Accounting for Cross-Border Renewable Energy Trade

CDP working paper
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Market boundaries define current renewable energy claims frameworks

The energy transition requires regional cooperation. Renewable electricity (RE) resources are not evenly distributed, and many gigawatts of transmission lines will need to be built across borders to integrate higher levels of RE into the global energy mix.

The theory of change for corporate RE procurement is that voluntary demand for RE can accelerate the energy transition. In markets with limited RE supply, there is pressure for change. Many companies with individual targets can help drive collective change.

Some users view RE attributes as fungible commodities that can be purchased from any location and used to make a claim about physical electricity consumption in any location. Claims made with this view are not credible. At present, outside of most countries in Europe, and Canada and the USA, companies only have claims to be consuming RE when they purchase it from the same country they claim to consume it in[1,2]. Europe and North America benefit from harmonized regulation of their electricity sectors, mutually recognized renewable electricity accounting instruments and extensive interconnection, making international single markets for RE use claims possible. These conditions are not found in any other areas spanning multiple countries at present.

Driving change across market boundaries

Standardized market boundary definitions based on jurisdictional boundaries have driven credibility and comparability in corporate RE use claims. However, the energy transition will require regional cooperation across these boundaries. Companies could play a more direct role in driving this cooperation than current RE use claims frameworks allow them to.

New international single markets for RE use claims like those found in Europe and North America are unlikely to form soon. They depend on deeper integration of entire energy markets; a complex process[3] that will require political cooperation in new ways for the markets that wish to integrate[4].

However, many countries plan to import RE to meet their energy and climate targets. Some are developing promising frameworks to involve the voluntary market in these imports.

There is a growing need to understand how RE imports could impact corporate emissions reporting and related claims, and wider effects on energy and climate targets.

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[1] 2022 RE100 technical criteria (Appendix B)

[2] 2023 CDP scope 2 technical note (2.3 Claiming renewable electricity use: the market boundary criteria)

[3] Co-operation across borders is key to building interconnected power systems of the future (IEA, 2023)

[4] Do, T.N. and Burke, P.J. (2023), *Is ASEAN ready to move to multilateral cross-border electricity trade?* Asia Pac. Viewp., 64: 110-125. https://doi.org/10.1111/apv.12343

Aims of this document

This document:

- Proposes a framework for three "levels" or "venues" of environmental accounting that are impacted by RE trade between countries;
- Uses this framework to pose unresolved questions regarding RE trade and corporate RE use claims derived from it; and
- Proposes necessary but not sufficient solutions to these questions.

This document does not:

- Redefine what a market for RE use claims is;
- Apply its questions to RE use claims within a market (ie it does not comment on deliverability within a market); or
- Situate its recommendations in the formation of new, larger markets for RE use claims (ie it does not present its recommendations as part of a series of steps for two markets to become joined).

"Necessary but not sufficient" solutions in this document refer to requirements that must be met but do not without additional elements constitute a sufficient body of evidence that the underlying question has been addressed.

How governments, regulators, RE developers, and energy attribute certificate system operators can use this document

The voluntary market can play a role in the regional cooperation that is necessary for the energy transition. As frameworks for renewable energy trade are developed for companies to import renewable electricity, the fundamental environmental accounting questions outlined in this document should be used to assess the integrity of those frameworks.

Each of the three venues of environmental accounting presented in this document, the questions raised in them, and the necessary but not sufficient solutions suggested, call upon different stakeholders and authorities to develop the solutions.

Venues of environmental accounting impacted by RE trade

The problems discussed in this document exist in three venues of environmental accounting of increasing scope. The first venue is the energy and emissions accounting of companies claiming to use imported RE. The second is the energy and emissions accounting of all other energy users in the countries trading RE. The third venue is the national environmental accounts of the countries trading RE (ie the venue where progress towards national climate and energy targets is measured).

1 Claims of organizations using imported RE

1.1 How can we be sure RE use claims are unique and exclusive across markets?

It is unclear whether energy attribute certificate (EAC) registries in different countries are suited to cross-border RE trade. In some countries, multiple EAC registries exist where private and government-run EAC systems have been established. Market integration projects do not appear to specify requirements around which EAC systems must be used.

The European Energy Certificate System (EECS) exists to facilitate cross-border EAC trade. It is governed by the Association of Issuing Bodies (AIB), which coordinates all the EECS registries in the AIB member states and has been active in defending unique and exclusive claims.

Absent EAC registries, CDP is not aware of any international legal frameworks for making unique and exclusive RE use claims.

Necessary but not sufficient solution: Cross-border collaboration of EAC registries and MOUs between governments that assure mutual recognition of contractual instruments for renewable electricity use claims.

1.2 How can we be sure RE has been delivered from one market to another?

The concept of physical deliverability is central to credible RE use claims. Physical deliverability refers to the ability of generated electricity to be delivered through the grid to the buyer[5]. Different metrics exist for assessing deliverability, including flow-based and

[5] Where matters: Integrating deliverability into voluntary clean energy market boundaries (Singularity, Brattle, 2023) (page 5)

fungible metrics that vary in their precision. This document only uses the concept of deliverability to discuss import of electricity from one market across an interconnector into a different market. Buyers of RE that is generated in a different market must have assurance that RE has been physically imported to their market.

