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Engineering Education
The Challenges and Benefits Beyond 2010

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PHEE/PHOMME Conference
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Engineering

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… is exciting, creative and rewarding…..

BUT

The major challenge in the UK is instilling interest and enthusiasm in young people under the age of 16

STEM Education Then and Now

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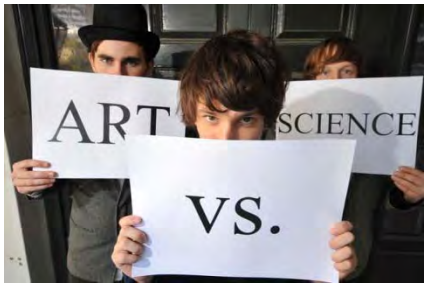
Promotion of Engineering

- Royal Academy of Engineering
- The engineering institutions and organisations
- Engineering UK
- Engineering Council
- Engineering Professors Council
- WISE
- SEMTA sector skills council
- EDT run schemes to motivate 11 – 21-year-olds to choose engineering careers such as the Engineering Education Scheme
- The Big Bang – UK Young Scientists and Engineers Fair
  - » 2010 – very successful Manchester event
  - » 2011 London's ExCel Centre, the date, 10-12 March

Challenges for Engineering Education

- **Seen as difficult subject by school children so variation in recruitment**
- **A decline in practical experiments in schools because of change of emphasis on curricula and Health and Safety issues**
- **University engineering requires a reasonable standard in mathematics**
- **Does not have a good perception with female students so low uptake**
  - **c5 – 15% females in most engineering courses**



How Can We Address This?

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The Dyson View:

- **Focus on great teachers and great curricula in schools and colleges**
- **Improve quality of careers advice to all students and school pupils with data on the average salaries following graduation**
- **Offering industrial scholarships to increase the attractiveness of engineering courses over others**
- **Target an enhanced postgraduate fellowship at doctoral students who currently receive an annual stipend of £13,290 from EPSRC**
- **Ensure that routes remain open for the best overseas STEM students to stay in the UK, such as the Post Study Work Route**
- **University courses providing real industry experience so students gain hands-on experience of the technologies used by industry**

Source: Ingenious Britain Making the UK the leading high tech exporter in Europe. A report by James Dyson March 2010

Routes to Engineering Education

- In the UK, as in United States and Canada, most professional engineers are trained in universities
- Some can start in a technical apprenticeship (4–5 years) prior to enrolling in a university engineering degree or Foundation Deg'
- Those unable to attend university can enrol in the Engineering Council UK examination program administered by the City and Guilds of London Institute
- Professional Institutes accredit degree programmes from the perspective of UK Engineering Council registration and routes to CEng, IEng, EngTech and ICTTech

City & Guilds

uk ec

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Universities and Engineering Education

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- **UK Government says it will support Engineering (STEM) and fund it differentially with respect to Arts, Humanities and Social Sciences**
- **Engineering and technology are the most popular subjects at universities for international students, with around 24% coming from outside the EU in 2007/08**
- **Postgraduate education offers a significant route to industry, as well as producing the next generation of lecturers and researchers**
- **Jobs widely available for good graduates from recognised courses**
- **Engineers can be amongst the best paid when employed in companies that value them – see IET salary survey for examples**
- **Enhanced university/industry partnerships support experience-led engineering**

