TECHNICAL ASSISTANCE FOR OPERATIONAL READINESS OF THE EAPP

Power Balance Statement 2019

EAPP - Eastern Africa Power Pool
ETHIOPIA

INTERNAL

4 October 2019

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Eastern African Power Pool
Power balance statement

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Frontpage: The Ethiopia – Kenya HVDC interconnector near Lake Naivasha, Kenya

Contents

Foreword

A power balance statement is a tool designed to provide early warnings about potential security of supply issues. The EAPP planning code (from 2011) defines the power balance statement. It focuses on remaining capacity, i.e. available generation capacity minus the peak demand in a normal year. This calculation is undertaken each year for a 10-year period. The power balance statement will be issued by the Planning Committee at the end of September each year. Members of the planning committee are listed in appendix 1.

This is the first EAPP power balance statement, and includes an extra year, i.e. it covers the years 2019-2030. Improvements in data and methodology are planned for the following years' statements.

The activities are supported by the World Bank within the project entitled *Technical assistance to support operational readiness to the EAPP.* This technical assistance project is managed by Tractebel, in cooperation with Energinet and Ea Energy Analyses and Dr Fatma Moustafa (local consultant). Ea Energy Analyses, in close cooperation with the Planning Committee, is responsible for developing the methodology and producing the first annual power balance statement.

In addition to the current report, draft methodology (EAPP, 2019, b) and data format reports (EAPP, 2019, c) have been delivered. The methodology report also includes a discussion of possible improvements in the methodology compared with the current planning code.

1 Executive summary

Within a few years all EAPP countries will be interconnected and may assist each other in ensuring a high level of security of supply. If plans for new transmission lines are realised as planned, the entire EAPP area will be connected by 2025. Differences in the timing of peak demand, as well as differences in generation structure, may be used to generate mutual benefits.

High risk in the short term

The present power balance analysis indicates a high-risk situation in 2020 for the DRC, Libya, Rwanda, Sudan and Tanzania[1]. When only considering *existing projects* (generation and transmission), based on anticipated electricity demand growth, these countries have a calculated capacity deficit in 2020. For DRC, Libya, Sudan and Tanzania the deficit during peak demand is in the order of 800–1,200 MW. The benefit of import is limited because of lack of generation and transmission capacity. Only Libya has benefit of import.

If, however, all projects currently *under construction* for 2020 are realised on time, and full import capability is included, the calculated capacity deficit is reduced significantly. Only the DRC has a high risk of capacity deficit in 2020 (in the order of 800 MW).

Improvements in medium term

In 2025, when including possible contribution from import, and assuming that projects currently *under construction* are completed, the DRC and Sudan both face high risk of capacity deficits. Kenya and Sudan benefit from import during peak demand. When extending the generation potential to include projects where *financing is secured* and include import, all countries except the DRC have a positive remaining capacity (generation capacity minus peak demand). However, in Kenya, Rwanda and Sudan a 15% reserve margin cannot be fulfilled.

In the long term: Dependency on timely completion of all projects

By 2030, if *all planned projects* (i.e. those under construction, with finance secured, specific candidate, and general candidate projects) come to fruition, then all countries will have a positive remaining capacity.

When only considering projects currently *under construction*, without assistance through imports from their neighbours, six countries (DRC, Egypt, Kenya, Libya, Rwanda and Sudan) will have significant capacity deficits. Including imports in the analysis reduces the deficit in Kenya and Rwanda.

[1] See chapter 4. Detailed results can be found in Table 6.

Continued focus on planning of new generation and transmission projects, and the timely completion of planned projects, must have the highest priority if security of electricity supply should satisfy modern society requirements. Delays in implementing the planned projects may challenge security of supply. Member utilities must alone and together accelerate investments in generation and transmission.

Other benefits

Cross-border transmission capacity can reduce capacity deficits – but can also encourage economic operation of electricity systems, including sharing of reserves and economic dispatch of generation. The analyses indicate that many countries have difficulties in fulfilling a reserve margin of 15% only be national generation.

Exchange of electricity will also be beneficial as wind and solar power will expand.

Development of Power balance Statement

The annual power balance statements are an important part of the continuous monitoring of development in electricity generation, demand, and transmission within the EAPP region.

The power balance statement will be updated annually, and the focus for next year's statement includes improved data quality. Information about future generation and transmission projects, as well as demand prognoses, are crucial for the quality of the power balance statement and this information should be fully updated and evaluated in an impartial fashion.

The current analysis focuses on a normal hydro year, as described in the EAPP planning code. It is recommended to extend the analysis to include dry year situations.

2 Introduction

Security of electricity supply is crucial for economic development, and all of the EAPP countries have experienced challenges at one point in delivering reliable electricity supply. Rapid growth in electricity demand often requires a doubling of generation capacity every ten years. As a result, even minor delays in construction of new generation and transmission capacity may challenge the security of supply.

The EAPP Planning code (EAPP, 2011) focuses on the difference between the available generating capacity and the demand. This is called the *Remaining Capacity* and is calculated under normal climatic conditions. The remaining capacity represents the reserves available that can be used to cover electricity demand that results from demand greater than that forecasted, as well as outages of generation or transmission units.

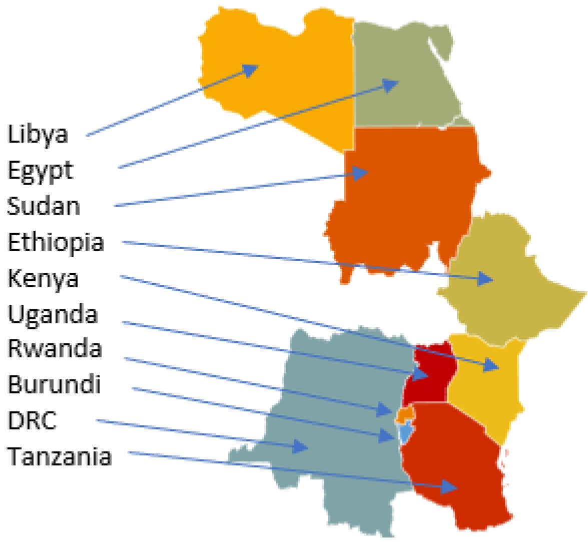

Figure 1. The ten analysed EAPP countries. Djibouti will be included when data is available.