Electricity imports are proven through metering. RE imports are tied to ownership of EACs. There may be greater need for assurance around how EAC imports can never exceed physical electricity imports. This might be complicated by the exporting generator's relationship with the exporting country's grid. In the case of direct connection to the importing grid with no involvement of the exporting country's grid, as is proposed by some projects participating in a Singapore tender, assurance that EAC imports do not exceed physical imports is inherent. When exporting generators are connected to the grid in the exporting country, interconnector usage, rather than generator output, may limit physical electricity imports. Singapore's EMA states that it "is not prepared to consider the use of RECs purchased from other sources of generation that do not supply electricity to Singapore" without describing how generators will prove their own output is imported into Singapore.

Necessary but not sufficient solution: Exporters book transmission capacity as part of their supply agreements with importers.

2 All other organizations' claims

RE imports affect more than only the claims by the users that claim the imports. Rather, trade has consequences for the energy and emissions accounting of all users in both the exporting and importing countries.

2.1 How can we be sure all energy users report Scope 2 emissions that account for RE trade across markets?

Location-based emissions factors should consider trade. A location-based factor may be defined differently in different countries, sometimes considering trade (ie considering the generation and emissions that serve the country's load), and sometimes not considering trade (ie considering generation and emissions occurring only within defined spatial boundaries, without accounting for imports or exports)[6].

The residual mix is another important characteristic of the grids in both the importing and exporting countries that may be affected by trade. Calculation of a residual mix will require coordination with the EAC registries in both countries. Its calculation may be complicated when multiple EAC systems are in use. In Europe, EECS is the authority for all residual mixes in AIB member countries. A similar system with a view of maintaining grid data integrity is not yet seen in regions outside Europe[7].

[6] Scope 2 guidance ("Spatial boundaries" – 6.10.1 Grid average emissions factors – page 53)

[7] RE100 included a residual mix requirement in a (withdrawn) proposal to recognize cross-market RE use claims in a consultation in 2022. The requirement received mixed feedback from respondents.

Necessary but not sufficient solution: In each country participating in RE trade, the authorities that publish location-based and residual mix factors for their grids agree on a common methodology that accounts for trade.

3 National environmental accounts

3.1 How can we be sure national environmental accounts reflect RE trade?

RE trade creates questions for national environmental accounts. National targets can be defined differently, using emissions, RE capacity, or RE generation or consumption.

Emissions targets are directly affected by RE trade, and also by trade of carbon credits issued to RE generation. A country could meet an emissions target by importing RE. It could also meet an emissions target using carbon credits issued to RE abroad. This raises a double-counting concern.

RE consumption targets are directly affected by RE trade.

RE capacity or generation targets may not be affected by trade if they are defined to only be on capacity or generation occurring within the borders of the country with the capacity or generation target.

Necessary but not sufficient solution: Ideally, a single, mutually recognized instrument (eg an EAC) aggregates all attributes of generation, including any avoided emissions. Where this is not possible, national environmental accounting frameworks between countries trading RE consider all attributes of generation, including any avoided emissions. Corresponding adjustments resulting from RE trade are made to national environmental accounts.

Appendix A: Additional information around RE trade and Scope 2 factors

Consider two countries' grids before and after RE is added to one country for export to the other country.

Country A has a relatively dirty grid. It consumes 10 TWh of electricity annually. Without importing electricity, this load is served entirely by emitting domestic generation. Country B has a relatively clean grid. It consumes 25 TWh of electricity annually. Country A chooses to invest in RE interconnection infrastructure in Country B to import electricity and reduce its own reliance on fossil fuels. It also wants to be able to claim that the electricity it is importing is renewable. After interconnection, domestic generation in Country A falls to 5 TWh annually, with 5 TWh imported. Country B's domestic generation increases to 30 TWh annually, with 5 TWh exported.

Before trade

	Country A (importer)	Country B (exporter)
Electricity generation (TWh)	**10**	**25**
CO2e emissions (Mt CO2e)	**2**	**2**
Zero emissions EACs issued (TWh)	**0**	**10**
Location-based factor (t CO2e/MWh)	**0.2**	**0.08**
Residual mix factor (t CO2e/MWh)	**0.2**	**0.13**

After trade of electricity without EACs

	Country A (importer)	Country B (exporter)
Electricity generation (TWh)	**5**	**30**
CO2e emissions (Mt CO2e)	**1**	**2**
Zero emissions EACs issued (TWh)	**0**	**15**
Location-based factor (generation basis/spatial boundaries do not consider trade) (t CO2e/MWh)	**0.2**	**0.07**
Residual mix factor (t CO2e/MWh)	**0.2**	**0.13**

After trade of electricity and EACs

	Country A (importer)	Country B (exporter)
Electricity consumption (TWh)	**10**	**25**
CO2e emissions (Mt CO2e)	**1**	**2**
Zero emissions EACs retired (TWh)	**5**	**10**
Location-based factor (consumption basis/spatial boundaries consider trade) (t CO2e/MWh)	**0.1**	**0.08**
Residual mix factor (t CO2e/MWh)	**0.2**	**0.13**

For Scope 2 factors to make sense when considering RE trade, emissions factors must be defined in terms of consumption of electricity occurring within the country (not generation) and therefore also EAC retirement in the country (not issuance in the country).