Challenges for Engineering Education

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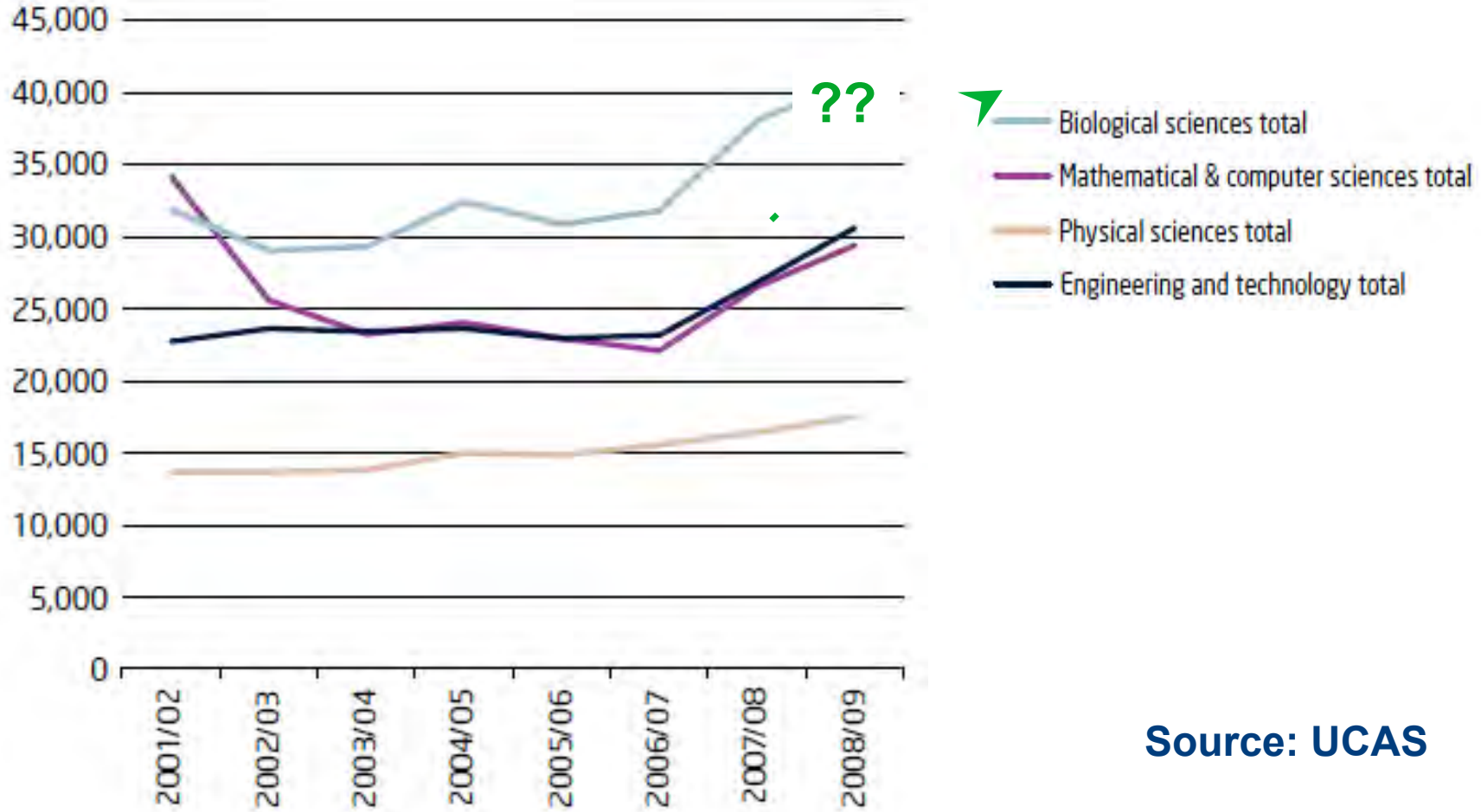
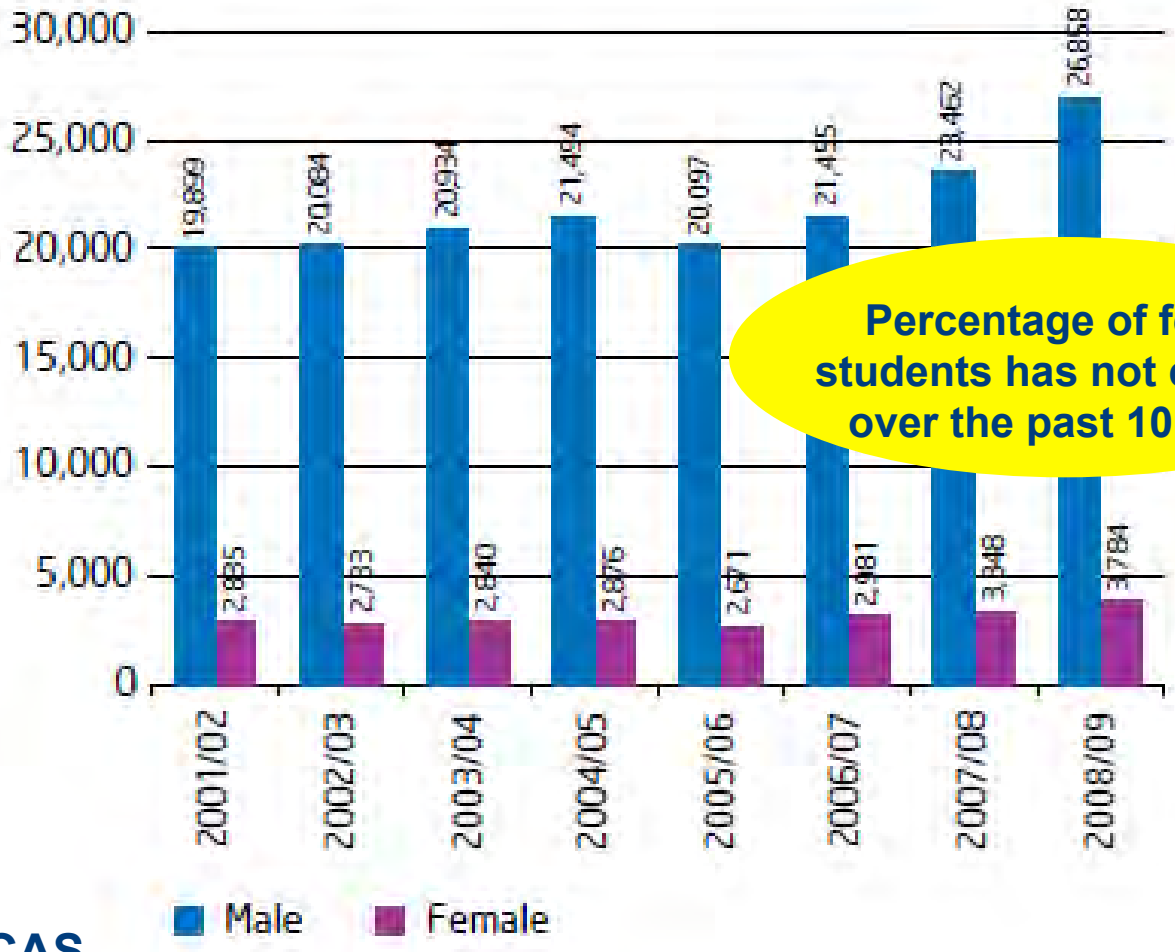
- **More expensive than most other disciplines – cost of labs, practical work, field trips etc**
  - » **This will be a factor for universities if not properly funded by fees and STEM HEFCE support**
- **In 2001/02 STEM subjects accounted for 22% of all applicants to HEIs but by 2008/09 this had dropped to 18% although the absolute numbers are increasing.**
- **A challenge is the potential failure to keep the best overseas STEM graduates in the UK if further restrictions imposed to Post-Study Work Route of immigration system**

