2015 Baseline Survey of Engineering Departments Report

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Hotel InterContinental, Nairobi

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What is Our Agenda

- What was the Rationale for the Survey?
- How Did We Collect the Data?
  - KENET data collection and analysis system
  - Challenges and lessons
  - Institutional ERPs and databases on departmental academic and research outputs
- What is New Data in the Baseline Report?
  - Faculty numbers and qualifications
  - Graduation rates at Bachelors, Masters and Doctoral levels
  - Institutional budgets for engineering departments
  - Research and innovation outputs of engineering departments
- Conclusions, Recommendations and Policy Implications

Rationale for the Baseline Survey of Engineering Departments

- KENET is the National Research and Education Network (NREN) of Kenya
  - *Employs graduate electrical engineers who build and operate the national broadband network and data centers*
- KENET 's Strategic Plan 2011-2016 Focus on five STEM academic areas
  - *Engineering, computer science/information systems, medicine, agriculture, educational technology*
  - *SIGs in engineering education and in educational technology are operational*
- 2014 IEEE Conference on the Future of Engineering Education in Kenya
  - Recognized lack of *Open National Baseline Data* on the State of Engineering Education and Research
- E-readiness Survey Research Series since 2006, recognized lack of open university education data to inform policy and strategy
  - KENET is a member of higher education data committee of CUE
- KENET needed to discover engineering faculty and research champions for global collaboration and access to advanced e-infrastructures

- Data shall create some dissatisfaction (or discomfort) and trigger change!

What will trigger change and transformation in engineering education in Kenya?

Happiness Index	Why Change?
H = A / E	C = D x V x S

Happiness

Achievements

Expectations

Change

Dissatisfactio n

Vision

Strategy

(steps)

Who is dissatisfied with the state of engineering education and research?

KENET as the NREN of KE

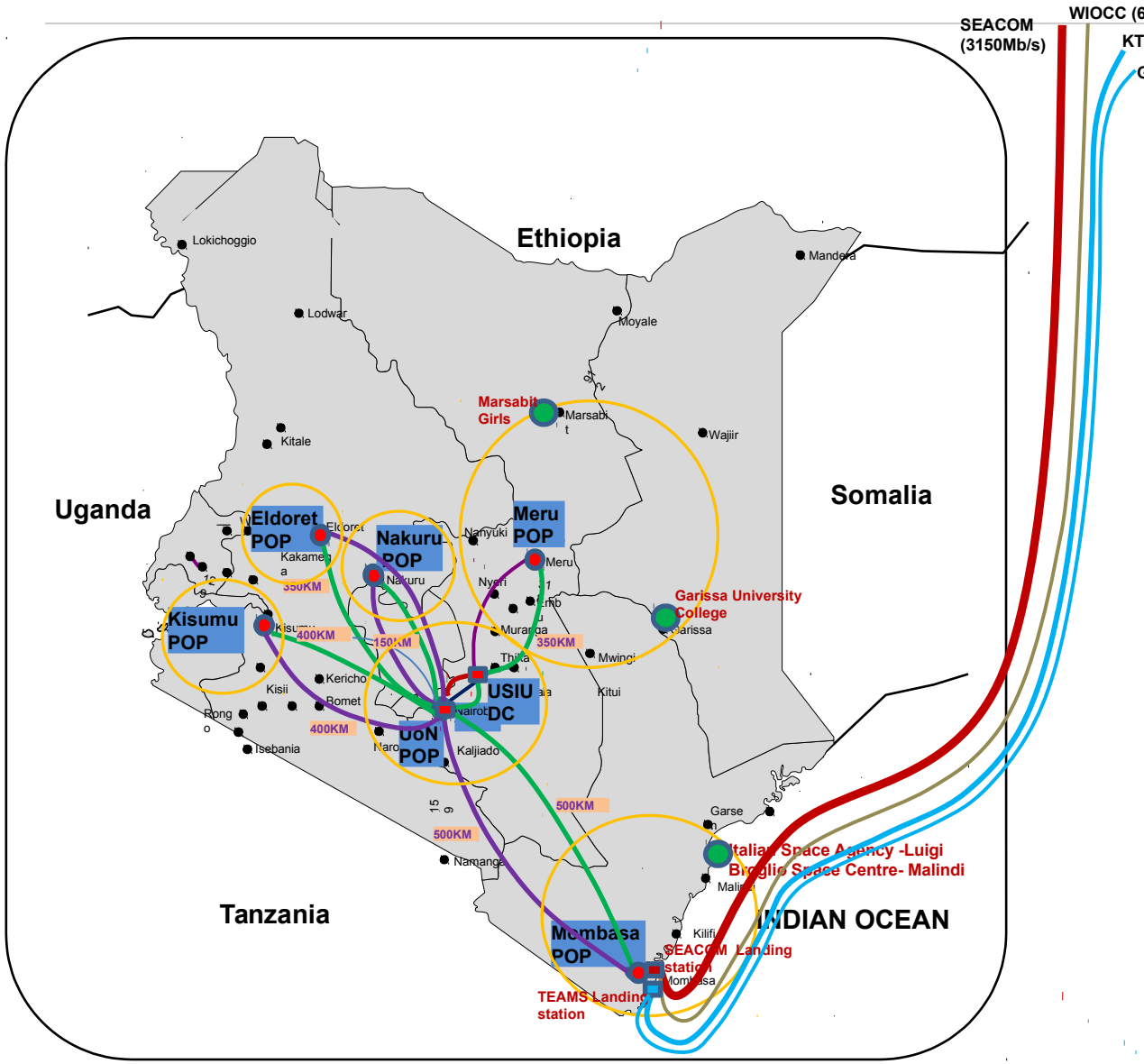
- **Catalyst for transformation of education and research using ICT**
  - Discovers and supports research and innovation champions
  - Offers up to 10 travel grants per year to faculty researchers or post-graduate students in STEM areas
  - Sponsors innovative research projects using Mini-grants of $10,000 per University faculty team (see http://raspberry.kenet.or.ke)
  - Organizes forums of faculty in different areas (e.g., engineering faculty forum in 2015)

- **Regularly Conducts E-readiness Survey of Connected Universities**
  - *2006, 2008, 2013 and 2015 (see http://ereadiness.kenet.or.ke)*
  - *Data-driven advocacy and influencing ICT strategies to increase use of ICT in education and research*

- **Collects Annual Data on Enrollment of Connected Higher Education Institutions**
  - 2015 data collected for 57 universities / university colleges connected to KENET

