

# A Regional Solution to Transform Science and Technology Education in Africa

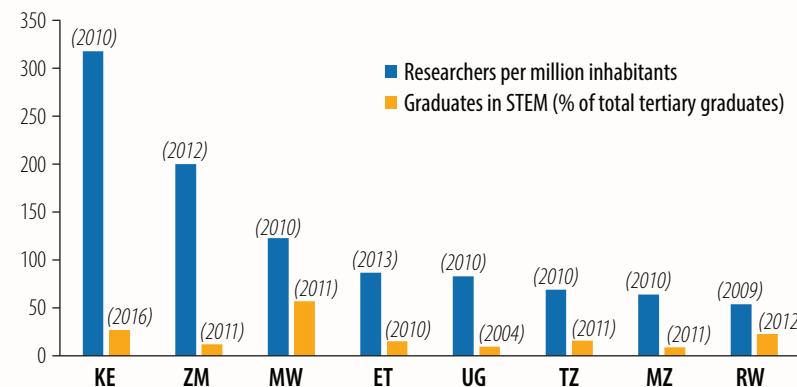
# Africa's Economic Transformation Challenge: Inadequate Skills in STEM

Since individual countries have limited resources and capacity, they would take much longer to meet labor market demands on their own. Despite differences in economic structures, most of these countries rely heavily on agriculture, mining, oil and gas, which together account for 60 percent of their overall growth. To sustain and expand this growth to the next level, the ESA countries now face an urgent need to develop higher level skills and knowledge, with a special focus on Science, Technology, Engineering and Mathematics (STEM). However, ESA countries simply do not produce enough skilled graduates that they need to expand and diversify their economy. While their higher education enrollment has risen over the years, they lag far behind other regions in science, technology, health and related fields. Regional surveys reveal that firms face acute challenges in filling technical and managerial positions, not just due to the inadequate number of graduates, but also because of low quality and relevance of their education and training. Additionally, many universities lack highly qualified faculty members, especially with PhDs, which further prevents them from providing high quality education, training, and research mentoring.

## **KEY MESSAGES**

- Eastern and Southern Africa (ESA) lags behind other regions in higher education and research output in science, technology, agriculture, health and related fields. But recent rapid economic transformation as well as foreign investment in the region have boosted demand for advanced skills and applied research in these areas.
  - Since individual countries have limited resources and capacity, they would take much longer to meet labor market demands on their own. A coordinated regional approach can build upon existing, relatively strong academic institutions in the region to collectively produce skilled workforce, especially in priority sectors where demand skills is the greatest.
  - The Eastern and Southern Africa Higher Education Centers of Excellence Project (ACE II) will strengthen 24 competitively selected centers to deliver quality, market-relevant post-graduate education, and build collaborative research capacity in five regional priority areas: industry, agriculture, health, education and applied statistics.
  - Funding of each center will be tied to agreed results and only disbursed for their achievement, ensuring stronger ownership and impact.
  - These centers plan to collectively enroll over 3,500 graduate students, including 700 PhD students; publish 1,500 journal articles; and launch over 300 partnerships and research collaborations with private sector and other academic institutions both in and outside the region.

**Figure 1: Tertiary Graduates in STEM (%) and Researchers in Participating Countries**



*Note:* For Malawi, while the STEM tertiary graduate ratio is high, overall enrollment is among the lowest in Sub-Saharan Africa. According to UN (2010), less than 1% of Malawi's qualified cohort were enrolled in tertiary education.

Sources: Southern African Regional Universities Association Profiles (2008–2011); The Global Innovation Index 2015; Kenya Commission for University Education (2016). State of University Education in Kenya.

## A Regional Solution to Transform Higher Education

A regional approach in areas of science and technology higher education in Eastern and Southern Africa offers the most effective use of the region's resources to bridge its skill gap. Scarcity of faculty and resources, along with gender disparity, limit the ability of each individual country in the region to develop a whole spectrum of research and teaching excellence. But coordinated investments with country-specific specializations can help the region as well as the country develop a broad based science and technology ecosystem, covering all critical areas as well as resulting in economy of scale in producing graduates and innovation. By being able to collaborate and share ideas within and across disciplines, faculty, PhD students, and researchers across countries can reap benefits well beyond their individual centers.