Trends in Applicants to STEM HE Courses



Source: UCAS

Applicant Numbers to HEIs in Engineering and Technology by Gender



Percentage of female students has not changed over the past 10 years!

Source: UCAS

Engineering Projects Then and Now

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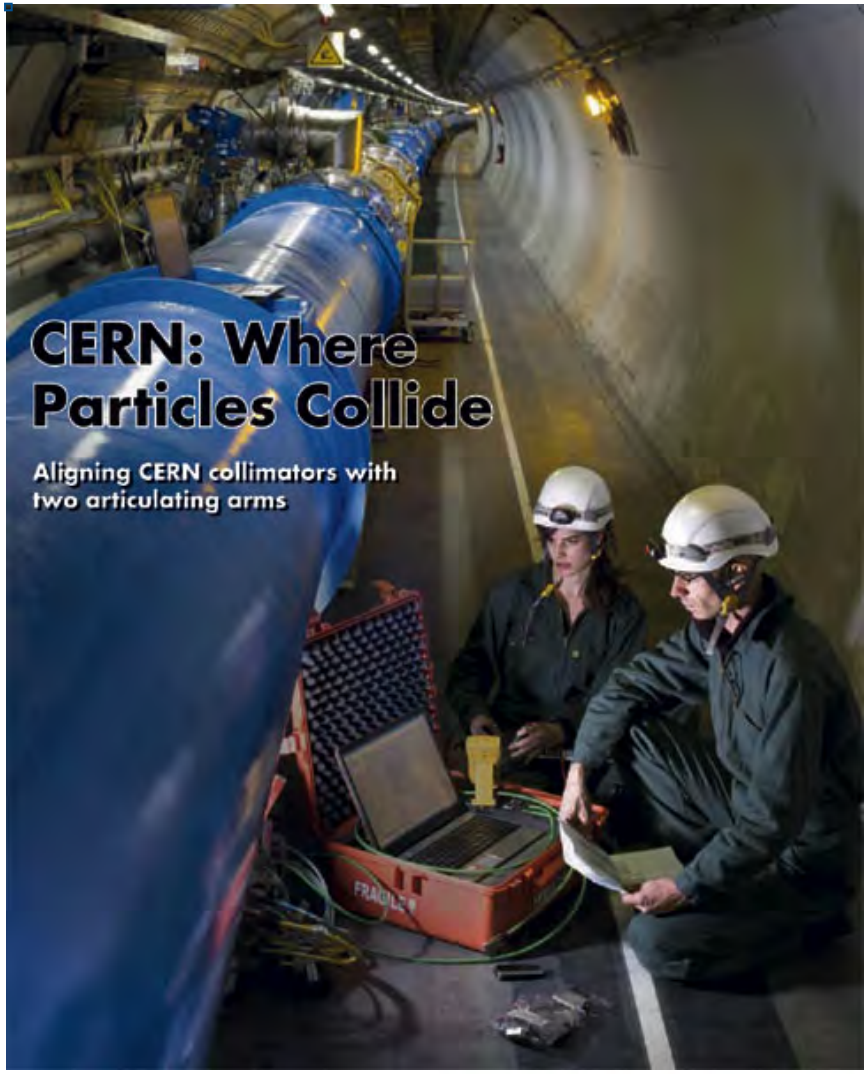

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Our Engineering Degree Programmes Must Be Seen As Exciting!

- **Applicants are attracted to aspects of engineering that are exciting and project-oriented**
- **University open-days and the work of professional institutes (annual lectures etc) support interest in schools/colleges**
- **Even so the gender imbalance suggests that engineering still fails to be an attractive career to most girls in schools**
- **The recent increase in 'competitive' projects in universities, such as the racing car build-and-race projects, is increasing enthusiasm amongst students**

Engineering Education
In a brave new HE world!