Establishing a data foundation

Detailed information has been collected for all of the EAPP member countries. This includes existing generation and interconnector capacity, and annual electricity demand. The information has been collected for the next 10 years (2020-2030). Some of the information used in the power balance statement is also used in the detailed grid analyses (another subtask in the World bank project), and effort has been made to harmonise data.

Generation and transmission project pipeline

Future generation and transmission projects have each been assigned to one of the four following categories of development status:

1. Construction started[2]
2. Finance secured, and construction expected to start in a specific year
3. Specific candidate project, location and design determined
4. General candidate project

This allocation is crucial to address that the risk of delays is higher for e.g. candidate projects, than for projects under construction. Together with the status, a starting year for operation of the project is described. This indicates the year where the project is active at the *start of the year* (January). A project completed in e.g. September 2019, would have start year of 2020.

Country specific balances computed

A capacity (MW) and energy (GWh) balance has been computed for each country. The capacity balance studies the balance under peak demand, while the energy balance studies the annual balance. For countries dominated by thermal generation (like Libya and Egypt) the capacity is typically the biggest challenge, while countries dominated by hydro generation (like DRC and Ethiopia), typically have an excess of capacity, but may have restrictions on an energy basis because the generation from hydro plants is limited by the inflow.

Estimation of capacity credit

In the absence of specific data, the assumptions regarding capacity factor (during peak demand) and maximum full-load-hours utilised in the study are made as shown in Table 1. E.g. solar PV is assumed not to generate during peak demand, as most countries have an evening peak. For hydro plants with reservoir yearly generation has been obtained for all plants, and these plants are assumed to generate at 100% during peak demand hour.

[2] In a few cases a project (e.g. a transmission line) has been completed but is not yet in use. Such projects have been labelled as under construction and the expected year of actual used has been used.

	Energy balance: Max full-load-hours (%)	Capacity balance: Capacity credit (generation during peak demand)
Thermal	7,000 hours (80%)[3]	100%
Nuclear[4]	7,800 hours (90%)	100%
Hydro, reservoir	Actual data	100%
Hydro, run of river	3,500 hours (40%)	50%
Wind[5]	3,000 hours (35%)	5%
Solar	2,000 hours (23%)	0%
Waste	4,400 hours (50%)	50%

Table 1: Assumptions used if no specific information exists.

In undertaking the calculations, the capacity of interconnectors is set to the maximum capacity during safe operation – or according to standard practices on that line. Maximum capacity during safe operation is also called net transfer capacity (NTC). It depends on the surrounding system (e.g. strength of grid) and may vary over time. NTC is significantly lower than the installed capacity.

Demand prognoses

The future electricity demand is highly uncertain. Data has been collected to form a medium prognosis, and high and low alternatives have also been established. The current power balance statement focuses on the central electricity demand prognosis. Some countries have generation plans that alter according to the electricity demand prognosis (i.e. with a high electricity demand prognosis, the timetable for completion of some generation units is shifted forward), but this dynamic between demand growth and generation planning has not yet been included in the current power balance.

Demand figures for countries using fiscal years (July to June), were converted to calendar years (January to December).

Import during peak demand

When import/export is considered, it is assumed to be undertaken if technically possible. Economically this is a sound assumption, if the alternative to electricity import is curtailment of electricity demand (which has a very high socio-economic cost). The economic value of import in this case is the value of lost load.

[3] For Egypt 7,446 hours is used (85%)
[4] See: (World Nuclear Association, 2019)
[5] In Egypt, wind power generation during the peak hour has been studied for the last 8 years. Between 2 and 60% of the installed wind power capacity generated during the peak hour. The median value is 18%. The 20% percentile (that will happen one out of five years) is 5%. More data should be collected in the future.

Power Balance for EAPP as a whole

The development in total peak demand and generation is illustrated in Figure 2. In 2020, total existing generation is larger than the total peak demand, however in just a few years the balance depends on the realisation of new generation. These initial results will be further analysed in the next chapters, taking the specific national situations and transmission capacity availability into account.

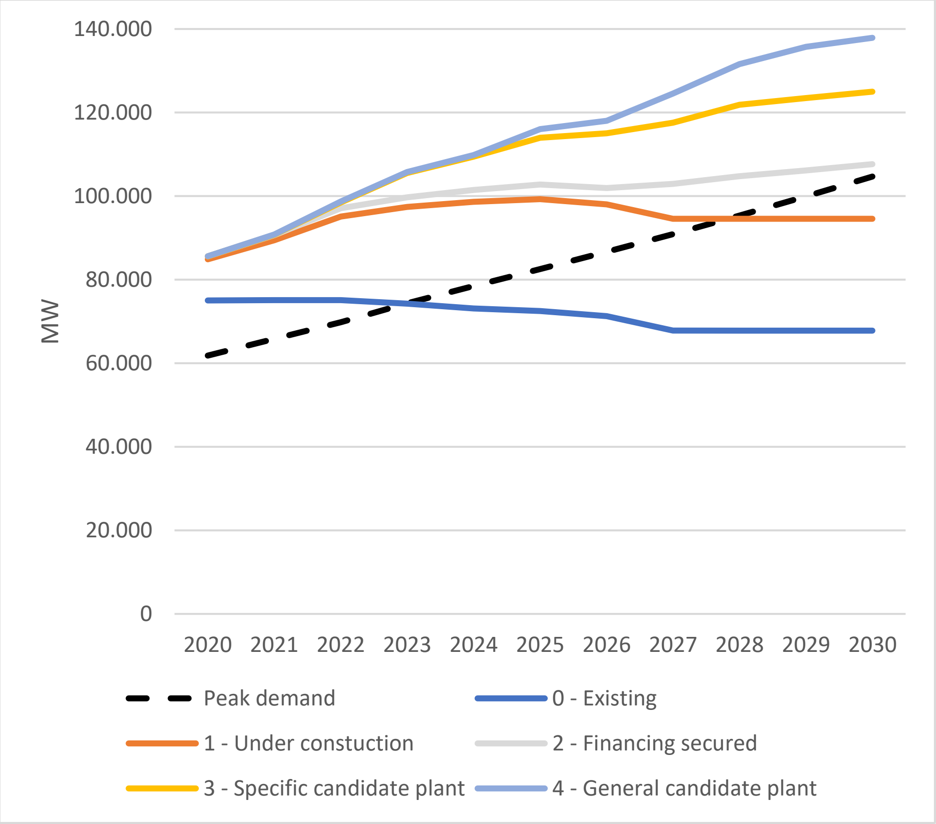

Figure 2: Projected development of total peak demand (MW) for the ten countries (black dashed line) and expected development in total generation capacity (MW) for the ten countries. The capacity is the expected capacity during the peak hour. The capacity factors utilised are displayed in Table 1.

