

Case Study



Opportunities for commercial weather and climate services serving the East African energy sector

Kenya Meteorological Department and Tanzania Meteorological Agency

The steady growth of the energy sector in East Africa means that it has the potential to develop rapidly. Although weather and climate have a huge impact on energy industries, their use of weather and climate information is currently limited. In part, this is because local weather and climate services that provide weather and climate information for selecting sites, developing and constructing plants, and operating energy installations are still being developed.

Recent discoveries of oil and high-potential gas fields, along with the emerging renewable solar and wind energy sectors, are likely to stimulate demand for sophisticated weather and climate forecasting. To meet demand, it will be necessary to build capacity, and to engage and establish partnerships with energy sector operators. Industry-specific weather services open up opportunities, encourage investment, maximise returns on investment, and lessen the impact of weather and climate on operations. Information on the likely impacts of climate change is also significant for selecting sites and operational planning.



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The challenge

The Kenya Meteorological Department (KMD) and the Tanzania Meteorological Agency (TMA) have unrivalled meteorological archives and knowledge of local weather and climate. Both organisations have expressed determination to strengthen their capacity to deliver value-added products and services to a wide range of stakeholders, including energy industries. In order to plan appropriate commercial services that best meet energy industry requirements, however, a comprehensive understanding of how weather and climate information can support energy industries is essential.

The approach

Taking a customer-focused approach, KMD and TMA, with support from the Met Office, the UK's national weather service, mapped energy industry needs as part of the Foreign and Commonwealth Office Africa Prosperity Fund project, 'East Africa Energy and Extractives Services'. KMD and TMA provided local expertise, and the Met Office provided insight into delivering operational weather and climate services to energy industries using specialist market intelligence techniques and knowledge.

KMD, TMA and Met Office marketing experts engaged with companies in the energy sector in East Africa and the UK to scope user requirements. Scientists from KMD, TMA and the Met Office carried out detailed analyses to assess strengths and gaps in capacity within local meteorological services.

The market research, combined with the assessments, built the capacity of staff and provided robust evidence for the creation of product development plans to achieve the ambition of serving energy industries in the region.

Market research

Surveys by experts at KMD, TMA and the Met Office determined the weather and climate information needs of energy industries operating in East Africa and the types of products that would meet their needs.

This involved:

- desk-based research and stakeholder mapping to scope out oil and gas, and renewable energy markets in Kenya and Tanzania;
- engaging with users through workshops, one-to-one meetings and questionnaires; and
- analysing user insights using industry-standard political, economic, social, technological, legal and environmental (PESTLE) assessment and other market analysis techniques.



Participants of the product development workshop held at the Kenya Meteorological Department on 9 and 10 February 2016



Assessment of Kenya and Tanzania meteorological services

Staff at KMD and TMA, working with a team from the Met Office, carried out situational assessments in order to map current products and services, and the stakeholders that use them. They identified the current strengths of the meteorological services as well as areas for development related to providing products and services for energy industries.

Kenya Meteorological Department

The assessment found that KMD is keen to provide weather and climate information to a range of stakeholders to enable them to operate efficiently and sustainably. Staff have significant skills in maintaining World Meteorological Organization observation standards, and have the expertise to set up bespoke observation stations for industry. The KMD archive has observations dating from 1894, with more complete records from the 1970s.

The department has a sound reputation for short, medium and long-range forecasts that serve, among other areas, agriculture and livestock, water resources management, energy, transport (air, surface and maritime) and disaster risk reduction. Index-based crop insurance and general insurance are emerging areas. KMD has expertise in communicating forecasts to non-meteorologists and have useful local knowledge and connections. The severe weather forecasting team informs all alerts and warnings issued by KMD. The Public Weather Service is the dissemination unit for general public services. The Business Support and Consultancy unit provides some commercial forecast services and data at cost-recovery rates.

