

Danish Ministry of Foreign Affairs of Denmark
Danish Ministry of Energy, Utilities and Climate

Danida

**Renewable Energy Integration into the National Power System
of South Africa
ESKOM Holdings SOC Ltd**

**Development Engagement Document
Annex E to
Energy Partnership Programme between South Africa and Denmark
Development Engagement 2**

Draft April 28th 2017

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1 INTRODUCTION

The present development engagement (DE) document details the objectives and management arrangements for the development cooperation concerning “Renewable energy integration into the National Power System of South Africa” with Electricity Supply Commission of South Africa (ESKOM) for the period from July 2017 to June 2020 as agreed between the parties specified below. The development engagement document is an annex to the Bilateral Agreement with the Implementing Partner and constitutes an integrated part hereof together with the documentation specified below. This DE with ESKOM is part of the support provided through the Energy Partnership Program between South Africa and Denmark. The Partnership Programme with South Africa is embedded in the Danish Energy Agency (DEA) Energy Partnership Programme (DEPP) supported by the Danish Climate Envelope focusing on four countries including also China, Mexico and Vietnam.

2 PARTIES

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and

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3 DOCUMENTATION

The partner documents that support this intervention are:

1. National Development Plan 2030
2. Integrated Energy Plan (IEP) from 22 November 2016.
3. Integrated Resource Plan (IRP), 2010-30
4. Integrated Resource Plan (IRP), 2010-50 update from November 2016.
5. Eskom Research, Testing and Development. Research Direction Report: a working document (RaDaR) - 2014-2019.
6. Eskom RT&D Focus Areas 2017 – 2022. 12 Grand Challenges.
7. ESKOM Corporate Plan 2017-2022

4 BACKGROUND

In 2014 South Africa was denoted as the 15th largest emitter of CO₂ in the world. South Africa has relatively high emissions, both measured per capita and by emissions per unit of GDP. The power sector is the single largest emitter of CO₂ in South Africa, accounting for 50 % of total

carbon emissions. This is due to a high reliance on coal for electricity generation. The Government recognises that the high use of fossil fuels is contributing to climate change and regards climate change as one of the greatest threats to sustainable development. This is clearly stated in the *National Climate Change Response White Paper* published by the Government in October 2011 and in the *Integrated Resource Plan (IRP), 2010-30*.

In its Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change, South Africa has committed to a peak in greenhouse gas (GHG) emissions between 2020 and 2025 at a level between 398 and 614 Mt CO₂-equivalents. The NDC does not entail specific energy sector GHG targets. Neither does it entail RE-targets. South Africa has in recent years taken significant and positive steps to support its low carbon transition, and has ratified the Paris Agreement at the 21st meeting of the Conference of Parties. Policy instruments under development include a carbon tax, emission reduction targets for sectors, company level carbon budgets, as well as regulatory standards and controls for certain GHG emitters.

As a growing economy, South Africa focuses on balancing the need for continued economic growth with its social needs and the protection of the natural environment. The National Development Plan 2030 defines South Africa's main goals as eliminating poverty and reducing inequality by 2030. Among 'enabling milestones' are the need "to produce sufficient energy to support industry at competitive prices, ensuring access for poor households, while reducing carbon emissions per unit of power by approximately one-third". To achieve this, the plan outlines a range of significant energy infrastructure investments: procuring at least 20,000 MW of renewable electricity by 2030; importing electricity from other countries; decommissioning 11,000 MW of ageing coal-fired power stations and; stepping up investments in energy efficiency. (The current IRP 2010 – 2030 has a target of app. 17,000 MW subject to future IRP update).

The Integrated Energy Plan provides the national energy roadmap for the future energy landscape of the country which guides energy infrastructure investments and policy development. The Integrated Resource Plan forms the basis of South Africa's power generation capacity expansion programme.