3 Power balance – without contribution from import

The basis for the power balance statement is detailed information about future electricity demand and generation capacity for each country. This chapter reports the analysis of the power balance without electricity imports, while the following chapter includes the option to exchange electricity.

An indicator of the power balance per country is shown in Table 2. Note that the DRC consists of three different synchronous areas (plus a number of smaller isolated islands) and is represented with the three regions: West, South and East[6].

The *Ideal reference* shown in the table should be understood as a simple, normative indication of a secure development, with a slow increase in the indicator value. In the table results are highlighted when the indicator is worse than the ideal reference.

Status of projects

Potential import has not been included in the table. The numbers in the table (0-5) reflect the following:

0. Balance can be achieved with existing generation
1. Balance can be achieved when also including projects where construction has started
2. Balance can be achieved when adding projects where financing has been secured, and construction is expected to start in a specific year
3. Balance can be achieved when also including specific candidate projects, where location and design are determined
4. Balance can be achieved when adding general candidate projects
5. Balance cannot be achieved.

[6] 52% of total DRC demand is in West, 35% in South, 6% in East and 7% in other areas (2019). Currently Libya is also operated with an Eastern and a Western system that is not synchronous. However, this is expected to normalise again, and Libya is analysed as one area.

MW	Burundi	DRC			Egypt	Ethiopia	Kenya	Libya	Rwanda	Sudan	Tanzania	Uganda	Ideal reference
		E	W	S									
2020	0	5	0	5	0	0	0	5	1	1	1	0	0
2021	0	5	0	5	0	1	0	1	1	2	1	0	0
2022	1	3	5	5	0	1	1	1	1	2	1	0	1
2023	1	3	5	5	0	1	1	1	1	2	1	0	1
2024	1	3	2	5	0	1	3	1	2	2	1	0	2
2025	1	3	2	5	0	1	3	1	2	2	1	0	2
2026	1	3	2	5	0	1	3	1	3	2	1	1	2
2027	1	3	2	4	1	1	3	3	3	3	1	1	3
2028	1	3	2	4	1	1	3	3	3	3	1	1	3
2029	1	3	2	4	2	1	3	3	5	3	1	1	3
2030	1	3	2	4	2	1	3	3	4	4	1	1	4

GWh	Burundi	DRC			Egypt	Ethiopia	Kenya	Libya	Rwanda	Sudan	Tanzania	Uganda	Ideal reference
		E	W	S									
2020	5	5	5	5	0	0	0	0	0	1	1	0	0
2021	5	5	5	5	0	1	1	0	1	1	1	0	0
2022	1	3	5	5	0	1	1	0	1	1	1	0	1
2023	1	3	5	5	0	1	2	1	1	1	1	0	1
2024	1	3	2	4	0	1	3	1	1	1	1	0	2
2025	1	3	2	4	0	1	3	1	2	1	1	0	2
2026	1	3	2	4	0	1	3	1	2	2	1	0	2
2027	1	3	2	4	0	1	3	1	2	2	1	0	3
2028	1	3	2	4	0	2	3	1	3	2	1	1	3
2029	1	3	2	4	0	2	3	1	3	2	1	1	3
2030	1	3	2	4	1	3	3	1	4	2	1	1	4

Table 2: National power balance without import/export. Upper table: Capacity balance during peak demand (MW), Lower table: Yearly energy balance (GWh). Cells are highlighted when the indicator is worse than the ideal reference.

In the short term (2020-2021), Egypt and Uganda have a sufficient power balance, that is to say that balance (both in MW and GWh) can be achieved with existing generation (0). Other countries, such as Ethiopia, Kenya, Rwanda, Sudan and Tanzania, will depend on the timely completion of projects under construction (1), or projects where finance has been secured, but where construction has not yet started (2). Finally, Burundi, the DRC and Libya are not expected to have adequate generation capacity to meet peak demand for the first years (5). As a result, if imports are not available in a tight situation it may be necessary to curtail electricity demand.

In the longer term (2027-2030), most countries have a good balance, i.e. they are more or less in line with the ideal reference. During these years it is forecasted that only DRC-South and Rwanda will have serious challenges with periods where balance cannot be achieved (5).

4 Power balance – with imports

With existing transmission capacities (as outlined in Table 3), the EAPP will be divided into six "islands" (countries with connections) in 2019:

- The DRC (West and South)
- Burundi, Rwanda, DRC (East)
- Egypt, Libya
- Kenya, Uganda
- Ethiopia, Sudan
- Tanzania

DRC West and DRC South are two synchronous systems connected with a DC line. The other five islands are each a synchronous system, thus giving seven synchronous systems in total.

