

IOP Institute of Physics Energy Group

NEWSLETTER

Issue no. 50

November 2017



Photograph © Robin Morris

Chair's remarks

Welcome to the latest newsletter from the Energy Group, with guest editor John Twidell. John had reached the maximum term on the committee but kindly offered to edit an edition of our newsletter. We are grateful for his continued contribution. I hope you enjoy his perspective.

Thank you to all those who participated in our survey and for suggestions of newsletter themes. The responses are analysed later in this issue. They provided very useful feedback – including enthusiastic support for themed newsletters. Apologies for technical problems, which had left the May 2016 issue on the group pages for over a year.

One research student, Cian McKeown, made use of financial support offered by the IOP Research Student Conference Fund to attend a major international meeting. His short report appears in this newsletter. I hope Cian's experience will encourage other student members to consider applying for a travel bursary from the conference fund.

Committee members Jenny Love and Neil Hewitt developed a very interesting day meeting on advances in integration of heat pumps. We responded to member requests for meetings outside London and this event was to be hosted the School of Engineering at Warwick University. The generous offer of the use of meeting facilities helped support very modest registration fees. It is very disappointing that we had to cancel this meeting, as only a few people had registered. We look forward to the opportunities to organise a richer programme when the new IOP headquarters opens.

Robin Morris, Chair

This newsletter is also available on the web and in larger print sizes.

The Energy Group website is <http://eg.iop.org>

The Institute of Physics, 76 Portland Place, W1B 1NT, UK.
Tel: 020 7470 4800 Fax: 020 7470 4848

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Call for Energy Group committee nominations

We warmly invite nominations for four Ordinary committee members and one Early Career member.

Our primary aim is to organise day meetings on relevant topics, sometimes in cooperation with other groups. We publish this newsletter, consider bursary requests and contribute to consultation responses.

We normally meet once or twice a year, at the IOP in London. We usually hold other meetings online.

With support, you would be expected to help to define and organise a day meeting or evening talk and to help with at least one newsletter issue.

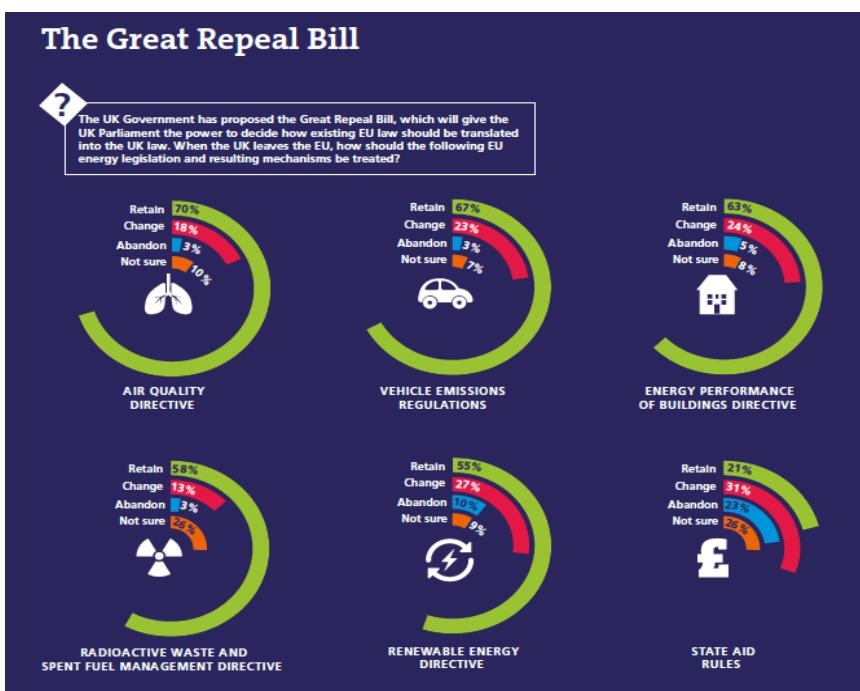
Find out more and submit a nomination via <https://www.micnomination.com/iop>. **Closing date Friday 29 December 2017.**

Editorial

This issue's guest editor, **John Twidell**, considers the relationship between economy and energy supply.

There is obviously a relationship between every economy and its energy supply. But can we judge economic change by considering the amounts and mechanisms of energy supply? Moreover, by spotting innovation can we foresee future economies? To test such hypotheses, I have summarised energy-related news of the last six months. Do you see any patterns to predict the future?

June 26th: Institute of Energy's '**Energy Barometer**' released; results of broad-ranging survey of 900 UK professional members. The questions on Brexit related to government ministerial actions allowed by the '*Great Repeal Bill*'. The responses (figure below) clearly indicated a preference that present EU energy policies and actions should be retained.



May 10th: Nissan and Enel, with the co-operation of the UK National Grid, initiated an intelligent remotely-controlled **electric vehicle battery charging/discharging system**. The aim is to use the vehicle batteries for night-time use and grid support. About 100 private and group-owned vehicles will have their batteries so connected and remotely controlled that charging is when grid supplies are cheapest, and, when permitted, the batteries export for grid reinforcement.

