between their support schemes for RES & cogeneration on the one side and GOs and disclosure schemes on the other side. Where necessary, the support schemes should be defined as RTS (see item [23]).

[37] If support schemes in a country are using transferable certificates, then these certificates should be separated from GOs and should not be used for disclosure (see also item [14]).

[38] All electricity products offered by suppliers with claims regarding the origin of the energy (for example "green" or low-carbon power) should be based exclusively on cancelled GOs. No other tracking systems should be allowed, with the exception of mechanisms required by law, e.g. a pro-rata allocation of generation attributes to all consumers which is related to a support scheme (see item [24]).

[39] Suppliers offering two or more products which differ in terms of the origin of the energy should be required to give product-related disclosure information to all their customers, including those who are buying the default "remaining" product of the supplier.

[40] There should be clear rules for the claims which suppliers of, for example, "green" power can make towards their consumers. There should be rules how the "additionality" of such products can be measured (the effect which the product has on actually reducing the environmental impact of power generation), and suppliers should be required to provide to consumers the rating of each product based on these rules.

[41] Claims made by suppliers and consumers of "green" or other low-carbon energy relating to carbon emissions or carbon reductions should also be regulated clearly. These regulations should avoid double counting of low-carbon energy in such claims. A decision needs to be taken whether such claims should adequately reflect whether the energy purchased was "additional" or not.

[42] If suppliers are serving final consumers in several countries rules must be developed and consistently implemented in the countries involved on whether the company disclosure mix of these suppliers should relate to all consumers or only to those in a single country.[11]

[43] The following recommendations should be followed with respect to the relation of disclosure to the cooperation mechanisms (Art. 6 – 11 of Directive 2009/28/EC):

- *If EU member states or member states and other countries agree on Joint Projects, such agreements should also clarify the allocation of attributes (via GOs, RTS or Residual Mix) issued from the respective power plants.*
- *If EU member states agree on Joint Support Schemes, such agreements should also clarify the allocation of attributes (via GOs, RTS or Residual Mix) issued from the power plants supported under these schemes.*

11 This is also relevant in Belgium, in which disclosure is governed on the regional level.

9 Steps for determining the disclosure figures of a supplier

In order to clarify how the recommendations in this document could be applied by market participants, the following process description is given.

[44] Suppliers should apply the following steps in order to determine their disclosure figures:

- *During the disclosure period, suppliers which aim at a certain disclosure mix should use the "explicit" tracking mechanisms which are available in the respective countries in order to acquire the desired generation attributes. In all countries this comprises GOs, but contract-based tracking and certain other Reliable Tracking Systems might also be available.*
- *If suppliers are offering electricity products with claims regarding the origin of the energy (for example "green" or low-carbon power) then they should acquire the related generation attributes during the disclosure period exclusively based on GOs. Besides such products, GOs can also be used for shaping the overall disclosure mix of a supplier.*
- *All GOs which are meant to be used for the disclosure period of calendar year X should be cancelled before the deadline of 31 March X+1.*
- *After this deadline, the total volume of electricity sold to final consumers and all generation attributes which have been acquired based on cancelled GOs and other Reliable Tracking Systems including contract-based tracking (if applicable) should be accounted for. This may include a pro-rata allocation of attributes of electricity supported, for example, under a feed-in tariff to all suppliers, which might have been implemented in the respective country as a Reliable Tracking System.*
- *Any use of contract-based tracking should strictly follow the regulations issued for the respective country. Any attributes assumed for or notified by the contractual counterpart in the electricity market may only be used if explicitly allowed by such regulations. National generation statistics and other data which is not corrected by the different tracking systems in use should not be used at all. Instead, the Residual Mix should be used (see below).*
- *Suppliers should respond in time to requests by the Competent Body on statistical reporting of volumes of electricity sold to final consumers and of any "explicit" tracking mechanisms used.*
- *Typically the volume of electricity sold to final consumers is larger than that of the generation attributes acquired through "explicit" tracking mechanisms. In this case the missing generation attributes should be "filled up" from the Residual Mix for the respective country, which will be determined and published by the Competent Body according to the schedule set out in chapter 7.*
- *The overall supplier disclosure mix consists of the attributes of all electricity sold to final consumers, including all products which might be differentiated.*
- *If electricity products which differ in terms of the origin of the energy have been offered to part of the consumers then these consumers will receive product-related disclosure information based on the GOs cancelled for this purpose. However, in this case such product-related disclosure information should also be given to those consumers who have not purchased a specific product. This means that a "remaining" product should be defined which consists of the disclosure mix of the supplier minus the attributes of all separated products.*

This information should be disclosed as product-specific disclosure data to the consumers who are receiving the "remaining" product.[12]

- *CO_2 emissions and radioactive waste should be disclosed on the supplier and product levels in direct relation to the fuel mix which is being disclosed.*[13]

Disclaimer:

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12 This recommendation avoids the implicit double counting of attributes which might be part of, for example, a "green" power product and which also appears in the overall disclosure mix of the supplier. See the E-TRACK final report for more details.

13 For this purpose, generic technology-specific emission factors could be applied, which are defined by the domain in which the GO is used.

Electricity Residual Mix Calculation According to the RE-DISS Project

Methodology of Residual Mix Calculation

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Content

List of Figures

Glossary

(Electricity generation/production) Attribute – Attribute refers to a piece of information, which is tracked in order to disclose specific consumption. Most important attributes for disclosure are the energy source and the associated CO_2 emissions and radioactive waste. In the de-linked tracking system the information content of a GO represents all the relevant generation attributes of 1 MWh of electricity. In the residual mix calculation, the term attribute often means merely the energy source, and hence RES, NUC and FOS attributes are discussed.

Available attributes – Attributes that are not explicitly tracked in order to disclose certain consumption. The pool of yearly available attributes in a domain constitutes the domestic residual mix.

European Attribute Mix (EAM) – The EAM is a calculatory pool of available attributes in residual mix calculation. It results from surpluses of available attributes compared to untracked consumption in surplus domains. The EAM is used to cover deficits of available attributes compared to untracked consumption in deficit domains.

Reliable Tracking Systems (RTS) – RTSs are other explicit tracking systems besides EECS that are considered reliability and transparency. Typical examples of certificate-based RTSs are national GO systems and examples of non certificate-based RTSs are Feed-in tariffs when linked to disclosure or in some cases contract-based tracking.

Residual mix – The residual mix is a pool of available generation attributes, which are not explicitly tracked in order to disclose certain consumption.

Residual mix calculation – Residual mix calculation is an implicit tracking mechanism in which shares of energy sources and environmental impacts of untracked consumption are determined by the statistical mix of available attributes.

Total supplier mix (TSM) – TSM means the total volume of attributes disclosed in a domain, both explicitly tracked and those disclosed through the residual mix.

Untracked consumption – Untracked consumption refers to consumption that is not disclosed by using explicit tracking mechanisms, such as GOs. Untracked consumption is disclosed with the residual mix.