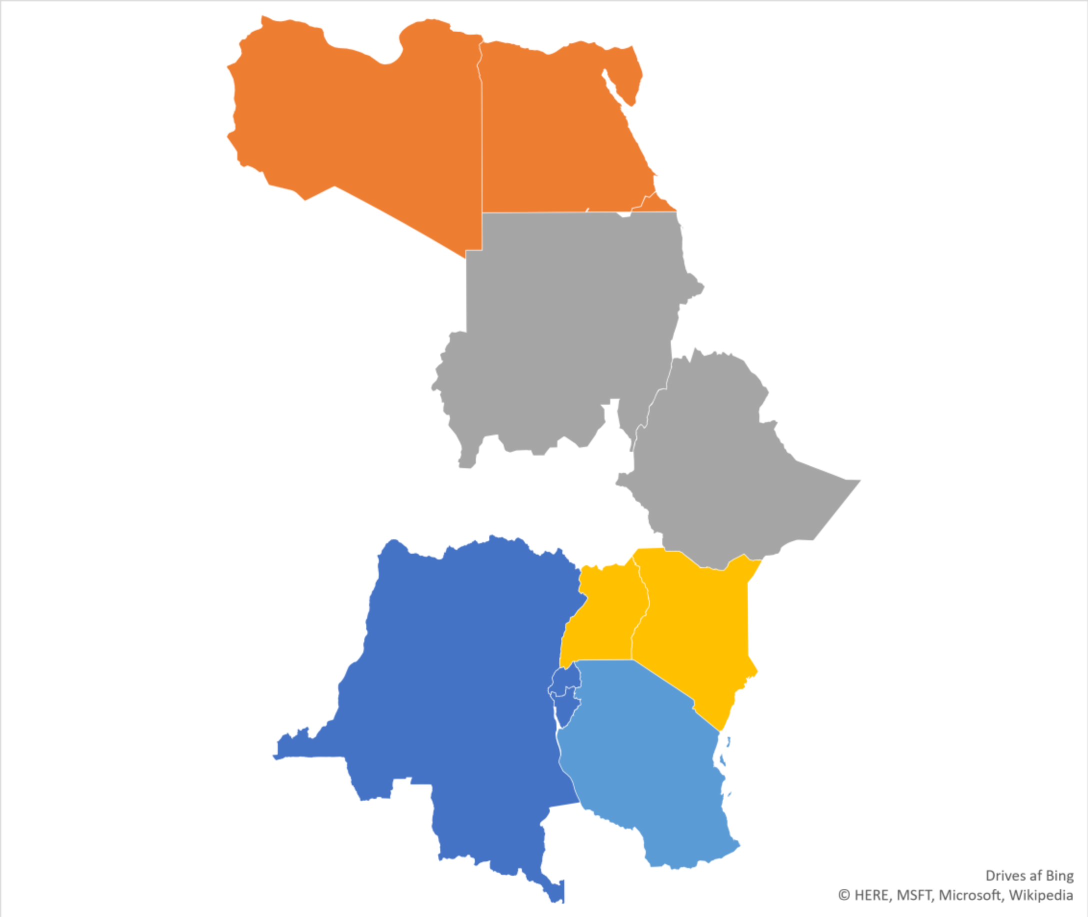

Figure 3: The six EAPP islands in 2019. Only existing lines are included. Note that the DRC should be divided into both West and South, as well as East.

MW	Bu-rundi	DRC			Egypt	Ethio-pia	Kenya	Libya	Rwand a	Sudan	Tanza-nia	Uganda
		E	W	S								
Burundi		4							0		0	
DRC E	4		0	0					4		0	0
DRC W		0		480								
DRC S		0	480									
Egypt								240		0		
Ethiopia							0			200		
Kenya						0					0	70
Libya					240					0		
Rwanda	0	4									0	0
Sudan					0	200		0				
Tanzania	0	0					0		0			0
Uganda		0					70		0		0	

Table 3: Assumed transmission capacities (MW) in 2019 - existing lines. White cells indicate neighbouring countries.

Table 3 shows a 2019 situation relying solely on existing lines. This results in the 6 'islands' as depicted in Figure 3. However, when all transmission projects currently under construction are taken into account, then all EAPP countries would be connected by 2025 (either via AC or DC links). Tanzania will join in 2021 and DRC in 2025. Dependent on the specific technology decisions under-taken, the EAPP will then have 4 synchronous areas:

- Libya, Egypt, Sudan, Ethiopia, Djibouti
- Kenya, Tanzania, Uganda, Burundi, Rwanda, DRC/East
- DRC/East
- DRC/South

MW	Burundi	DRC			Egypt	Ethiopia	Kenya	Libya	Rwanda	Sudan	Tanzania	Uganda
		E	W	S								
Burundi		4							27		0	
DRC E	4		0	0					104		0	0
DRC W		0		480								
DRC S		0	480									
Egypt								240		300		
Ethiopia							1,100			200		
Kenya						1,100					500	370
Libya					240					0		
Rwanda	27	104									0	347
Sudan					300	200		0				
Tanzania	0	0					500		0			70
Uganda		0					370		347		70	

Table 4: Assumed transmission capacities (MW) in 2025 – existing lines and lines under construction. White cells indicate neighbouring countries.

Looking further ahead, Table 4 displays the anticipated transmission capacities in 2030 based on the completion of all potential projects.

MW	Burundi	DRC			Egypt	Ethiopia	Kenya	Libya	Rwanda	Sudan	Tanzania	Uganda
		E	W	S								
Burundi		149	0	0					27		0	
DRC E	149		0	500					200		0	140
DRC W		0		1,480								
DRC S		500	1,480									
Egypt								240		2,300		
Ethiopia							1,100			1,200		
Kenya						1,100					500	370
Libya					240					0		
Rwanda	27	200									0	347
Sudan					2,300	1,200		0				
Tanzania	0	0					500		0			279
Uganda		140					370		347		279	

Table 5: Assumed transmission capacities (MW) in 2030 based on all potential projects. White cells indicate neighbouring countries.

Procedure to minimise capacity deficit

A simple procedure has been developed to compute the capacity potential deficit after maximum use of transmission capacity. The procedure works with any configuration of EAPP wide transmission network (e.g. as indicated in Table 3 to Table 5). Optimisation is minimising the total capacity deficit, while respecting the capacity of transmission lines. A country will first cover its own demand. All excess capacity (after holding back capacity to cover the reserve margin) will then be offered to other countries in order to reduce any capacity deficit.

Transmission lines are not used to fulfil reserve margins[7].

In practice, this means that generation capacity is first used to cover local demand, secondly to supply neighbours and finally to supply other countries prioritising countries nearby.

EAPP wide results

For simplicity the results are first presented for all countries as a whole. In the next section results for individual countries are presented.

If only existing generation and transmission are considered (and without the possibility to import electricity from neighbouring countries), the EAPP wide deficit would increase from 4,000 MW in 2020 to above 35,000 MW in 2030. The addition of projects currently under construction will reduce the deficit to 12,000 MW.

[7] The reserve margin is defined as the total local generation capacity minus local peak demand. This is a simplification, that means that reserves are not delivered by interconnectors. This simplification may be relaxed in future work.