- **Builds advanced research infrastructures** and community in different areas
  - Africa Science Gateway and federated services (KENET CA, iDP, EDUROAM)
  - The first NREN in Africa to have a Certification Authority (CA) accredited by EUGRDPMA allowing Kenyan researchers access global e-infrastructures for FREE!
- **New Initiative to start measuring research collaboration and productivity of Kenyan universities and research institutes**
  - Will be using research intelligence tool from Elsevier SciVal to prepare research advocacy reports

KENET National Broadband Network Coverage



POP	No. of Campuses Connected	No of Schools connected
Nairobi POP	100	146
Kisumu POP	20	1
Mombasa POP	16	0
Eldoret POP	22	0
Nakuru POP	17	0
Meru POP	15	1
Total Campuses connected	**190**	**148**

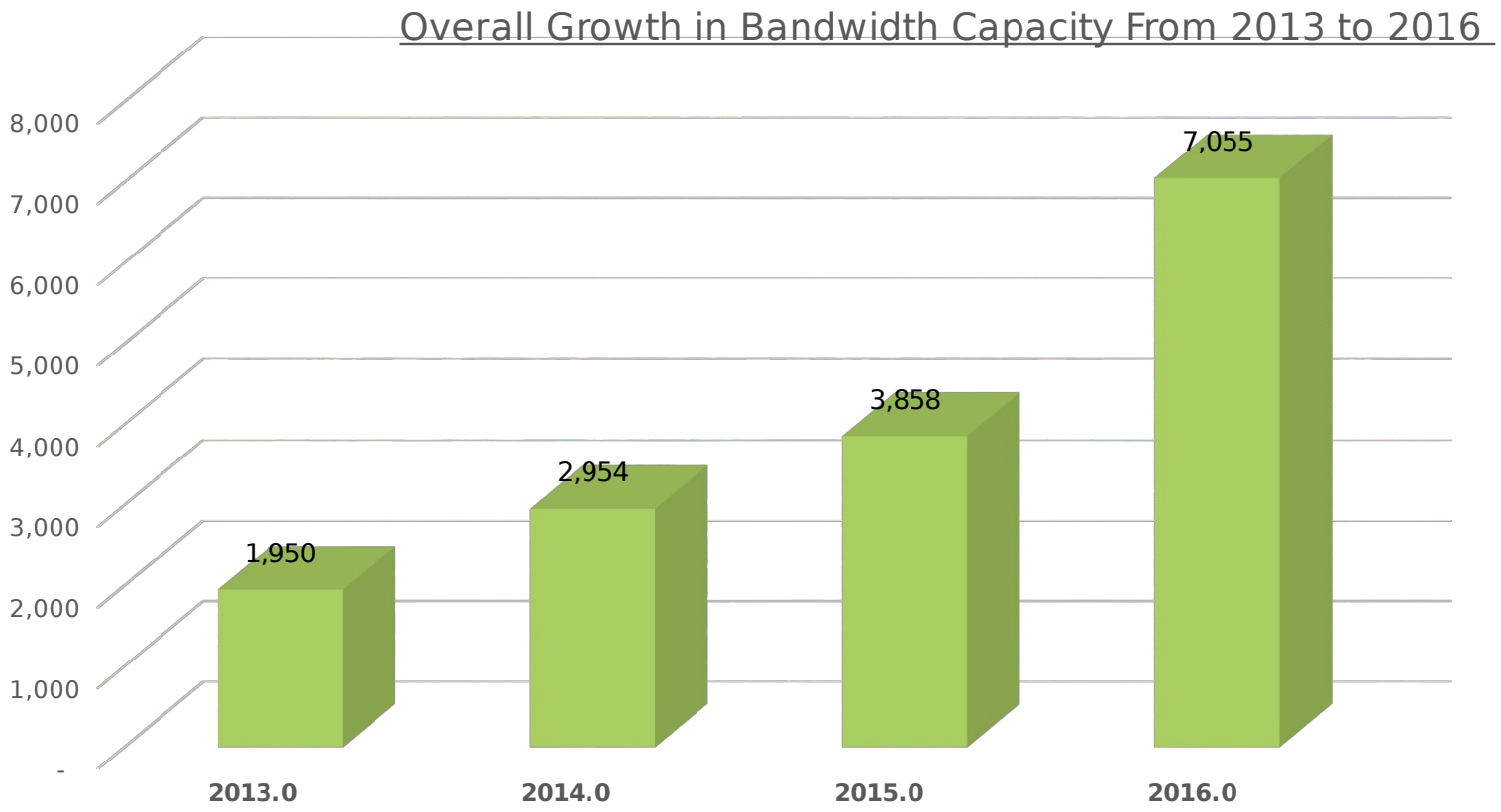
- NOFBI Distance- 856KM
- KENET Owned Last Mile Fiber – 188KM
- KENET Core Ring Fiber Network – 110KM
- Access Fiber Spurs – 30KM
- **Total KENET Owned fiber – 1084KM**
- **Connected Schools classified as follows;**

✓ KENET/Wananchi Partnership schools – 144 (all in Nairobi)

✓ KENET Schools – 4 (Alliance schools, Kisii and Marsabit Girls)

Growth in Internet Bandwidth (Mb/s)

(3.6x growth from Jan 2013 to Jan 2016)



How Did We Collect the Data?

KENET Seeks Permission of Vice Chancellors to Collect Data

Analog Data Collection and Data Entry over 14 months

- **Permission to collect data granted by Vice Chancellors**
- **Directed Detailed Questionnaires**
  - *One Research assistant per campus / university (junior ICT or engineering faculty) collects data from head of department*
- **Phase 1 – November 2014 – April 2015**
  - Printed questionnaires delivered by courier to department heads
  - Data even on enrolment NOT easily available
  - Completed questionnaires delivered back to KENET by Courier
- **Data Entry, Data Cleaning, Analysis and Draft Report (May – August 2015)**
  - **Data entry at KENET by statistician and student assistants**
  - **Engineering forum of heads of engineering departments and deans in October 2015 recommends data validation**
- ***Data Validated – November 2015 – January 2016***
  - ***Data more complete but still missing data on research output and departmental budgets!***
- ***SIG on engineering education and KENET network of engineering department heads essential for data cleaning***

Challenges and Lessons

- **Directed Detailed Questionnaires**
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Highlights of Engineering Baseline Survey Results

How many departments / degree programs?

