EDITOR'S NOTES:
Welcome to the summer edition of the newsletter and the weather is certainly making its presence felt with the first hosepipe ban of the year in force and a shortage of CO2 being the most important problem for some!

We are now just two months away from our premier event ECCRIA 12, the 12th European Conference on Fuel and Energy Research and Its Applications, which you may be interested to note will be the last in the present series although our biennial event will continue but will be badged differently and will include a wider scope for topics and papers – but more of that later. We have already received a large numbers of abstracts so we are hopeful of having a full and varied series of oral and poster sessions. Don’t forget our “early bird” registration date of 13th July to qualify for reduced registration fees.

An added attraction to the September event in Cardiff is a TOTeM meeting. Topic Orientated Technical Meetings (TOTeMs) are a series of technical events brought to you by the International Flame Research Foundation (IFRF). TOTeM45 is entitled ‘Gas turbines for future energy systems’ and will incorporate sessions on flexible power (operations, fuels); storage-to-power (P2G, hydrogen, ammonia); decarbonised power (higher efficiency, carbon capture); lower cost of manufacture (additive manufacturing). This event will be held in partnership with Cardiff University’s Gas Turbine Research Centre (GTRC), the Fuel and Energy Research Forum (FERF) and the Advanced Power Generation Technology Forum (APGTF).

Contact Details:
General Secretary
Dr David McCaffrey
The Fuel and Energy Research Forum
Tel: 01242-236973
E-mail: mail@tferf.org
Website: http://www.tferf.org

Newsletter Editor & Treasurer
Dr Alan Thompson
The Fuel and Energy Research Forum
Tel: 01332-514768
E-mail: alan.thompson5511@btinternet.com
Student Bursaries for 2018-2019

Travel and subsistence bursaries of up to £300 are on offer to bona-fide full-time students who wish to attend appropriate National and International fuel and energy related conferences, (for example, the 12th ECCRIA Conference, please see the Calendar of Fuel and Energy Research Events for details of future conferences), and whose supervisor is a member of the Fuel and Energy Research Forum. To apply, please send the abstract submitted to the conference with a brief supporting letter from your supervisor together with details of the expected expenditure and other sources of funding applied for, to:

Professor J.W. Patrick,
Dept. of Chemical and Environmental Engineering,
Faculty of Engineering,
The University of Nottingham,
Energy Technologies Building,
Innovation Park, Triumph Road,
Nottingham NG7 2TU

The requirements for eligibility for award of a bursary are that the recipient will submit a short report about his or her impressions of the conference to the Newsletter Editor for inclusion in the next edition. In addition, this report will provide some brief details of the beneficiary, their topic of study and the reasons for wishing to attend the conference. Potential applicants should see the template for these reports on the FERF website, http://www.tferf.org where such reports must comply with these requirements.

Please note that these bursaries are only for travel and subsistence to attend the conference, (i.e. not for conference or other fees). In addition, priority will be given to applicants who will be attending the whole of a conference rather than one day of a multi-day event and will be using the conference accommodation provided should this be required. It may not be possible to fund all applications for bursaries or meet the request in full as this will depend on the funds available at the time.

---ooo---

Following the recent controversy over the use of biomass as a carbon-neutral energy source the following article from Chatham House may serve to clarify or at least provide a platform for some current thinking on the matter:-

Wood is not a Carbon-Neutral Energy Source

Chatham House’s recent paper, Woody Biomass for Power and Heat: Impacts on the Global Climate, highlights how the use of wood for electricity generation and heat in modern (non-traditional) technologies has grown rapidly in recent years, and has the potential to continue to do so. EU member states’ national targets for renewable energy generation agreed in 2009 have helped ensure that the EU is now the world’s largest producer and consumer of wood for energy. And although other member states use wood more extensively for heat, the UK is the EU’s largest user for electricity generation, mostly sourced from the US and Canada.