June 30th: Installed capacity of **solar PV power in China** reached 100GW (generating 1% of consumption). The worldwide total is ~320GW; 12GW in the UK (representing 3.5% of consumption).

July 7th: The South Australian government contracted Tesla Batteries to install a 130MWh grid-connected lithium ion battery for grid support. At the time, this would be the **world's largest battery** 'by a factor of 3'.

August 30th: Oxford City and Oxfordshire County Councils announced a programme of 100 **electric vehicle-charging points** in the city to gain experience. The stations are for either residential or public use at kerbside positions (e.g. within lamp posts). Electricity will be obtained from a renewable energy supplier. The plan is typical of many cities and towns as they prepare for near-zero traffic pollution and associated low carbon footprint. [Editor's note: Oxford City recently announced plans for a zero-emission zone.]

September: Renewable energy auctions saw **offshore wind achieving a record-low strike price of £57.50 per MWh**, halving the cost of two years ago, and approaching half the guaranteed price for future nuclear power.

September 18th: Dubai Electricity and Water Authority contracted for 700MW of **concentrated solar power reported at US\$7.3cent/kWh**. Another programme is on track for 1,000MW of installed photovoltaic power by 2020, at a reported cost of US\$2.4cent/kWh.

October 1st: German company Sonnen and Arizona builders Mandalay Homes initiated a new site **development of 2,900 energy-conscious homes, each with solar PV (total 12MW capacity) and battery storage (total 23MWh)**. Central control allows surplus solar daytime power to be stored for night use and integrates grid export. Householders have cheaper electricity and the network is reinforced without other peaking generation.

October 10th: IKEA announced that it **owns** worldwide more [multi-megawatt] **wind turbines** (415) than shops (355), with an aim to be 'net' energy independent with IKEA-owned renewable energy by 2020.

October 11th: The UK **Nuclear Decommissioning Authority** paid £122m in legal fees and damage payments for an inappropriate contract in 2014 for a further £6.2bn to continue decommissioning 12 UK Magnox nuclear plants. A new bid is to be announced. Only the lawyers were happy!

October 12th: The long-awaited UK **Clean Growth Strategy** included an Energy Innovation Programme, with up to £10m for low-carbon heating in domestic and commercial buildings, and £10m for energy efficiency innovation in these buildings. Carbon Capture and Storage (CCS) returned with a £20m demonstration programme. Up to £20m was included to help industries switch to low-carbon fuels. A similar investment will be made to support early stage funding of clean technologies. £14m will be added to the Energy Entrepreneurs Fund for emerging energy technologies. Renewables will be supported with £557m for energy auctions. For transport, the aim is to cease new conventional fossil-fuelled vehicles on UK roads by 2040. £1,000m long-term support is promised for ultra-low emission vehicles, especially electric vehicles and the deployment of charging facilities. There will be an "ambitious" Sector Deal for offshore wind to add an extra 10GW of new capacity by the 2020s, with wind power on Scottish islands being treated as 'offshore' for supportive tariffs. The Government expects an extra 10GW of new wind capacity by the early 2020s (present total 16.4GW).

October 17th: Shell announced the initiation of **electric vehicle charging points at standard filling stations**, initially in London. Shell had just purchased the Dutch company 'NewMotion', with 80,000 charging points across Europe.



*John Twidell graduated BSc and DPhil in physics from Oxford University. His first post was Khartoum University where he 'found the Sun'. He moved to the Universities of Essex (2 years), Strathclyde (20y), South Pacific (Fiji 2y) and De Montfort (5y). He lectures and researches in renewable energy topics. His university textbook, with Tony Weir, *Renewable Energy Resources* (Routledge) is now in its 3rd edition and is used internationally. A 4th edition is in preparation. Prof. Twidell is a former member of the Energy Group committee and is a Fellow of the Institute of Physics.*

Energy at the world's largest potato crisp factory

John Twidell reports on a visit to PepsiCo's facilities in Leicester.

The Energy Group has supported the formation of the new *Physics in Food Manufacturing Group*. John Bows of PepsiCo R&D, Leicester is the Group's founding secretary. PepsiCo has about 250,000 employees worldwide, with a turnover of over \$63bn (2016). It has many food- and beverage-related companies in its portfolio, including in Leicester the R&D building and the adjacent Walkers Crisp factory.