ESKOM is the vertically integrated and state-owned power generation company of South Africa. ESKOM's mandate is to provide electricity in an efficient and sustainable manner, including generation, transmission, distribution and sales. The power utility is an important contributor to the government's objective to have a high level of electricity supply security as well as to promote economic growth and prosperity. Eskom's Corporate Plan (2017-2022) implements a strategy to lead South Africa into an era of reliable power supply and excess capacity while supplying economic growth through moderate tariff increases. The utility comprises of several Divisions which include Generation, Transmission, Distribution, Group Customer Services, Technology, Commercial, Finance, Group Capital, Enterprise Development, and Sustainability

The proposed counterparts in Eskom for this DE, is the Research, Testing and Development (RT&D) business unit which is part of the Sustainability Division. The RT&D business unit is mandated to select, develop and demonstrate technologies that support Eskom's future strategic objectives and has relationships with all business units and Divisions of Eskom ensuring broader stakeholder commitment across Eskom for the implementation of this DE.

South Africa needs to grow its energy supply to support economic expansion and in doing so, alleviate supply bottlenecks and supply-demand deficits. In 2016 approximately 3,000 MW RE was procured through the Renewable Energy Independent Power Producer Programme (REIPPP). Current plans show an accumulated REIPPP RE target for 2020 is app. 7,900 MW. With growing shares of fluctuating RE generation, the demand for flexibility from both generation and demand increases. Aspects of power plant flexibility and system stability need to be carefully assessed. Future power plant development and necessary retrofitting to increase the performance of existing and new coal power plants may likely be relevant. ESKOM recognizes that the Danish power market is a successful paradigm for integration of RE and optimization of the power system at lowest price. This includes profound experience with operating coal power plants at low load levels and with high ramping rates, ensuring very low curtailment of RE despite of its shares in the power supply mix. This experience could potentially benefit South Africa.

An essential tool for safe and efficient balancing of electricity systems with high shares of variable renewable energy (RE) generation is accurate RE generation forecasts. With a wind power share of around 40%, the Danish transmission system operator has developed “state-of-the-art” forecasting tools and procedures in the control centre. Danish support in this regard has been requested by ESKOM in order to strengthen forecasting through learning from Denmark’s long-standing experience with accurate forecasting.

Fluctuating and distributed generation is increasingly representing a major change in the way power systems are planned and operated worldwide. This is also the case in South Africa. Local distribution centres of ESKOM and centres at municipal level in areas of existing or potential high penetration of RE has expressed a need to better understand the constraints and limitations of their power system control as they begin to experience increased levels of fluctuating, distributed generation and RE IPPs. This particular part of the cooperation is a continuation of previous support successfully provided by Denmark.

The engagement is designed to address the specific needs of ESKOM in an areas specified above where Denmark has unique expertise as well as a good track-record in South Africa and where other development partners are currently not providing support.

5 DEVELOPMENT ENGAGEMENT OBJECTIVE

The objective of the wider Energy Partnership Programme between South Africa and Denmark is to assist South Africa in moving to less carbon-intensive electricity production including through expansion of RE generation capacity. This objective is in alignment with South Africa’s National Development Plan.

The particular objective of this DE is to facilitate the development of a less carbon intensive electricity sector by preparing ESKOM to integrate a larger share of RE into the electricity grid in accordance with the IRP. The present power generation is largely based on coal. The IEP foresee an increase of RE in the future power supply mix, and the IRP outlines possible scenarios and attached investments. Consequently, this DE can contribute to the reduction of the carbon intensity of the economy and indirectly contribute to the reduction of GHGs in support for the Nationally Determined Contributions.

The DEA will base the actual support on progress attained in the implementation of the engagement as described in the documentation. South African progress will be measured through the ability to integration of RE into the grid, the Climate Change Envelope indicators and some specific indicators developed in this DE.

6 THEORY OF CHANGE

The targeted outcome is to prepare the electrical power system for a future where more RE-capacity is connected to the grid. If the system should be able to integrate a large share of RE power in a cost-effective way, then changes would be required in order to deal with the technical challenges that follow fluctuating power generation.