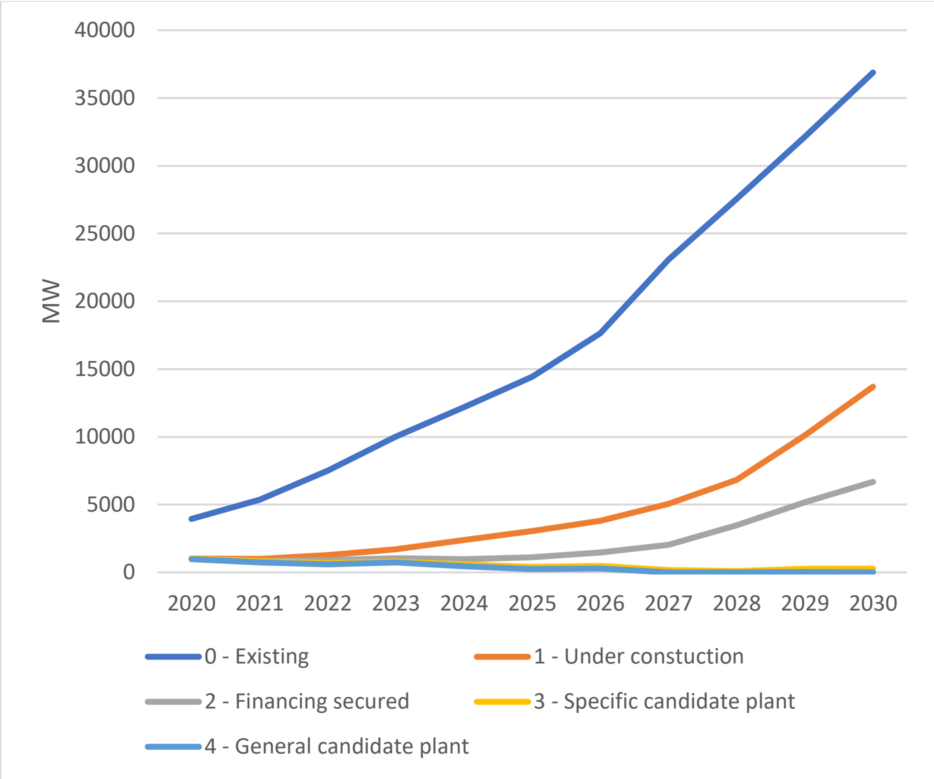

Figure 4: Capacity deficit for all EAPP countries with different assumptions concerning future projects (generation and transmission), in a situation without electricity import/export.

The capacity deficit can in some cases be reduced by electricity imports from neighbouring countries[8]. Referred to here as the ‘benefit from import’, for this benefit to exist several conditions must be fulfilled:

- A capacity deficit must exist.
- Another country must have surplus capacity available for export, and a country will only export if the national reserve margin is fulfilled.
- The required transmission capacity must exist between the relevant countries.

The resulting benefits of allowing electricity imports/exports (depicted as a reduction in capacity deficit) are illustrated in Figure 5. When only existing generation and transmission projects are considered, then there is no benefit associated with the import/export of electricity after 2025. This is because with growing electricity demand, and no new capacity, there will not be any countries with the required export capacity. The largest calculated benefits associated with import/export are realised when also including projects that are under construction and where financing is secured. When considering this

[8] Wheeling of electricity can take place from other countries.

classification of projects, allowing for imports/exports reduces the capacity deficit by more than 2,000 MW in 2030.

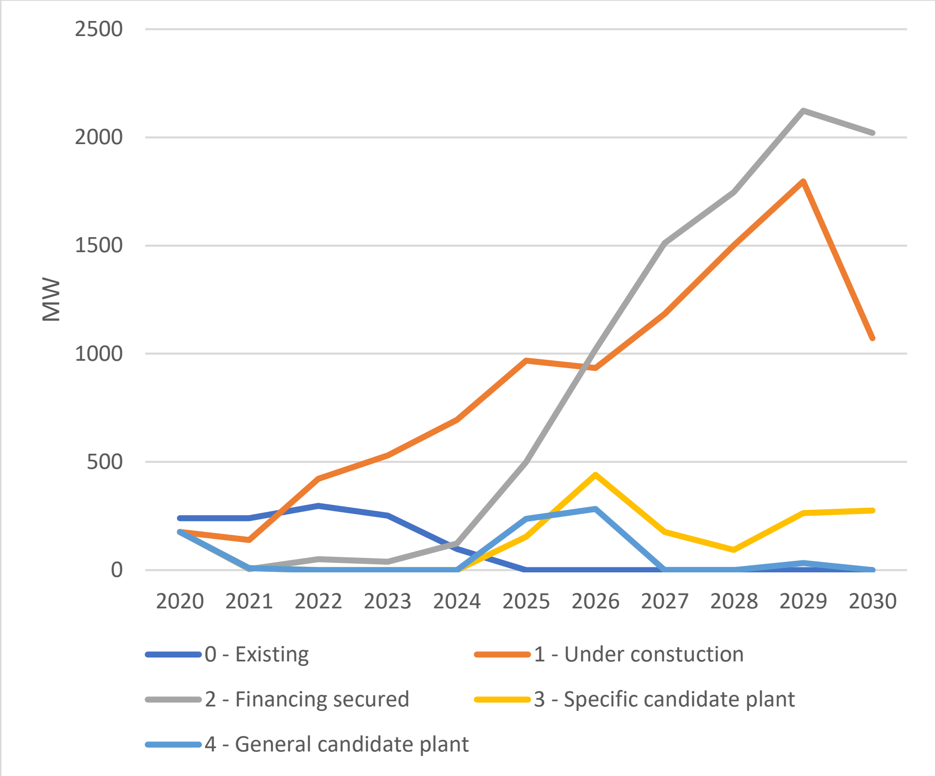

Figure 5: Benefit of import for all EAPP countries (depicted as a reduction in capacity deficit) given different assumptions concerning future generation and transmission projects.

Detailed results

Table 6 shows the power balance for selected combinations of year and project status. The capacity deficit is illustrated both in a situation with and without electricity import/export. In the computation it has been assumed that export only takes place from a country with a reserve margin exceeding 15%.[9] All combinations of years and project status can be analysed. With 11 years and 5 project status types, 55 combinations exist. For the sake of simplicity, only a handful of combinations are shown in the table.

[9] Note that this is a capacity balance where national peak demand has been considered, but the seasonal timing of the peak has not been considered. The seasonal variation of the peak demand will be studied in next year's power balance statement.