- **12 Universities offering engineering degree programs**
- **44 departments and 54 unique degree programs**
- **All departments / degree programs classified as:**
  - **CSE – Civil and Structural Engineering programs (10 departments)**
  - **EEE – Electrical and electronics engineering (13 departments**
  - **MME – Mechanical and mechatronics engineering programs (includes agricultural engineering) = 21 departments**
- **MME has the widest range of degree programs and departments (not sure why?)**

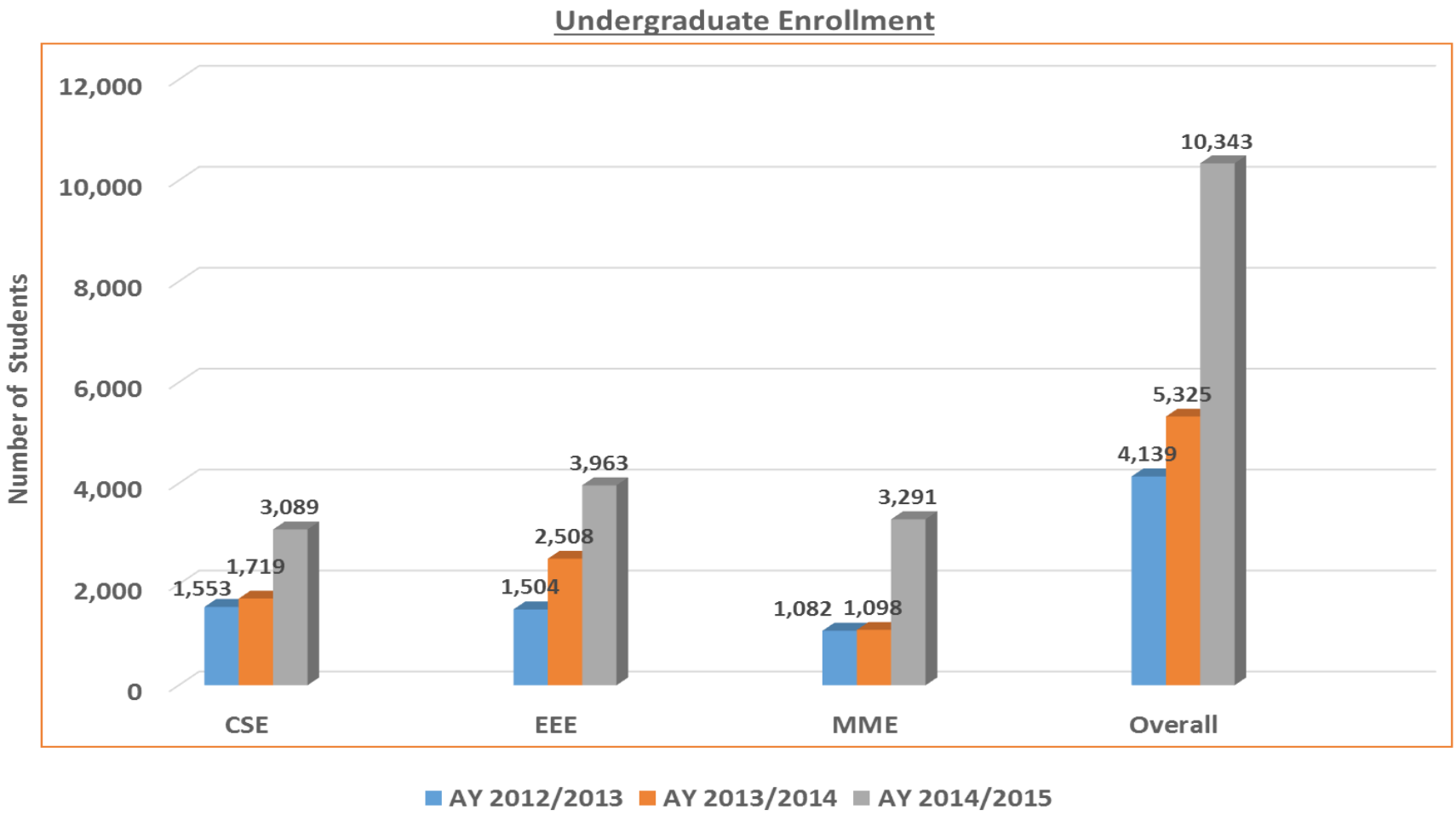
Enrolment in 12 Universities

	University	Number of departments	Total enrollment AY 2014/2015
1	Dedan Kimathi University	4	534
2	Egerton University	4	428
3	Jomo Kenyatta University of Agriculture and Technology	6	2,844
4	Kenyatta University	5	1,163
5	Masinde Muliro University of Science and Technology	3	149
6	Meru University of Science and Technology	1	90
7	Moi University	5	1,211
8	Multimedia University of Kenya	1	65
9	Technical University of Kenya	4	1,765
10	Technical University of Mombasa	4	226
11	University of Eldoret	3	70
12	University of Nairobi	4	1,798
	Total	44	10,343