South Africa has a well-developed electricity system based on large, central coal-fired power plants and introduction of variable generation technologies, geographically dispersed throughout the country, will fundamentally change the dynamics of the electricity system. Power plants will have to be able to operate at lower load rates and faster ramping rates in order to provide greater flexibility in the power system, but it is yet to be fully understood whether existing coal power plants potentially could be retrofitted to increase flexibility, which cost-effective and scalable technical solutions there are for increased flexibility of thermal power plants and how compensation/incentive schemes for additional balancing services by power plants potentially could spur the changes. Experts will work with ESKOM to help understand the options better for ESKOM to further pursue how best to enhance the flexibility of power plants.

Changes in control room operations are required too and in this regard, protocols to facilitate integration of thermal power production in the dispatch operation under conditions of high penetration of RE generation will be developed with technical assistance from the programme. The majority of future variable renewable generation technologies will likely be located far from load centres and hence connected into relatively weak networks causing network stability issues that need to be resolved. This part of the assistance to ESKOM is a continuation of present support from Denmark.

The programme will also support ESKOM's national operational centres with the development of relevant tools and procedures for more accurate forecasting of RE generation in order for ESKOM to eventually practice hourly forecasting, linking real-time weather data to forecasting models. This will allow for dispatching of non-renewable energy to be done in a more cost-effective manner.

ESKOM's local distribution control centres including centres at municipal levels will be engaged in the cooperation to strengthen their ability to foresee the impact of variable generation from RE on the operation of distribution networks. This will be done through training and knowledge sharing of best practice from Denmark. Thus, under this engagement, distribution control centres are expected to develop operational frameworks that efficiently integrate variable generation at the distribution level. The good results from similar activities under the present support from Denmark suggest that assumptions for changes to happen are well in place.

ESKOM recognizes that the Danish Transmission System Operator has expertise to maintain grid stability under conditions of high penetration of RE and that thermal power plants in the Danish system are able to operate in a highly flexible manner. The changes envisaged for this DE to be successful will be achieved through a cooperation between the Danish Transmission System Operator and ESKOM, short-term advisory support by DEA and external consultants who will work closely in a peer-to-peer relationship with ESKOM and municipal control centres engineers, and exchange visits to Denmark of key people involved in the national operational centres of ESKOM.

Successful achievement of the outcomes rests on the assumption that the operational and planning divisions of ESKOM are closely engaged in the cooperation through the RT&D unit, the DE anchor at ESKOM, and the participation of ESKOM local distribution control centres in relevant trainings on RE-integration at distribution level. It is also an assumption that DEA is able to provide relevant experts and technical assistance in a timely manner as per agreed work plans. Another key assumption is that RE will continue to come online in a scale that requires increased attention to the technical and operational grid integration issues that this DE addresses.

7 RESULTS FRAMEWORK

For Danida's reporting purposes the following key outcome and output indicators have been selected to document progress:

Outcome		Enhanced power system ability to integrate the renewable energy generated in a cost effective way.	
Outcome indicator		1) Capacity to effectively integrate RE into the grid. 2) RE generation uptake in the supply mix of South Africa.	
Baseline	Year	2017	1) Limited capacity available to integrate all generated RE. 2) No significant curtailment with current level of RE integration
Target	Year	2020	1) ESKOM has the capacity to fully integrate all generated RE while at the same time minimizing the costs of the base load needed to balance the variable nature of the resource 2) No significant curtailment with the increased level of RE integration
Output 1		Operational flexibility of the national electricity system is enhanced The national electricity system is well prepared to integrate increased shares of fluctuating RE in the power supply in a cost-effective way, including through additional use of thermal power plants balancing services, dispatch operation under conditions of high penetration of RE generation and grid stability issues.	
Output indicator		Ability to operate the power system to serve varying demand as well as supply load	
Baseline	Year	2017	ESKOM is operating the power system primarily to serve a varying demand load and are able to integrate most of the produced RE generation at current penetration.
Target	Year 1 1.5	2018	ESKOM has identified tools to operate the power system in a way that may serve increasing amounts of varying demand and supply load when more RE is coming online.