The Africa Higher Education Centers of Excellence (ACE) initiative was launched by the World Bank and key regional stakeholders as a key step toward implementing this solution across Africa. Its first phase, ACE I was launched in 2013 for West and Central Africa, 22 Centers of Excellence across eight countries in three priority sectors – STEM, Agriculture, and Health. Building on the ACE I experience, the second phase, the **Eastern and Southern Africa Higher Education Centers of Excellence (ACE II)** seeks to strengthen selected ESA institutions to deliver quality post-graduate education and build collaborative research capacity in five regional priority areas: **industry, agriculture, health, education and applied statistics**. It shall do so by:

- Competitively and transparently selecting ACEs from existing higher education institutions that have the capacity and potential to address the selected priority sectors;
- Strengthening these specialized ACEs to produce excellent training and applied research;

- Building networks among the ACEs to promote regional collaboration with other institutions and the industry to produce innovative solutions with real impact;
- Developing a culture of results-orientation and accountability through an exemplary performance-based financing mechanism.

## How are the Centers Selected?

A rigorous, competitive and transparent process marked the selection of the centers financed under the ACE II project. A call for proposals preceded an independent, two-step evaluation, which included a technical review as well as an onsite and leadership assessment. Out of the 92 eligible proposals submitted, 24 were selected from eight countries – Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, and Zambia (See Tables 1 & 2 for a full list by center name, cluster and country). The selection criteria included: (a) addressing a specific challenge in one of the five priority areas in the region – industry, agriculture, health, education and applied statistics; (b)

high proposal quality; (c) institutional capacity; (d) providing geographical balance; and (e) eligibility and availability for IDA funding. The selected ACEs also underwent financial management, procurement and safeguards assessments.

## What are the ACEs Expected to Achieve?

Each of the selected 24 specialized regional centers will receive funding up to US\$6 million and is expected to perform the following tasks:

- Build institutional capacity to provide quality post-graduate education and conduct high quality applied research, both relevant to key development challenges/priorities;
- Develop and enhance partnerships with national, regional and international academic institutions, as well as industry and the private sector to pursue academic excellence and greater impact;
- Improve institutional governance and management and set up a role model for other higher education institutions;

### Box 1: How will ACE II Contribute to the Priority Sectors?

Below two examples illustrate the potential impact of the ACEs.

**ACE in Energy for Sustainable Development, University of Rwanda, Rwanda:** This center will promote regional post-graduate specialization in micro-grid energy systems and energy management (trade and policy) for the region's sustainable development. Its expected outputs under the project include: international accreditation for at least one new specialized graduate program; enrolling 40 PhDs and 120 Masters' students, of which 30 percent would be regional; and establishing a state-of-the-art micro-grid research laboratory and a high performance energy computing unit. The center will also work with the private sector for curriculum development, student internships, and manufacturing of components for its micro grids systems.

**African Railway Education and Research Institute, Addis Ababa University, Ethiopia:** This center will focus on developing modern railway research and professionals capable of designing, building, operating, maintaining and managing regional railway systems. It will offer Masters programs in Rolling Stock Engineering, Electrical Engineering for Railway Systems, Railway Civil Engineering, and Railway Systems Management. It will also design a railway PhD program, and work with private sector, such as the Ethiopian Railways Corp., to provide student internships and trainings. It aims to produce at least 25 PhDs and 250 MSc graduates – of which 20 percent will be regional.

**Table 1: Distribution of Selected ACEs by Country and Cluster**

Country	Industry	Agriculture	Health	Education	Statistics	Total
Ethiopia	2	1	1			4
Kenya	1	2				3
Malawi		1	1			2
Mozambique	1					1
Rwanda	2			1	1	4
Tanzania	1	2	1			4
Uganda	1	2	1			4
Zambia	1		1			2
<b>Total</b>	<b>9</b>	<b>8</b>	<b>5</b>	<b>1</b>	<b>1</b>	<b>24</b>

Over the project's five-year duration, these ACEs plan to achieve the following measurable results:

- Enrolment of over 3,500 graduate students in priority sectors, of which over 700 will be PhD students and more than 1,000 will be female;
- Publish almost 1,500 journal articles and launch over 300 research collaborations with private sector and other institutions;
- Generate almost US\$30 million in external revenue.

Each ACE will have the autonomy to implement its own proposals with support from its host university, government, and a regional facilitation unit housed at the Inter-University Council for East Africa (IUCEA). All host universities will be urged to join a new regional benchmarking initiative to improve their programs' quality, in association with the World Bank-facilitated Partnership for skills in Applied Sciences, Engineering and Technology (PASET).

## Who Benefits from ACE II?

- **The students** in the participating universities and their partner institutions across ESA stand to gain the most from strengthening of higher education and training in regional priority areas;
- **Employers** in priority sectors, and government and non-governmental organizations will gain access to highly skilled personnel and top quality applied research to improve productivity.

■ **Communities** around which the ACEs reside will benefit from improved educational and research outreach of the ACEs, particularly to school students.

