ERCST

European Roundtable on Climate Change and Sustainable Transition

Renewable Energy Sales on Integrated Grids and Article 6

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1. Scope

This paper analyses how MOs resulting from the transfer of renewable energy (RE) on transnationally integrated grids are transferred internationally. In must be emphasized that it addresses the case of long-term, significant transfers of RE from one Party to another which results in the displacement of fossil fuel generation and, ultimately, in a decrease of emissions in the integrated grid.

It should also cover the case of power pools, which are integrated grids with a central control that maximizes the efficient use of transmission and generation resources, including the dispatch of renewable energy of the grid. All these instances of cross-border transfer of renewable electricity demonstrate that mitigation outcome can occur in national jurisdictions that are separate from the location of the mitigation activity. One of the main outcomes is that integrated grids can permit a greater ambition of climate action through greater use of renewables in the connected jurisdictions.

This discussion first started under the Kyoto Protocol with the topic of "Canadian clean energy exports". The argument, which lasted several years, concerned Canada wanting to get credit for clean energy exports to the US (hydro power from Quebec, Manitoba and BC to US to displace coal fired generation).

The paper will cover

- Examples of integrated power grids and their associated mitigation potential
- Treatment of internationally integrated power grid projects under the KP's CDM
- Potential treatment of internationally integrated power grid projects under Art 6.2 of the Paris Agreement

2. Main benefits of integrated grids

The new decade will see important changes in the electricity sector around the world, driven by the diffusion of renewable energy and the cost advantages often associated with it, including resulting from the climate change benefits and the reduction of GHG emissions. As a result, power networks and markets have increasingly integrated, both internationally and at the regional level. The benefits of transnational grid interconnection are economic, environmental, and political.

International power trading through integrated transnational grids produces increased cost savings and results in efficiency gains, particularly given the rising global demand and increased diffusion of renewable energy in the power mix.

The transnational integration of energy grids can be a way of addressing intermittent power generation exacerbated by daily and seasonal variability. For instance, during peak hours, countries that have a non-integrated grid must have enough capacity to support that demand, but because electricity is difficult to store, this may lead to temporary power shortages or the need for expensive back up capacity. Interconnected grids can ensure system reliability while requiring less reserve generation capacity.

Trans-border interconnections allow developers and market participants to reap the benefits of economies of scale: on the supply side, by allowing a more efficient use of resources by countries with a better endowment, and on the demand side by allowing consumers to access cheaper energy sources. However, to deliver tangible benefits, interconnected grids must be backed by effective market design and regulatory approaches and require also coordinated cooperation.

From an environmental perspective, the main benefit of integration arises from the fact that it allows for a higher share of renewables to be integrated into larger power systems that were relying on fossil fuel-based power mix. This can clearly accelerate the process of decarbonization for economies that find it more difficult to do so, for instance because they do not have a high renewable potential.

Indeed, the larger geographical scope balances out some differences in natural resource endowment while allowing countries to make a more efficient use of their renewable power sources. It is important to note that, together with market electricity design and regulatory approaches associated to network coupling, appropriate climate policy regulation is necessary to avoid counter effects which could result from a combination of commodity prices and intermittency of renewable energy.

Finally, from a political standpoint, integration can increase energy security for the whole region where power from the interconnected grid is distributed, thus reducing dependence on external sources of fossil fuels. Additionally, another element that can be a consequence of integration, but that is also a requirement for a successful interconnection, is increased trust between the countries participating in the grid.

3. Examples of Internationally Integrated Power Grids

Regional coordination and integrated power grids are not uncommon, with many examples around the world. Many of these integrated grids export renewable energy from one country to another.

Below is an outline of some examples of such arrangements, with or without central dispatch, with some exporting renewables and displacing fossil fired generation:

- US/Canada
- EU and neighbourhood
- Finland/Sweden
- SAPP – South African Power Pool
  West Africa Power Pool
- Angola – Botswana
- Ethiopia- Kenya
- Félou Regional Hydropower Project
- Morocco/Spain
- Mekong Basin
- Bhutan/India/Bangladesh
- ELTAM Project involving Egypt, Libya, Tunisia, Algeria and Morocco
- SIEPAC Project (Central Latin American countries – Panama, Costa Rica, Honduras, Nicaragua, El Salvador and Guatemala)

Important information for such projects would include:

- Project location
- Countries involved
- Type of grid
- Capacity
- Who gets what, in terms of volume, capacity, and percentage of energy
- Information on whether it replaces fossil fuel generation and how much GHG is being displaced.

The table below summarises the capacity and the share of renewables in some of the aforementioned integrated grids.

	Capacity	Share of renewables	Grid Emission Factor	Mitigation outcome
US - Canada[1]	10 GW	63.8%	-	-
Nordic Grid[2]	68 GW	8.08% (5.49 GW)	-	-
ELTAM Project[3]	4.5 GW	0%	-	-
Bhutan - India[4]	1.460 GW	99.44% (1.452GW)	1.004 tCO_2/MWh	-
West Africa Power Pool[5]	15.49 GW	68.9% (10.67GW)	0.562$_a$ tCO2/MWh, 0.561$_b$ tCO2/MWh	-
Southern African Power Pool[6]	61.86 GW	29% (17.96GW)	0.9481$_c$ tCO2/MWh, 0.9871$_d$ tCO2/MWh	-
Mekong Basin: Nam Lik 1-2[7]	100 MW	100%	0.58604 tCO_2/MWh	1,452,586 tCO_2e

[1] Own estimation based on data from the Canadian government of energy exports amounting to 77TWh/year. The share of renewables is taken from The North American Grid: Powering Cooperation on Clean Energy & the Environment

[2] Source: European Network of Transmission System Operators for Electricity. In the document, assumed availability of wind power is 6 % in Finland, 9 % in Sweden, 9 % in Norway, 3 % in Denmark.

[3] Source: Programme for Infrastructure Development in Africa. The capacity for this project is only a part of the whole capacity of the countries involved. The share of renewables is 0% because "The countries involved will share in the benefit of the low-cost, gas-based power generated in Algeria and Libya."

[4] Source: Renewable Readiness Assessment: Kingdom of Bhutan says that Bhutan's total power generation capacity was 1,623 MW in 2018, of which 1,614 MW hydro. In the PDD of the Dagacchu project, it says that Bhutan exports 90% of its electricity to India's Eastern Grid and that 157MW is used for used own consumption. By adding 1460 MW (90% of 1623MW) and 157MW we get 1617MW, which only leaves 6MW of power which is exported to other countries (negligible). Additionally 99.4% of Bhutan's capacity is hydro so we can assume that 1452MW of exported power is renewable. The GEF is also taken from the PDD.

[5] The numbers refer to the generation capacity of the countries in the pool, but this does not imply that this whole generation will be transferred on the grid. Only a part will be transferred depending on the interconnection capacity between the members of the pool. a. The GEF refers to the applicable value for the first crediting period for all project activities except wind and solar power generation. b. The GEF refers to the applicable value for all crediting periods for wind and solar power generation project activities.

[6] Source: SAPP website. Same assumption as for the WAPP. c. The GEF refers to the applicable value for the first crediting period for all project activities except wind and solar power generation. d. The GEF refers to the applicable value for the first crediting period for wind and solar power generation project activities.