			Financial incentive needed to integrate even more RE through thermal power plant balancing services is identified in close dialogue with ESKOM.
Target	Year 3	2020	ESKOM is able to operate the power system to serve varying demand as well as supply load as more RE is coming on line. Also, it is known what kind of financial incentive is needed to do this in a cost-neutral way.
Output 2		RE generation forecasting is improved ESKOM uses advanced tools and procedures for RE generation forecasting and dispatch of non-renewable generation.	
Output indicator		Ability to do advanced forecasting more accurately	
Baseline	Year	2017	ESKOM uses a 24h forecasting (or day-ahead) of the RE generation to plan the dispatch of non-renewable power plants.
Target	Year 1.5	2018	ESKOM is able to use hourly forecasting of RE generation based on real-time meteorological data.
Target	Year	2020	ESKOM is able to use hourly forecasting more accurately of RE generation by linking real-time weather data to forecasting models and can dispatch non-renewable generation in a cost-efficient manner.
Output 3		Integration of RE generation at distribution level is strengthened ESKOM's local distribution control centres including centres at municipal levels has developed operational frameworks that can efficiently integrate and operate variable generation at the distribution level without compromising grid stability	
Output indicator		Change in operational strategies as a result of training	
Baseline	Year	2017	Not applicable as training has not started. Small scale embedded generation not captured fully in the existing network
Target	Year 1.5	2018	Centres have developed new or revised their existing operating strategies due to training received. Percentage small scale embedded generation captured in the existing network measured in data acquisition systems
Target	Year	2020	No additional target for 2020, this output is in principle designed to be implemented in the first year of the DE.

8 Risk Management

The major risks related to successful implementation of the development engagement are that:

The government puts high priority of nuclear and coal produced energy. This would potentially lead ESKOM to divert away from options on RE. However, the residual risk is assessed to be minor. Renewable energy is firmly expected to be part of South Africa's energy future. Likewise, through the activities in this DE, the benefits from increased integration of RE will be more clearly outlined throughout relevant divisions and units across ESKOM.

Renewable energy is not at highest priority in ESKOM, because ancillary services to the grid to incorporate a large variable RE share is perceived to be non-recoverable costs. This would result in slowing down the expansion of RE integration. In addition, in a market of excess capacity RE generation will displace Eskom generation. But with the DE demonstrating that RE integration is economically feasible the residual risk is considered minor.

The ESKOM research department does not get other departments on-board in implementation of the development engagement, particularly the operational and planning departments. However, with the high-level commitment from ESKOM to this DE the risk is considered to be minor.

No other major risks are identified that have not been mitigated as part of the design, but risks will be monitored closely throughout implementation and measures will be carried out accordingly.

The engagement is designed to address special needs of ESKOM where Denmark has unique expertise and a good track-record in South Africa, where other development partners are currently not providing support.

9 Inputs/budget

Outputs	Contribution with Danish funds	Partner Contribution in-kind
1. Operational flexibility of the national electric system is enhanced	2,764	
TA travel costs etc. in DKK '000	258	
Delegations to Denmark in DKK '000	130	
Other costs in DKK '000	70	Venue, Workshop & Staff R300 000
TA from DEA in hours	1040	1040
TA from other international experts in hours	1765	1765
2. RE generation forecasting is improved	845	
TA travel costs etc. in DKK '000	85	
Delegations to Denmark in DKK '000	130	
Other costs in DKK '000	70	Venue, Workshop & Staff R200000
TA from DEA in hours	500	500
TA from other international experts in hours	300	300
3. Integration of RE generation at distribution level is strengthened	1,552	
TA travel costs etc. in DKK '000	98	
Delegations to Denmark in DKK '000	130	
Other costs DKK '000	70	Venue, Workshop & Staff R500000
TA from DEA in hours	200	
TA from other international. experts in hours	1000	1000
TA from local consultants in hours	200	200
GRAND TOTAL	5,161	

Partner contribution in terms of hours is intended to at least be equivalent to the Danish input. This will be measured and reported on.