This October, I visited the complex, on behalf of the Energy Group, to see how energy and resource efficiency moulds and improves this most modern of enterprises. The impressions of a personal visit are quite different from reading facts and figures or, say, watching a video. So what made immediate impressions on me, firstly at PepsiCo R&D and then at the nearby factory? I can list them very clearly:

- In the entrance area, there was a welcoming photo of the PepsiCo CEO **Mrs Indra Krishnamurthy Nooyi**, born and educated in India. *Fortune* magazine named her first in its annual ranking of Most Powerful Women in business for five consecutive years from 2006. No glass ceiling here.
- The company's sustainability aims (a core part of PepsiCo's 'Performance with Purpose'), as formed with the help of the UK based Carbon Trust, including reduction in energy consumption and carbon footprints.
- Well-designed and scrupulously clean factory processes and layouts¹.
- About 500 tonnes of potatoes per day are washed out of dedicated lorries, which deliver into a ten bay wide platform to enter production.
- Three main, parallel production lines produce the basic crisps, before division into about twenty end lines, where seasoning is added by spray mixing to produce each variety of crisp, followed by automatic packing and sealing into packets. About 6 million packets are produced per day from a similar number of potatoes.

¹ See **BBC** programme *Inside the Factory S02E02* for a lively YouTube presentation of the whole process. Also refer to the article, *The Journey of a Crisp* in the November 2016 issue of **Physics World**, pp 38-42.

- Sophisticated and sensitive sensors throughout the process to check quality parameters and remove blemished material, ranging from misshaped potatoes automatically washed from the delivery lorries, to individual below-quality crisps being sensed and then air-jetted in milliseconds from the total flow.
- Cooked and seasoned crisps are weighed in groups of about 10-20 'cups' that empty under computer control so each packet has the same weight. It takes just 30 minutes for a potato to become a bag of crisps.

Automatic weighing and computer controlled delivery to packets of about 10 crisps at a time for an even distribution of crisp sizes per packet.



(Photographs kindly supplied by PepsiCo.)

- The very few factory personnel, mostly inspecting the fully automatic processes of parallel production lines.
- The final large-scale anaerobic digester for treating the organic waste of 'peelings' and spoilt crisps automatically fed to it. The biogas feeds engine-generators, producing a constant 2MW of grid-connected electricity for the factory.
- The ultimate waste after digestion is transported to farms as soil and nutrient improvement. No waste of any sort goes to landfill.
- An on-site wastewater treatment plant allows water to be returned to the production process, reducing overall water use.
- Production continues 24 hours a day throughout the year, entirely machine operated and with just-in-time delivery of potatoes from the linked farms of, mostly, East Anglia. The 'untouched by human hand' packaged crisps are likewise transported nationally to suppliers of shops and pubs.

Efficiency by Design

Once built, the overall processes cannot be easily changed. So improvements in energy efficiency, water recycling and waste minimisation are linked to maintenance. For example slicing machines, motor drives, compressors and pumps are replaced with improved designs. Compressors use 16% of electricity supply, so detecting and sealing leaks is vital. Heat recovery from condensed steam is an important design feature. The online tasks are to measure and monitor at each individual item of equipment, to analyse and then to improve as opportunity arises. For instance, the latest low-emissivity coatings have been used on the cooking ‘furnaces’ through which the conveyors rapidly move the potato slices. Factory lighting is now dominated by LEDs. On-site electricity generation from the anaerobic digester is maximised and is integrated to reduce grid import.

The anaerobic digester, heat and power generation



Previously, potato and crisp wastes were transported away from the site, but since Feb 2016 this resource has been channelled - as solids and slurry - to the onsite digester plant. This £5m plant was imported from Belgium, where the technology is well advanced. The large insulated tank dominates, being about 14m

high by 25m in diameter. The slurry temperature is kept at around 53°C. Thermophilic bacteria digest the slurry with a bubbling gaseous output of methane and CO₂. These gases pass to the adjacent spark-ignition engines of the 2MW electricity power plant. This onsite generation displaces £1.3m/year of imported electricity. Heated engine cooling water passes back to heater tubes within the digestion tank so the critical thermophilic temperature is maintained. Operation of the plant has required dedicated and sensitive ‘nursing’ as parameters, especially temperature, are optimised with experience. Digested slurry is pasteurised within the tank and so can be dried externally to produce a solid fertiliser for distribution and sale to farms, including potato growers.

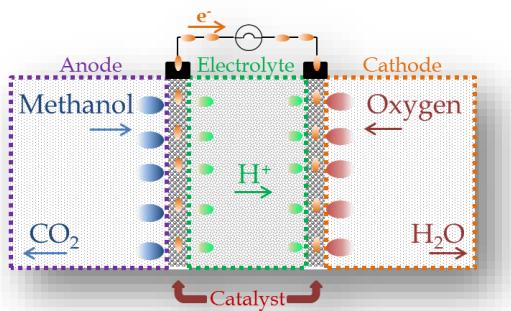
Report on attendance of ICMAT 2017

Cian McKeown received financial support from IOP to help him attend an international conference. He presented some results from his doctoral research on direct methanol fuel cell (DMFCs).

This ninth **International Conference on Materials for Advanced Technologies** (ICMAT 2017) was held 18–23 June in Singapore. I attended the conference with the financial support of the *IOP Research Student Conference Fund* and the *CR Barber Trust Fund* and presented some results from my PhD.