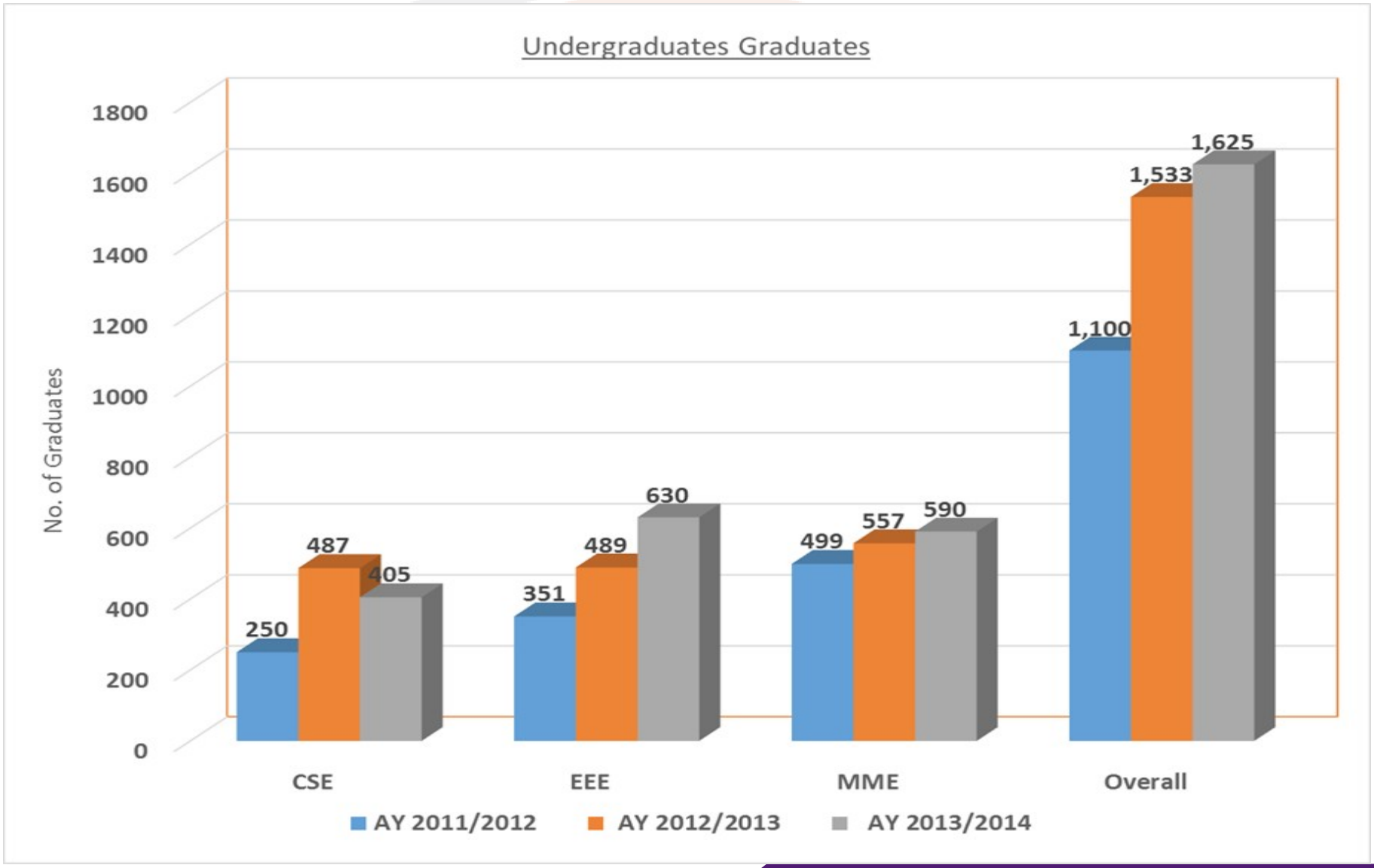
UG Student Enrolment over 3 years

Department	2012/2013	2013/2014	2014/2015	Number of Depts
Civil and structural engineering (CSE)	1,553	1,719	3,089	10
Electrical and electronics engineering (EEE)	1,504	2,508	3,963	13
Mechanical and mechatronic engineering (MME)	1,082	1,098	3,291	21
Total	4,139	5,325	10,343	44

UG Eng. Student Enrolment
(AY 2012/2013 – AY 2014/2015)



UG Eng. Graduates (3 AYs



Faculty availability in Kenya

Department name	Total full-time faculty	Total part-time faculty	Full-time faculty with PhD	UG Student enrolment AY 2014/2015	Full-time Faculty-to-student ratio
CSE	142	56	53	3089	22
EEE	150	110	51	3963	26
MME	211	70	89	3291	16
Overall	**503**	**236**	**193**	**10,343**	21

Are they enough?

Where are the eng. lecturers?

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	University	Full-time faculty (excluding tutorial fellows)	Part-time faculty	Full-time faculty with PhDs
1	Dedan Kimathi University	37	19	8
2	Egerton University	42	10	6
3	Jomo Kenyatta University of Agriculture and Technology	118	4	46
4	Kenyatta University	35	55	15
5	Masinde Muliro University of Science and Technology	32	16	15
6	Meru University of Science and Technology	7	15	2
7	Moi University	56	8	31
8	Multimedia University of Kenya	19	17	2
9	Technical University of Kenya	36	46	13
10	Technical University of Mombasa	45	28	9
11	University of Eldoret	13	18	2
12	University of Nairobi	63	0	44
	Total	503	236	193

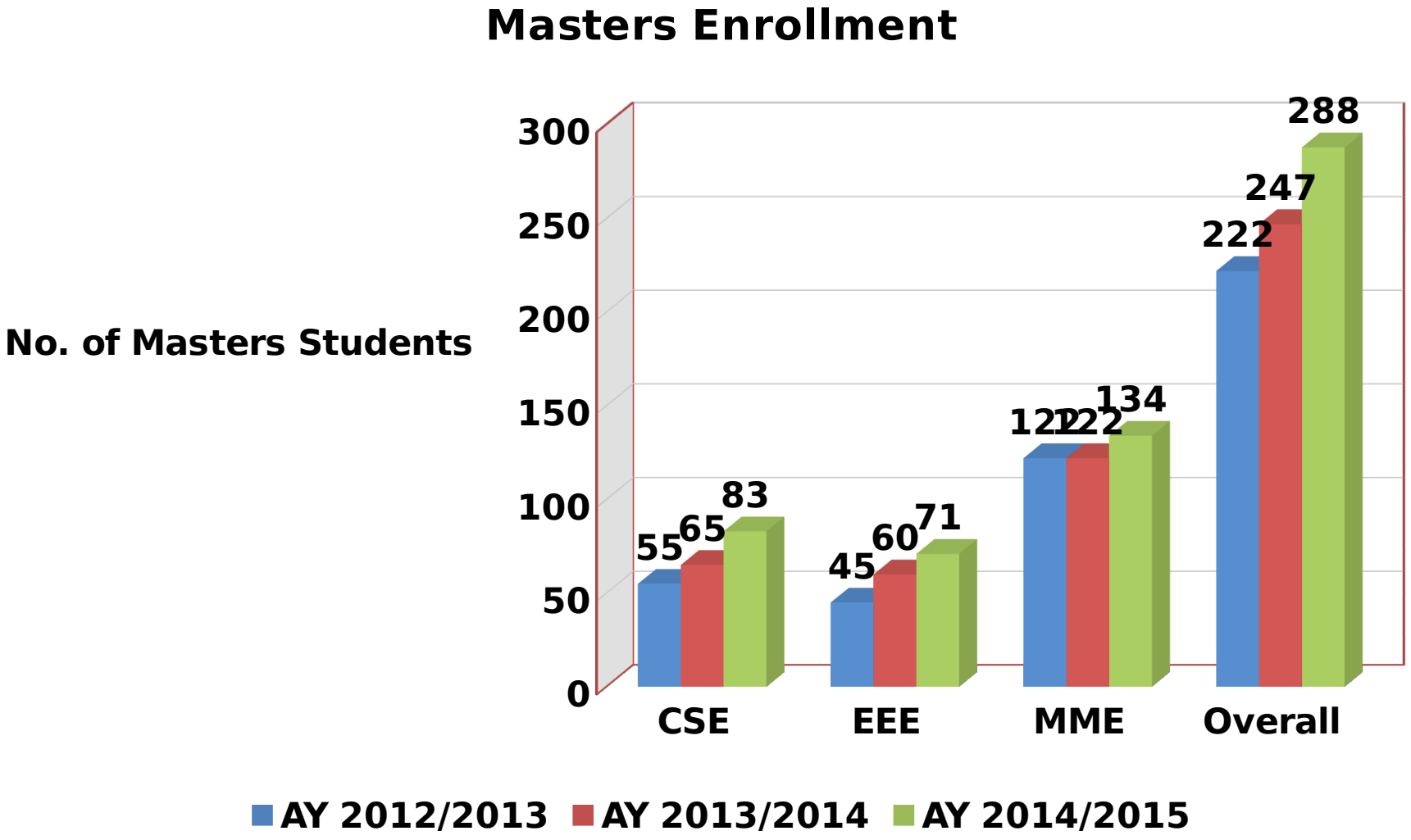
3% of lecturers with PhD degrees at UoN, JKUAT and Moi