MW	Burundi	DRC			Egypt	Ethiopia	Kenya	Libya	Rwanda	Sudan	Tanzania	Uganda
		East	West	South								
2020												
Only existing (0)												
CD1	0	129	0	771	0	0	0	1,021	22	1,215	786	0
CD2	0	129	0	771	0	0	0	781	22	1,215	786	0
RMD	x	x	x	x		X	x	x	x	x	x	X
Under construction (1)												
CD1	0	129	0	711	0	0	0	172	0	0	0	0
CD2	0	126	0	711	0	0	0	0	0	0	0	0
RMD	x	x	x	x			x	x		X		
2025												
Under construction (1)												
CD1	0	134	338	995	0	0	384	0	53	1,149	0	0
CD2	0	104	338	995	0	0	0	0	0	649	0	0
RMD		x	x	x			x		x	X		
Finance secured (2)												
CD1	0	134	0	670	0	0	315	0	0	0	0	0
CD2	0	104	0	517	0	0	0	0	0	0	0	0
RMD		x		x			x		x	x		
2030												
Under construction (1)												
CD1	0	180	881	1,631	3,141	0	1,639	3,493	243	2,494	0	0
CD2	0	177	881	1,631	3,141	0	797	3,493	216	2,294	0	0
RMD		x	x	x	x		x	x	x	x		
Finance secured (2)												
CD1	0	180	0	378	0	0	1,565	3,493	163	904	0	0
CD2	0	150	0	0	0	0	315	3,493	0	704	0	0
RMD		x		x	x		x	x	x	X		
Specific candidate projects (3)												
CD1	0	0	0	72	0	0	0	0	80	124	0	0
CD2	0	0	0	0	0	0	0	0	0	0	0	0
RMD				x	x			x	x	x		
General candidate projects (4)												
CD1	0	0	0	0	0	0	0	0	0	0	0	0
CD2	0	0	0	0	0	0	0	0	0	0	0	0
RMD				x					x			

Table 6: Power balance.

CD1 = Capacity Deficit before import. CD2 = Capacity Deficit after import. RMD = Reserve Margin Deficit ("x" indicate that the 15% reserve margin is not fulfilled).

Selected years (2020, 2025, and 2030) and selected project status for generation and transmission (Existing projects (0), Under construction (1), Finance secured (2), and Specific candidate projects (3) and General candidate projects (4)).

2020

For 2020, the following observations can be made:

- If only considering existing projects, then the DRC, Libya, Rwanda, Sudan and Tanzania have security of supply issues.
    - Electricity import from Egypt can reduce deficits in Libya, but not solve the problems entirely.
    - For the other countries with supply issues, imports cannot be assumed available to assist the situation, because there is no surplus capacity in the neighbouring countries (when a 15% domestic reserve margin is required in all countries).
    - Only Egypt has a reserve margin above 15%.
- When including projects that are currently under construction (but expected to be completed by 2020), and the ability to import/export, all countries are fine, except the DRC.
    - Projects under construction may be delayed, and this can threaten the security of supply in the DRC, Libya, Rwanda, Sudan and Tanzania.
    - Burundi, DRC, Kenya, Libya and Sudan has a reserve margin below 15%.

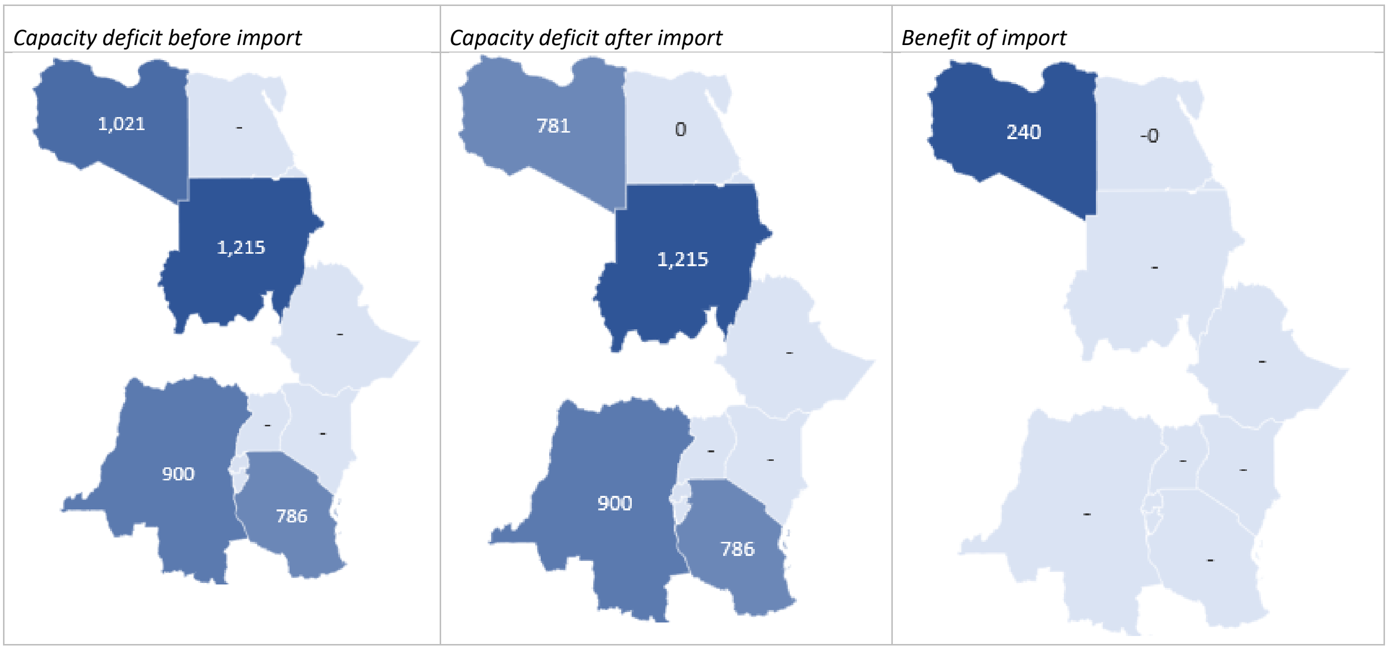

Figure 6: Capacity deficit and benefit of import. 2020, only existing projects (MW). Values for DRC has been summed across the three regions.