[7] Source: CDM Project Design Document

SIEPAC project[8]	300 MW	46%	-	-

[8]Central American Electric Interconnection System (SIEPAC) | Transmission & Trading Case Study. At this stage, the assumption is made that the share of renewables in the grid is the same as the share of renewables in the region.

4. Kyoto Protocol Situation

During the KP a number of projects involved transboundary integrated power grids. A methodology was developed for these projects: ACM0002. While the projects and methodology were developed and obtained approval from the CDM EB, there continued to be objections and contestation for these projects to be accepted as CDM projects.

During the KP period, a number of projects that included transnational integrated power grids became CDM projects. Some are identified in the table below.
Others, like the LT-Amazonas project in Brazil or the Upper Marsayangdi-2 Hydro Electric projects, got rejected.

Title	Host country	Host country 2	Province/ state	Status	Type	Sub-type	Methodology	1st period ktCO2e/ yr
Dagachhu	Bhutan	India	Dagana	Registered	Hydro	Run of river	ACM0002	499
Upper Marsayangdi-2	Nepal	India	Gandaki	Validation Terminated	Hydro	Run of river	ACM0002	2007
Félou	Mali	Mauritania Senegal	Kayes	Registered	Hydro	Run of river	ACM0002	188
Nam Lik 1-2	Lao PDR	Thailand	Vientiane	Registered	Hydro	New dam	ACM0002	208
Nam Lik 1	Lao PDR	Thailand	Vientiane	Registered	Hydro	Run of river	ACM0002	122

For each of these projects, the information that will be identified will include:

- Where the project is located
- Who is the host country
- Capacity
- Energy
- Output distribution (energy)
- Is it an export of renewables and what does it replace
- Project participants
- Letter(s) of approval
- Methodology used
- Who is the buyer of CERs/ how are the CERs distributed

- Special issues

These features have been selected as they are likely to represent issues that require special attention and treatment, as projects that cover transnational integrated grids that are used to export renewable energy displacing CO_2 emitting sources.

5. Examples

Dagachhu Hydropower Project

Dagachhu Hydropower Project is located in Dagana Dzongkhag (District) in Bhutan on the Dagachhu River.
The Project uses the water of the Dagachhu, which is a tributary stream to the Punatsangchhu (Sunkosh) that drains into the Brahmaputra in India. The total size of the catchment area utilized by the Project is 676 km^2. The elevation within the catchment ranges from approximately 800 m to 4000 m.

The powerhouse is located about 11.5 km upstream of the junction of the Dagachhu and the Punatsangchhu. The intake is about 8.8 km upstream of the powerhouse.

India and Bhutan are the host countries. The capacity of the project is 126MW (63MWx2), with an average annual generation of 515GWh (as per the registered PDD) and 90% dependable of 360GWh.
The Power generated at DHPC is transmitted through a Bhutan grid and injected to India Grid. All the energy generated are renewable and is being exported to India. As stated in the registered PDD, CO_2 emission from fossil fuel fired power plant in India are considered to be displaced by the project activity.

The project participant for Bhutan is Dagachhu Hydro Power Corporation Limited, while for India it is Tata Power Trading Company Ltd. Both the Bhutanese and Indian governments had to issue letters of approval.

The methodology applied in the PDD is ACM0002 (Version 7) - Consolidated methodology for grid connected electricity generation from renewable sources. The tool used was “Tool to calculate the emission factor for an electricity system,” Version 1.0.

The DHPC project has sold 775,000.00 CERs Generated in the year 2015-2017 to the Asian Development Bank’s Future Carbon Fund. DHPC is exploring the market for the balance verified CERs (approx. 729,000 CERs).

No special issues were identified with this project.

Félou Regional Hydropower Project

The Félou Regional Hydropower Project is located in the Senegal River Basin/Kayes Region of Mali. The host Parties are Mali, Senegal, Mauritania. The project participants are

- Société de Gestion de l'Energie de Manantali (SOGEM) authorized by Mali, Senegal and Mauritania;
- The International Bank for Reconstruction and Development (IBRD) acting as Trustee for the Spanish Carbon Fund;
- Kingdom of Spain – Ministry of Environment and Rural and Marine Affairs

The other Parties involved are:

- Italy, involved indirectly. Authorized Participants: Enel Trade S.p.A. (withdrawn as of 29/05/2018);
- Belgium, involved indirectly. Authorized Participants: Electrabel SA (withdrawn as of 29/05/2018)
- Sweden, involved indirectly. Authorized Participants: Swedish Energy Agency (withdrawn as of 29/05/2018)
- Germany, involved indirectly. Authorized Participants: Statkraft Markets GmbH (withdrawn as of 29/05/2018)

All these Parties issued letters of approval.

The project has an installed capacity of 63.45 MW. The electricity produced amounts to 330,158 MWh and it is distributed to the integrated trans-national grid between Mali, Senegal and Mauritania. The electricity produced is renewable and expected to deliver emissions reductions for 1,342,355 T CO_2 in the first crediting period (2014 – 2020).
The methodology used for the project is ACM0002, version 8 (Consolidated baseline methodology for grid-connected electricity generation from renewable sources). The tool used was “Tool to calculate the emission factor for an electricity system,” Version 01.1, EB35.

No special issues were identified with this project.

Nam Lik 1-2 Hydropower project

The Nam Lik 1-2 Hydropower Project is located on the Nam Lik River, in the Vientiane Capital province of the Lao People's Democratic Republic. The project is a diversion hydropower station which involved the construction of a dam, reservoir, diversion system, power house and transmission system.

Three countries are involved in the project: Lao PDR and Thailand (both host countries) authorized Nam Lik 1-2 Power Company Limited, and Germany authorized EnBW Trading GmbH. Initially, as set out in the PDD, Nam Lik 1-2 Power Company Limited was the only project participant.

Because the Lao power grid is connected with that of Thailand, although the project is physically located in Lao PDR, the power supplied by it did not only meet domestic electricity demand but was also delivered to the Thai grid. This resulted in an increase in the net power export to Thailand and a consequent decrease of the net power import from Thailand, where the power grid is dominated by thermal power plants.

By displacing part of the power generated by thermal power plants, the project was expected to result in a reduction of CO2 emissions by an estimated 207,512 tCO2e per year during the first crediting period.

The installed capacity of the project is 100MW, with an annual gross power generation of 435,000 MWh. Both Thailand and Lao PDR have access to energy from the project.

For this project, the methodology used was ACM0002, version 12 (Consolidated baseline methodology for grid-connected electricity generation from renewable sources). The tool used was "Tool to calculate the emission factor for an electricity system" (version 02.2.1, EB 63).

No special issues were identified with this project.

LT-Amazonas project

The Tucuruí-Macapá-Manaus Electrical Interconnected grid, also known as the "LT-Amazonas Project", is a national interconnected grid project for which a PDD wassubmitted in 2012.
During its 81st meeting, the CDM EB decided to reject the project. The main problem was that the simplified combined margin used in the PDD was not in line with the methodology and tool also used.
The full reasons for the rejection are outlined in ruling note CDM-PA9051-RULE01. The ruling also mentions that, with the appropriate revisions, the project could be resubmitted for validation and registration.