Introduction

This methodology paper aims to describe, in detail, how electricity residual mixes are calculated according to the Best Practice Recommendations of the RE-DISS project (Reliable Electricity Disclosure Systems for Europe) in EU27 (incl. EEA and Switzerland).

Residual mix is an implicit disclosure mechanism in which volumes and shares of energy sources and environmental impacts of untracked electricity consumption[1] are determined by the statistical mix of a domain's yearly generation attributes, available after explicit tracking. Residual mix is defined on a domain level[2] and calculated based on a calendar year. Data on reference-year electricity generation and consumption as well as explicit tracking until the disclosure deadline are accumulated in order to calculate the domestic residual mix.

Due to the international transfer of both electricity and guarantees of origin (which represent electricity generation attributes), the calculation of residual mixes needs to be harmonized across Europe. This means domains can themselves calculate the domestic residual mix, but have to coordinate to form the European Attribute Mix (EAM), which is needed in order to establish the final residual mix of each domain. This coordination was, from 2010 to 2012 carried out by the RE-DISS project.

RE-DISS project finished with two equally reliable calculation methodologies: transaction-based method (TBM) and the issuance-based method (IBM), both of which will be explained in this document. In the past, methodology relating to transactions has been used, but recent discussion has favoured the issuance-based method. It must be stressed that the correct implementation of either of these methods effectively removes double counting in residual mix calculation. This is required to secure the reliability of explicit tracking instruments; guarantees of origin.

[1] i.e. consumption, which has not been disclosed with explicit tracking instruments such as guarantees of origin or contract-based tracking.

[2] With the exception that the three domains in Belgium only have a single residual mix. Under unified power markets (e.g. the Nordic countries) a broader approach can be taken as long as all associated domains agree upon it.

Background

The need for residual mix calculation arises from the combined effect of Directives 2009/28/EC and 2009/72/EC, but interestingly enough, it is not mentioned in either of them and it is still a rarity among national legislations and regulations transposing those Directives. The Article 15 of the RES directive, 2009/28/EC, sets forth guarantees of origin, which can be used for explicit tracking of electricity generation attributes from production to consumption. It also requires Member States to "ensure that the same unit of energy from renewable sources is taken into account only once" (2009/28/EC, Art.15(2)). On the other hand Article 3 paragraph 9 of the Internal Energy Market directive (2009/72/EC) obliges regulatory authorities of Member States to ensure the reliability of electricity disclosure information, which energy suppliers are obliged to deliver to their customers according to the same directive.

Using explicit tracking mechanisms, guarantees of origin, for the disclosure of a part of electricity consumption, requires that the explicitly tracked attributes are removed from the energy source mix of other consumption (untracked consumption), when complying with 2009/28/EC, Art.15(2) and with 2009/72/EC, Art. 3(9). Reliable and transparent residual mix calculation, enables this task, and is an accurate way to disclose untracked consumption to consumers and in the best case, to increase demand for green power.

The residual mix calculation process divides into four phases:

1. Data collection
2. Determination of the domestic residual mixes of European countries (henceforth domains[3])
3. Determination of the European Attribute Mix (EAM)
4. Determination of the final residual mixes of European countries

[3] The use of the word domain derives from the terminology of the rules of the European Energy Certificate System (EECS), in which countries are defined as domains with the exception of Belgium, which constitutes 3 domains. In the residual mix calculation, also Belgium is considered as only one domain.

Data Collection

Common Data Collection in both Methods

- **Domain's net electricity production during year X**
  - All own consumption of power production is excluded. For hydro plants this means that only electricity production relating to natural inflow should be considered
  - Energy losses related to hydro pumping should be considered as consumption and not deducted from hydro production.
- **Domain's electricity consumption during year X**
  - Grid losses are included as well as losses from hydro pumping.
- **Net electricity export to and import from external domains**[4]
  - The domain should determine the net exchange of electricity with all relevant external domains.
    - In case the domain has net import from a specific external domain, the net imported volume should be specified by energy source (at least at accuracy of RES, NUC, FOS) according to the production mix of the external domain (or if available, residual mix). Sources for external domains' production mixes are Entso-e[5] and International Energy Agency[6].
    - In case the domain has net export to a specific external domain, the net exported volume is collected as a single value to be used in the calculation.
  - *Important: note that information of electricity transfers between the domain and other internal domains* ***should not be*** *collected.*
- **CO_2 emissions from fossil-based electricity production in gCO_2 per kWh**
  - Only relates to direct emissions from electricity production. CO_2 data based on LCA has not yet been utilized in residual mix calculation due to absence of mutually agreed, reliable and consistent data source.
- **Radioactive waste from nuclear electricity production in mg of radioactive waste per kWh**[7]

[4] Currently the list of external domains contains all countries outside EU27. As exceptions, Iceland, Norway and Switzerland are not external domains, but Malta and Cyprus are such. The list of internal domains is: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Great Britain, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and Switzerland

[5] https://www.entsoe.eu/resources/data-portal/production/

[6] http://www.iea.org/stats/index.asp

[7] In the future, the level of radioactive waste should be distinguished.

Explicit Electricity Tracking Information in Transaction-Based Method

- EECS certificates and certificate-based RTSs[8]:
  - Volume of imports, exports and cancellations of tracking certificates in the domain during 1.4.year X – 31.3.year X+1[9] per attribute.
    - Note that this relates to transactions of all production year GOs that occur during this time period (not only production year X)[10].
    - Ex-domain cancellations from the domain, for the benefit of other domains, should be considered as exports.
    - Ex-domain cancellations for the benefit of the domain, from other domains, should be considered as both imports and cancellations.
- Non certificate-based RTSs:
  - Explicit tracking per attribute in the domain for calendar year X disclosure (e.g. Contract-based tracking, feed-in tariff linked to disclosure)
    - Explicit tracking by non-certificate-based RTSs should be considered as cancellations.

Explicit Electricity Tracking Information in Issuance-Based Method

- EECS certificates and certificate-based RTSs[8]:
  - Volume of issuance of tracking certificates for year X electricity production per attribute.
  - Volume of cancellations and expiries in the domain during 1.4.year X – 31.3.year X+1[9] per attribute.
    - Note that this relates to expiries of X and X-1 production year certificates that occur during this time period.
    - Ex-domain cancellations from the domain, for the benefit of other domains, should not be considered.
    - Ex-domain cancellations for the benefit of the domain, from other domains should be considered as cancellations.
- Non-certificate-based RTSs:
  - Explicit tracking per attribute in the domain for calendar year X disclosure. (E.g. Contract-based tracking, feed-in tariff linked to disclosure).
    - Explicit tracking by non-certificate-based RTSs should be considered as both issuance and cancellation.

[8] Certificate-based RTSs can be for example national GO systems or other tracking certificate systems

[9] According to RE-DISS BPR [32] “The deadline for cancelling GO for purposes of disclosure in a given year X should be 31 March of year X+1”. This means that cancellations which relate to disclosure of year X occur during 1.4.X – 31.3.X+1. Imports and exports are collected for the same time period (relevant for the transaction-based method).