2025

For 2025, the following observations can be highlighted:

- In a situation without imports, and if only projects that are currently under construction are considered, the DRC, Kenya, Rwanda and Sudan have capacity deficits.

- For Libya, Kenya and Rwanda this deficit can be resolved by taking account of electricity imports during peak demand. This is possible as both generation capacity in neighbouring countries and sufficient transmission capacity exist.
- When also including projects that have secured financing the situation improves. However, even with potential import, the DRC still has a capacity deficit.
    - DRC, Kenya, Rwanda and Sudan have a reserve margin below 15%.

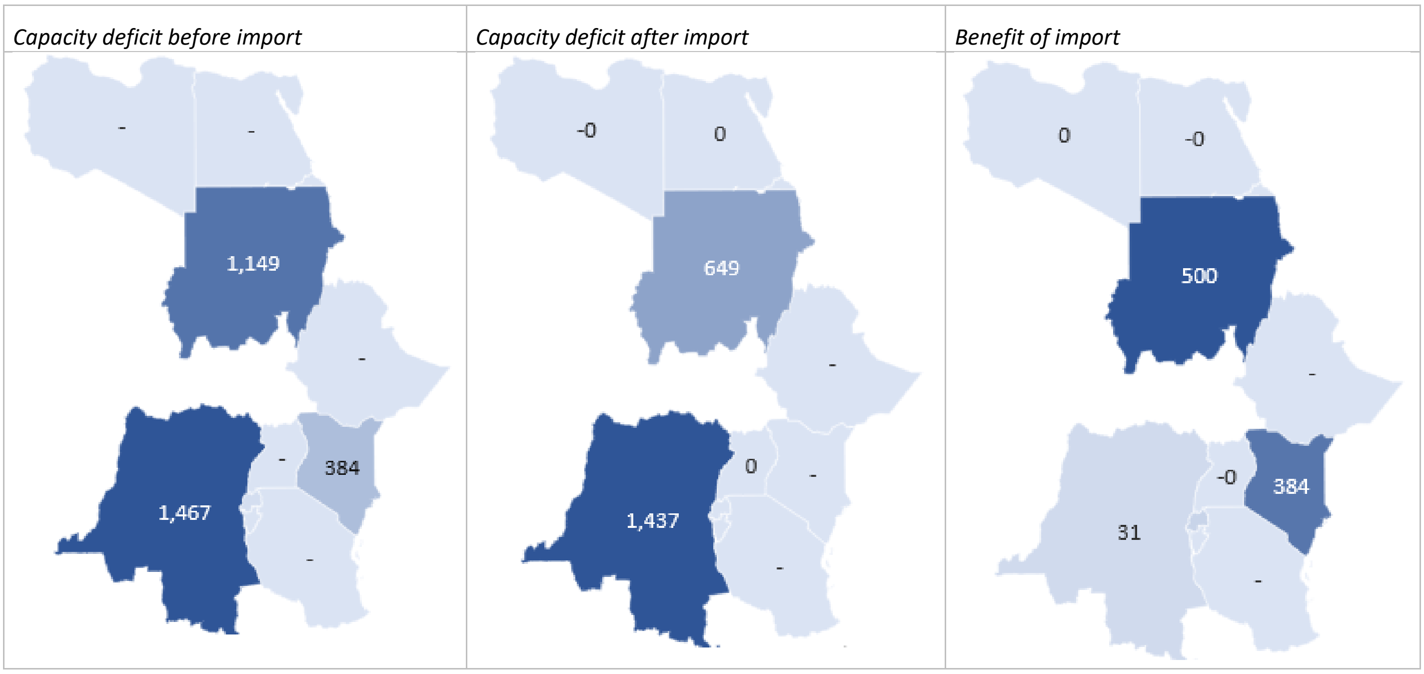

Figure 7. Capacity deficit and benefit of imports in 2025 when including projects under construction (MW). Values for DRC has been summed across the three regions.

2030

For 2030, the following findings can be highlighted:

- When solely considering existing projects and projects under construction, six countries will have capacity deficits.
    - Imports can reduce but not completely resolve capacity deficits. The DRC, Egypt, Kenya, Libya, Rwanda and Sudan will all face challenges despite considering imports. Several countries have examples with deficits in the order of 2,000 to 3,500 MW.
        - Note that Libya in the analysis is not assisted by import from Egypt, because the required 15% reserve margin is not fulfilled in Egypt.

- Assuming that projects with finance secured are realised, clearly reduces the deficit.
    - However, Libya still has a large deficit.
    - The DRC, Kenya and Sudan has smaller deficits.
    - DRC, Egypt, Kenya, Libya, Rwanda and Sudan have a reserve margin below 15%.
- Assuming all specific candidate projects come to fruition, all countries are in good shape. For DRC, Rwanda and Sudan a positive capacity balance depends of import.
- If all planned projects (including general candidate projects) are realised, all countries have a positive capacity balance – even without import.
    - DRC (South) and Rwanda have a reserve margin below 15%.