6. Integrated grid projects under the Paris Agreement

Under the Paris Agreement, when the project under consideration involves the export of clean energy over integrated grids, there will likely be special features that will need special attention and thinking. There is an expectation that such projects will be considered by those hosting them under both Article 6.2, as well as Article 6.4, which is seen by many as successor of the CDM. This paper will examine how such projects will be examined under Art 6.2, and what the potential treatment could be.

Features under Art 6.2

1. Relationship between NDCs, MO and ITMOs
2. Letters of approval
3. Relation with NDC
4. Grid emissions factor
5. Corresponding adjustment
6. Tracking of ITMOs (registries – features for domestic and international registries)
7. ITMO ownership

Assumptions/Considerations

In the case of integrated power grids and ITMOs resulting from the export of renewable energy (RE), the potential double counting is one of the main concerns that have been expressed by stakeholders in the CDM, and now under Art 6.

Another equally important concern expressed is the fact that these projects are predicated on economic/ financial viability and therefore there is no need for creating additional revenue flow based on sale of carbon assets. However what needs to be emphasized as well is that integrated grids can permit a greater ambition of climate action through greater use of renewables in the connected jurisdictions.

One example is the European integrated grid where hydro from Norway for example allows much greater level of renewable use in countries like Germany or Denmark. This is clearly indicated as one of the main benefits by the European Commission (https://ec.europa.eu/commission/presscorner/detail/en/qanda_20_1258).

Another example is the significant amount of imported hydro power from Canada into US, which displaces a lot of fossil fired energy. This could also be an important strategy for many developing countries to raise the ambition of their NDCs through coordinated action and cooperation though Art 6.

The key issue in case of regional cooperation to raise climate ambition is how to split the benefits/ incentives that can be created through Art 6 and on how accounting and tracking is done in a way that supports environmental integrity and ensures absence of double counting

Double counting has been expressed as concern since there is export of RE, which already benefits the exporting country as it gets paid for the contract. The importing country is seen as benefiting as its GHG inventory decrease as a result of the substitution of fossil fuels based electricity with RE (albeit from imports). The benefit needs to be seen on the integrated system which sees an overall decrease in emissions.

However, it is difficult to see how this discussion can take place without a number of "assumptions" – this is meant to explain the external conditions that this discussion is premised upon, rather than indicate any expected (or accepted) outcome from the negotiations on the Art 6 rule book.

Also a clear understanding of what are mitigation actions and mitigation outcomes (MO), which when transferred internationally become ITMOs is needed. Mitigation action is the actual action that will result in a contribution to mitigation. In our discussion the mitigation action will the production of renewable energy (RE) - and it results in a mitigation outcome through the reduction in GHG emissions by displacing fossil fueled power production.

This shows that a mitigation action in one jurisdiction can result in a mitigation outcome in another jurisdiction. Typically, the mitigation action (production of RE) and the mitigation outcome takes place in the same country. In this case it is clear that the reduction (MO) can be used as an ITMO. However, as the examples above show, the export of RE which results in a MO in another jurisdiction is by no means an exceptions situation.

Assumption # 1: ITMOs originate from a mitigation action, that has a Mitigation Outcome (MO). The metrics of MOs can vary from case to case. In the case of exports of RE via internationally integrated power grids the MO is in RE MWh or MW.

A second way of looking at this case, is to assume that the mitigation action is the RE generated and exported and the mitigation outcome is the CO2 reduction on the importing grid.

Assumption # 2: MOs, when they become ITMOs, are tradable further, that is, they are not a bilateral undertaking only. There are some who see ITMOs as the transfer of a MO between two countries, with no possibility of further transfer.

Assumption # 3: ITMOs and MO do not have to be in the same metric. ITMOs can be in any metric as long as a conversion factor can be calculated between the metric of the MO and that of the ITMO, or between the metric of the ITMO and the NDC. For the great majority of ITMOs the metric will be CO2. In the case of ITMOs from exports of RE it can also be in MWh, depending on what the agreement is between the cooperating Parties.

The Paris Agreement does not in any way specify the relationship between the metrics of the MO, NDC and ITMOs. One should conclude that as long as there is **no double counting and no increase in overall emissions** all permutations are possible between these three elements. Some examples are given below.

Assumption # 4: only one ITMO characteristic can be used at any time in one jurisdiction towards its NDC. One issue that needs to be internalized is the difference between domestic and NDC commitments. For illustration purposes a country may have its NDC in MW of RE and in GHG intensity. In this case the RE imported can only be counted towards one of these commitments, but not both. That is, exports of RE cannot be counted by the same using Party both in meeting the MW of RE provision of the NDC and at the same time the CO2 provision in its NDC. It can be moved between commitments with the "right" conversion factor, but, for illustration purposes, an import of ITMOs cannot result in a decrease in emissions balance and increase of MWh at the same time.

However, if the import of RE is counted towards its NDC in GHG, it could be counted for purely domestic purposes for any RE targets. ITMOs in either metric can be used for further international transfers, as long as double counting towards the NDC is avoided. The real concern is double counting toward NDCs.

The concern of double counting was less important in the KP and the CDM since only Annex 1 countries had obligations. In the PA everyone has obligations through NDCs and therefore the avoidance of double counting through corresponding adjustments is a significant concern.

Assumption # 5: a Corresponding Adjustment is done to the NDC related number

- at issuance or first transfer of an ITMO by the Issuing Party (Party where MO is produced and which exports the ITMO for the first time)
- at the time of ITMOs use towards its NDC by the Using Party (Party which uses the ITMO towards the NDC or towards another purpose recognized under the Paris Agreement).

The issues around Corresponding Adjustments (CA) will also require some assumptions to allow for a productive discussion.

Assumption # 6: registries could, at the discretion of the Party, have accounts in metrics different from their own NDC, and hold ITMOs in those metrics. In a multiple-metric environment there could be multiple Interchange Accounts (IA)/Buffer Account (BA)in registries (one IA for each ITMO metric, similar to currency accounts) that get adjusted (starting from 0) every time there is a transfer. The corresponding adjustment (CA), discussed below, relies on information in the IA in order to adjust a number that has the NDC commitment as a starting point.

<u>What gets adjusted:</u>

Assumption: ITMOs are used to show progress towards NDCs and therefore a CA will indicate whether the transfer has made it easier or more difficult for the Party to meet its NDC. While the adjustment is made to the NDC, this does not in any way preclude also reporting of an Emissions Balance, even if the NDC is not in CO2e.

The two reports, "Progress towards the NDC" and "Emissions Balance", complement each other and provide a complete picture – one indicates Party's progress towards the NDC it has committed to; the other can be used to understand progress towards the global goals of the Paris Agreement.

<u>IMPORTANT.</u> The fact that an ITMO is in the Registry of a Party does not require, and actually does not entitle that Party to undertake a CA. For a Corresponding Adjustment to take

- the Party must have ownership of the ITMO. This is not dissimilar from the KP when traders had account in a Registry, but that Party could not use those CERs to meet its KP obligations
- The Party must use the ITMO towards its NDC

For the sake of clarity, CA needs to occur at issuance of the ITMO and at the use of the ITMO for the purpose of the using Party's NDC.