[10] Considering only production year X GO transactions would lead to cancellations, exports and imports of GOs from production year X-1 after 31.3.X not to be accounted for in any residual mix calculation.

Determination of the Domestic Residual Mix

Underlying Theory

After the necessary data has been collected, the first step of the calculation is to determine the yearly available generation attributes of the domain (available after explicit tracking). This pool of available attributes is called the domestic residual mix. Excluding explicitly tracked attributes from the domestic residual mix can be achieved by two ways:

- Transaction-based method where the focus is on the use of the attributes, i.e. where attributes represented by cancelled and exported certificates are removed from the residual mix, but consequently attributes represented by imported certificates are added to the residual mix.
- Issuance-based method where the focus is on the supply of the attributes, i.e. where all attributes which are issued (and will thus potentially be used) are removed from the residual mix and those which are, in the end, not used (expired) are added back to the residual mix.

These two methods are essentially the same, because if we consider the entire lifetime of production year X certificates for example, the input of certificates to a domain has to equal the use of certificate in the domain, i.e:

Issue + import = cancellation + export + expiries

By rearranging the above equation, we can illustrate that the two methods described above are just two sides of the same equation:

- issue + expiry = - cancellation - export + import

However, they differ in the sense of how attributes of unused GOs are returned to the residual mix. The transaction-based method returns attributes of all GOs of production year X, which are unused at 31.3.X+1 to the residual mix of year X, but then removes them from residual mix of year X+1 in case the GOs are used after 31.3.X+1. Whereas the issuance-based method removes attributes of all issued GOs of production year X (used or unused at 31.3.X+1) from the residual mix of year X, but returns those which remain unused (expire) to the residual mix of X+1[11]. The downside of the transaction-based method is that since year X "left-over" attributes can be removed from the year X+1 residual mix, in a very rare occasion it might happen that there is a negative balance of renewable attributes in the residual mix of year X+1.

For as long as production year X certificates are allowed to be used after the deadline for disclosure of year X (31.3.X+1), leakage between production and consumption years is unavoidable also in the residual mix calculation. The main question is, which of the two is more accurate: Leakage of "minus" from year X to X+1 (TBM) or leakage of "plus" from year X to X+1 (IBM)? This report considers the latter solution (IBM) to portray the use of generation attributes from year X for electricity disclosure in year X more accurately, but it needs to be stressed that neither of the solutions risks double counting and therefore both are applicable.

Step 1: Determining Available Attributes

The calculation begins with the domain's production mix of year X, which is corrected by explicit tracking of generation attributes to obtain the available attributes of the domestic residual mix. Depending on which calculation method is used (TBM or IBM) select either chapter 4.2.1 or 4.2.2 to determine the available attributes.

- Please see chapter 3.1 for instructions on how power production data should be considered.
- In case the domain has import or export of physical electricity from external domains, see chapter 4.5.

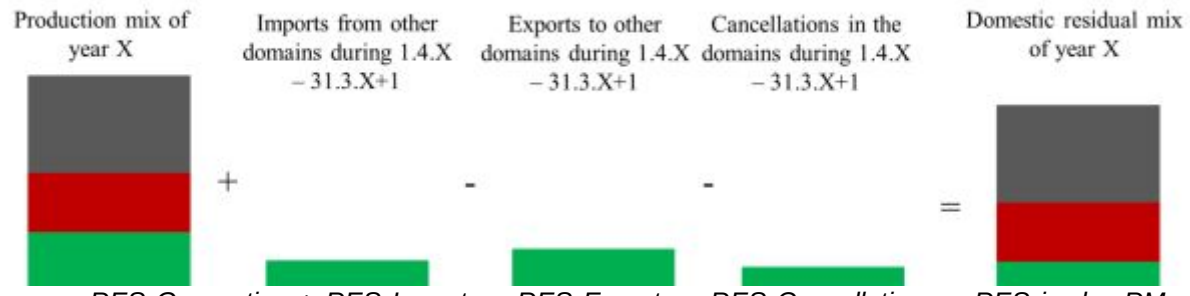
[11] Or into the year X residual mix in case the GO from production year X expires before 31.3.X+1.

Transaction-Based Method

In the transaction-based method, as explained, attribute imports are added to the production mix, and attribute exports and cancellations are subtracted from it. Note that the volume of the domestic residual mix in TWh is lower than that of the production mix in domains where electricity is explicitly tracked.

- Please see the data collection chapter for information on how ex-domain cancellations and non-certificate based RTSs should be considered.

Figure 1 Determining available attributes for the domestic residual mix in the transaction-based method



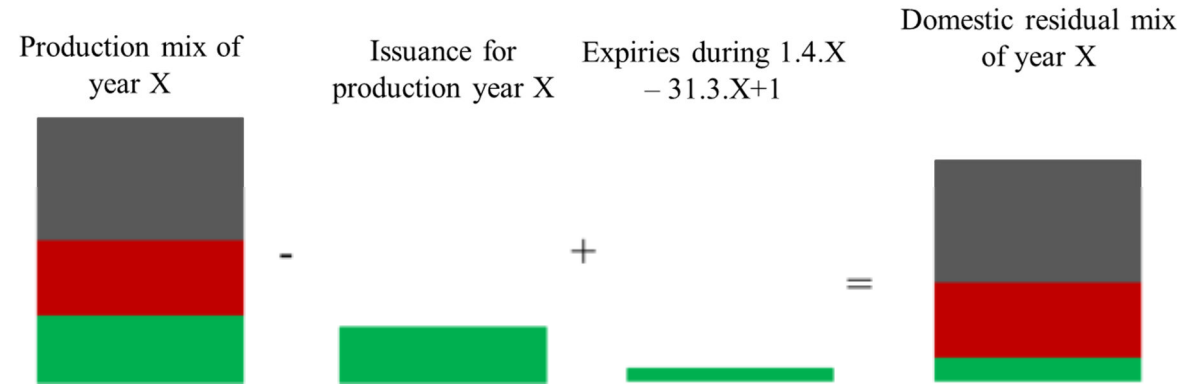
- *RES Generation + RES Imports – RES Exports – RES Cancellations = RES in domRM (Likewise for NUC and FOS)*

Issuance-Based Method

In the issuance-based method, the issuing for generation attributes is considered. As explained, attributes, which are issued a tracking certificate (or are tracked by non-certificate based RTSs) are subtracted from the production mix and unused attributes from previous years (expiries) are added to it. Note that the volume of the domestic residual mix in TWh is lower than that of the production mix in domains where electricity is explicitly tracked.

- Please see the data collection chapter on information how ex-domain cancellations and non-certificate based RTSs should be considered.