Aggregate Faculty and Faculty Ratios

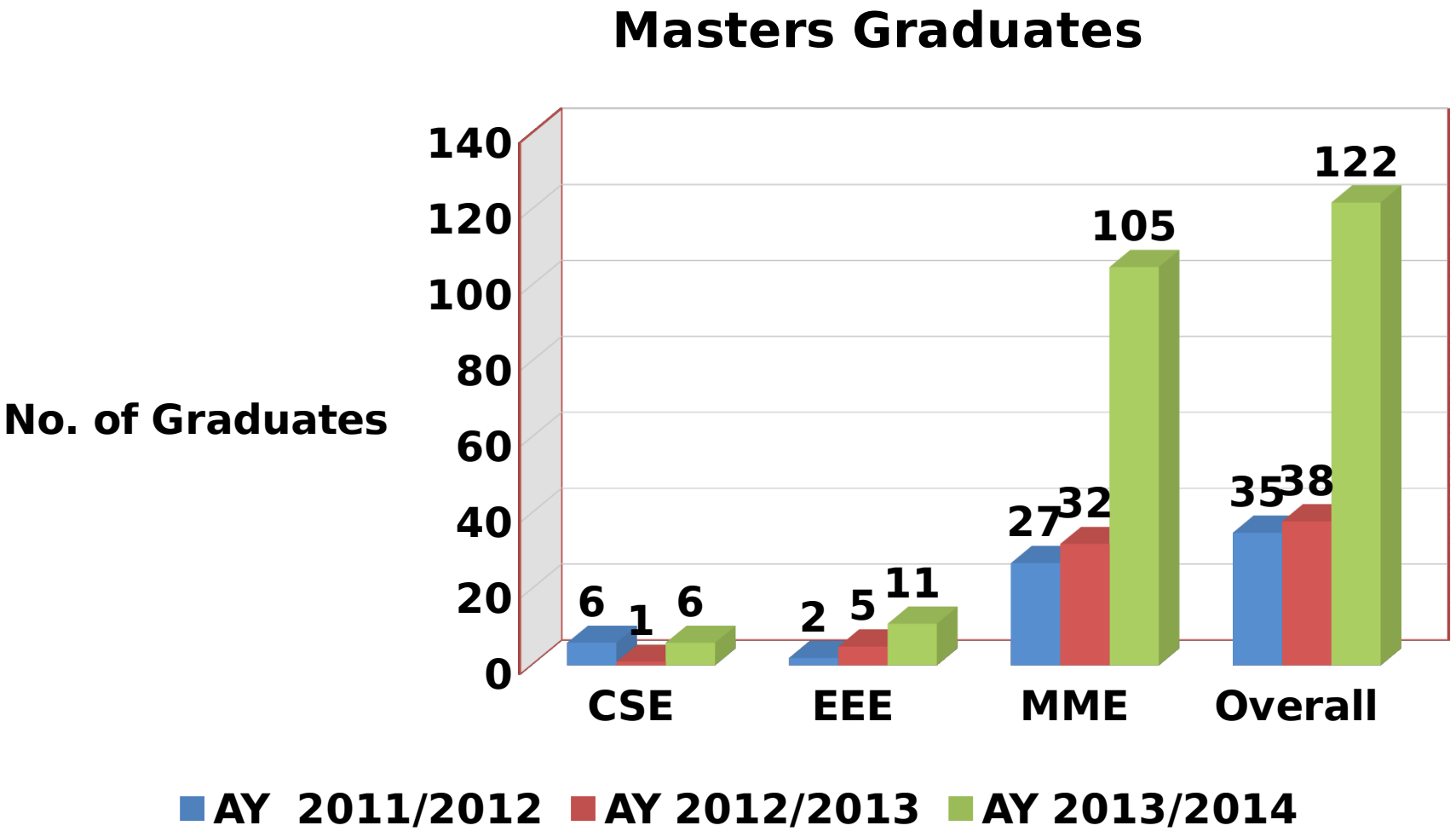
Department name	Total full-time faculty	Total part-time faculty	Full-time faculty with PhD	Undergraduate Student enrollment AY 2014/2015	Full-time Faculty to student ratio
CSE	142	56	53	3089	22
EEE	150	110	51	3963	26
MME	211	70	89	3291	16
Overall	503	236	193	10,343	21

There no shortage of engineering faculty or faculty with PhDs!