<u>When is the adjustment done:</u>

Assumption: Issuing Party (IP) makes a CA at first transfer. The CA remains "open" until the Using Party uses the ITMOs towards its NDC. Further transfers are tracked (possibly through a buffer or interchange account) but the corresponding adjustment to match that of the Issuing Party will only be made by a Using Party at the time of use towards an NDC (or agreed purposes). This is further illustrated in the examples for India/Bhutan and Felou (below).

This discussion about CA (again) may seem theoretical and more oriented to the interest of negotiators, but it actually has practical implications. This is why it needs a number of clear assumptions in moving forward.

In general, not only for the special case if the transfer of clean energy on linked grids, the question needs to be posed regarding what happens to the ITMOs that are in a Party's registry (in different currencies) and surplus to what is needed to meet a Party's NDC (if it has more ITMOs than it needs to meet its NDC). The two options that are:

- They are banked for future NDC periods
- Are cancelled at the end of the NDC period (i.e. cannot be banked). It will be hard to entice the private sector to act and produce MO for a Paris Agreement carbon market if ITMOs are not bankable at the end of an NDC period. Their value will go to zero as we approach the end of an NDC period and will drag down the price in the whole carbon market with them.

<u>**Treatment for internationally integrated power grid which exports RE.**</u>

Since there are three elements that need to be taken into account (NDCs, MO and ITMOs), there are a number of scenarios that need to be analyzed. This analysis can be complex and must be based on assumptions, at least until there is some clarity from both the PA rule book and/or case law will start to emerge from doing transactions under Art 6.2.

In the case of RE exports the production of RE can be a mitigation action, with GHG reductions taking place in the import market. In this view the GHG reduction is the mitigation outcome. The ITMOs would be any further transfers of reductions from the place where they take place on.

Alternatively, and this would account for all transactions and transfers, and would be more Cartesian, the production of RE is a MO. The transfer of RE from the country producing RE to the buying country must be seen as ITMOs. Any further transfers are also ITMOs.

Given that different metrics are assumed as possible, a number of cases can be examined for the IP (Issuing Party), Using Party (UP), ITMO:

1. <u>NDCs (MWh/MWh); ITMO (MWh)</u>
   - MO (MWh) and ITMO (MWh); no conversion required
   - ITMO can be traded and transferred in CO2 or MWh (for CO_2 a conversion using the GEF will be needed).
   - CA done by IP in MWh
   - CA done by UP in MWh

2. NDCs (MWh/MWh); ITMO (CO2)
    - MO(MWh) and ITMO (CO2); GEF needs to be used for conversion from MWh to CO_2
    - ITMO can be traded and transferred in CO_2 or MWh
    - CA done by IP in MWh. ITMO needs to be converted to MWh using GEF
    - CA done by UP in MWh; ITMO needs to be converted to MWh using GEF

3. NDCs (CO2/MWh); ITMO (MWh)
    - MO (MWh) and ITMO (MWh); no conversion needed
    - CA done by IP in CO2; ITMOs need to be converted from MWh to CO2 using GEF
    - CA done for UP in MWh

4. NDCs (CO2/MWh); ITMOs (CO2)
    - MO (MWh); ITMO (CO2) -> conversion using GEF
    - ITMO can be traded and transferred in CO2 or MWh
    - CA done for IP in CO2
    - CA done for UP in MWh; ITMOs need to be converted from CO2 to MWh using GEF

Letter of Approval

Projects under Art 6.2 are projects which are bilateral (or plurilateral, as is the case for SAPP or the West Africa Power Pool) and some may include the export of renewable energy and the displacement of fossil fired generation on the importing system(s). They will need to have in some way the blessing of the government for the transfer of the ITMOs resulting from these power sales and will have to meet the requirements of Art 6.2 and 6.3, as well as whatever other provisions will be in the Art 6 rulebook. Also, a number of important elements will need to included in the LoA.

One important purpose of the LoA is to document the split the benefits/ incentives that can be created through Art 6; this needs to be done through clear specification of the necessary Corresponding Adjustment by the cooperating Parties and on how accounting and tracking is done in a way that supports environmental integrity and ensures absence of double counting. This may prove to be important as one key consideration will be to ensure environmental integrity i.e. to ensure that the outcome of the transfer does not result in higher overall emissions. This will be necessary if options for accounting for ITMOs will be available to Parties.

In the case of an internationally integrated grid that is used to export RE and displace fossil fired generation, it may be useful to state what is the grid emission factor (GEF) that is used by all Parties involved. Whether this will be used at issuance or not will depend on the NDCs of the Parties involved, their metrics and how the CA are undertaken

Art 6 is different from CDM, as the CDM invariably took place in a developing country that had in principle to issue one Letter of Approval (LoA) to the CDM EB. In the case of the internationally integrated power grid CDM projects, the letter of approval was in general issued by both/all countries involved in the CDM project, but not always. Dagachhu is one case, in other cases in Bhutan projects only had letters of approval from Bhutan, and not from India.

In the case of Art 6 and the Paris Agreement there are is no more differentiation according to any annex. All countries have NDCs and as such there is the expectation that all countries involved, whether they are exporting or importing clean energy will also need to issue an LoA. In the case of a power pool all members of the power pool should issue such LoAs.

However, the LoA may be different and play a different role in Art 6.2 though this is general, and not directly related to integrated grid projects. In the case of Art 6.2, the LoA should signal to other Parties that the exporting Party will allow for the ITMOs to be used for meeting an NDC or for other obligations, and that it will undertake a CA. Therefore, other Parties may allow their own private sector organizations to buy and transfer that ITMO.

Under Art 6.2 these letters can take different forms. One way is for Parties to issue a blanket letter of approval that will allow any entity in that jurisdiction to enter into an ITMO transaction with, and transfer to an entity in another Party that has been issued an LoA from the Party where they are based. The importing Party would also need to commit to undertake a CA according to the rules put in place by the CMA, in case it uses that MO as an ITMO towards its NDC.

Alternatively, it may well be that a Party could authorize any entity only to purchase and transfer ITMOs from any Party that has provided a Letter of Authorization for the export of the ITMOs.

Alternatively, exporting countries may wish to issue individual letters of approval for projects or collaboration that involve the international transfer of mitigation outcomes (MO) generated in its jurisdiction.

The letters should further state that these ITMOs will be good for compliance with the NDC of the importing Party, and that the exporting country will undertake a corresponding adjustment, according to the rules set in place under Art 6.2.

Relationship with NDC

How the project relates to the NDC (of issuing Party) will be an important consideration in the transfer of ITMOs resulting from the transfer of RE on international integrated power grids. This will influence how and if corresponding adjustments will be done, and how it will show in accounting of the different Parties that participate in the project, together other issues listed below.

It will strongly depend on what is the definition of an NDC, with very different interpretations that seem to exist. One interpretation, the classic one, and the one that is generally accepted, is the commitment, potentially expressed in different metrics. A second view is that the NDC is the aggregation of all activities that lead to the attainment of the "pledge" included in the NDC. These two views represent a subtle but powerfully different interpretation. Depending on how the rulebook will land on this issue, an activity generating MO, even in an economy wide cap, may not be seen as being in the NDC.

The relationship with the NDC will be regulatory but will also relate to environmental integrity. This will be true of all projects under Art 6.2 and 6.4. In the case of the KP and CDM, projects had to define a baseline and then demonstrate additionality. In the case of Art 6.2 on an integrated grid, there is an NDC so the calculation of the baseline and the application of an CA should suffice to demonstrate environmental integrity.