Figure 2 Determining available attributes for the domestic residual mix in the issuance-based method



- *RES Generation – RES Issuance + RES expiries = RES in domRM (Likewise for NUC and FOS)*

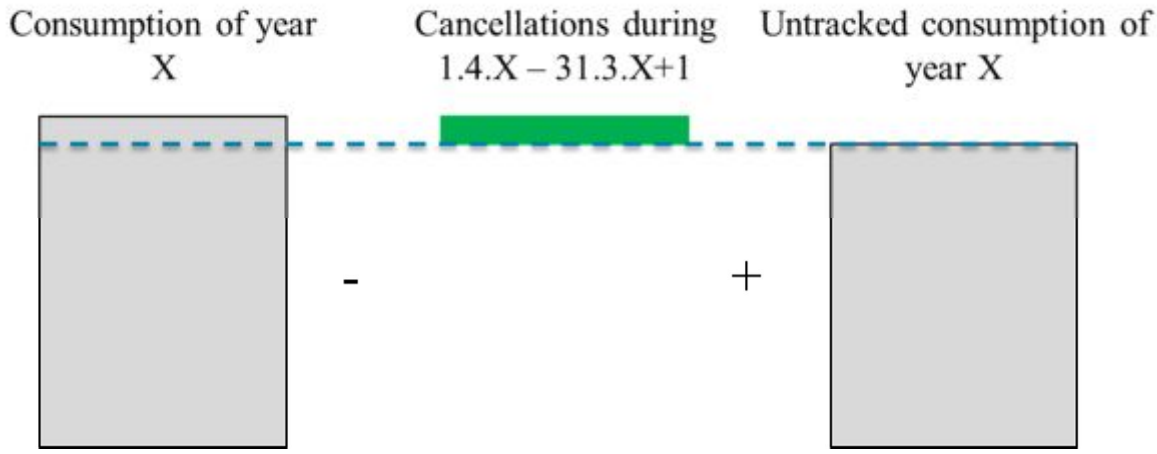
Step 2: Establishing Surplus/Deficit

In the second phase of the calculation, the domestic residual mix is compared to the physical volume of untracked consumption in the domain.

Untracked consumption is such consumption, which has not been disclosed with explicit tracking instruments. Therefore it can be obtained simply by deducting cancellations from the domain's yearly electricity consumption.

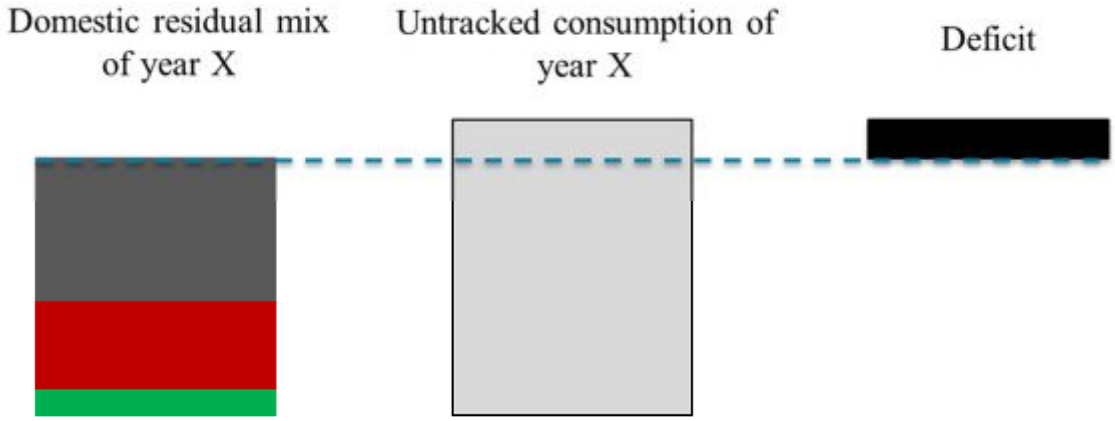
- Please see the chapter 3 on information how ex-domain cancellations and non-certificate based RTSs should be considered.

Figure 3 Determining untracked consumption out of the total electricity consumption of the domain



The difference between the volumes of the domestic residual mix and untracked consumption shows the deficit or surplus of attributes in the domain. In case the domain has an attribute deficit, the deficit needs to be fulfilled with attributes from the European Attribute Mix (Figure 4). In case the domain has an attribute surplus, the surplus needs to be transferred to the European Attribute Mix. This will be explained in chapters 5 and 6.

Figure 4 Determining attribute deficit/surplus as the difference between the residual mix and untracked consumption



Environmental Indicators

The calculation for environmental attributes of power production in the residual mix mostly follows the calculation of energy source attributes. The first step is to determine the total volume of CO_2 and radioactive waste associated with the year X electricity production in the domain. Unless fossil or nuclear attributes are explicitly tracked, the same volume of CO_2 and radioactive waste is also included in the domestic residual mix. To obtain the value per kWh, the total volume simply needs to be divided with the physical volume of the residual mix. If fossil and/or nuclear attributes are explicitly tracked, the associated CO_2 and/or radioactive waste should not be included in the residual mix. In case the domain has physical electricity import from or export to external domains, the FOS / NUC generation needs to be corrected accordingly by considering it as part of domestic production.

- *CO_2 Factor * (FOS Generation – Explicit FOS tracking) = CO_2 in domRM*
- *CO_2 in domRM / Volume of domRM = CO_2 / kWh of domRM*
- *Likewise for radioactive waste*

Physical Electricity Import or Export with External Domains

The effect of physical electricity import or export with external domains on residual mix calculation is elaborated separately, because it only concerns a small number of domains and because its significance is relatively small[12].

- Net electricity import during year X from an external domain is added to the production data of the importing (internal) domain according to the shares of different energy sources in the production mix (or if available, residual mix) of the exporting (external) domain.
- Net electricity export during year X from an internal domain to an external domain is deducted from the available attributes of the exporting (internal) domain according to the shares of different energy sources in the domestic residual mix of the exporting (internal) domain.
- Exchange with external domains is always considered domain by domain, so it is possible for an internal domain to have both physical electricity import from external domain A and physical electricity export to external domain B.

Note: Physical electricity import from external domains should also be reflected in the CO_2 and radioactive waste factor of the domain.

- *Physical electricity import RES = Volume of net import from the external domain * Share of RES in the production mix (residual mix if available) of the external domain. (likewise for NUC and FOS)*
- *Physical electricity export RES = Volume of net export to the external domain * Share of RES in the domestic residual mix of the internal domain. (likewise for NUC and FOS)*
- *Corrected RES in domRM = RES in domRM + Physical electricity import RES – Physical electricity export RES (likewise for NUC and FOS)*

[12] However for some domains this might have a significant effect, for example Finland and Slovenia in the 2011 calculation.

Determination of the European Attribute Mix

Underlying Theory

It is important to outline first, that electricity production in Europe in a given year X always equals electricity consumption during the same year as long as physical electricity transfer with external domains is accounted for. Consequently, in the residual mix calculation of year X, the amount of attribute surplus equals the amount of attribute deficit at European level. Attributes are transferred between borders due to:

1. Physical transfer of electricity across borders, which causes a net exporter to have more attributes than consumption and a net importer to have less attributes than consumption
2. Explicit tracking of electricity generation attributes, which causes a net exporter of tracking instruments (most generally GOs) to have less attributes than consumption and a net importer to have more attributes than consumption.