Tanzania Meteorological Agency

The detailed situational assessment of TMA found that it provides valuable, impact-based services to the public, aviation, marine, agriculture and energy sectors over timescales ranging from hours to months. TMA staff are competent in delivering products and advice, and there is the capacity and ambition to expand services to new sectors. TMA also has an extensive database of site-specific observations and spatial climatologies, which is being digitised to ensure that data is available for sector-specific products and services.

TMA run a wave model across the coast of Tanzania that provides input for offshore forecasting services. This model could be archived to create a climatology of wave activity for Tanzania to support planning and operational decisions in the offshore energy sector.

The Port Meteorological Officer in Dar es Salaam, reported that there was a lack of tidal gauge data and other observations across inshore waters. Closer cooperation with the port authority and shipping companies, who regularly record observations data, could feed into TMA forecasting to improve services for marine customers.

Weather services of interest to the energy sector

Analysis of information collected from the market research identified weather information of interest to operators in the energy sector.

Wind Siting of wind generators requires data on wind direction, strength and frequency at the height of the hub.

Temperature affects oil pumping, the operation of gas turbines and working conditions in oil production.

Waves, coastal and ocean currents Sea conditions affect loading oil tankers, shipping schedules, the design of pipelines and may trigger coastal landslides that damage pipelines.

Sea surface temperature and baroclinic waves

Information on sea surface temperatures and the density and pressure of waves is necessary for designing pipelines and offshore infrastructure.

Solar irradiance Measurements of solar power are required for forecasting solar site yield for on-grid power generation (limited requirement at present as most solar power generated is off-grid).

Squalls Analysis of sustained wind data is required to indicate the intensity of storms, as squalls affect transportation of high value cargo.

Cyclone frequency The frequency of cyclones affects design thresholds.

Rainfall The amount, frequency and intensity of rain affects the design and operations of energy installations.

The Kenya energy sector

Biofuel and waste generate 72 percent of Kenya's energy, fossil fuels generate 17 percent and all other sources, including geothermal and renewables, generate 10 percent (Figure 1). Falling oil prices have led some companies to consider selling exploration blocks in Kenya. Interest in wind power is growing. The Ngong Hills Wind Farm, constructed in 1993, generates 5 Megawatts (MW) and there are plans to expand to 25.5 MW. The Government of Kenya has also endorsed the Lake Turkana Wind Power Project, the largest single private-consortium wind power investment in Kenya. Feed-in tariffs encourage small wind (50 MW), hydro (10 MW) and biomass (40 MW), geothermal, biogas and solar plants. Equipment for renewable energy is exempt from import duties and value-added tax (VAT). Kenya has also signed an agreement with China to build a nuclear power plant by 2025.

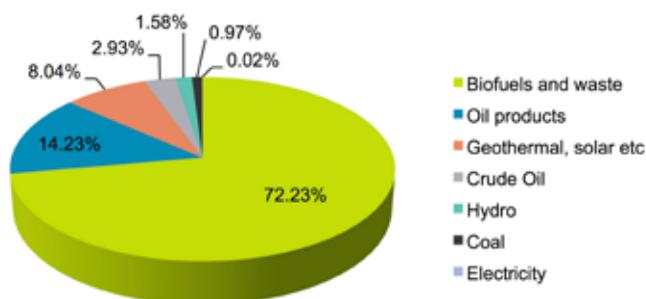


Figure 1. Kenya total primary energy supply¹

Industry feedback

Feedback from those involved in exploration and operations in the oil and gas and renewables sectors identified a need for weather and hydro-meteorological information and, in particular, accurate climate information and timely, accurate weather forecasts.

"Long term met-ocean datasets for East Africa are critical for designing oil and gas facilities and it is difficult to identify what data exists and then obtain the relevant data. We have in the past used local consultants to contact in country met services on our behalf but this adds a further link in the chain with associated risk of miscommunication."

Iain Gunn
HR Wallingford

Challenges

Assessing wind potential to support project development is time consuming and site-specific, demanding sophisticated equipment and technical expertise. Developing wind energy requires wind prospecting services. Infrastructure designs need to be based on accurate climate information to ensure structures withstand the effects of weather over time.