The residual mix uses this concept by definition, but the location-based mix does not necessarily[8].

The middle table does not give accurate Scope 2 factors to energy users on the grids in each country. The factors are not considering trade, but only in-country generation and emissions.

Appendix B: Additional information around RE trade and national environmental accounts

Target types and possible implications for RE trade

Target type	Unit	Relationship with RE trade
Emissions target (absolute or intensity basis)	**t CO2e**	**Direct relationship with RE trade.** **RE trade will reduce domestic emissions from the power sector and contribute to the target. International transfers of carbon credits will also contribute to the target. If EACs and carbon credits are both issued to RE generation, a double-counting problem arises.**
Consumption target	**GWh**	**Direct relationship with RE trade.** **It is unclear in NDCs whether RE targets are on capacity, generation or consumption.**
Generation target	**GWh**	**No relationship with RE trade if the target is only on generation occurring within the borders of the country with the target.** **It is unclear in NDCs whether RE targets are on capacity, generation or consumption.**
Capacity target	**GW**	**No relationship with RE trade if the target is only on capacity built within the borders of the country with the target.** **It is unclear in NDCs whether RE targets are on capacity, generation or consumption.**

Renewable energy in NDCs

IRENA concludes that 109 UNFCC Parties define targets for renewables in the power sector in their NDCs. 49 Parties define targets in terms of capacity or output additions only (not a target on the share of renewables), while 41 Parties have share-based targets and 19 Parties have a combination of capacity/output and share-based targets[9]. Many of these may need to consider how RE trade will affect them.

[8] The Residual Mix and European Attribute Mix Calculation (2.2 Residual Mix – page 7)
[9] NDCs and Renewable Energy Targets in 2021

Renewable energy in ASEAN NDCs

Country-wide RE targets do not feature in many ASEAN NDCs. The table below summarizes them and comments on how trade might impact them.

Party	Total % emissions reductions relative to BAU	Total % emissions reductions relative to BAU (energy sector)	Other economy-wide emissions target (if no BAU target)	RE (non-emissions) target	Implications of RE trade	NDC date
Brunei Darussalam	20% by 2030	No specific target	N/A	30% RE in capacity mix by 2035	Capacity targets are presumably not affected by RE trade.	30/12/2020
Cambodia	42% by 2030	40% by 2030 (relative to sector BAU)	N/A	25% RE in generation mix by 2030	Is the 'energy mix' based on consumption? If so, trade affects this RE target.	31/12/2020
Indonesia	31.89% by 2030 43.20% by 2030 (conditional)	12.5% by 2030 (relative to total BAU) 15.5% by 2030 (relative to total BAU) (conditional)	N/A	2030 capacity addition target	Capacity targets are presumably not affected by RE trade.	23/09/2022
Lao PDR	60% by 2030	No specific target	N/A	2030 capacity addition target	Capacity targets are presumably not affected by RE trade.	11/05/2021

Party	Total % emissions reductions relative to BAU	Total % emissions reductions relative to BAU (energy sector)	Other economy-wide emissions target (if no BAU target)	RE (non-emissions) target	Implications of RE trade	NDC date
Malaysia	No specific target	No specific target	45% carbon intensity (GDP) reduction by 2030 compared to 2005	No specific target		30/07/2021
Myanmar	No specific target	35% by 2030 (relative to sector BAU) 48% by 2030 (relative to sector BAU) (conditional)10	Absolute conditional and unconditional emissions reductions targets (baseline unclear)	39% in generation mix by 2030 48% in generation mix by 2030 (conditional)	Is the 'energy mix' based on consumption? If so, trade affects this RE target.	03/08/2021
Philippines	2.71% by 2030 75% by 2030 (conditional)	No specific target	N/A	No specific target		15/04/2021
Singapore	No specific target	No specific target	Absolute emissions target of 60 Mt CO2e in 2030	2030 capacity addition target	Capacity targets are presumably not affected by RE trade.	04/11/2022

[10] Targets not directly stated but inferred.

Party	Total % emissions reductions relative to BAU	Total % emissions reductions relative to BAU (energy sector)	Other economy-wide emissions target (if no BAU target)	RE (non-emissions) target	Implications of RE trade	NDC date
Thailand	30% by 2030 40% by 2030 (conditional)	No specific target	N/A	No specific target		02/11/2022
Vietnam	15.8% by 2030 43.5% by 2030 (conditional)	7% by 2030 (relative to total BAU) 24.4% by 2030 (relative to total BAU) (conditional)	N/A	No specific target		08/11/2022