- **In the UK – Post Browne, Post CSR, Post Fees Debate…**
- **Engineering – part of the remaining HEFCE 'T' funding – but how much?**
- **Perceived value of vocationally-oriented courses in a fee-funded HE sector – possible increased demand?**
- **Cost of engineering education – can it be met by fees + HEFCE? Laboratory and fieldwork elements are costly and reduced capital from public finds may impact future course development**
- **What will be impact of the access regulation in engineering – fee levels Vs costs?**
- **What will TRAC mean for future HEFCE funding in STEM?**
- **Importance of international students and the challenge of visa restrictions**

Engineering and the UK Economy

- **The engineering sector is proving vital to the UK's economic revival**
- **It accounted for nearly a fifth of the UK economy (19.6% of GDP) in March 2009 almost three times the size of the financial services sector**
- **Total turnover stood at £848.6 billion and the sector provided jobs for over 4.5 million people across 482,880 different enterprises**
- **All of our lives and livelihoods depend on energy and the security, sustainability and affordability of energy can only be delivered via a strong engineering sector**

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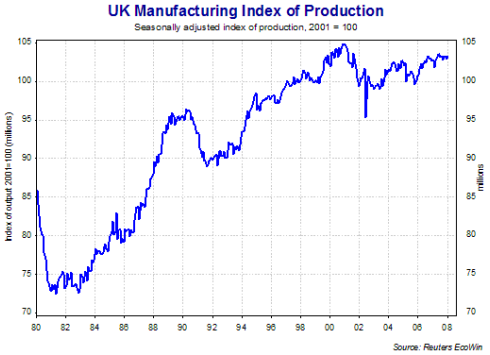

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Engineering and the UK Economy

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- **The engineering research base, which will help drive technological change, remains healthy within our Higher Education Institutions**
- **In 2009/10, 59% to 71% of research assessed for engineering subject area sub disciplines was classed as being internationally excellent**
- ***"A dynamic and well-balanced economy needs to draw on the dynamism and research capacity of university departments in STEM subjects"***
  – David Willetts
- **BUT this is happening at a time when public funding is under pressure and there are modest cuts in research funding and increased selectivity**

Research Councils UK Digital Economy Transforming Business and Society

EPSRC
Engineering and Physical Sciences Research Council

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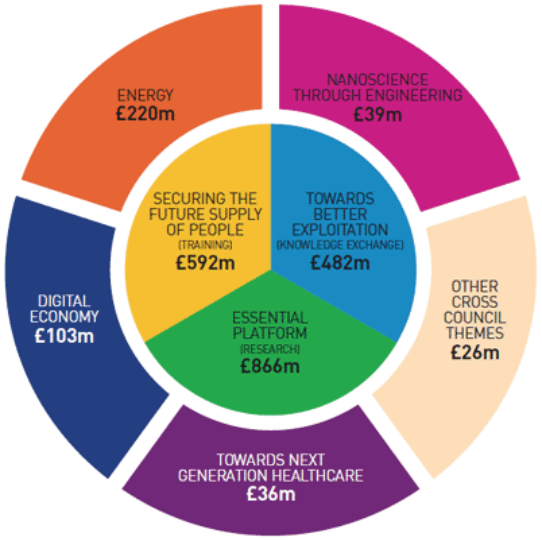
EPSRC Priority Research Areas

- **Digital economy**
- **Energy – sustainable power generation and supply, demand reduction and transport**
- **Nanoscience through engineering to application**
- **Next generation healthcare**
- **Ageing – lifelong health & wellbeing**
- **Global Uncertainties – causes of security threats, their detection and interventions to prevent harm**
- **Living with environmental change**

Engineering and Physical Sciences Research Council



Universities and the UK Economy

- **Universities have a key role to play in government plans to rebalance the economy away from finance to high-end manufacturing, the creative and digital industries**
- **Higher Education is the key provider of the skills needed by the ever-evolving knowledge economy and are critical to supply of new engineers into the economy**
- **Universities are educating students for jobs that haven't yet been invented**
- **Postgraduate education will be increasingly important in an economy needing more specialist skills**
- **New knowledge is critical to the UK's economic future and the value of research conducted in a university environment will be just as important as that in specialist organisations**

Case Study

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How can Engineering HEIs contribute to a sustainable economy?