The conference brought together the world's leading materials research scientists to share their work. The attendance was large, with 2300 speakers over the five days, giving plenary lectures, theme lectures, Nobel laureate lectures, invited talks and student talks. Thirty individual symposia ran in parallel each day, covering topics on all aspects of materials research.

Our research group investigates new catalyst materials for fuel cells, with the aim of finding commercially viable candidates to replace fossil fuel based technologies. I presented some of our results in two oral presentations in Symposium E – Nanomaterials for Advanced Energy and Environmental Applications. Firstly, I spoke about our recently published study of strained platinum catalysts that show increased efficiency for direct methanol fuel cells. The strain increased the coverage of fuel on the catalyst surface.



One of the main factors holding back widespread commercialisation of DMFCs is the fact that platinum is susceptible to poisoning during the methanol oxidation process, which reduces cell efficiency. Recently, we have shown that the activity of platinum catalysts can be enhanced by applying strain to them².

In my second talk, I presented on thin-film, noble metal catalysts with high activity, for direct formic acid fuel cells.

Presenting these results at a large international conference allowed me to highlight the work I'm doing and to make new contacts for future collaborations.

The ICMAT 2017 conference also gave the opportunity to hear top-level scientists present their work. Nobel Laureate lectures were held in the evenings with inspirational talks given by **Hiroshi Amano**, **Sir Fraser Stoddart** and **Kostya Novoselov**, who had each been awarded a *Nobel Prize* (in 2014, 2016 and 2010, respectively). The three lectures shared similar themes, including the story of receiving the Nobel Prize, the humble shock they felt about it, the lucky breaks and numerous mistakes they made throughout their careers in science. The importance of exploring new scientific avenues and ideas was also highlighted in the talks, as well as the importance of international collaboration.

Attending ICMAT 2017 in Singapore was an amazing experience. It was great to see such a large gathering of scientists willing to present, listen and share ideas with the aim of finding solutions to some of the biggest challenges facing the world. I am glad to have had the opportunity to present two papers in the area of fuel cell catalysis, and get feedback from experts in the field. I am very grateful to the IOP Energy Group for awarding me support from the Research Student Conference Fund and to the CR Barber Trust. I would highly recommend applying, to anybody who wishes to travel to an international conference during their PhD.

Cian McKeown is a postgraduate student in the Physics Department of the University of Limerick. He works in the Nanoscale Physics Group, under the supervision of Dr Fernando Rhen.

² See: <http://pubs.acs.org/doi/abs/10.1021/acs.jpcc.6b11290>

Research Student Conference Fund

The Institute of Physics provides financial support to research students attending international meetings and major national meetings.

Research Student Conference Fund (RSCF) bursaries are available to PhD students who are a member of the Institute and of an appropriate Institute group. The Institute of Physics (IOP) handles the application process but it is the relevant IOP group that makes the decision on whether to award the bursary and its value.



Students may apply for up to £300 during the course of their PhD. Students may apply more than once, for example they may request the full amount or decide to request a smaller amount and then apply for funding again for another conference at a later stage.

Groups have limited funds to award bursaries and so students may not receive the full amount they have requested.

RSCF applications are considered on a quarterly basis and should reach the Institute by: 1 March, 1 June, 1 September or 1 December; a decision will be made within eight weeks of the closing date. Your application must reach us by the deadline which is at least three months before the conference you wish to attend. For example, for an event taking place in July, your application should reach us by the 1 March. We strongly recommend that you submit your application early – it is not necessary to know the outcome of any abstract submission in order to apply.

Note that grants will normally cover only part of the expenses incurred in attending a conference and are intended to supplement grants from other sources.

[**Application form**](#)

Exploring the Future of Mobility Engineering

Colin Axon reports on this one day meeting held on 13 July 2017 at County Hall, London.

The event was organised by FISITA³ with the aim of bringing together mechanical and electronic engineers, computing scientists, IT specialists, policy-makers, and others working on robotics and artificial intelligence to discuss what may be the major sources of disruptive innovation for the provision of future mobility.



The opening talk was by **Michael Hurwitz** (Director of Transport Innovation, TfL) on the transport issues specific to megacities. The key problem identified by Hurwitz was how to deal with air pollution. It is a problem not solely in the hands of city authorities. The most interesting statistics mentioned were that in London 90% of the street space is taken up by passenger and light goods vehicles, carrying 14% of people. By contrast, buses take up 14% of the road space but are carrying 57% of passengers. Hurwitz went on to say that central London will become a zero emissions zone through tightening policy and pricing, and perhaps by 2025.

Venkatesh Prasad (Senior Technical Leader of Open Innovation, Ford) spoke about how his company were approaching the process of innovation for autonomous vehicles. The main point was that they recognised the need for people with a wide range of expertise and backgrounds not usually found in the automotive industry. The most interesting figure Prasad gave was that UK drivers spend between 44-56 hours per year in finding a parking space, leading to unnecessary emissions.