10 Management arrangement

The parties have agreed to the following management arrangement with the aim to ensure adequate dialogue and timely decisions regarding this development engagement.

The development engagement is anchored in the Research, Testing and Development (RT&D) business unit of ESKOM that has the overall responsibility for implementation of the engagement. The daily implementation is the responsibility of the General Manager Research, Testing and Development, ESKOM.

A Development Engagement Implementation Group, hereafter called the Implementation Group, managing daily implementation of the development engagement will be headed by a person from the partner institutions and consist of the Long Term Adviser, a programme officer from the Embassy of Denmark (EDK), the DEA country coordinator/DEA expert and partner specialists as required. It is envisaged that operational staff will form the majority of this group. The Implementation Group will guide daily implementation and meet on a needs basis, and will: i) develop annual and detailed half-yearly work plans for the DE, matching priorities in the partners work plans, ii) associated with the detailed half-yearly work plan determine need for Technical Assistance (TA) inputs from DEA experts and from national and international TA through development of a TA provision plan; iii) endorse inputs based on TOR prepared at output level; iv) monitor day-to-day progress of DE implementation. The head of the Implementation Group reports on DE outputs to the Management Group.

A Management Group will be established to coordinate and manage the entire partnership programme in South Africa. The Management Group will be co-chaired by DoE and the DEA-country coordinator. ESKOM, the LTA, an EDK representative and partner specialists participates as relevant. The Management group will meet at least twice per year and have the responsibility to: i) consolidate and check annual and detailed half-yearly work-plans and budgets against DE partners work-plans and TA provision plan; ii) monitor programme progress at output level, using the “traffic light” system; iii) ensure cross fertilisation between engagements. The Management Group reports on programme development to the Steering Committee and acts as Secretary to the Steering Committee. Decisions are made by consensus.

The Steering Committee is established and co-chaired by the Deputy Director General of Department of Energy and the Ambassador of Denmark. DEA participates at high-level in the Steering committee. DE partners are all represented in the Steering Committee at senior management level. The Steering Committee should meet one to twice per year to approve annual work plans and progress reports; discuss and resolve issues related to programme progress, and; decide on any reallocation of resources between DEs, e.g. based on recommendations from the Management Group and from the mid-term review. Decisions are made by consensus.

Implementation arrangements

At implementation level the DE partners are responsible for implementation of the DE with DEA being responsible for providing the necessary and timely resources to deliver the outputs, according to the output-based budget and along the request for TA from the DEs. Each DE partner has, at output level, dedicated partner specialists, assisted by DEA that provide inputs to the annual and bi-annual work-plans, and proposed needs for provision of TA. This includes formulating detailed Terms of Reference and specific TA profiles and time-input required to deliver the outputs. Provision of TA should be based on the principles of a) national TA where relevant; b) DEA/Energinet.dk experts where peer advice is required and; c) international specialists where dedicated specialist tasks will be needed.

DEA is also responsible for coordination of inputs from Denmark and for advising DEA is also responsible for coordination of inputs from Denmark and for advising on implementation, and approving deliverables from external service providers.

In addition to national and international short term TA the partnership programme in South Africa will finance a Long Term Adviser to be placed in DoE and may be assisted by a local consultant on a needs basis. DoE will arrange and finance project office facilities. While the LTA serves as adviser to the entire programme, the LTA will have primary focus on delivering technical advice at output level to DE 1. As programme advisor, the LTA would use any opportunity to encourage partners (as duty bearers) to ensure consultation of relevant DE outputs with right holders – CSO's, private sector investors and other relevant stakeholders. The LTA will also support integrated policy dialogues. The LTA will be able to draw on local and international TA from the programme, when required.