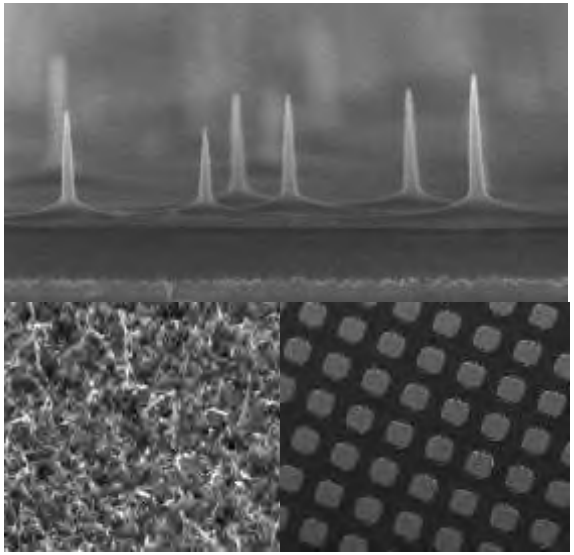
Renewable Energy Projects at University of Surrey

The Challenge

- Energy is the key to the world's problems – cheaper, sustainable, widely available energy can help deliver water (pumps), food and fight poverty, and reduce global political tensions
- How do we achieve this and is it possible?
- The Sun bathes the earth with 165,000 TW of energy per day
- Conventional technologies have not been able to address the key issue facing the solar electricity market; the high cost of a unit of energy produced
- Solar cell technology is a key opportunity – especially for the developing countries
- The global low carbon market is projected to reach £4.5 trillion by 2015 ……

I Application of Nanotechnology

- **Currently over 90% of solar cell modules are silicon-based – relatively high power conversion efficiencies, but at a high cost**
- **Emergence of organic material based solar cell technologies promise great potential towards low cost energy**
- **Three year project, led by Professor Ravi Silva, Director of the Advanced Technology Institute (ATI) aims to improve solar cell technologies and move closer to commercialisation**



ATI Advanced Technology Institute

NEC Nano-Electronics Centre

I Application of Nanotechnology

- **Project utilises the carbon nanotechnology expertise of the ATI in the design, fabrication and characterisation of the organic-inorganic hybrid solar cells**
- **Supported by research funding from e·on**
- **Surrey holds a number of patents in developing hybrid systems for practical applications including solar cells and solid state lighting**
- **Aim is to develop low cost, efficient and flexible solar cells that are easy to manufacture**

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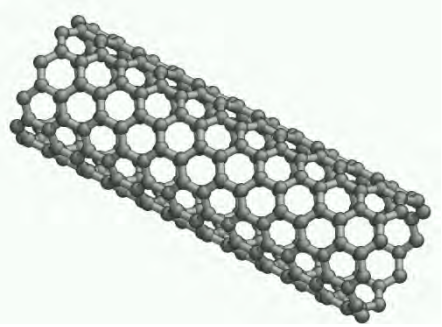