Needs

Hydropower generators need rainfall data and climate information to understand seasonal rainfall patterns, their impact on energy production and when back up energy may be required. Some of this information is provided free of charge but all energy generators need weather forecasts to predict demand for power and to balance the grid.

"The interviews, research and situational assessments provided a range of findings that gave insight into how weather impacts operations. For example, in Kenya, air quality information is important for geothermal operations and across East Africa temperature affects the pumping of oil."

Kathrin Hall

Senior International Development Manager
Met Office



The Tanzania energy sector

In Tanzania, 85 percent of energy currently comes from biofuels and waste, 11 percent from oil products, and the remainder from natural gas, hydropower and electricity (Figure 2). Liquid fuels and natural gas account for 65 percent of Tanzania's installed generation capacity and hydropower for 35 percent of installed capacity.³

Demand for electricity is growing by 10–15 percent a year. On the mainland, only 24 percent of the population are connected to mains electricity and only 11 percent in rural areas.² Government policy on renewable energies is still evolving, meaning that few renewable energy companies are active as the sector is still developing.

Recent exploration in deep offshore water has discovered significant natural gas, opening up opportunities for developing and constructing liquefied natural gas plants and pipelines. Sources and opportunities for renewable energy, including geothermal, wind, biomass and solar, are untapped. Some oil and gas companies recently withdrew from the country because of the fall in oil prices.

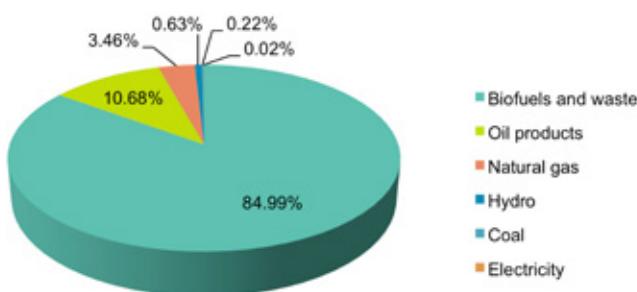


Figure 2. Tanzania total primary energy supply⁴

Industry feedback

At present there are no timely, accurate forecasts to aid operational planning in order to mitigate the effects of, for example, droughts and landslides. In the renewable energy sector, contractors currently provide a range of services to support the development of wind farms, such as wind mapping, wind farm layout and wind farm forecasting, for example for Singida Wind Farm.

"The closing of the hydropower dams was beyond the government's control, we cannot do anything because of the changes in environment - we are not getting enough rain."

Badra Masoud

Head of Communication at the Tanzanian Ministry. BBC News, 9 October 2015

Challenges

Climate change, particularly changes in the frequency of droughts that influence river flow, evaporation and variability, will affect hydropower, which currently accounts for a third of installed generating capacity.

Repairing damage caused by weather events, such as damage to the 532 km (330 mile) gas pipeline from Mtwara to Dar es Salaam and the 225 km gas pipeline from Songo Island to Dar es Salaam, is expensive. At present, forecast information is not provided to mitigate against damage to oil and gas infrastructure and operations.

"Major storms in Tanzania cause erosion and exposure of the pipelines. It can be costly repairing damage from one storm."

Nigel Whittaker

Songas

Needs

Sustainable operation of the energy sector requires a flow of timely, appropriate weather and climate information. Although hydropower is expected to continue to dominate installed generating capacity, the discovery of natural gas will lead to diversification. Modelling services could help forecast when back up energy production is required and help understanding of how to mitigate the impact of climate change.

¹ International Energy Agency, 2013

² United Republic of Tanzania, Ministry of Energy and Minerals. The Draft National Energy Policy 2015. <https://mem.go.tz/wp-content/uploads/2015/02/NATIONAL-ENERGY-POLICY-2015-Feb-2015.pdf>

³ Ministry of Energy, Electricity Supply Reform Strategy and Roadmap 2014-2025

⁴ International Energy Agency, 2013 <https://www.iea.org/statistics/statisticssearch/report/?year=2013&country=Tanzania&product=Balances>

Outcomes and product development plans

Workshops involving KMD and TMA forecasting and business teams examined the findings of the market surveys and the assessments of the meteorological services, and generated ideas for new products.