The second session started with **Luc Van Gool** (ETH, Zurich) who is professor of computer vision. He described work part of collaboration with KU Leuven and Toyota to develop software for a mobile robot with a stereo camera, with ETH focusing on the 3D reconstruction of the environment. The basis of this is the co-evolution of neural networks and so-called 'deep learning'. The idea is to be able to recognise features in an image and distinguish which are relevant and important. The methods Van Gool and his

³ Fédération Internationale des Sociétés d'Ingénieurs des Techniques de l'Automobile, founded in Paris in 1948.

team have developed seem to perform better than current methods and have greater potential, but are more demanding. The demands are principally to do with data for training the algorithms. The use of real images and video requires intensive input from humans to tag features. To an algorithm, an object can look very different from different angles and lighting conditions. They are exploring the use of gamified environments as a way of speeding up this stage.

Tim Leverton (President and CTO, TATA Motors) pointed out the differences in requirements and expectations for vehicles in a developing nation. Air pollution was highlighted as a key issue. Interestingly, Leverton pointed out that the Indian Government was forcing change through policy and regulation.

Walter Van Dyck (Vlerick Business School, Belgium) emphasised ways for business models to change with the advent of autonomous vehicles. Van Dyck showed that, albeit from very different starting points, there was some convergence in the requirements of automotive consumers in a developing nation (such as India) and younger people in Europe. This manifests as a sharing economy, which is based on trust. If there is no trust, Van Dyck said, there is no market. And in this sense platforms (for technology) were more important than products.

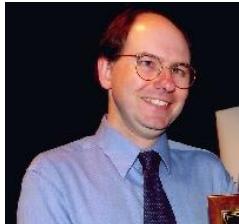
Following lunch was an interview of **Jon Lauckner** (CTO, General Motors) by **Paul Mascarenas**. Lauckner is a third generation GM employee. He discussed futurist ideas about where the industry might go e.g. exploiting additive manufacturing (3D printing) as part of mainstream production. Lauckner also discussed some of the problems associated with owning autonomous and electric vehicles. He said that GM were looking up and down their value chains to see what might be brought closer to GM to aid smaller companies in developing technologies. I wondered whether this was a hint that perhaps car companies might move closer to becoming vertically integrated 'mobility providers'.

The next two talks were looking at the future of propulsion systems. **Wolfgang Warnecke** (Shell) reiterated many of the well-tested arguments for alternative fuels. He considered that the internal combustion engine was going to be in use for a long time and so he left us with the question: for emissions and pollutants: how low is 'low enough'? **Remi Bastien** (Renault) started by showing that the figures for 'corporate average fuel economy' in all regions are converging. Bastien moved the discussion to electric drivetrains, but sadly in my view, his thinking on the fit of electric vehicles into society was

behind the times. For example, he was advocating the use of electric vehicle batteries for supporting the grid, though this has been shown clearly not to be a viable prospect⁴.

The day ended with a headline talk from **Andy Palmer** (Vehicle Line Director, McLaren Automotive). Palmer boldly stated that for him it was still “all about the car”. It was interesting to hear about the origins of McLaren and the desire of its founder Bruce McLaren in the 1960s and 1970s to develop the best technology possible. From the very slick videos Palmer played, it was clear that the current McLaren company upholds these standards. The manufacturing facilities looked to be fantastic and it is easy to see why young engineers would want to work in such an environment. Palmer also showed the promotional video to their just-unveiled new hybrid...it's bewilderingly powerful, very sleek, very, very expensive, but not remotely low carbon, low energy, or sustainable.

It was a very interesting day. There was a wide variety of people attending; I spoke with design engineers, educators, lawyers, transport planners, policy makers, component manufacturers, and investors. Many speakers and attendees came from across the world, including Nepal.



Colin Axon is Lecturer in the Institute of Energy Futures at Brunel University London, and UG Admissions Tutor in the Department of Mechanical and Aerospace Engineering. He works on smart grids, energy and resource use in the built environment, metrics and indicators for energy security, and sustainable mobility. Previously he worked in the Department of Engineering Science at the University of Oxford. He is Founder of the James Martin Institute for Carbon and Energy Reduction in Transport, at the University of Oxford. Colin was the Chair of the Institute of Physics Energy Group 2011-14.

⁴ J.D.K. Bishop, C.J. Axon, D. Bonilla, D. Banister, 2016. *Estimating the grid payments necessary to compensate additional costs to prospective electric vehicle owners who provide vehicle-to-grid ancillary services.*

Energy 94, 715–727 doi:10.1016/j.energy.2015.11.029

Small and Medium Sized Enterprises and Energy Management

Jeremy Rawlings of University of Reading explores SME demand flexibility

SMEs consist of enterprises with fewer than 250 employees and a turnover of up to €50m/y. They number 99% of all UK private sector companies and provide 60% of private sector employment and 47% of total company turnover. Many have low energy bills and some pay for energy indirectly through a service charge. The challenges in engaging small and medium sized enterprises (SMEs) with energy reduction are widely recognised. Individual SMEs often consume little energy but collectively their energy use is significant. Large energy consumers are likely to be taking action to reduce their consumption due to the increasing price of energy. This effect is reinforced by policies such as the Energy Savings Opportunity Scheme (ESOS) and Carbon Reduction Commitment (CRC), which encourage large organisations or major energy consumers to reduce their consumption.