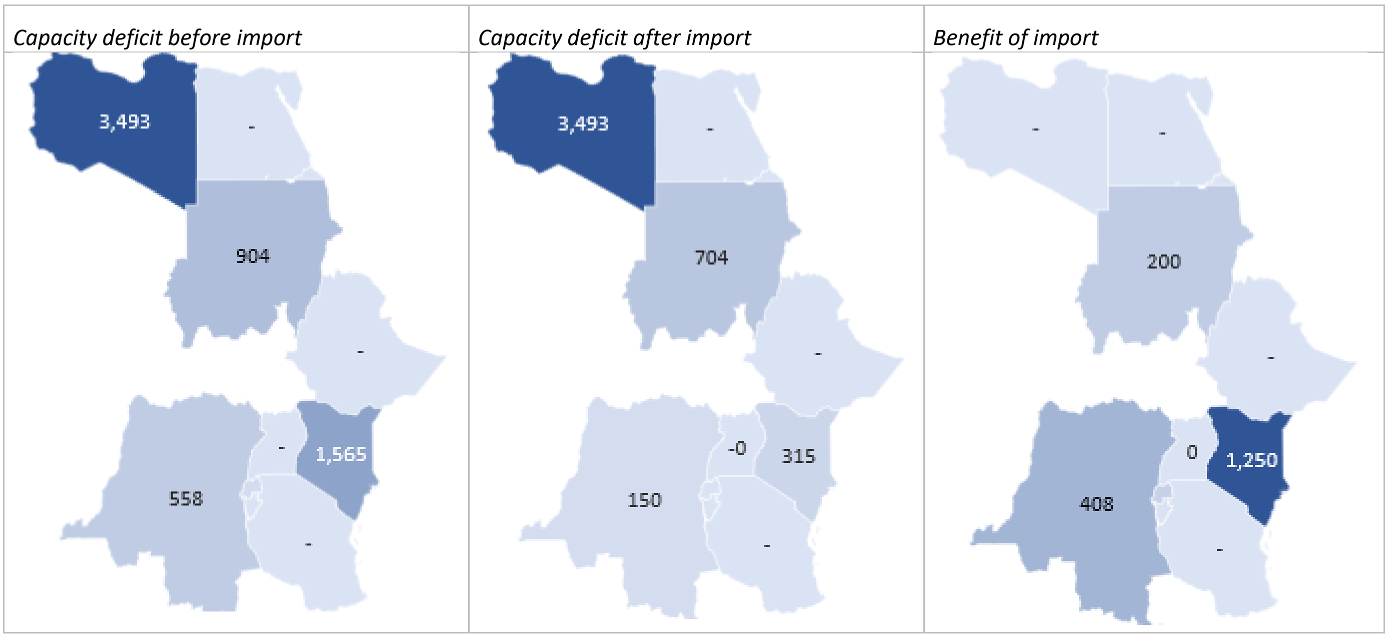

Figure 8. Capacity deficit and benefit of imports in 2030 when including projects with finance secured (MW). Values for DRC has been summed across the three regions.

Summary

To eliminate the capacity deficit to reduce dependency on unsecure projects and to fulfil the required reserve margin, future projects for both transmission and generation need to be accelerated and the project status must move in direction of “under construction” or “finance secured” (see Figure 8).

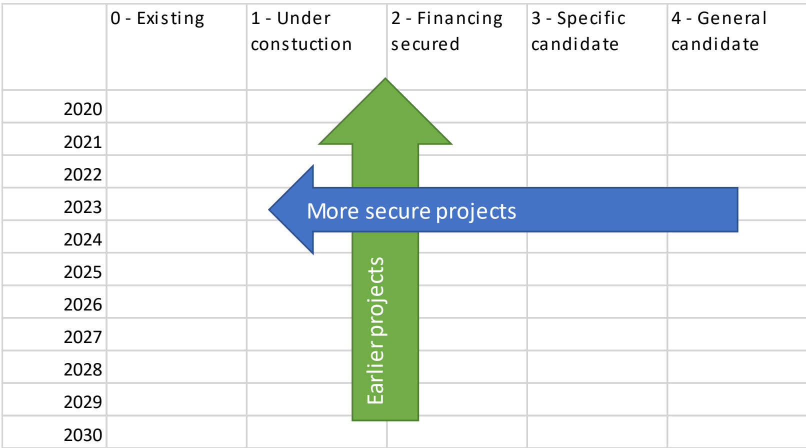

Figure 9. The two dimensions to increase security of supply.

5 Improving future power balance statements

The main observation from the process of developing the first EAPP power balance statement is that many of the future data may be uncertain and that the highest possible effort should be made to achieve accurate and updated information. This includes both demand prognoses and information (e.g. status and start year) about new projects (generation and transmission).

Data

Improved data could also be collected within a number of areas. Examples include:

- Hourly electricity demand profile for all countries. This could complete the study of the timing of the peak demand hour across countries. So far, the observation is that most countries currently have a night peak, however with some seasonality. Differences in the timing of the peak demand can be useful when assisting neighbouring countries during peak demand.
- Individual reserve margins per country. Within this analysis, a standard rate of 15% is used for all countries. A starting point could be to define the critical incidence per country and for each synchronous zone (N-1). This can be the largest single error, e.g. the loss of the largest generation unit or transmission line. In addition, historical statistics about planned and unplanned outages could be helpful in defining appropriate reserve margins.

Method

Potential improvements to the methodology used for preparing the power balance statement should include:

- Adding dry hydro year considerations. Based on historical inflow data a standardised dry year could be defined.
- Making a monthly power balance to reflect the limited energy that can be generated from hydro plants. This would require more data but would provide a more realistic picture of the power balance challenges in countries with considerable power supply from hydro.
    - In the current analyses the power balance without contribution from import is done in both energy (GWh) and capacity (MW) (chapter 3). However, the EAPP wide analysis is only performed in capacity (MW) (chapter 4).
- Develop a simple method to include the potential for import from non-EAPP countries during peak demand.
- Improve the method, so requirement about reserve margins also can be (partly) be fulfilled by interconnectors.

Within the current work, other power balance statements have been studied, e.g. (ENTSO-E, 2018b), (Wright, 2018) and (Ea Energy Analyses, 2016). In the long-term, stochasticity should be included in the analyses. The method used by ENTSO-E could act as inspiration regarding implementation of stochastic methods (EAPP, 2019, b).

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Appendix 1: EAPP Planning committee

Members per August 2019.

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Eng. Harrison Sungu	KETRACO – Kenya
Eng. Erastus Kiruja	KPLC – Kenya
Eng. Rachel Arinda Baalessanvu	UETCL – Uganda
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Eng. Adil Ali Ibrahim	MWRE – Sudan
Eng. Tesfaye Batu	EEP – Ethiopia
Mr. Nestor Nitunga	REGIDESO – Burundi
Eng. Claver GAKWAVU	EUCL – Rwanda
Eng. Ghada Bahdadi	EEHC – Egypt
Eng. Mohamed Abdulaziz Mohamed Alashhab	GAEREL – Libya
Eng. Elvis Babala Felo	SNEL – DR Congo
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Eng. Daniel Mulatu	EEP – Ethiopia
Mr. ARAKZA Audifax	REGIDESO – Burundi
Eng. Ronald NTARE	EUCL – Rwanda
Eng. Rania Mohamed Raafat	EEHC – Egypt
Eng. Saleh Omar Ramadhan Osman	GAEREL – Libya
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