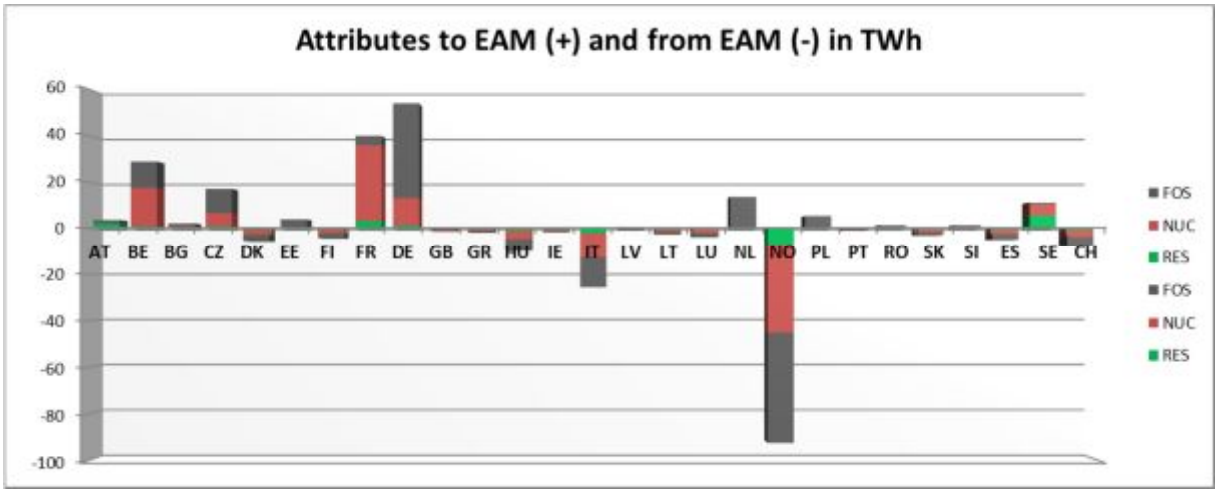
The total surplus or deficit of a domain is the combined effect of these two factors.

Figure 5 illustrates the surpluses (+) and deficits (-) of domains and how the surplus and deficit attributes have been balanced in the EAM in the 2011 residual mix calculation. If GO trading is set aside, domains on the negative side would be the ones net importing physical electricity (i.e. such in which the domestic production would not amount to the domestic consumption). On the other hand, net exporters of electricity, would have too many attributes to merely disclose the domestic consumption. The status of Czech Republic, Italy and France in

Figure 5 can be largely explained by this factor, and not by the exchange of GOs.

When GO exporting and importing is added to the picture, large exporters of GOs, such as Norway, lose generation attributes. Even though the difference between production and consumption in Norway is not great, the large export of GOs causes there to be significantly more untracked consumption than available attributes in the domestic residual mix. This would not happen, if GOs were used internally, since cancellations as such do not cause surplus or deficit; though they decrease the amount of available attributes, they also decrease the amount of untracked consumption: i.e. there is less consumption to be disclosed with the residual mix. The counter-effect of Norway can be seen mainly in Belgium, Germany and the Netherlands. Also there the production and consumption are quite equal, but Norwegian attributes as well as the domestic ones are used for disclosure.

Figure 5 Attribute Balancing with the EAM in 2011



Note: Though these elaborations seem to only apply to the transaction-based model, indirectly they are also valid for the issuance-based model, as every GO issued in the domain is either exported, cancelled or expired and the difference between issuance versus cancellations and expiries in the domain is the net import/export of the domain.

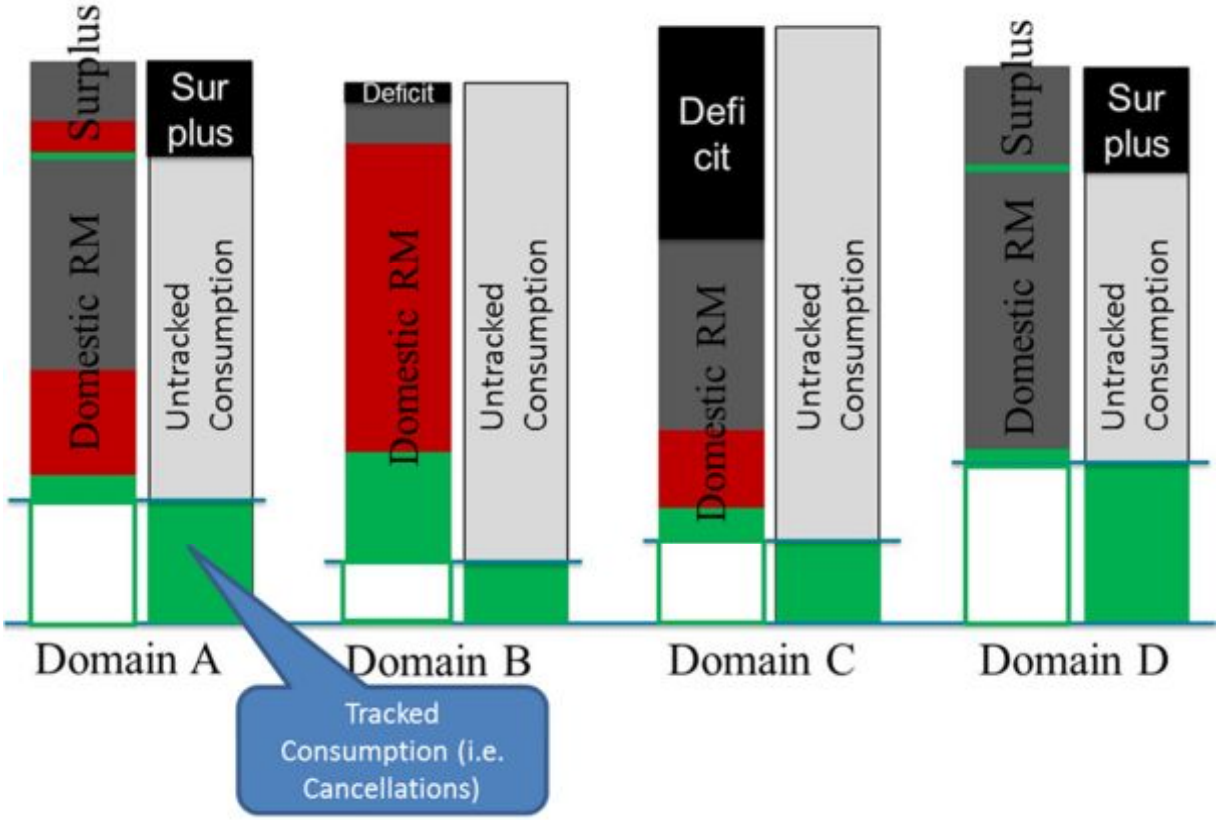
Calculation

Due to the uneven allocation of attributes to different domains, which is portrayed as surplus or deficit of attributes in the domestic residual mix, the harmonized residual mix of RE-DISS needs to balance surpluses and deficits by establishing a European Attribute Mix for surplus attributes.