The discussion on whether there will be a CA is not likely to happen under Art 6.2, as it is clear that a CA is needed under this provision based on the PA and 1/CMP21. The implication is that only MO coming from under the NDC, or that have been accounted for, or can be accounted by a Party towards its NDC, should be transferred.

Other important elements that will need to be accounted for are the metric and the nature of the NDC. In the case of the metric, any CA will need to be undertaken in the metric of the NDC, if we are to be able to convert the ITMO to that metric. Conversion may not always be possible.

With respect to the nature of the NDC, there are specific cases, such cases on countries that are carbon neutral already or even carbon negative which will need a special understanding of how the transfer is made.

The differences between the way the NDCs are expressed by the IP and the UP, will also be important. NDCs can be expressed and are expressed in many ways and in many metrics. Given the fact that ITMOs for RE exports on integrated grids will be in MWh or CO2, the metrics of the ITMOs and how the ITMOs and the NDCs articulate with each other is important.

With respect to the country situation, and also related to the NDC, is examining whether a country is carbon **negative, net-zero, or has a GHG inventory showing emissions.**

One such particular case will be countries that are carbon neutral or negative. In such a case, negativity will come from the zero or low energy emissions, which is then brought into the negative zone through sinks. In such a case, exports of renewables which will displace fossil fired generation will subtract ITMOs from the inventory balance, potentially playing a role in decreasing the negativity of the NDC of the exporting country. Alternatively, they can also be seen as a decrease in a component of the NDC in MWh of renewables.

Grid Emission Factor

Electricity trade among power grids might lead to difficulties in measuring greenhouse gas (GHG) emission factors of purchased electricity if not all related factors are considered appropriately. The CDM methodological tool has served this purpose to a large extent in the past two decades though with some compromises. The tool largely facilitated countries with selection of methodological options depending on the data availability and its quality. Though, this led to significant variation in baseline levels within an individual country (and grid), depending on the methodology used and the details applied in its calculation.

Under the Paris Agreement, with different level and types of NDC targets for the electricity sector, which in many cases not aligned with long term plans of the power sector, introduces a different level of complexities. Especially, the conditionality of NDCs can potentially affect the level of emissions baseline of individual mitigation activities (OECD, 2019). With regular updates to NDC targets and continuous technological improvements of renewable energy plants, the baselines require regular updates to reflect these changes and to ensure accurate emission reduction calculations. This new context requires new approach – 'Policy aligned emission factor approach' - that takes countries' least-cost future investment plans and sectors emission trajectory under the domestic policies and comparing them with NDC sector targets.

ITMO ownership

In the case of the Bhutan/India trade, the agreement is a country-to-country agreement, and the ownership of the CERs issued by the CDM EB is 50/50, as decided in PPA.

In the case of the Félou project in Mali, all CERs accrue to SOGEM, the company in charge of the technical and operational management of the plant. This is also an agreement between the countries involved in the project, and the split between countries is done function of how the power from the Felou power plant is distributed between the

In general, on integrated power pools the division of ITMOs should be specified by the Power Purchase Agreement of electricity. Though there could be further domestic arrangements for sharing of assets/ revenue between project entity and government and between government to government.

Examples of RE exports on integrated grids

Bhutan-India

The benefits of ER imports from Bhutan include the use of the energy and/or capacity, depending on the needs of India and the reduction of GHG in India since the energy imported is renewable displaces fossil fuel fired generation on the Indian grid. One additional and highly significant element that needs to be factored is the fact that this is not a spot market transaction, but rather a long-term predictable sale of energy. In some case power plants in this situation could be actually totally dedicated for exports and could be isolated on the importing system.

In this case, as mentioned before, the split in CERs under the CDM project is specified in the PPA as being 50-50. What the in-country arrangements are is something that can vary, with private or para-governmental organizations and governments playing different roles.

The whole agreement is premised on the fact that this is international cooperation and that all the benefits should be shared by participating Parties. There is nothing to oblige India to share all benefits, including the benefits resulting from climate change, from the imports of renewable energy power from Bhutan.

In this case there is no common dispatch and the GEF will be the GEF on the Indian grid.

Purely for illustration purpose some numbers are assumed:

- The GEF in India is .9 TCO_2/MWh
- Bhutan sells to India 100 MW of power which results in 500 GWh of energy
- The reduction in India will be 450 $kTCO_2$

- As a result of the purchase of the 100 MW India has recorded a reduction in the CO2e metric of its NDC by 450. It is a virtual CA of -450. One could say that the RE purchase is recognized in its inventory. India cannot do a CA to MW metric in its NDC as it cannot count towards its NDC two attributes of the same MO.
- India sends 225 kTCO2 to Bhutan and does a CA of +225. On this case this is the First Issuance and a CA is needed.
- Bhutan gets 225 kTCO2 and increases its "negativity" by 225 kTCO2. However, unless it uses the ITMO towards its NDC it does not have to do a CA.

The element that needs to be recognized is that India cannot do a CA for the purchase for both the MW and CO_2 indicators of its NDC – it cannot claim two environmental benefits from the same

MO. In both cases India at the end of the transaction will have +225 $kTCO_2$ while Bhutan will have -225 $kTCO_2$.

BOX 1

One thing that needs to be recognized is that alternatives approaches are possible which may take into account the fact that ITMOs can be in different metrics, depending also on the metrics of the NDCs. In this case, the Bhutan NDC, while it does not quantify a commitment, is specific in that it states that Bhutan "pursue sustainable and clean hydropower development with support from CDM or other climate market mechanisms to reduce emissions within Bhutan and the region by exporting surplus electricity".

In this case, Bhutan could do a CA for the (-)100 MW it exports, with a CA in India of +100 MW. The subsequent transfers will be similar to what is illustrated above.

Felou Hydroelectric project

- The Felou case considers the case of a hydro power plant which is located in Mali and is owned by a company called SOGEM, which in turn is owned by Senegal, Mauritania and Mali.

- This case can be seen in two different circumstances:
    - One in which the GEF is a grid GEF for all countries involved or
    - A different GEF for each country.

For both cases the principles of accounting and CA will stay the same, the only thing that will naturally change will be the total amount of reduction in TCO_2.

- For illustration purposes the GEF on the grid is considered 1 tCO_2/MWh.
- The distribution of power (and CO2 reductions) among the three countries is considered as follows
    - Mali: 45 MWh
    - Mauritania: 30 MWh
    - Senegal: 25 MWh

- Each country receives MWh from the Felou power plant.
    - Mali 45 MWh= 100 – 30 - 25
    - Mauritania 30 MWh
    - Senegal 25 MWh

- There are CO_2 reductions recognized in the inventory/ NDC expressed in CO_2 for each country – or an implicit corresponding adjustment
  - Mali - 45 CO_2
  - Mauritania – 30 CO_2
  - Senegal – 25 CO_2
- The 3 countries send CO2 reductions to Felou and the following CAs take place
  - Mali + 45 CO_2
  - Mauritania + 30 CO_2
  - Senegal + 25 CO_2
- Felou has in its account, not necessarily in the Mali registry, 100 CO_2. Even if it is in the Mali registry a CA will not take place in Mali until and unless
  - Mali Govt owns the ITMOs
  - Mali Govt uses them for NDC
- Felou may choose to sell these ITMOs in the future until someone use the 100 and then have to make a CA.