MSc degree enrolment trends

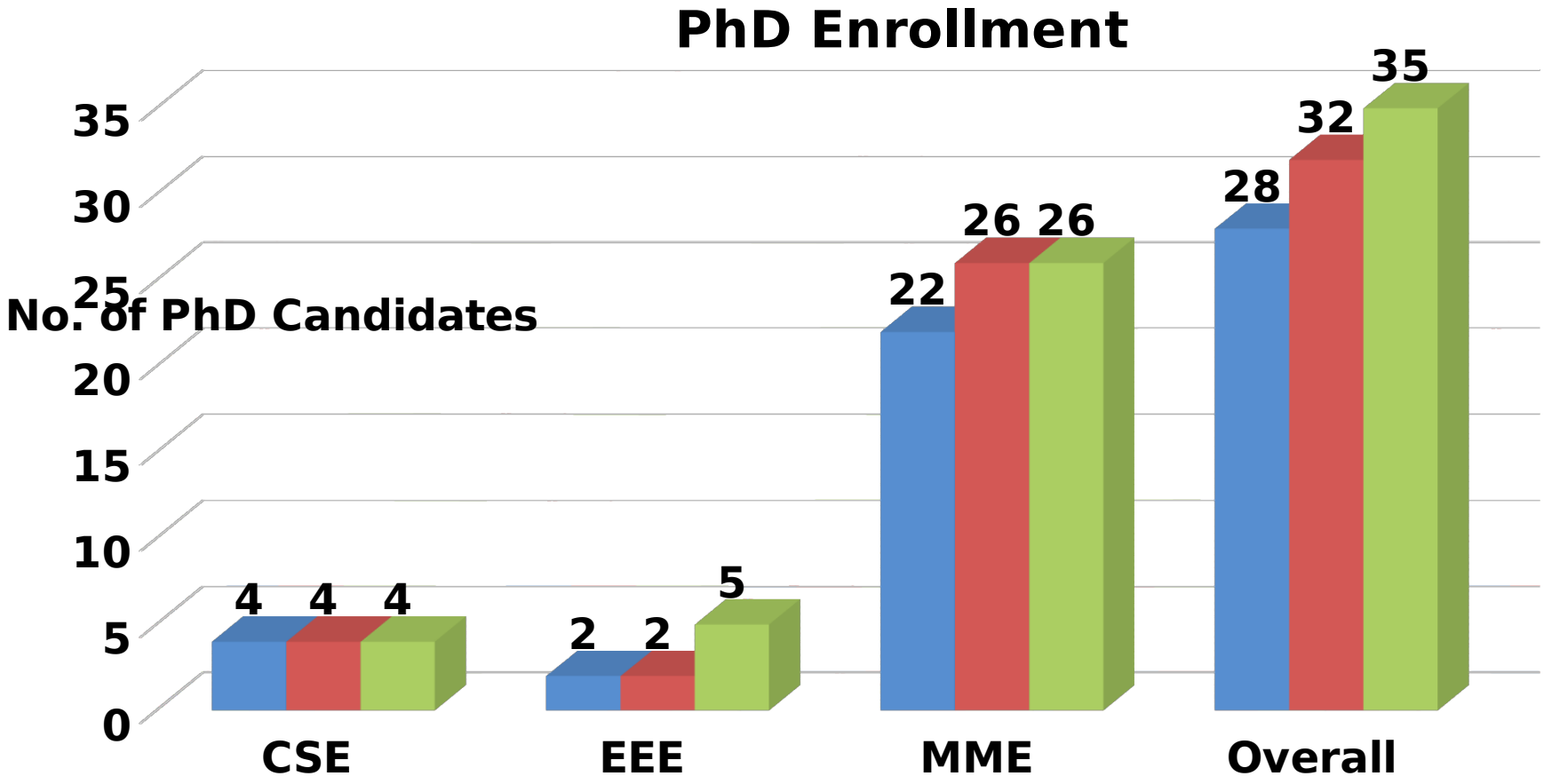


Masters Graduates (3 AYs)



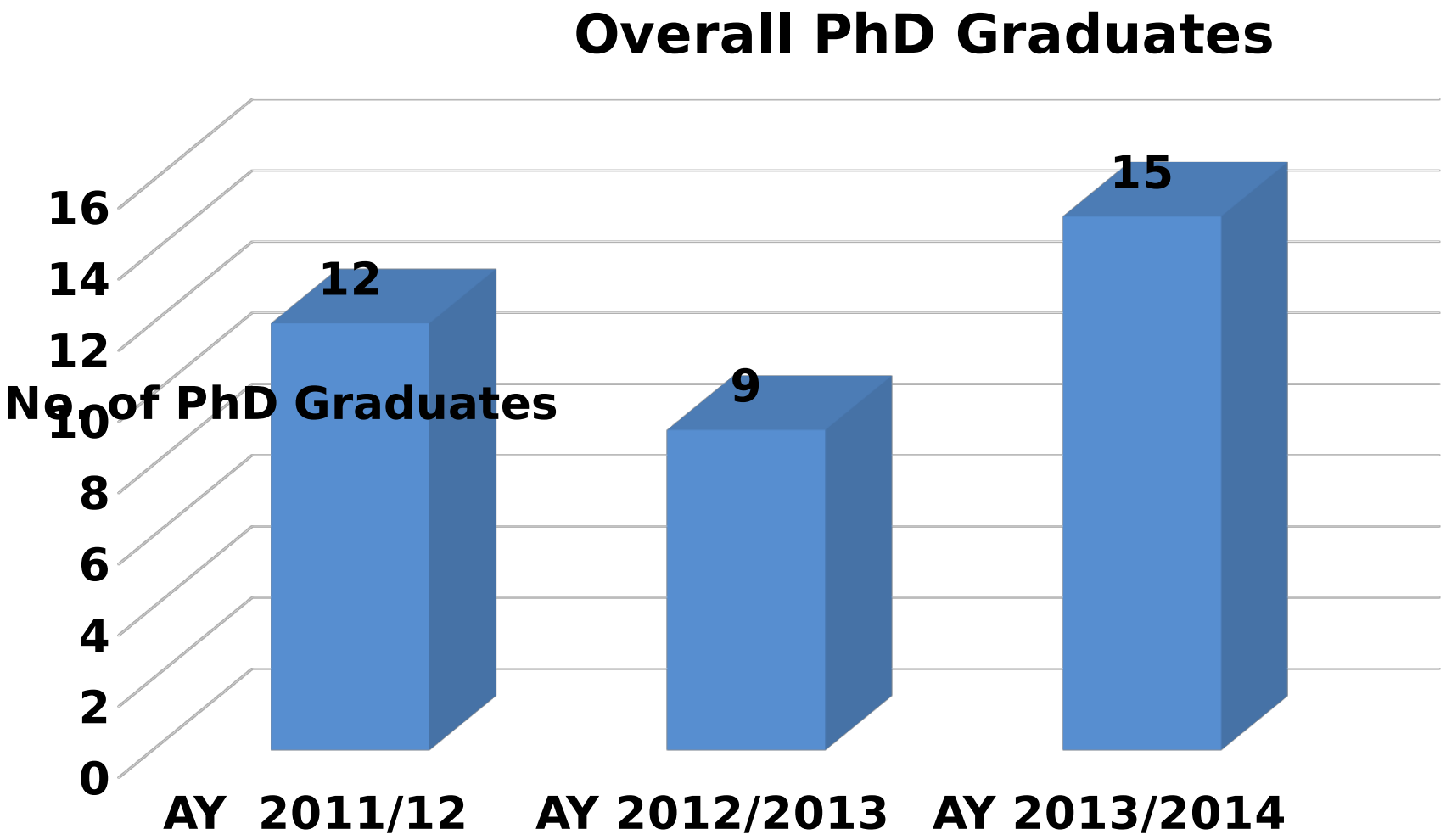
ny are most graduate students in MME degree programs?