Wood for energy often has a positive image: a natural product of growing forests. The biomass energy industry, which has grown rapidly on the back of government subsidies, likes to contrast it with dirty coal or oil. They point to the government’s sustainability criteria, which
notionally guarantee a reduction of at least 60 per cent in greenhouse gas emissions compared to the fossil fuels the biomass replaces.

The problem with this happy picture, however, is that in fact biomass, when burnt, emits more carbon per unit of energy than most fossil fuels. The exact amount varies with the type of biomass and the type and age of the power plant, but figures from the Drax power station, Europe’s largest consumer of wood pellets, show that in 2013 it emitted about 13 per cent more carbon dioxide per unit of energy generated from biomass than from coal.

How is this consistent with meeting the government’s requirement for a 60 per cent reduction in emissions? Only by completely ignoring the carbon emitted when the wood is burnt; the sustainability criteria measure only supply-chain emissions from harvesting, processing and transporting the wood. (Direct land-use change – for example, clearance of the forest for agriculture or urban development – also falls outside the criteria, but biomass for energy generally originates from existing forests.)

This treatment of combustion emissions as zero – and thus, the awarding to wood the same kind of financial and regulatory support as other renewables such as solar PV and wind – is justified on the basis that the carbon contained in woody biomass is part of the natural forest cycle. The carbon released during combustion was absorbed by forest growth in the past and will be reabsorbed by forest growth in the future; in contrast, fossil fuels originate outside this cycle and their combustion adds carbon to the atmosphere.

But this argument rests on a basic fallacy. Carbon is carbon, wherever it comes from, and if you burn wood for energy, you increase carbon dioxide concentrations in the atmosphere (by more than if you had used fossil fuels), and thereby contribute to climate change. The fact that the carbon emitted was absorbed by growing trees in the past is simply irrelevant. After all, when it’s harvested you don’t have to burn it; you could use it for construction or furniture or window frames or a host of other uses, fixing the carbon in wood products rather than emitting it to the atmosphere.

Climate impacts
It is true that continued forest growth will absorb carbon in the future, but the process is a long one, taking decades or even centuries if whole trees are harvested and burnt. Replacing large mature trees, with plentiful leaf cover absorbing large volumes of carbon dioxide, with small young ones mean that the rate of carbon uptake will be far lower for years. On top of that, the impact of harvesting itself releases soil carbon into the atmosphere, further accelerating climate change.

The impact on the climate of using sawmill or forest residues for energy rather than whole trees is undoubtedly lower, since these tend to be wastes from other industries which harvest trees for their own purposes, and do not imply any additional harvesting. Sawmill wastes which, if left to themselves, would rot and release their stored carbon into the atmosphere in a matter of months or years, are in many ways the ideal feedstock; it makes sense to use them for energy rather than leave them to decay. However, mill residues are already intensively used and there seems little room for expansion; a survey in the US in 2011 (opens in new window) found that over 99 per cent of mill residues were already used, mainly for energy and wood products such as particleboard.

Forest residues are the parts of harvested trees that are left in the forest after log products have been removed, including stumps, tops and small branches, and pieces too short or defective to
be used; these can amount to as much as 40–60 per cent of the total tree volume. Their impact on the climate if used for energy varies significantly. While the smallest pieces tend to rot and release their stored carbon into the atmosphere quite quickly, if left in the forest, they are generally not suitable for use for energy, as they contain too much dirt and ash to be burnt cleanly. Larger pieces are more suitable but take much longer to decay; burning them for energy instead of leaving them in the forest thereby increases carbon concentrations in the atmosphere for years or decades. And on top of that, a portion of the carbon and other substances contained in the residues is transferred to the soil as they decay; their removal from the forest for energy may reduce both soil carbon and the levels of the nutrients trees need to grow, again with negative impacts on the climate.

The biomass industry generally likes to claim that it uses mainly mill and forest residues, though on closer inspection the categories they report often contain whole trees, perhaps classified as ‘unmerchantable’ or similar, (This is not helped by the fact the categories used by Ofgem, for example, to whom UK biomass users have to report, are confusing and potentially overlapping). Several independent studies, however, have concluded that the use of mill and forest residues is in reality substantially lower; pellet plants in the US – the UK’s main source of supply – in fact(source about 75 per cent whole trees.