These ideas were used to develop product development plans for each meteorological service, which detailed product features and functions, customer requirements, pricing guides and recommendations for making products operational.

The product development plans took account of the services currently provided free of charge to the public and the commercial products that recover costs. In the future there may be opportunities to consider profit margins and reconsider pricing strategies to ensure that TMA and KMD have funding available to reinvest in the long term development of these services.

Potential products and services

The project identified areas where the Kenya and Tanzania meteorological services could potentially develop products and services, including:

- Grid forecast data to enable forecasters to sell new forecast products.
- Statistically verified daily rainfall forecast charts to foster customer confidence.
- Customised warnings and forecasts according to the type of end-user and based on gridded model data inputs.
- Weather research and forecasting model or external gridded forecasts to fill gaps in observational records.
- Expansion of existing sophisticated flood forecasting capability to other flood-prone areas.
- Technical observations consultancy.
- Information on June–August strong winds for wind power.
- Digitised data on rainfall, rainfall intensity, wind speed, radiation and near-surface temperature.
- Industry-specific training on weather and climate.
- Research papers relevant to weather and climate services.



Benefits to industries

- Weather forecast services and customised warnings allow offshore oil and gas companies to effectively plan their operations and mitigate weather risks.
- Enhanced wind speed information supports the development of the wind power industry as this information can be used to understand supply.
- Flood forecasting and enhanced rainfall information helps hydropower producers understand supply.
- Air quality information can be used to mitigate risks of geothermal energy production.

Closer collaboration

The project has identified that there is a need for closer collaboration with local and international energy, oil and gas companies and ministries, building on the relationships forged through this project. There is a requirement for a number of developments, both short and long term, some needing additional investment. There is potential, for example, to increase the density of marine observations by accessing ship observations in the Indian Ocean as well as developing and adopting a more comprehensive pricing policy.

Increasing capability

The situation assessment and product development plan revealed that KMD and TMA's internal infrastructures require additional support to meet the demand for localised energy services. Staff capability could be built in respect of product, marketing and stakeholder management as well as production of operational services. To be able to fully meet the requirements of energy customers, additional investment in staff resources is also recommended.

Further recommendations

KMD and TMA will be able to address some of these recommendations through their normal operations as well as other projects, for example through funding from the UK's Department for International Development. We would recommend a follow on project to specifically support the development of energy services to include user testing of product developments with a range of international companies. The project would allow the building of sustainable capabilities and skills within KMD and TMA, enabling them to deliver operational commercial weather and climate services to the oil and gas, and renewable energy sectors. This would support and encourage national and UK companies to make confident investment decisions in the Tanzanian and Kenyan energy markets as well as support them to run their operations efficiently and safely on a long term basis.



Who we are

The Met Office is a global centre of excellence in weather and climate science, and the UK's national weather service. Founded in 1854, the Met Office pioneered weather forecasting. Ever since then we have been at the forefront of developments in weather and climate science.

Our international development work

We draw on our scientific and operational strengths to offer practical advice and specialist consultancies. Our wide range of skills and expertise enables us to support countries around the globe in developing and enhancing their weather and climate services.

What makes us different?

As an international organisation, we are exposed to many challenges and have a reputation of meeting and exceeding expectations. Our strong track record includes:

- experience of working in over 150 countries;
- a pool of internationally-experienced specialist staff;
- World Meteorological Organization (WMO) accredited training;
- a thorough understanding of how weather and climate are linked to development goals and policies;
- design of impact-based forecasting for WMO policy;
- supercomputing capacity for sophisticated modelling;
- developing one of the most accurate regional meteorological models in the world, now adopted by Australia, South Africa and South Korea.



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