PhD Enrollment (3 AYs)



Why are most are in MME degree programs

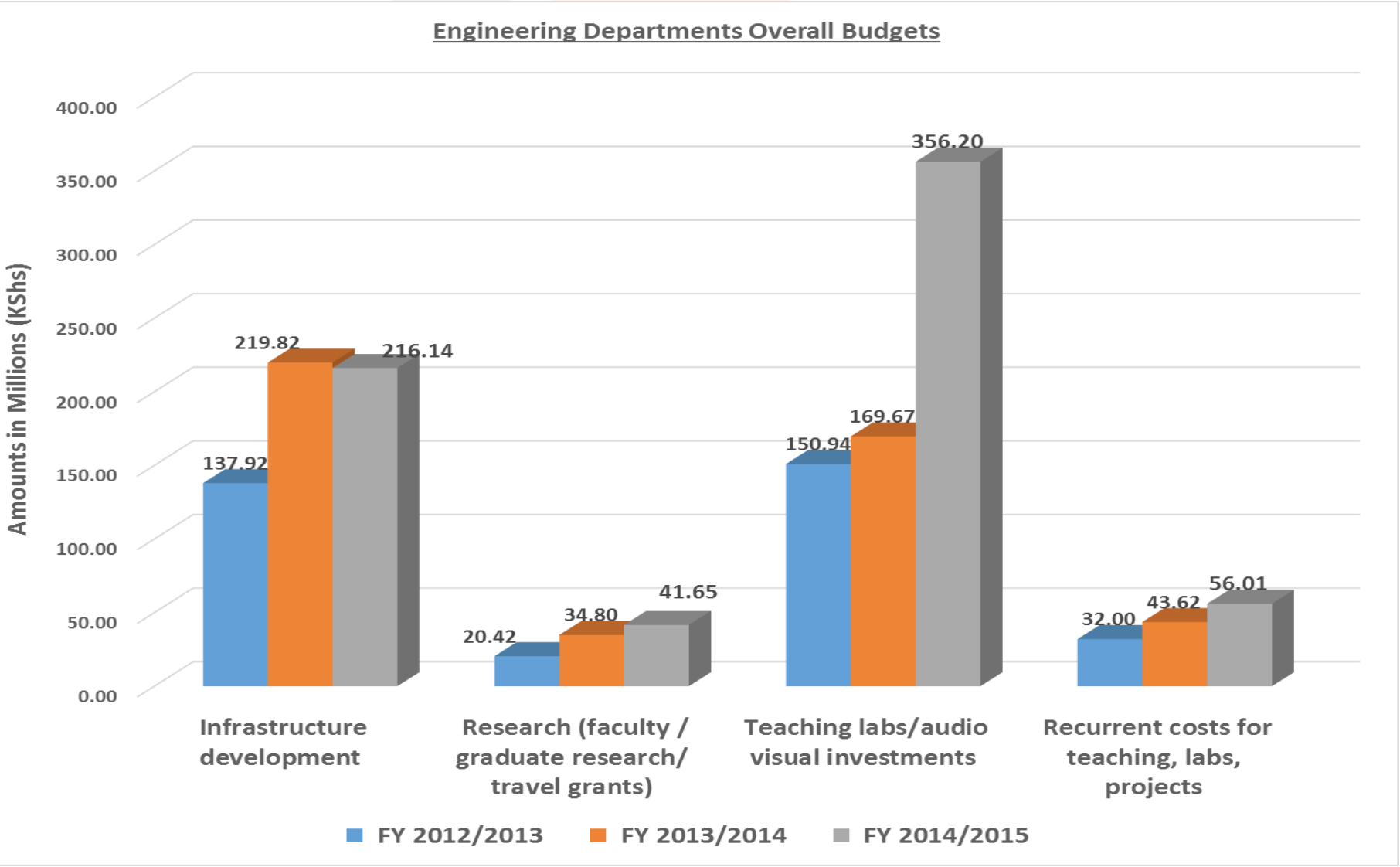
PhD graduates (3 AYs)



Graduates at Post-graduate levels & faculty publications

- **195 Masters graduates over 3 years (AY 2011/2012 to AY 2013/2014)**
- **36 PhD graduates in engineering over 3 years**
  - **50% in Agricultural engineering**
  - **Egerton, JKUAT and UoN**
- **0.4, 0.6, 0.7 papers per faculty per year in EEE, CSE and MME areas!**

Institutional budget allocations



Faculty Remuneration – Are universities attracting young faculty?

Faculty rank	Average gross salary (including all monthly allowances) (KSh)	Maximum gross salary (including all monthly allowances) (KSh)	Comparable network engineers ranks	50th percentile PWC salary (Ksh)
a)Tutorial fellow	89,259	152,411	Assistant network engineer	120,076
b)Assistant lecturer	94,032	152,411	Network engineer	254,713
c)Lecturer	114,566	210,000	Senior engineer	354,095
d)Senior lecturer	131,358	288,200	Senior engineer	354,095
e)Associate professor	161,338	310,000	Chief technical officer	646,105

payment non-practicing allowance a solution?

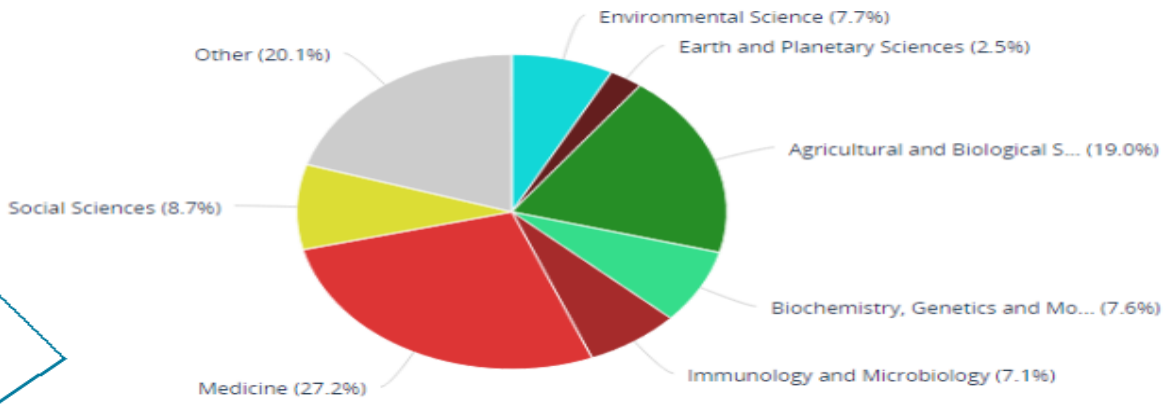
How about the external view? - Elsevier's Scival