Setting aside these arguments about feedstock, however, can it be safely assumed that future forest growth allows us to treat biomass as carbon-neutral? If the trees would have grown anyway, even in the absence of the biomass energy industry, it cannot be assumed that their future absorption of carbon cancels out the carbon emitted when wood is burnt. If the rate of carbon absorption in forests remains the same whether or not some of the harvested wood is burnt, then clearly, the best outcome for the climate in the short and probably medium term is not to burn it, but to use it for wood products or leave it to decay slowly in the forest. This is not an academic argument: the current global rate of emissions of greenhouse gases is incompatible with the aims of the Paris Agreement and may risk triggering irreversible tipping points in the Earth’s climate system. We need to reduce carbon emissions now, not in several decades’ or centuries’ time.

The biomass industry likes to point to the expansion of US forests in recent decades to show that forests overall have been absorbing more carbon even while increasing volumes are burnt for energy – sometimes implying that this forest growth has been encouraged by the demand for energy. But in fact US forest expansion started in the 1950s, decades before European subsidies stimulated the expansion of the modern biomass industry. And there is little evidence of recent overall forest growth in the US southeast, the location of almost all the pellet plants supplying European demand. In any case, the point is not whether US (or European) forests are expanding, but whether they would have grown at a different rate if part of their wood had not been burnt for energy. If they would have grown at the same rate, or faster, in the absence of biomass energy use then it cannot be assumed that using wood for biomass is good for forests, or the climate.

**Redirecting public money**

There is no question that renewable energy policy and forest policy both have a critical role to play in the mitigation of climate change. But governments have limited resources to deploy in their support, which is why the Chatham House paper questions whether it is really a good use of public money to subsidise activities which release stored forest carbon into the atmosphere, thereby increasing carbon emissions and accelerating climate change.
I argue instead that support should be limited to those feedstocks which genuinely reduce carbon emissions over the short term – i.e. mill residues and post-consumer wood waste. This would not only have a positive direct impact on the climate but would also release more resources for genuine zero-carbon technologies, such as solar, wind or tidal – and perhaps also for programmes encouraging afforestation and the more extensive use of wood in buildings and products. Use it, don’t burn it.

by Duncan Brack, 1st March 2017, Chatham House.

---ooo---

From Burn-out to New Burners and Beyond – or
How time ran out for the Coal Chemist!
by Alan Thompson

Many years ago when I was a fledgling coal chemist in the power generation industry the mantra for unburnt carbon was – “How low can you go?” And indeed, that was the case, the lower the carbon-in-ash the better it was for everyone - in terms of plant efficiency, the collectability and the re-use and resale of fly and bottom ash. Almost all of the fuels burnt were ‘fossil-fuels’ at that time and any other consequences such as NOx formation or CO2 build-up in the atmosphere were barely considered.

The method of achieving lowest unburnt carbon was simply to use the highest flame temperatures possible. I remember one colleague with a propensity for tongue-in-cheek comments saying to a potential client “NOx! How much do you want?” Needless to say, although coal-dependent, low unburnt carbon was relatively straightforward to achieve. Such a simple situation could not last and we soon found ourselves competing in a business, mainly across ‘the pond’, which not only wanted low carbon-in-ash but low NOx in their flue gas. This was also required in a strange unit of “Pounds per million BTUs”!! So, we had to quickly identify ways in which the various forms of NOx which occur during fossil fuel combustion could be controlled and it soon became obvious that the most effective ways of doing this were all at the expense of increasing the carbon-in-ash! Now wouldn’t you just know it!!