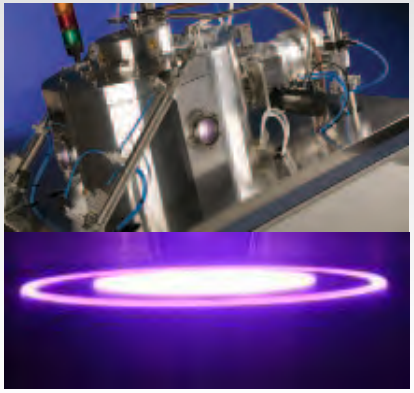

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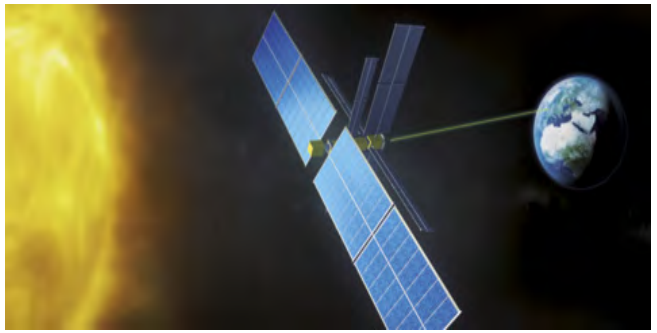
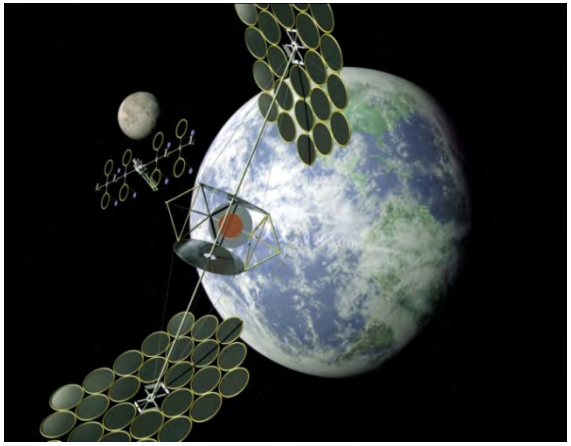
II Space-Based Solar Power

- **A good example of industry working with academia on knowledge transfer**
- **Pioneering research led by Dr Stephen Sweeney at Surrey's ATI working closely with EADS Astrium, Europe's largest space company**
- **The aim of the research is to use infrared lasers as a means of beaming solar energy from a satellite system to Earth**



II Space-Based Solar Power – The Vision

- **A permanent (24/7), discrete and emissions free power supply**
- **Energy directed to users – no large scale distribution network**
- **On-demand access to power for visible areas of the Earth**
- **Low cost energy with higher capacity than current terrestrial solar cells**
- **Energy security & reliability for asset holder**
- **Safe, inexhaustible, low-carbon footprint**



The Engineering Workforce

Paul Jackson, Chief Executive of Engineering UK:

"….the underlying issue, upon which all else rests, is the need to produce the right number of engineers with the right level of skills to maximise the UK's economic potential"

Business Minister, Mark Prisk:

"Nearly half of those currently employed are over 45, so the industry faces the challenge of filling more than 500,000 posts over the coming six years"

Commercial Secretary to the Treasury, Lord Sassoon:

"Engineering has an important role to play in the rebalancing of the economy ……..we'll need skilled engineers."