- **Six Universities visible as offering engineering degree programs**
- **36 PhD graduates in engineering over same period**
  - **50% in Agricultural engineering**
  - **Egerton, JKUAT and UoN**
- **0.4, 0.6, 0.7 papers per faculty per year in EEE, CSE and MME areas!**

Research output of medicine, engineering & ICT disciplines

Leading discipline in Kenya 2010-2015

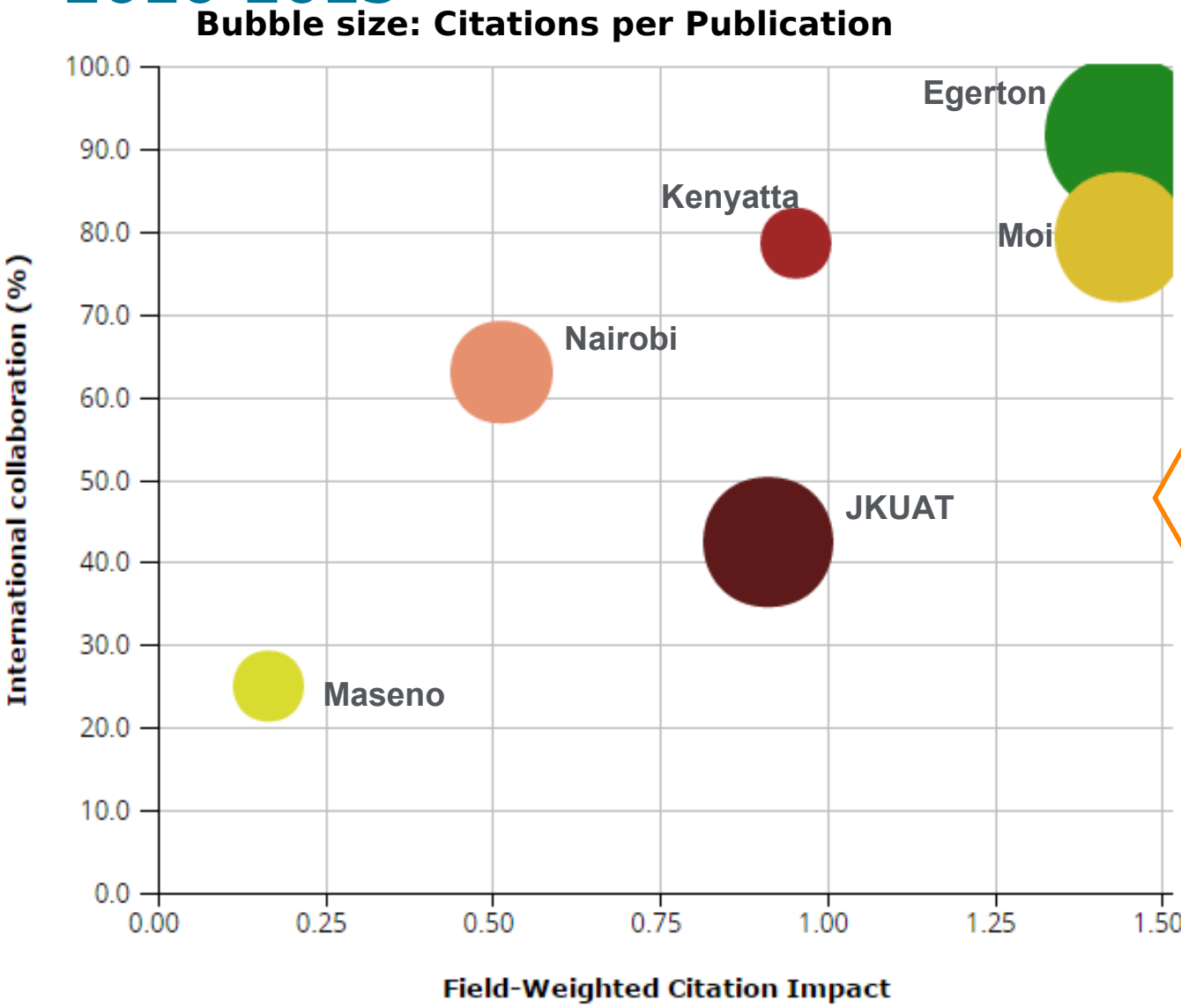
Medicine is the leading discipline in Kenya based on publication counts; and has a Field-weighted Citation Impact of 103% more than world average. The citation impact of Engineering and Computer Science is 3% below world average



Discipline	Publications	Citations	Authors	FWCI
Medicine	5,148	51,062	5,387	2.03
Engineering	339	770	511	0.97
Computer Science	32	310	314	0.97

Source: SciVal

Universities performance in Engineering 2010-2015



Egerton has highest international collaboration; highest Field-weighted Citation Impact and most citations per publications

Source: SciVal

Conclusions

- **The 503 full-time faculty appear adequate for the 10,343 UG students in AY 2014/2015**
  - **But they are spread over 44 departments, teaching 54 degree programs**
  - **59% of the 10,343 enrolled in EBK accredited engineering program**
- **Engineering faculty publications are low at between 0.4 and 1.1 per faculty per year (confirmation with SciVal or in comparison to Medicine)**
  - **It has to do with research funding / reward system?**
  - **Low enrollment at post-graduate levels and low graduation rates at PhD**
- **No evidence that universities are committing adequate resources to engineering departments – *invest in data infrastructures***
  - **Most of heads of departments did not know their budgets!**
- **University ERPs and databases do not appear to be**

Recommendations

1. **Reduce the number of degree programs and departments to ensure critical mass of faculty in each degree program**
2. **Implement an incentive mechanism for Eng. Faculty e.g. Payment of non-practicing allowance OR implement differential pay for critical disciplines to achieve V2030 e.g. Eng – to attract young engineers into universities and retain them**
3. **Improve faculty motivation, working environments, remuneration, research grants, travel grants and scholarships for Masters and PhD students by Universities and GoK**
   - **It is NOT about lack of equipment!**
4. **Conduct detailed demand-side study for**

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Transforming education using ICT

Thank You

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