However, we were able to produce a series of totally new burner designs which had the effect of lowering the overall peak flame temperature. This combustion staging had the effect of reducing the contribution of so-called ‘thermal NOx’ which was formed by the direct combination of nitrogen and oxygen. Not surprisingly, the lower peak flame temperature also produced a poorer carbon burn-out. The other contributor to flue gas NOx is the nitrogen content of the coal and this was also linked to the amount of nitrogen that could be volatilised in the early stages of combustion. The new designs had to separate the combustion process into two distinct phases. The first, close to the burner throat, produced a recirculating oxygen-lean zone in which the nitrogen was volatilised from the coal and reduced to harmless nitrogen. In the tail of the flame, controlled amounts of air were admitted, and the nitrogen-lean char was burned out to produce mostly CO2 and some NOx. That was the theory and, to be fair, it did work up to a degree. Inevitably, it was a compromise between acceptable NOx and carbon-in-ash levels with agreement having to be reached with the client on what was required under closely specified boiler operating conditions.

At this time, I was heavily involved in the study of various coal qualities using drop-tube furnaces and thermogravimetric analysers. The idea was to determine the nitrogen content, volatility and char burn-out of the coals to allow us to predict how they were likely to perform in our low NOx burner systems. Many of the coals were from overseas and we had little
previous experience of their characteristics. In many cases they were being imported and burned in boilers designed for a diet of UK coals. A further complicating factor was the much wider variation, with consequent effects on combustion, of the petrographic analysis of the imported coals. Macerals, which, in simple terms, are the visually different organic components showed important variations in composition and these had profound effects on the level of unburnt carbon in the fly ash. The concept of reactive components in coal took on a real significance.

Armed with this new knowledge, and with much help from Ed Lester’s group at the University of Nottingham, we began to get a handle on the tricky requirements to achieve both low NOx and low carbon. Whilst this situation would have been fine, regulatory emission standards kept the goal posts moving and for us and other manufacturers, and in the wrong direction! Emission limits were being driven lower and lower making the required NOx/carbon-in-ash envelope more difficult to achieve. Whilst the Coal Chemist at this point did not metaphorically throw in the towel it was clearly time to (mixing metaphors) hand the baton to the combustion engineers! The time had come for SCR, selective catalytic reduction, and SNCR, selective non-catalytic reduction, using NOx reducing amines. It was apparent that the time for navel gazing into coal to solve this problem had, for the coal chemist, come to an end. Yes, the realisation that climate change was almost certainly real and that the future lay in “renewables” was finally sinking in. Coal chemists, as such, were now effectively redundant but, in my case at least, coal had helped me to pay off my mortgage!

---ooo---

Cardiff University
Venue for ECCRIA 12,
the 12th European Conference on Fuel and Energy Research and Its Applications

Cardiff’s history spans over 2000 years.
Cardiff’s rich culture has a diverse range of influences, from the Romans and Normans of antiquity to the industrial revolution and the coal industry – which transformed Cardiff from a small town into a thriving, international city.

Origins of the Name
There are two rival theories regarding the precise origins of the name Cardiff or Caerdydd in Welsh. There is uncertainty concerning the origin of “Caerdydd” — “Caer” means “fort” or “castle,” but although “Dydd” means “Day” in modern Welsh, it is unclear what was meant in this context. Some believe that “Dydd ” or “Diff” was a corruption of “Taf”, the river on which Cardiff Castle stands, in which case “Cardiff” would mean “the fort on the river Taff” (in Welsh the T mutates to D). A rival theory favours a link with Aulus Didius Gallus who was a Roman governor in the region at the time the fort was established. The name may have originated as Caer Didius – The Fort of Didius.

Roman origins
Cardiff lies at the centre of three river systems, the Taff, the Ely and the Rhymney. Its location allowed its first residents to control trade and movement along these rivers, giving them power over a large area. The first people to take advantage of this location were the Romans who set up a fort here on the site of Cardiff Castle about AD55-60. This dominating fort protected its inhabitants until about AD350-375 when it was abandoned at the end of Roman rule in Britain.
The Vikings and the Normans also made their presence felt in Cardiff, and then in 1091 Robert Fitzhamon began work on the castle keep, which has been at the heart of the city ever since.

