Book, trade and claim systems in LCA: how to model certificates delinked from physical flows

Rolf Frischknecht[1], and René Itten[1]

[1]ESU-services Ltd., Kanzleistrasse 4, CH-8610 Uster, Switzerland, www.esu-services.ch
E-mail contact: frischknecht@esu-services.ch

1. Introduction

In May 2011, the association of issueing bodies AIB announced that 1 billion EECS certificates (which equals 1 billion MWh of electricity) have been issued in Europe since its start nine years ago. There is a large demand in renewable energy certificates, which helps electric utilities and companies from the manufacturing as well as service sector to reduce the environmental impacts of the electricity they purchase.

The international standards on life cycle assessment (ISO 14040 [1], ISO 14044 [2]) do not specify how certificates should be taken into account when performing a product or company life cycle assessment (LCA) study. The recently completed carbon footprint standard [3] are clear with regard to carbon offsetting measures (emission certificates): these are considered as a improvement measure and shall not included in the product LCA but kept separate.

Up to now, the role of renewable energy certificates has not been discussed widely. This presentation shows the mechanism and volume of RECS certificates as well as its consequences and proposes some guiding principles how RECS certificates may or may not be used within product LCAs and the eco-balances of companies.

2. Materials and methods

The international standard on life cycle assessment advises to use the “actual electricity production mix in order to reflect the various sources of resources consumed” (ISO 14044 [2]). The current draft standard on the carbon footprint of products requires that “specific electricity products, including a guarantee that the product sale and associated emission are not double counted” are used if the electricity supplier delivers such an electricity product (ISO 14067 [4]). The draft standard also notes that “some "green certificates" are sold without coupling to the electricity, which might lead to double counting”.

Countries issueing	2010	2009	2008	2007	2006	2005	2004
Unit	GWh	GWh	GWh	GWh	GWh	GWh	GWh
Norway	103'925'208	109'972'124	111'080'954	83'289'057	19'762'654	14'506'286	5'625'516
Sweden	67'270'258	68'039'502	67'433'903	34'358'895	25'293'491	16'589'875	5'832'690
Belgium	3'777'459	3'148'822	1'761'062	1'389'626	1'236'592	0	0
Germany	0	0	20'901	0	0	0	5'963
Italy	11'693'754	8'924'377	7'047'084	1'288'221	1'185'323	418'397	73'970
France	9'194'442	4'441'234	2'667'701	2'241'296	960'349	719'430	443'662
Rest of Europe	35'876'974	24'320'552	23'043'776	23'043'863	18'037'109	16'023'937	19'443'084
Total	231'738'095	218'846'611	213'055'381	145'610'958	66'475'518	48'257'925	31'424'885

Technologies	2010	2009	2008	2007	2006	2005	2004
Unit	GWh	GWh	GWh	GWh	GWh	GWh	GWh
Hydropower	181'520'628	171'503'962	168'339'409	134'064'076	54'133'365	38'080'648	19'947'178
Wind power	12'701'701	10'343'571	8'652'480	5'870'060	4'224'211	3'266'322	2'151'274
Biomass	5'738'159	4'723'245	4'372'315	2'647'034	4'010'122	3'504'878	7'826'163
Other renewables	5'734'272	4'743'671	4'033'705	3'029'788	4'107'820	3'406'077	1'500'270
Nuclear	26'043'335	27'532'162	27'657'472	0	0	0	0
Total	231'738'095	218'846'611	213'055'381	145'610'958	66'475'518	48'257'925	31'424'885

Countries cancelling	2010	2009	2008	2007	2006	2005	2004
Unit	GWh	GWh	GWh	GWh	GWh	GWh	GWh
Norway	28'514'371	28'763'116	28'062'028	12'636'718	2'711'968	1'101'274	827'342
Sweden	55'512'661	53'144'161	28'749'478	19'732'466	9'749'209	88'602	59'596
Belgium	48'735'704	7'644'139	14'360'402	4'064'499	647'349	450'730	50'000
Germany	21'420'979	17'078'933	8'150'988	5'289'723	616'653	25'036	48'647
Italy	7'670'751	5'678'056	3'759'063	928'675	573'660	241'048	76'873
France	6'225'743	5'421'017	3'630'351	10'356'326	610'996	461'004	214'878
Rest of Europe	43'899'918	33'845'910	24'295'137	22'265'906	20'835'990	22'387'331	15'290'442
Total	211'980'127	151'575'332	111'007'447	75'274'313	35'745'825	24'755'025	16'567'778