Skills Required of Tomorrow's Engineers

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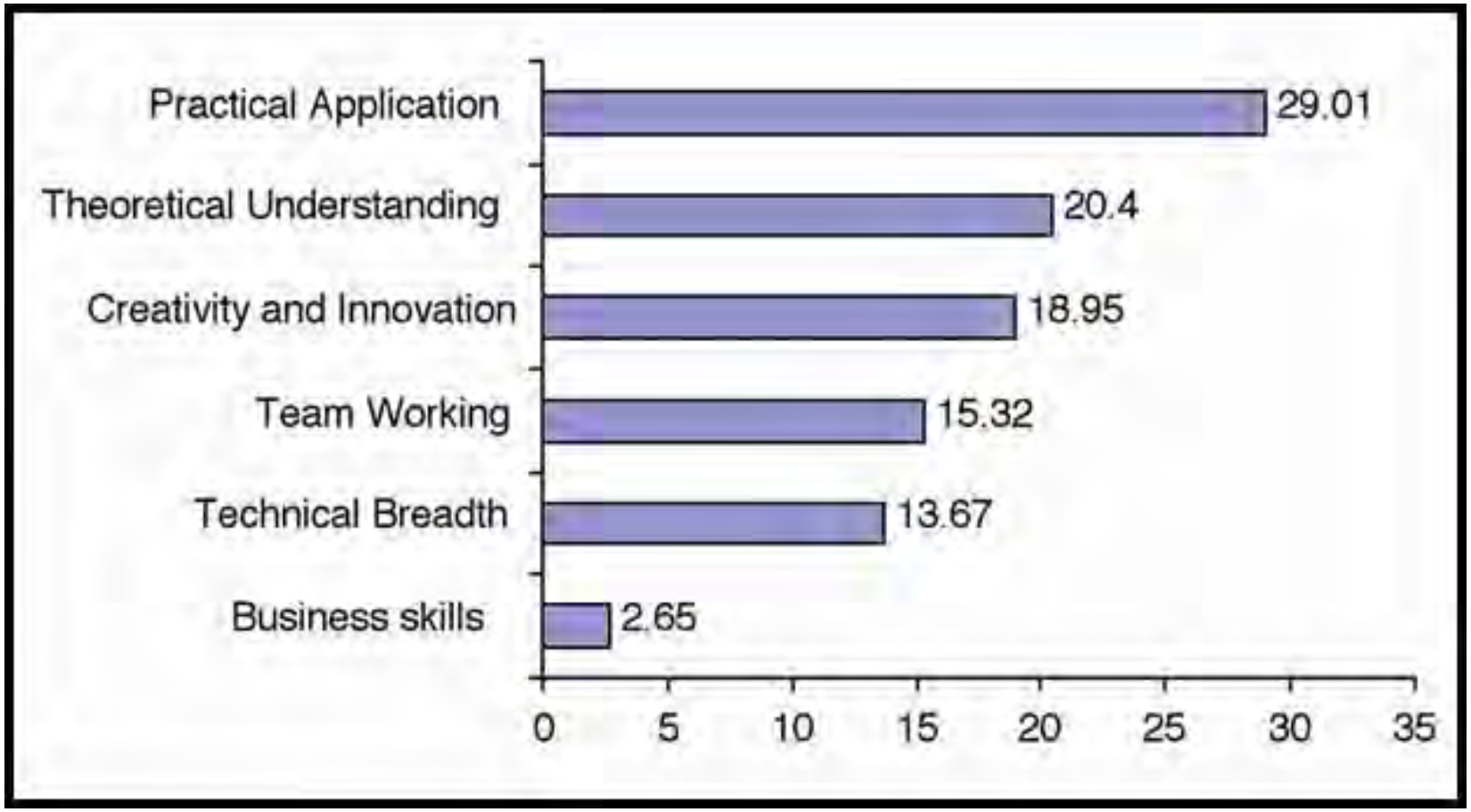

Industry Priorities for Engineering Graduates: The Royal Academy of Engineering "Educating Engineers for the 21st Century"

Tomorrow's World Problems Requiring the Skills of Engineers

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- **Engineers have the necessary skills to solve major problems facing the world – but they are not necessarily represented within the traditional 'boundaries' of engineering**
- **The IET's new strategy focuses on the challenges the professional engineering community wishes to engage with in the years ahead:**
  - **» A low carbon economy and clean technologies**
  - **» Renewal and resilience of the Public Infrastructure**
  - **» World health and wellbeing**
  - **» Security in the modern world**

IET Collective inspiration

- ***"Engineers have been the architects of past achievements; they will be the innovators for future success"***

– Professor William M Banks, President of IMechE 2008-9

Conclusions

- **Engineering still faces the challenge of instilling enthusiasm and interest in children – especially girls. They are tomorrow's engineers**
- **The opportunities and need for engineers are as strong as they have ever been – but reflect new areas of engineering and technology**
- **Engineering remains a key driver for the economy**
- **University engineering**
  - » **Teaching and learning will continue to receive support from HEFCE but is also entering the new student fee paradigm for funding**
  - » **Research funding through research councils is becoming much more selective and with modest cuts in real-terms funding**
  - » **Dependency on international students and engagement with industry will continue to be extremely significant**