**Medieval Cardiff**
The medieval castle dates from the 11th century, when the Normans conquered Glamorgan. It was begun by William the Conqueror on his return from St Davids in Pembrokeshire, in 1081. The castle was originally built in wood. In the 12th century, Robert Consol, Duke of Gloucester, rebuilt it in stone.

The medieval town started as a relatively small enclosure marked out by Working Street and Womanby (Hummanbye) Streets’ both names are linked to Old Norse. In the second stage of its development, Cardiff expanded south. The town was then enclosed and defended to the east by a bank and ditch and eventually a stone gate. To the west, the town was protected by the meandering river Taff. In the 15th century, the town was destroyed by Owain Glyndŵr’s Welsh army and the Castle lay in ruins until Richard Beauchamp, Earl of Warwick, restored the defences and castle buildings including the octagonal tower in 1423.

**Modern Cardiff**
Much of the rest of the castle and walls date back to the 19th century, when the third Marquess of Bute employed William Burges to restore, refurbish and rebuild it. In 1794, the ironmasters of Merthyr Tydfil opened the Glamorganshire Canal, which linked Merthyr Tydfil with Cardiff for the transport of iron and then later used to transport the huge amounts of coal for export following the opening of the West Bute Dock in 1839 by the 2nd Marquess of Bute. This saw Cardiff become the biggest coal exporting port in the world, resulting in Edward VII granting Cardiff city status in 1905. The port reached its peak in 1913, with more than 10 million tons going through the port. After going into decline in the 70’s and 80’s Cardiff’s docks and city centre have now been regenerated. Cardiff Bay is now a thriving waterside development, and the construction of the Millennium Stadium in the city centre helped transformed Cardiff into a true European capital city.

**Cardiff University**
The University opened its doors on 24 October 1883 and was formally established by Royal Charter in 1884. It was named the University College of South Wales and Monmouthshire and was tiny in comparison with just 13 academic staff, 12 departments, 102 full-time degree students and 49 part-time students. In 1893 it became one of the founding institutions of the University of Wales and began awarding their degrees. By 1972 it had taken the name University College, Cardiff. It merged with the University of Wales Institute of Science and Technology (UWIST) in 1988. In 1999 the public name of the University changed to Cardiff University. In 2004 the establishment merged with the University of Wales College of Medicine. The College of Medicine was part of the original University but had split off in 1931, making this a reunification. In December 2004 the Privy Council approved a new Supplemental Charter granting them university status. Their legal name was then changed to Cardiff University.

**Where is it?**
Cardiff, Wales’ capital is situated in South Wales, on the western side of Great Britain. It is easy to reach from anywhere in the UK or overseas. The closest capital to London, Cardiff is just two hours away by rail or road and only an hour and a half’s drive away from Heathrow.

Cardiff is an extremely accessible city, benefiting from excellent road, rail and air networks. There is an hourly high-speed train service to London, Paddington. It has easy connections to
Heathrow and Gatwick airports and has its own international airport. The M4 motorway provides fast links between Cardiff and the rest of the UK.

---ooo---

RESEARCH UPDATES

The Biomass and Fossil Fuel Research Alliance (BF2RA) – Research Portfolio Update

In late 2017 BF2RA issued a Targeted Call for Proposals that focussed on:-

- Condition Based Monitoring/Asset Management and Prediction Tools
- Plant Flexibility

Two projects have now been agreed for support as a result of this Call. Both relate to aspects of condition monitoring and will be undertaken by the Universities of Kent and Nottingham.

The Kent University research is titled “A condition-based monitoring and advisory tool for utility boilers” and will be a three year PhD study.

The University of Nottingham research is titled “Modelling creep and creep fatigue damage for power plant steels taking into account variable ductility and considerations for condition monitoring”. This will be a four year EngD within the Carbon Capture and Storage and Cleaner Fossil Energy Centre for Doctorate Training lead by the University of Nottingham.

Contracting and student recruitment is underway for both projects and autumn 2018 starts are anticipated.