At the EDK a programme officer will coordinate programme implementation and facilitate inputs from Denmark. The programme officer will also participate in meetings of the Implementation Group as needed.

11 PROCUREMENT AND FINANCIAL MANAGEMENT

This development engagement will have no cash transferred or disbursed directly to the development engagement partner. Hence, there are no requirements for accounting of funds and financial reporting at development engagement level. However, based on the agreed annual work plan the international and national adviser inputs will be budgeted and agreed in terms of days delivered in country. The bi-annual progress reports will include the actual time spent for each TA input to monitor the use against agreed TA budget.

Procurement of agreed international TA (in any form) will be carried out by DEA and follow Danish procurement rules or drawn from a pool of experts. Final selection of procured TA will be done in close cooperation with partners based on no objection from the Implementation Groups.

Procurement of agreed national specialist TA, not covered by the above, will be carried out by the EDK in consultation with DEA, and follow Danish procurement rules for local procurement of TA. Final selection will be done by in close cooperation with the Implementation Group.

Recruitment of the Long Term Adviser (LTA) follows procedures of the Danish Ministry of Foreign Affairs (MFA). Representatives from DoE will be part of the recruitment panel together with representatives from DEA, EDK and MFA.

Study tours by DE partners will be paid for by the partnership programme with South Africa. This includes airfares and accommodation. DEA, through the EDK, will arrange all bookings of airfares, hotels, transport and other practical arrangements. Workshops and seminars in South Africa will be paid for by the partnership programme through EDK, based on appropriate quotations approved by EDK and documented expenses. Sitting allowance for any workshop or meetings will be paid for out of partners own budgets.

12 MONITORING AND EVALUATION

Daily progress will be followed by the Implementation Groups who will report progress towards outputs and outcomes of this engagement through bi-annual progress reporting to the Management Group that consolidate reports across the programme and report this to the Steering Committee at annual or bi-annual Steering Committee meetings. The Management

Group will also provide an Annual Progress Report to be approved by the Steering Committee. All reporting should, to the extent possible and when relevant, be disaggregated by gender, area, sector, etc. forwarded to the DEPP Advisory Group in Copenhagen.

Detailed indicators for each specific development engagement output will be revisited and potentially refined as part of the inception, where annual targets, in line with already defined targets will be adjusted with reference to the Danish Climate Envelope guidelines for monitoring. Monitoring towards these targets will be reported through the bi-annual progress reporting using a “traffic-light” system, where:

- “green” is on-track – implementation continues as scheduled;
- “yellow” is partly on-track which needs an explanation by the Implementation Group to the Management Group, including actions taken to get back on-track and closer monitoring of progress by the Management Group;
- “red” is off-track, which needs a detailed explanation by Management Group to the Steering Committee with recommendations of changes to the implementation to get the engagement back on-track. If “red” in two consecutive reporting periods, the Steering Committee may consider reallocation between outputs within or between the development engagements as deemed relevant.

Monitoring of actual time spent by international and national advisers will be reported in the bi-annual progress reports with updated work plan and projection of TA input for the following quarter will be stipulated. Similar reporting will be done for workshops and study-tours.

The Danish MFA shall have the right to carry out any technical mission that is considered necessary to monitor the implementation of the programme, which may include a mid-term review.

After the termination of the programme support the MFA reserves the right to carry out evaluation in accordance with this article.

Anti-corruption

No offer, payment, consideration or benefit of any kind, which could be regarded as an illegal or corrupt practice, shall be made, promised, sought or accepted - neither directly nor indirectly - as an inducement or reward in relation to activities funded under this agreement, incl. tendering, award, or execution of contracts. Any such practice will be grounds for the immediate cancellation of this agreement or parts of it, and for such additional action, civil and/or criminal, as may be appropriate. At the discretion of the Danish Government, a further consequence of any such practice can be the definite exclusion from any projects funded by the Government of Denmark.

Prerequisites

This Development Engagement is in accord with xxxx
There are no additional prerequisites.

Signatures

Partner/DEA