First, domains with more available attributes than untracked consumption determine their surplus, which is the difference between available attributes and untracked consumption in the domain. The shares of different attributes in the surplus are defined by the shares of different attributes in the domestic residual mix.

So, for example if a domain has 20 TWh of available attributes of which 33 % is each RES, NUC and FOS, and 10 TWh of untracked consumption, it would have a surplus of 10 TWh of which 3,33 TWh would be each RES, NUC and FOS.

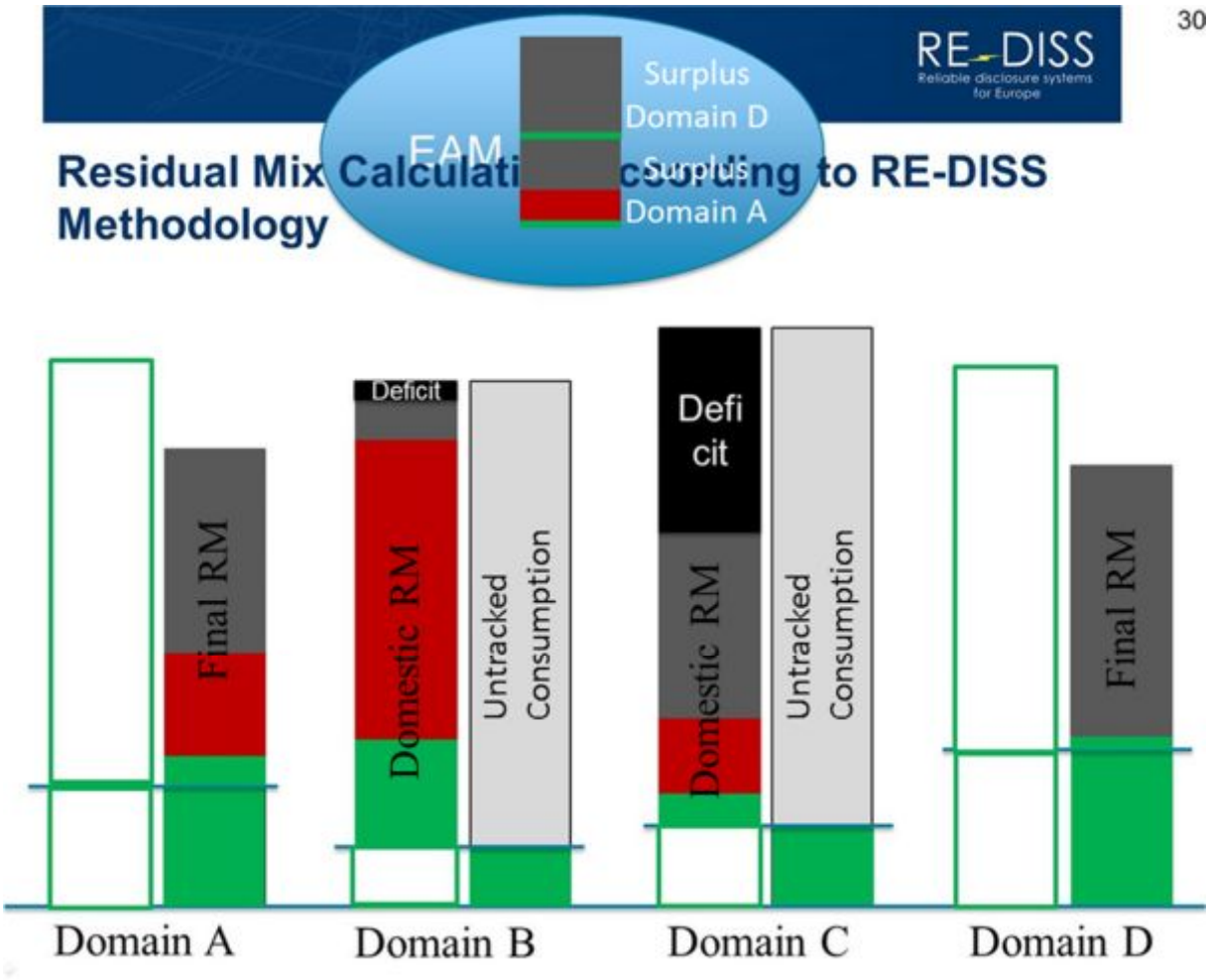
Figure 6 Determining surplus and deficit



- *IF (Available Attributes – Untracked Consumption) > 0 → Surplus*
- *REStoEAM = Surplus * Share of RES in the domestic residual mix (likewise for NUC and FOS)*

All surpluses are collected into a virtual pool of attributes, the European Attribute Mix. The share of different attributes in the EAM is determined by the combined surpluses of all surplus domains. Once the EAM is established, it can be used to fill in deficits in deficit domains.

Figure 7 Collecting surpluses to the EAM



- *TotalRESToEAM (TWh) = SUM((over domain 1,…i) RESToEAM) Likewise for NUC and FOS*
- *TotalSurplus (TWh) = TotalRESToEAM + TotalNUCToEAM + TotalFOSToEAM*
- *ShareOfRESInEAM (%) = TotalRESToEAM / TotalSurplus (Likewise for NUC and FOS)*

Environmental Indicators

The CO_2 and radioactive waste content of the EAM is determined by the CO_2 and radioactive waste contents of the surpluses transferred into the EAM. The total volume of CO_2 and radioactive waste which is transferred to the pool is first calculated by multiplying the amount of surplus of each surplus domain with the CO_2 and radioactive waste factor of the domestic residual mix of that domain. These surpluses of CO_2 and radioactive waste are then added up and divided by the total volume of the EAM.

- *SUM((over domain 1,…i) CO_2 / kWh in domRM * surplus) = CO_2 in EAM*
- *CO_2 in EAM / Total volume EAM = CO_2 / kWh in EAM (likewise for radioactive waste)*

Determination of the Final Residual Mixes of European Countries

Surplus domains

For surplus domains, the final residual mix equals the domestic one in shares of different attributes. In physical volume it is the amount of available attributes in the domestic residual mix subtracted with the surplus transferred to the EAM (since the shares of different attributes in the surplus is equal to their share in the domestic residual mix, the shares of different attributes remain unchanged when moving from domestic to final residual mix in surplus domains).

- *FinalAvailableRES = AvailableRES – RESToEAM (Likewise for NUC and FOS)*
- *FinalAvailableAttributes = FinalAvailableRES + FinalAvailableNUC + FinalAvailableFOS*
- *RMRES = FinalAvailableRES / FinalAvailableAttributes (Likewise for NUC and FOS)*

Deficit Domains

Deficit domains take in the volume of deficit from the EAM according to the share of different attributes in the EAM. These attributes are added with the attributes in the domestic residual mix to constitute the final residual mix of the deficit domain. Note that CO_2 and radioactive waste are also transferred according to the volume of the deficit and according to the CO_2 and radioactive waste content of the EAM.