Meanwhile, electricity network operators are developing smart grids. A smart grid manages the actions of distributed generators, consumers and those that both generate and consume. The smart management allows suppliers to offer tariffs that vary in time, thereby reflecting the wholesale electricity price. On the wholesale market, electricity is traded in half-hour blocks (settlement periods). At times of peak demand (such as 16:30 to 17:00 on a winter day), the price of electricity is substantially higher than at night. The challenge of balancing supply and demand is greater with a high national proportion of wind and solar electricity. However if consumers can be persuaded to reduce their consumption during peak consumption periods and consume more when there is a surplus of supply, this will help to reduce the network costs.

Demand side management (DSM) refers to supporting customers to shift a proportion of their consumption by changing how and when they use electricity. This includes reducing demand at peak times and can also mean increasing demand when there is surplus generation (for example, during a windy night). A DSM service may be provided by reducing demand (turning down or turning off equipment) or by customers generating electricity on site. Some companies with back-up generators or combined heat and power (CHP) plants are operating them to supply their own electricity at times of peak demand and receiving financial benefits for this.

Case Study. The *University of East Anglia* reduces air conditioning electricity demand to support National Grid's system balancing. Following an agreement in 2013 with *Open Energi*, air handling units and chillers with a combined consumption of 1MW are now equipped with automatic demand response controls. These increase or decrease the demand on a second-by-second-basis in response to changes in the frequency of the electricity supply. The consumption is only adjusted for a few minutes at a time so that students and staff remain comfortable. The University expects to earn more than £50,000 over three years through this service.

In our present study, a method was developed to estimate flexible loads within a group of office buildings, in the absence of detailed information at individual building level. Analysis of previous classifications of buildings, businesses and heating, ventilation and air conditioning (HVAC) systems identified that heating and cooling in offices represented the largest potential load for DSM, with SMEs responsible for a significant proportion of this. A building physics approach was developed to simulate temporal profiles of electricity use. Demand response potential was quantified for four built form types, three age bands and two HVAC types. The built form types distinguished the footprint (deep plan or narrow plan) and the internal construction (open plan and cellular). Three age bands represented buildings with different fabric-related heat loss (insulation, glazing and air infiltration). Two HVAC types were chosen to represent a current scenario with gas heating and air conditioning and a future scenario with electric heating and cooling supplied by a heat pump.

The model compared 'business as usual' with a load shift scenario in which heating and cooling were both reduced. The change was modest in order to minimise discomfort to the occupants. From 17:00 to 18:00 each weekday, the heating setpoint in office areas was reduced to 19°C (from 21°C to 23°C) and the cooling setpoint to 26°C (from 22°C to 24°C normally). In looking for DSM potential at the stock level, the simulation results indicated that an electricity company should focus on buildings with large cooling loads. These are buildings with additional cooling due to activities such as IT. Some of these buildings have back-up generators or batteries that could power the building (or part of it) and reduce or eliminate the requirement for the grid for short periods. The technical, regulatory and planning requirements were beyond the scope of this study. The simulations indicated that buildings with electric heating and cooling have the best DSM potential but this was still small (of the order of 10 to 20kW in a building of 1450m²). Well-insulated buildings in summer offer good potential for DSM due to cooling. The largest

load shift during the summer was from the 1990s buildings; during the winter it was from the older buildings (1970s and 1980s). The proportion of load considered flexible during the winter was very low, with gas heating. Peak electricity demand is currently occurs in winter. The model indicated that built form type had little impact on DSM. However DSM was slightly greater in open plan buildings.

The opportunity for DSM from office buildings is small but is expected to increase. Flexible HVAC load due to heating, cooling and mechanical ventilation, is present in 50–60% of office buildings. This is the best estimate currently available and is expected to increase due to refurbishment and new construction. A further requirement is a building control system capable of receiving demand response requests. The lack of information on the type and extent of cooling and ventilation in office buildings is a major limitation.

At present (2016), most DSM is supplied by organisations running generators or CHP plants instead of turning down their demand. HVAC in offices is likely to account for only a small proportion of total DSM, compared with generators. This reflects the need to keep the temperature variation during the working day to no more than 2 to 3°C to minimise discomfort to building occupants and the fact that up to 40% of buildings do not have cooling. Buildings with large hot water, lighting or process loads (such as, refrigeration or manufacturing) could contribute more DSM subject to operational requirements. The use of stand-by generators and CHP plants to meet on-site loads will continue to be larger contributors to DSM than reducing demand.

Introduction of half-hourly settlement meters opens up new electricity tariffs which can introduce SMEs to load shifting. Some of these tariffs are expected to reflect the variations in the price of electricity and charges for the distribution and transmission of electricity that are significantly higher at peak times. The benefits of DSM for SMEs currently appear small compared with the risks of engaging in a new area without dedicated legal or commercial resource and possible disruption to their operations caused by DSM. HVAC systems in smaller buildings currently need to be aggregated in order to meet the National Grid requirements for DSM services.