Table 1: Issued and cancelled volumes of RECS certificates during the years 2004 to 2010

The trade with electricity certificates in Europe developped dynamically during the recent past. Table 1 shows trade and cancellation (use) of RECS certificates during the year 2008 [5]. It shows that Norwegian electricity suppliers are most active in issuing RECS certificates, while other countries like Poland or United Kingdom have no activities. Norway exported about 50.5 TWh RECS certificates while Belgium (25.0 TWh), the Netherlands (18.9 TWh) and Germany (14.6 TWh) are the most important countries with respect to RECS imports. RECS certificates need not to be cancelled in the same year. Belgium, the Netherlands and Germany cancelled 13 TWh, 21 TWh, and 8 TWh RECS certificates in 2008.

Norway exports about one third of its domestic hydroelectric power quality, whereas the share of RECS imports to Belgium, the Netherlands and Germany represents about 30 %, 20 %, and 2.5 %, respectively of domestic electricity production. The RECS trade volumes exceed by far the physical trade volumes.

The question is, how to deal with RECS certificates in life cycle assessment and carbon footprint studies. This question calls for a more closer look. We may distinguish two situations: Either the RECS certificates are sold together with the respective physical delivery of renewable electricity or the RECS certificates are sold separately.

3. Results and discussion

3.1. The effect of RECS trade

In Table 2 the electricity mix and technology shares of Norway and Belgium are shown according to their domestic production and including the import of non verifiable electricity to Norway (compensating for RECS exports) and the import of RECS to Belgium. We assume that

- all RECS certificates exported and imported, respectively are actually used in the respective year. This is a conservative assumption.
- the LCI of the electricity mix is influenced not only by physical deliveries of renewable electricity but also by trading electricity quality (RECS certificates).
- the RECS exports are compensated by imports of non verifiable electricity, consisting of electricity based on fossil and nuclear power plants.

	Norway		Belgium	
	production mix without RECS trade %	production mix with RECS trade %	production mix without RECS trade %	production mix with RECS trade %
fossil	0.5	21.6	40.6	31.4
nuclear	0.0	15.3	55.0	42.5
renewable	99.5	63.1	4.4	26.1

Table 2: Share of fossil fuels, nuclear and renewable energy used for electricity production in Norway and Belgium excluding and including RECS trade

The environmental impacts of the national electricity mix in Norway and Belgium changes substantially if the trade of quality of electricity (renewable electricity) is taken into account (see Table 3). The carbon footprint of Norwegian electricity increases by about 2'650 %, while the carbon footpring of the Belgian electricity mix is reduced by about 22 %. With 246 g CO_2-eq/kWh (NO) and 254 g CO_2-eq/kWh (BE) the carbon footprint of the two electricity mixes is very similar. The amount of radioactive waste per kWh Norwegian electricity is increased by 13'600 %, while it decreases by 22 % per kWh Belgian electricity.

	unit	Norway		Belgium	
		production mix	production mix including RECS trade	production mix	production mix including RECS trade
Climate change	g CO_2-eq/kWh	0.90	246	328	254
Radioactive waste	mm^3/kWh	0.013	1.8	6.5	5.0

Table 3: Greenhouse gas emissions and radioactive wastes generated by the production of 1 kWh of Norwegian and Belgian electricity, excluding and including RECS trade

4. Conclusions and recommendations

The RECS trading scheme would substantially affect the national electricity mixes, if the purchase of independently traded RECS certificates would be considered for the national electricity mixes. Currently, the life cycle inventories of national electricity mixes are usually based on international statistics, which do not consider RECS trade but only trade connected to physical deliveries of electricity. If it were allowed to adjust the electricity mix purchased by buying independently traded RECS certificates, substantial double counting of renewable electricity production would occur.

We therefore recommend to disregard independently traded RECS certificates in product and service LCA as long as the LCI of national electricity mixes is based on international statistics disregarding RECS trade. If RECS certificates are linked to the production and delivery of renewable electricity, we recommend to include the respective share of renewables in the electricity mix.

5. References

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