Figure 8 Fulfilling deficits

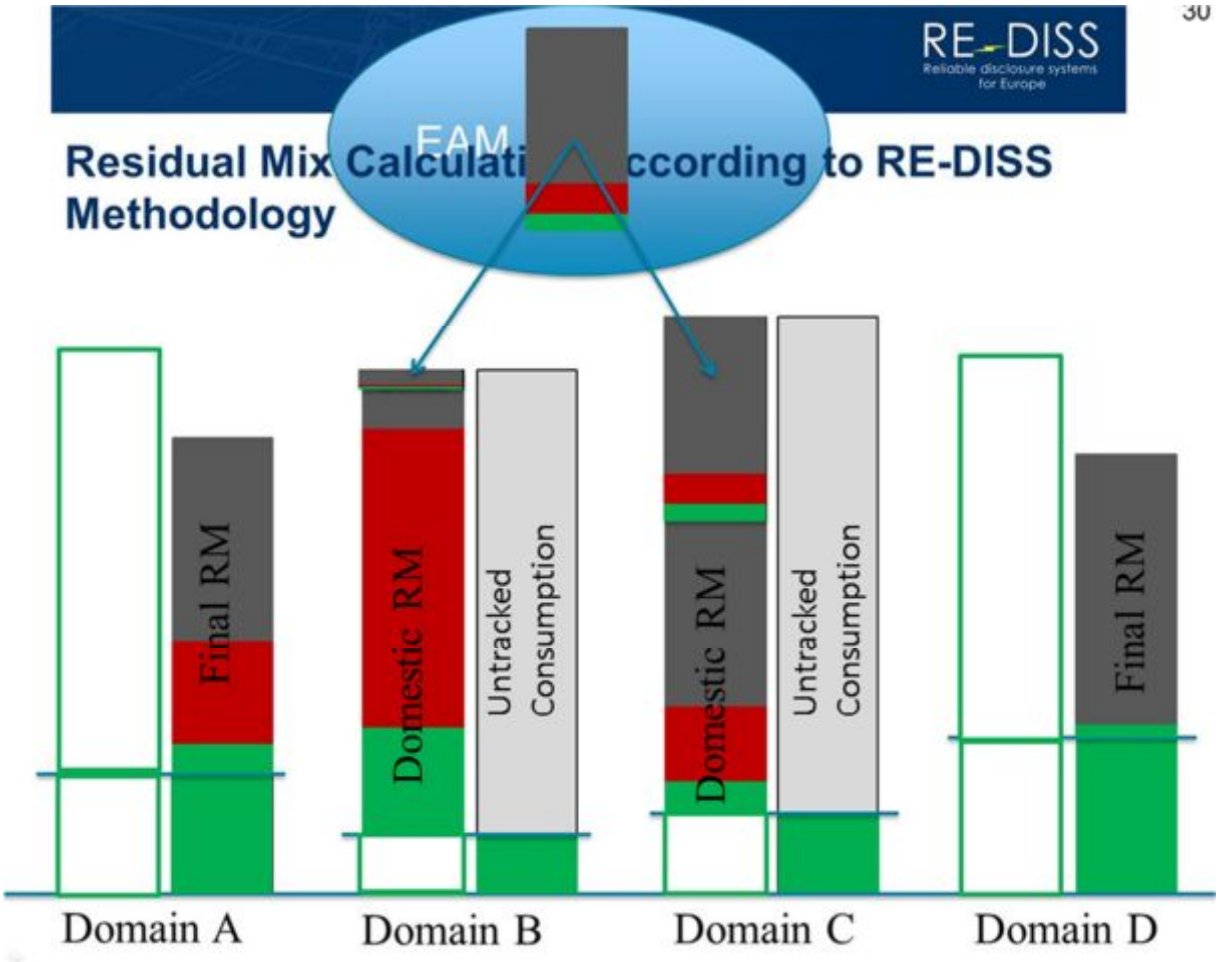
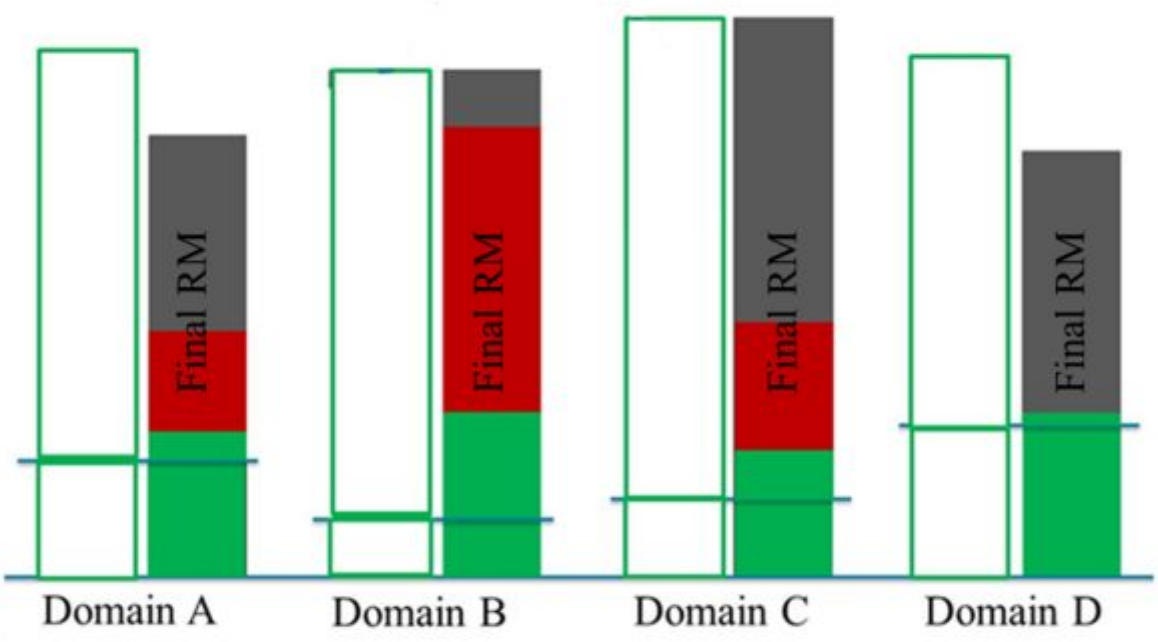


Figure 9 Disclosing untracked consumption with the final residual mixes



- *IF (Available Attributes – Untracked Consumption) < 0 → Untracked Consumption – Available Attributes = Deficit*
- *RESFromEAM (TWh) = Deficit*ShareOfRESInEAM (Likewise for NUC and FOS)*
- *FinalAvailableRES = AvailableRES + RESFromEAM (Likewise for NUC and FOS)*
- *FinalAvailableAttributes = FinalAvailableRES + FinalAvailableNUC + FinalAvailableFOS*
- *RMRES = FinalAvailableRES / FinalAvailableAttributes (Likewise for NUC and FOS)*

Environmental Indicators

The CO_2 and radioactive waste content of the final residual mix is determined by the CO_2 and radioactive waste contents of the domestic residual mixes deducted with what was transferred to the EAM relating to surpluses (surplus domains) and added with what was transferred from the EAM relating to deficits (deficit domains). The total volume of CO_2 and radioactive waste is divided by the total volume of the final residual mix to obtain the content of CO_2 and radioactive waste per kWh of residual mix.