This work was completed under EPSRC grant reference EP/G037787/1 as part of the Technologies for Sustainable Built Environments Centre at The University of Reading. The author is grateful to The Chartered Institute of Building and Reading Borough Council for sponsoring this work.

Energy Group Newsletter Survey

The Energy Group carried out a survey of members, to understand opinions and suggestions for the newsletter. A link to the on-line survey was included in the December 2016 newsletter. The link was also sent out in an email to members. The poll was hosted on EU Survey⁵ and was kept open from December 2016 to 6 February 2017.

Response Rate

A total of 81 responses were received, representing 10% of the group membership. This is a reasonable response rate for a survey which did not offer any incentive for participants, such as entry into a prize draw.

Respondents were first asked whether they wished to continue to receive a hardcopy of the newsletter in the post. The vast majority (89%) of respondents indicated that they would prefer not to receive a copy of the newsletter in the post. However, a hardcopy was still important to the other 11% of survey participants. This focus on opting out from a postal copy may have resulted in an enhanced response rate from members with an active preference, whether they wished to continue to receive the hardcopy or wishing to opt out.

Comments included people stating “*I think I would prefer an electronic version only*” in contrast to “*I have selected to receive a paper copy of the newsletter as I do not regularly log in to my IOP account and so wouldn't want to miss out on reading it.*” There were suggestions that, sometimes, the electronic version of the newsletter might not have reached every member: “*Please ensure that there is email notification when there is a new issue available to download*” and “*If a copy was emailed to me however, I would be happy to read an electronic copy.*”

The newsletter is normally emailed directly to members. We are aware that there has been a persistent error in the link on the Group's webpage, which had been directing users to an old issue of the newsletter.

Further information

The survey include additional questions, which were marked as optional. All but two of the survey participants answered these further questions.

⁵ <https://ec.europa.eu/eusurvey/home/welcome>

Membership category and Sector

Of those who indicated their membership category, a disproportionately large proportion (78%) of replies came from Members, compared with the group composition (53% Members). 9% of responses came from Fellows, broadly in line with group membership. The 13% of respondents in other membership types, including Student and Associate, under-represented the 40% of group members across these categories.

Almost a third (32%) of respondents stated that they were in the academic sector, 30% described themselves as being active in industry and 16% called themselves consultants. Only 4% of responses came from students. 19% of respondents were retired. In describing their field of involvement, more than a third of replies included the word *nuclear* [fission]. Offshore oil and gas, and renewables were the next largest groupings, followed by *fusion*. *Energy efficiency* and *alternative fuels* were the next most frequent descriptions, along with the word *lecturer*.

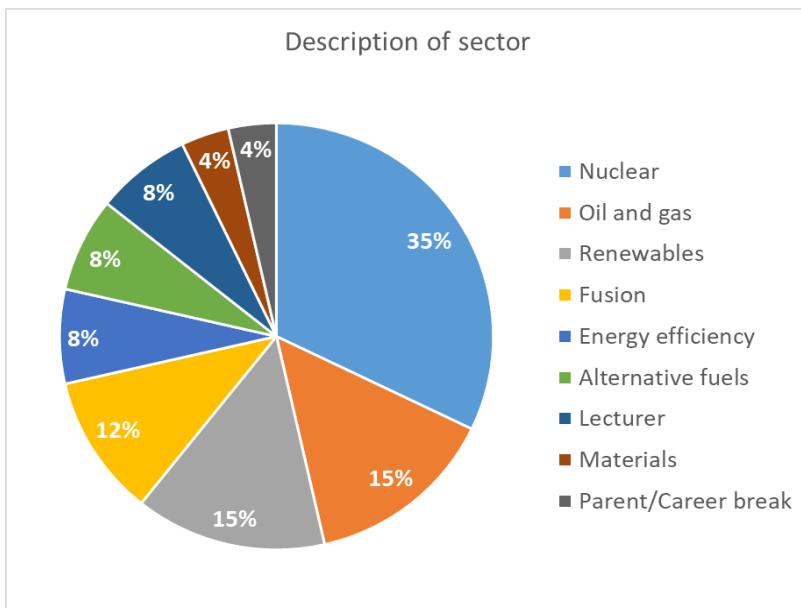
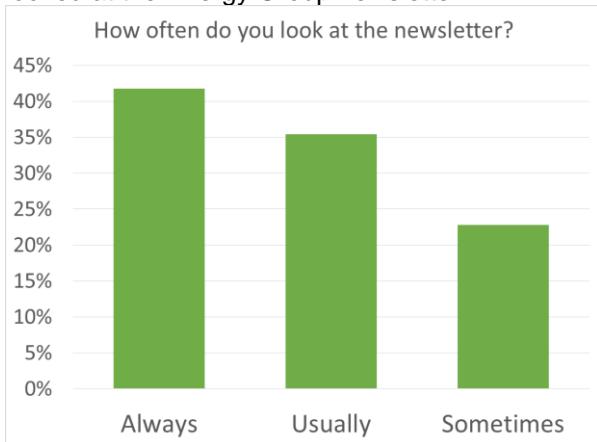