What needs to be retained is that the impact of the power sold is recognized in the inventory of the country buying as it emits less by displacing fossil fired generation. When it sells these ITMOS or gives it to SOGEM through an international contract/agreement then the "emission balance" or real inventory increases.

7. Conclusions

The sales of renewable energy on internationally integrated pools is an increasingly common occurrence. It was seen as being a special case, but the examples outlined is this paper show that currently it is increasingly used to optimize the use of resources and lower the carbon intensity of electricity.

Similarly, the use of the Kyoto mechanisms for such project has been relatively limited but in no way unique. The registration of such projects under the CDM has created controversy at the time of registration and continues to be seen as controversial. The reasons for the controversy can be seen as more ideological than technical but they are real, and many Parties still regard with suspicion. In general, develop countries in general have claimed that this is a normal occurrence in the course of cross border electricity exchange, and no use of carbon markets has been necessary or envisaged. However, as a South-South cooperation carbon markets are a tool that is seen as very useful in the context of carbon markets.

With the entry into force of the Paris Agreement and the obligations that come with each NDC, South-South cooperation, including the use of Article 6, is increasingly important.

Under Art 6.2 it is becoming increasing clear that this is an option that is largely at the discretion of countries which can use Art 6.2 to account for the cross-border sale of renewable power and the sharing of carbon benefits. In the end this will be a commercial agreement and what is necessary to be recognize is the fact that the Party where the mitigation outcome takes place will need to undertake a corresponding adjustment, which was not the case under the CDM. This is a significant change, but if implemented there is no impediment to the sharing of ITMOs under Art 6.2 from the cross-border sale of renewable power and the displacement of more carbon intense electricity. The grid emission factor is another element that will need to be accounted for, but that is not really something new.

What is unsolved and will remain unsolved until there is a Supervisory Body is the use of the Art 6.4 mechanism in such exchanges. While these types of projects were accepted under the CDM it can be envisaged that under the Art 6.4 mechanism it’s acceptance will be controversial and will need to be again validated. The fact that there is a provision in the version 3 of Presidency text from Madrid which states that the mitigation and outcome and the mitigation action must take place in the same country must be of concern and will need to be monitored closely for final outcome.

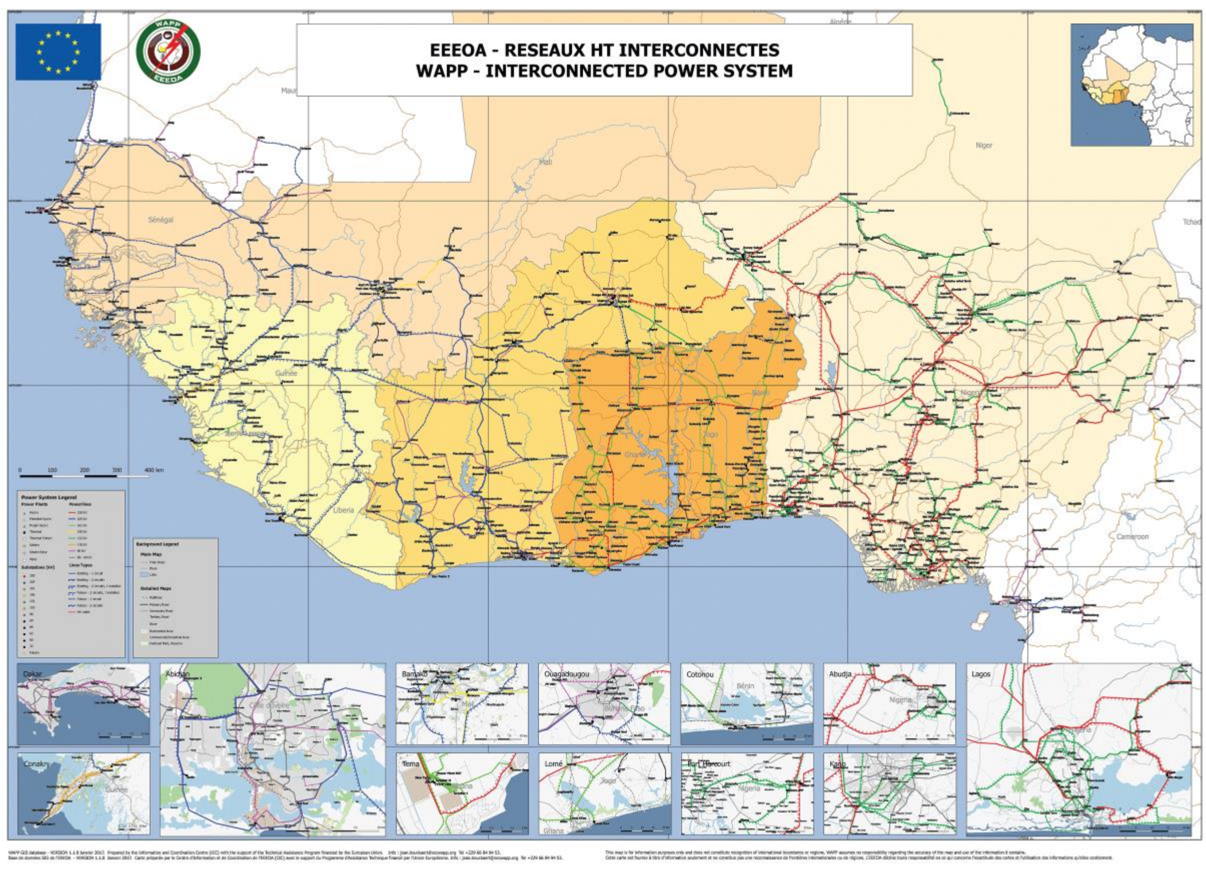
Annex: details of interconnected projects

A few examples of interconnection projects, taken from those that are listed above, are hereby outlined.

Examples:

West Africa Power Pool

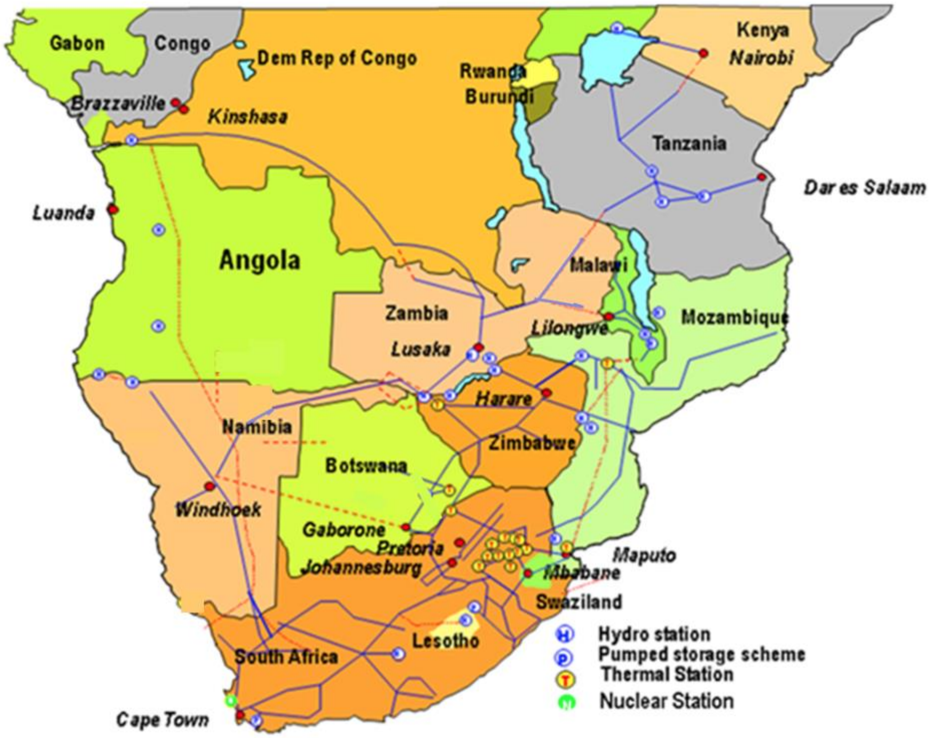
In 2006, the Authority of ECOWAS Heads of State and Government established the West African Power Pool (WAPP) with a mission to promote and develop infrastructure, for power generation and transmission, as well as to assure the coordination of electric power exchanges between ECOWAS Member States.