■ **Faculty and staff** in the ACEs will benefit from improved teaching and research conditions and professional development opportunities. Faculty and staff in STEM and related disciplines will also benefit from exchange visits and collaborative teaching and research.

■ **Regional institutions** such as Africa's Regional Economic Communities will gain better quality input from the improved ACEs.

■ **ACE hosting universities** will benefit from the strengthened capacity of their ACEs, and quality improvement measures such as regional benchmarking with other institutions.

■ Many higher education projects focus on improving the overall sector, but pay little attention to the needs of the employers that need the most research, innovation, and skills. This can lead to large outputs of unemployed graduates who are not aligned with market needs. ACE II focuses on not just quantity, but quality and relevance in the graduate pool for the region's priority sectors.

■ This project values regional ownership and linking the achievement of results with rewards, as opposed to just providing generic inputs to universities. It does so by linking its funding disbursements with incremental results throughout the project. Modern development discourse and evidence suggest that results-based approaches that focus on achieving mutually agreed targets yield greater ownership and outcomes. ACE II requires institutions to prepare and implement their own proposals and align them with national, regional, and industrial expectations. It will then reward them for achieving set targets as they move forward. For example, to encourage the ACEs' hosting universities to provide a supportive quality improvement environment for the centers, one of the project's disbursement-linked indicators rewards them if they participate in regional benchmarking.

## What Makes ACE II Different?

- ACE II's regional approach sets it apart from country-focused initiatives, which may rely on a limited pool of resources and have smaller scope and longer implementation timelines for what they want to achieve. ACE II capitalizes upon individual strengths of existing higher education institutions across ESA, tapping into them to produce a collective, efficient solution for the entire region's human capital and research needs.

- ACE II incorporates many important lessons from past regional projects, such as a simple design confined to only five priority cluster areas, manageable scope, common regional interest, cooperation from regional institutions, attention to implementation capacity among participants, and adequate allocation of resources for both preparation and implementation phases.

**Table 2: Selected ACEs and their Universities under ACE II (by Cluster)**

<b>INDUSTRY</b>		
ACE for Water Management	Addis Ababa University	Ethiopia
African Railway Education & Research Institute		
Center of Studies in Oil and Gas Engineering and Technology	Universidade Eduardo Mondlane	Mozambique
Center of Excellence in Phytochemicals, Textiles & Renewable Energy	Moi University	Kenya
ACE for Energy for Sustainable Development	University of Rwanda-College of Science & Technology	Rwanda
ACE in Internet of Things		
Water Infrastructure & Sustainable Energy Center for the Future	Nelson Mandela African Institution of Science & Technology	Tanzania
Center of Materials, Product Development and Nanotechnology	Makerere University	Uganda
Africa Center of Excellence for Sustainable Mining	Copperbelt University	Zambia
<b>AGRICULTURE</b>		
Center of Excellence in Sustainable Agriculture & Agribusiness Management	Egerton University	Kenya
ACE for Climate Smart Agriculture and Biodiversity Conservation	Haramaya University	Ethiopia
ACE for Aquaculture and Fisheries Science	Lilongwe University of Agriculture & Natural Resources	Malawi
Collaborating Center for Research, Evidence, Agricultural Advancement and Teaching Excellence & Sustainability	Nelson Mandela African Institution of Science & Technology	Tanzania
Center of Excellence in Sustainable Use of Insects as Food and Feeds	Jaramogi Oginga Odinga University of Science & Technology	Kenya
ACE for Innovative Rodent Pest Management & Biosensor Technology Development	Sokoine University of Agriculture	Tanzania
Center for Crop Improvement	Makerere University	Uganda
African Center for Agro-Ecology & Livelihood Systems	Uganda Martyrs University	Uganda
<b>HEALTH</b>		
ACE for Public Health and Herbal Medicine	University of Malawi College of Medicine	Malawi
Center for Innovative Drug Development & Therapeutic Trials for Africa	Addis Ababa University	Ethiopia
Southern African Center for Infectious Disease Surveillance	Sokoine University of Agriculture	Tanzania
Pharm-Biotechnology and Traditional Medicine Center	Mbarara University of Science & Technology	Uganda
African Center for Excellence for Infectious Diseases of Humans & Animals	University of Zambia	Zambia
<b>EDUCATION</b>		
ACE for Innovative Teaching & Learning Mathematics and Science	University of Rwanda-College of Education	Rwanda
<b>STATISTICS</b>		
African Center of Excellence for Data Sciences	University of Rwanda - College of Business & Economics	Rwanda

For more information and the latest progress, please visit <http://www.ace2.iucea.org> or <http://www.worldbank.org/projects/P151847?lang=en>.