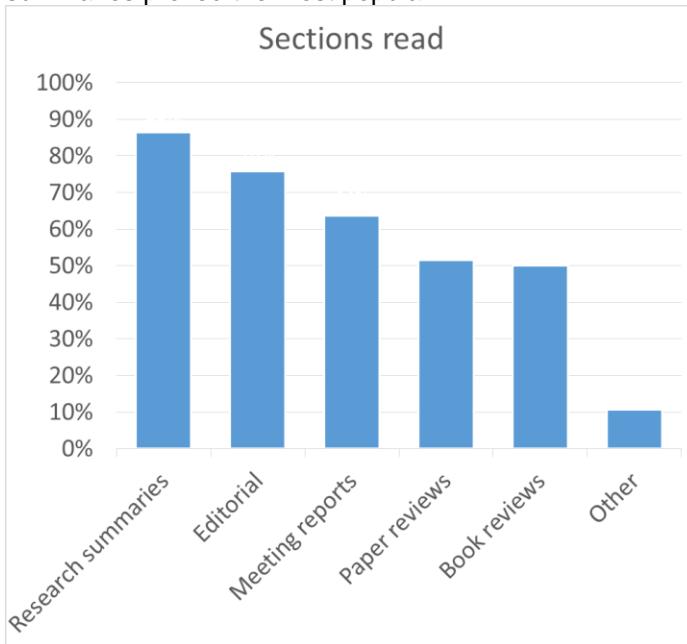
Figure 1. Responses analysed by sector

Reactions to the newsletter

More than three quarters of respondents said that they always or usually looked at the Energy Group newsletter.



When asked which sections of the newsletter people read, the research summaries proved the most popular.



Themes for future issues

There was a strong positive response to the suggestion of themed newsletter editions, with guest editors. Over 80% expressed their thought that this was a good idea, with a further one in six people indicating interest, depending on the topic. Suggestions for themed issues of the newsletter covered quite a wide range of topics, reflecting the diverse backgrounds of Energy Group members. Suggestions are grouped below.

Electricity grid:

- Grid challenges from integration of renewable generators
- Role of storage in electricity grids
- Impact of electric vehicles
- Electricity transmission
- ICT/smart/security impacts

Nuclear energy:

- New fission reactor concepts
- Waste and processing of spent fuel
- Decommissioning

Key renewable sectors:

- Tidal energy, wind power, solar; including latest advances
- Bioenergy, geothermal energy, solar photo catalysis/synthetic fuels
- Approaches taken in other countries

Others:

- Fusion
- Energy efficiency and social aspects of energy consumption
- Energy conversion
- Fossil fuels
- Materials issues

Political context:

- Energy policy
- Legislation and regulation

There was a desire expressed for contributions to be included from different standpoints, in order to achieve balanced coverage.

There was little or no mention of heat, transport (other than cars), built environment, or industrial processes.

Comments left by respondents

Positive feedback

I have no criticism to make of the content or format of recent newsletters and would congratulate the editorial team on their production. Objective criticisms of UK energy policies in various fields would be welcome.

The newsletter gives an interesting overview of physics-related energy topics.

As an educator, I particularly like articles that explain the underlying science and show how this affects industrial/large scale energy issues.

Well-constructed and always interesting

The comprehensive reports are good

Good reviews of technology

The newsletter doesn't take too long to read and the content has good depth to make it a very useful source of information.

Quite happy with the current format.

It's good as is

I like the newsletter - it's always interesting

Areas for improvement

These days the Newsletter largely ignores a number of important topics

Does not relate sufficiently closely the energy issues as they affect people

As someone who works outside research, I sometimes find the content a bit too focused on academia

Suggestions for new content

Community news

Energy Group Contacts

We welcome comments and suggestions for events and items for the newsletter. You may like to share a meeting report or provide a brief update on your research. If you would like take up one of the suggestions for a themed edition of the newsletter as guest editor, please get in touch.

Current Energy Group committee

Chair

Robin Morris, Energy Local CIC

Email: robin.morris@physics.org

Honorary Secretary

Dr Roger Welch, Philips Lighting

Email: roger.welch@gmail.com

Honorary Treasurer

Dr Jenny Love, UCL Energy Institute

Email: jenny.love@ucl.ac.uk

Committee

Colin Axon, Institute of Energy Futures, Brunel University

Professor Neil Hewitt, School of the Built Environment, University of Ulster

Dr Andrew Moffat, Frazer-Nash Consultancy

Professor Steve Roberts, Department of Materials, University of Oxford

Professor J Michael Walls, University of Loughborough

We are currently seeking nominations for four (4) Ordinary members and one (1) Early Career member to join the committee. For more information, see page 3.