For the period 2019 to 2033, a list of seventy-five (75) regional priority projects are proposed, with an estimated total investment cost of US$36.39 billion, of which are:

- Twenty-eight (28) transmission line projects of approximately 22,932 km of high voltage transmission lines at an estimated cost of US$10.48 billion;
- Forty-seven (47) generation projects with a total capacity of approximately 15.49 GW at an estimated cost of US$25.91 billion. The generation projects comprise:
  - 31.1% of thermal generation projects (4.82 GW) operating mainly with natural gas and;
  - 68.9% renewable energy projects (10.67 GW) :
    - 140 MW Gouina Hydropower plant (OMVS) (2020)
    - 450 MW Souapiti Hydropower plant In Guinea (2020)
    - 112 MW Gribo-Popoli Hydropower plant in Côte d'Ivoire (2021)
    - 128 MW Sambangalou Hydropower plant (OMVG -2022)
    - 700 MW Zungeru Hydropower plant in Nigeria (2022)
    - 90 MW Fomi Hydropower plant in Guinea (2022)
    - 150 MW Wind Farm in Senegal (2019-2021)
    - 150 MW Boutoubre Hydropower plant in Côte d'Ivoire (2022)
    - 300 MW Amaria Hydropower plant in Guinea (2023)
    - 143 MW Bumbuna II Hydropower plant in Sierra Leone (2023)
    - 246 MW Louga Hydropower plant in Côte d'Ivoire (2023)
    - 294 MW Koukoutamba Hydropower plant (OMVS – 2024)
    - 3050 MW Mambilla Hydropower plant in Nigeria (2024)
    - 147 MW Adjaralla Hydropower plant (Togo-Benin – 2026)
    - 225 MW Tiboto Hydropower plant (Côte d'Ivoire-Liberia – 2028)
    - 150 MW Solar Farm PV in Burkina Faso (2022-2024)
    - 150 MW Solar Farm PV in Mali (2022-2024)
    - 150 MW Solar Farm PV in Côte d'Ivoire (2022-2024)
    - 150 MW Solar Farm PV in The Gambia (2023-2025)
    - 150 MW Solar Farm PV in Benin (2024-2026)
    - 1000 MW Solar Farm PV in Nigeria (2025-2029)
    - 150 MW Solar Farm PV in Ghana (2026-2027)
    - 150 MW Solar Farm PV in Togo (2028-2030)
    - 291 MW Grand Kinkon Hydropower plant in Guinea (2023)
    - 200 MW Morisananko in Guinea (Hybrid PV – Hydro) (2025)
    - 174 MW Bonkon Diara Hydropower plant in Guinea (2025)
    - 114 MW Boureya Hydropower plant (OMVS -2029)
    - 150 MW Solar Farm PV in Niger (2030)
    - 150 MW Solar Farm PV in Burkina (Phase II -2031)
    - 150 MW Solar Farm PV in Mali (Phase II – 2032)
    - 300 MW Wind Farm in Nigeria (2030)
    - 180 MW Mano Hydropower plant (MRU – 2030)
    - 360 MW to 585MW Saint Paul Reservoir In Liberia (2025 – 2030).

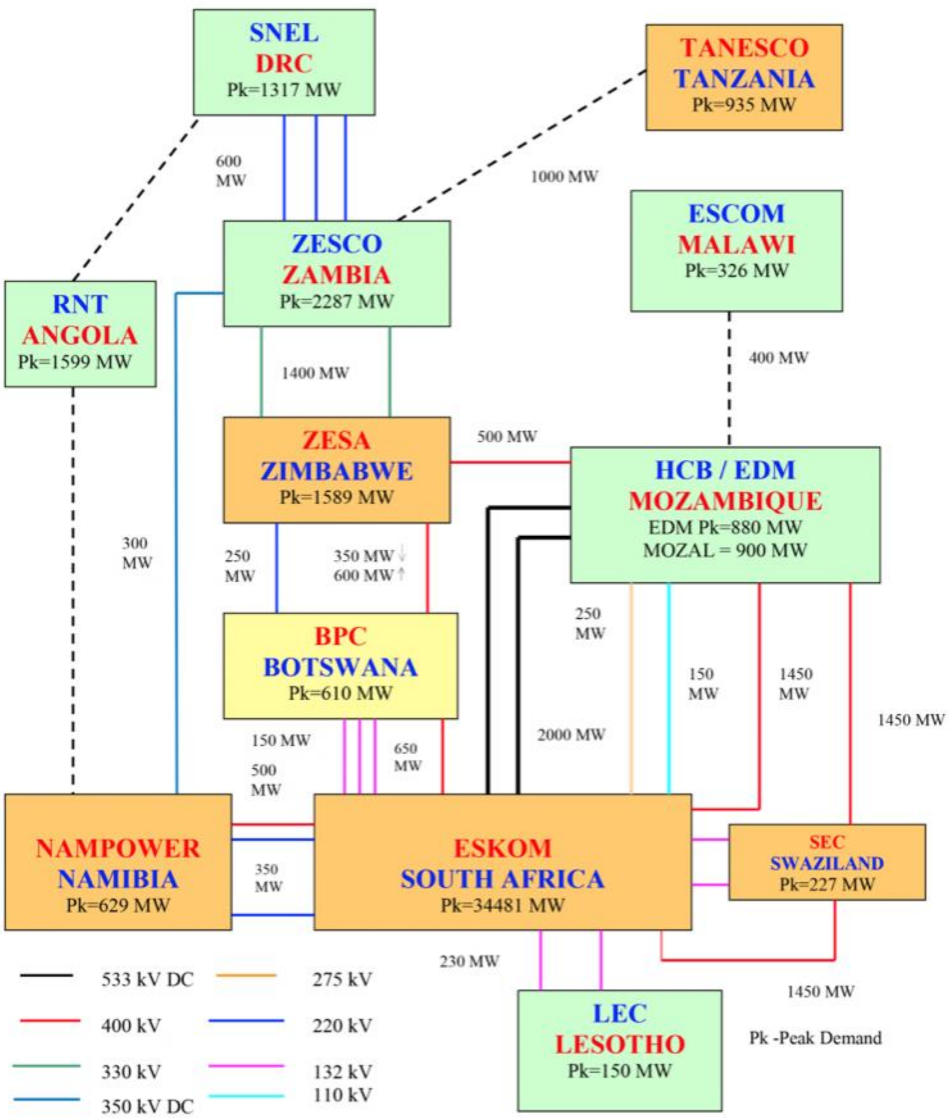
Southern African Power Pool



Source: SAPP

The Southern African Power Pool, or SAPP, includes nine operating member countries: Botswana, Democratic Republic of Congo, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe. These countries have developed a common power grid, as well as a common market for electricity in the Southern African Development Community (SADC) region, including 7 other countries.