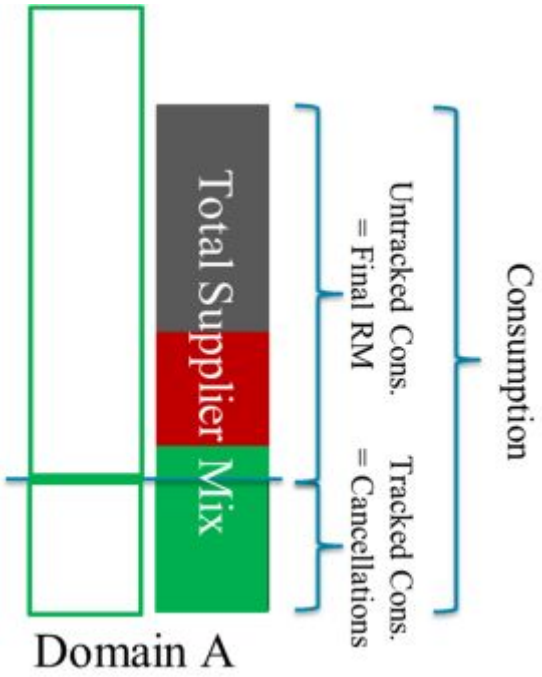
- *Surplus domains:*
  - *CO_2 in domRM – CO_2 / kWh in domRM * surplus = CO_2 in final RM*
  - *CO_2 in final RM / volume of finalRM = CO_2 / kWh in finalRM*
- *Deficit domains:*
  - *CO_2 in domRM – CO_2 / kWh in EAM * deficit = CO_2 in final RM*
  - *CO_2 in final RM / volume of finalRM = CO_2 / kWh in finalRM*
- *Likewise for radioactive waste*

Total Supplier Mix

Total supplier mix means the total volume of attributes disclosed in a domain, both explicitly tracked and those disclosed through the residual mix. It is obtained by summing the volume of cancellations per attribute with the final residual mix. In physical size it equals the total electricity consumption in the domain.

Environmental indicators of the total supplier mix are calculated by adding CO_2 / radioactive waste content of the final residual mix with the possible CO_2 / radioactive waste content of tracked consumption (e.g. if FOS or NUC GOs are used). This sum is divided by the volume of electricity consumption in the domain to obtain the CO_2 / radioactive waste content per kWh of consumption.

Figure 10 Determining total supplier mix



Process Description

Figure 11 and

Figure 12 portray the entire residual mix calculation process.

Figure 11 Residual mix calculation process

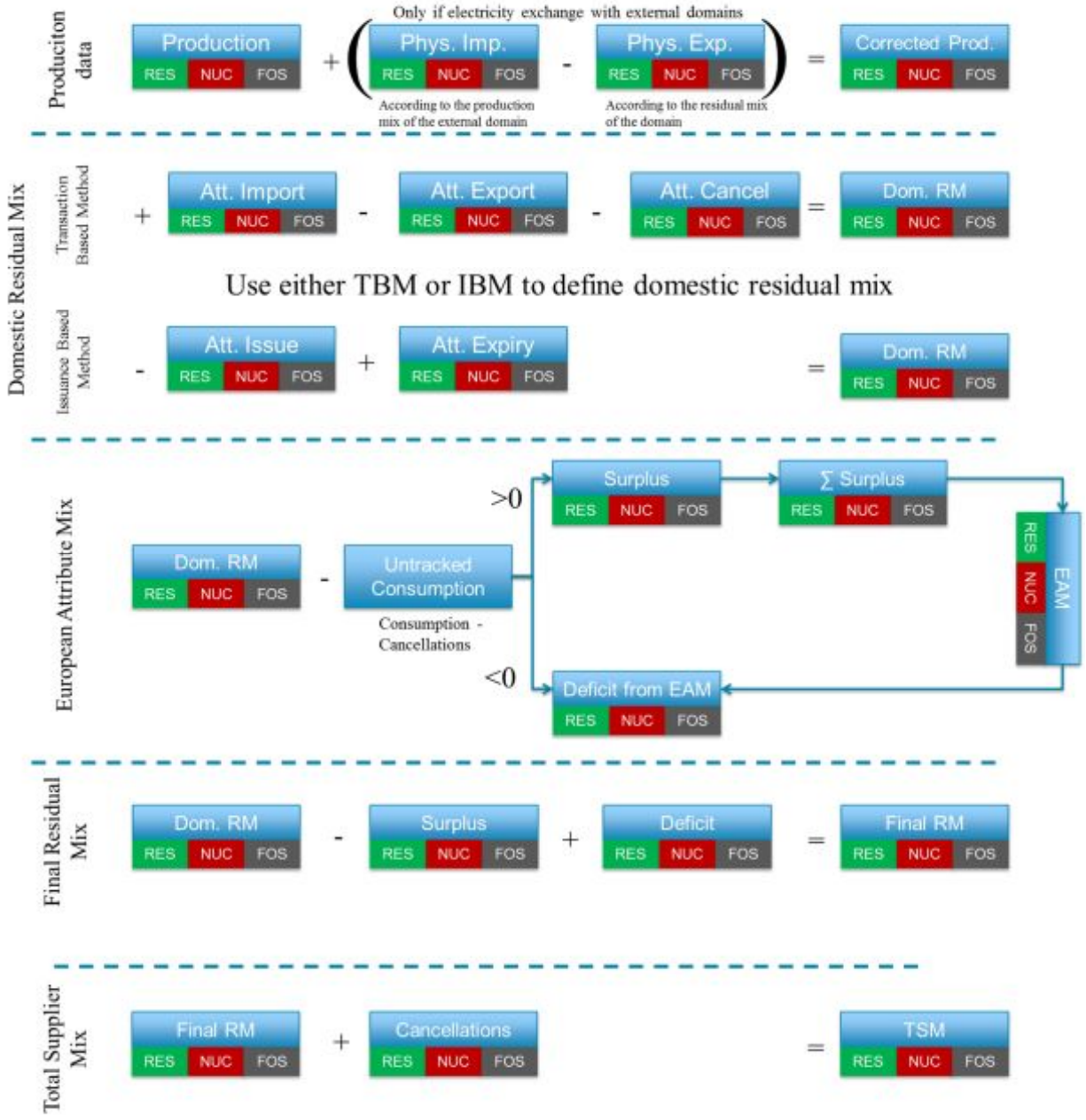


Figure 12 Calculation process for content of CO_2 in the residual mix