Interconnectors



Source: SAPP

Among the participating countries, South Africa has the highest electricity production.
Although the grid is dominated by coal which contributes 62% of the total generation mix, hydropower accounted for 13,000MW of total generation in 2016, making it the second most available source. It is also worth noting that all power generators, except for Botwana Power Corporation, provided hydroelectric power, although in varying capacity.

Table1: SAPP EXISTING GENERATION STATIONS – 2015/16

	SAPP UTILITY GENERATION MIX , MW														
Technology / Utility	BPC	EDM	ENE	ESCOM	Eskom	LEC	NamPower	SEC	SNEL	TANESCO	ZESA	ZESCO	LHPC	HCB	Total
Baseload hydro		498	1,528	351	2,000	74	348	61	2,442	717	750	2,107	49	2,075	13,000
Coal	732		492		35,721		132	9			1,295				38,381
Nuclear					1,860					-					1,860
OCGT	160	-	190	1						585					936
Distillate		151			2,409		21			78		50			2,709
Wind					2,492										2,492
Solar CSP					600										600
Solar PV					1,821										1,821
Landfill					18										18
Biomass					42										42
Total	892	649	2,210	352	46,963	74	501	70	2,442	1,380	2,045	2,157	49	2,075	61,859

	SAPP UTILITY GENERATION MIX , %														
Technology / Utility	BPC	EDM	ENE	ESCOM	Eskom	LEC	NamPower	SEC	SNEL	TANESCO	ZESA	ZESCO	LHPC	HCB	Total
Baseload hydro	0.0%	76.7%	69.1%	99.7%	4.3%	100.0%	69.5%	87.1%	100.0%	52.0%	36.7%	97.7%	100.0%	100.0%	21.0%
Coal	82.1%	0.0%	22.3%	0.0%	76.1%	0.0%	26.3%	12.9%	0.0%	0.0%	63.3%	0.0%	0.0%	0.0%	62.0%
Nuclear	0.0%	0.0%	0.0%	0.0%	4.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.0%
OCGT	17.9%	0.0%	8.6%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	42.4%	0.0%	0.0%	0.0%	0.0%	1.5%
Distillate	0.0%	23.3%	0.0%	0.0%	5.1%	0.0%	4.2%	0.0%	0.0%	5.7%	0.0%	2.3%	0.0%	0.0%	4.4%
Wind	0.0%	0.0%	0.0%	0.0%	5.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.0%
Solar CSP	0.0%	0.0%	0.0%	0.0%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.0%
Solar PV	0.0%	0.0%	0.0%	0.0%	3.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.9%
Landfill	0.0%	0.0%	0.0%	0.0%	0.04%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Biomass	0.0%	0.0%	0.0%	0.0%	0.09%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: SAPP

SIEPAC

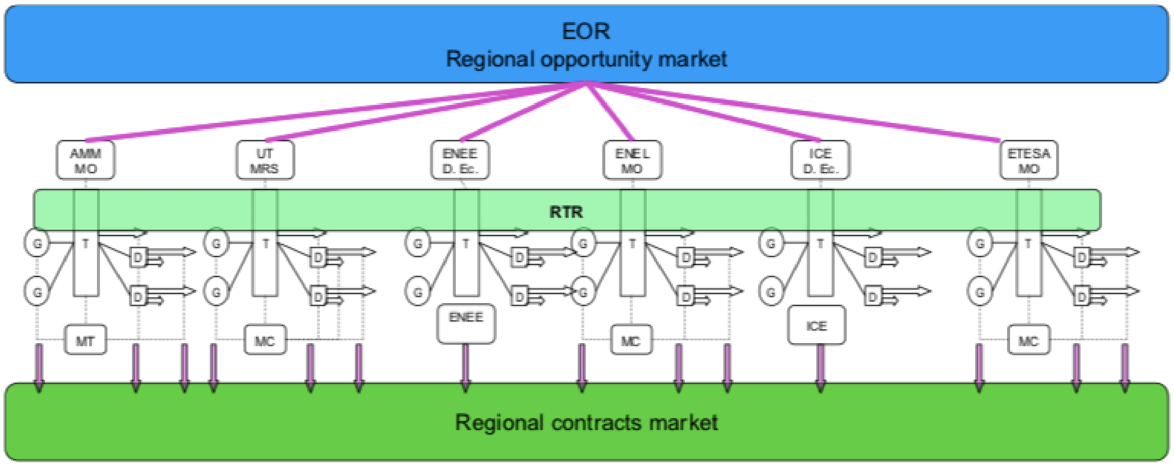
Figure 11 Route of the SIEPAC Line

Source: EPR

The Central American Electrical Interconnection System (SIEPAC) is an interconnection of power grids between Costa Rica, El Salvador, Guatemala, Honduras, Panama and Nicaragua. The network comprises a 1790km, 230kV transmission line with a capacity of 300MW between Panama and Guatemala. The project also involves improvements to existing infrastructure.

In addition to the development of the South-North transmission line from Panama to Guatemala, the project also foresees the development of a regional electricity market and the creation of a regional institutional structure.

Figure 12 MER as the Seventh Market Atop the Six National Markets



Source: World Bank
The organizations listed in the row above the RTR are the national system and market operators for Guatemala (AMM), El Salvador (UT), Honduras (ENEE), Nicaragua (ENEL), Costa Rica (ICE), and Panama (ETESA). ENEE and ICE are single buyers.
G = generation, T = transmission, D = distribution;

The parties involved in the project include:

- The government of the six host countries and their agencies;
- The transmissions, system and market operators in each country;
- The regional planning body (the Central American Electrification Council);
- One private utility as well as State utilities of neighbouring countries as shareholders in the regional transmission company;
- Governments of neighboring countries and regional cooperation organizations;
- International Financial Institutions led by the Inter-American Development Bank;
- Private contractors for project design, management and supervision, construction works, and procurement.

The fuel mix in the region is dominated by hydroelectricity. Indeed, one of the goals of the interconnection is to optimise use of hydroelectric power by the participating countries. In particular, Costa Rica is considered to have a high potential for the development of new hydropower plants to serve the regional market.

Bhutan-India

To meet high energy demand in India, the country has signed bilateral power purchase agreements with Bhutan. The India-Bhutan grid was designed to tap into Bhutan's hydroelectricity potential to meet India's growing energy demand with clean sources. As of 2017, India was importing 1450MW of electricity from Bhutan.

The trade of electricity flows one-way from Bhutan to India, as Bhutan has a surplus of electricity. Since Bhutan exports hydroelectricity, these arrangements between the countries help displace fossil fuel generation in India.