BF2RA now has a total portfolio of some thirty projects of which fifteen are completed and the rest are ongoing or scheduled to start shortly. BF2RA research projects are mainly PhD and EngD studies with some post-doctoral studies.

For further information about BF2RA and Membership please visit www.bf2ra.org or email technical@bf2ra.org

---ooo---

Reports from the Technical Press

BIOMASS

Carbon Capture with Storage: A New Frontier for Biomass?
Biomass Magazine
As power prices have dropped consistently over the past decade, partly due to government renewable energy credits awarded lopsidedly to wind and solar, we have worked to ensure our members are capturing the many public benefits provided by biomass power. Aside from shoring up forest-based ...
Biomass Power Burns Quickly Through Legislature
ecoRI news

Woody biomass has been criticized by environmentalists who say that burning wood, and construction debris in particular, release high levels of particulate matter and carbon dioxide. Wood-based fuel has triggered a global debate as coal-burning power plants are being replaced in Europe and China ...

Drax planning to cut cost of biomass power by a third
Bioenergy Insight Magazine

A spokesperson for Drax told Bioenergy Insight: “We’re looking at a range of options – it’s too early to give details, but we’re looking to reduce biomass costs across the chain, from the fibre, through the processing, to the transportation. We want to transport more heat and less water in the fibre.” Gardiner ...

Drax plans to cut cost of biomass electricity by a third
Investing.com UK

LONDON (Reuters) - Britain’s Drax plans to cut the cost of the electricity it generates from biomass by a third over the next 10 years to reduce its reliance on subsidies, its CEO told Reuters. Drax, which generates about 6 percent of Britain’s electricity, has converted three of its previously coal-fired units to ...

Hardwood forests cut down to feed Drax Power plant, Channel 4 Dispatches claims
The Ecologist

Britain has pledged to cut carbon emissions by 57 percent by 2030 and getting Drax to switch from burning coal to wood is meant to play an important part in that. Drax now produces up to 17 percent of Britain’s ‘renewable’ electricity, enough to power four million homes. The power station giant claims ...

Wood pellets: Renewable, but not carbon neutral

A return to firewood is bad for forests and the climate.

Congress Says Biomass Is Carbon-Neutral, but Scientists Disagree
Scientific American

Lawmakers are once again pushing U.S. EPA and other federal agencies to recognize the burning of biomass as a carbon-neutral energy source. But scientists say that could be a bad move for the climate. A massive fiscal 2018 federal spending bill unveiled by congressional leaders Wednesday night ...

Wood pellets are renewable, but not carbon neutral
domain-B

A return to firewood is bad for forests and the climate. So reports William Schlesinger, President Emeritus of the Cary Institute of Ecosystem Studies, in an Insights article published today in the journal Science. In the race to meet clean energy standards, biomass energy is often touted as carbon neutral.

Are wood pellets a green fuel?
Science Magazine

Recently, attention has focused on woody biomass—a return to firewood—to generate electricity. Trees remove CO2 from the atmosphere, and burning wood returns it. But recent evidence shows that the use of wood as fuel is likely to result in net CO2 emissions and may endanger forest biodiversity.

Wood formation model to fuel progress in bioenergy, paper, new applications

Need stronger timber, better biofuels or new sources of green chemicals? A systems biology model developed over decades of research will accelerate progress in engineering trees for specific needs.
Debottlenecking of Sustainability Performance for Integrated Biomass Supply Chain

**Biomass** supply chain has been extended to cope with the growing concern on sustainability development and cleaner production. Process network optimisation is no.

**Biomass a modern and environmentally acceptable fuel**

The energy of the sun and carbon dioxide from the atmosphere are captured by plants during photosynthesis. Plant **biomass** can be used to absorb carbon dioxide emissions from fossil fuels, or it can be converted into modem energy carriers such as electricity, and liquid and gaseous fuels.

**When will the biomass bubble burst?**

www.businessgreen.com

Boiled down, that means burning **biomass** pours additional CO2 into the atmosphere just when we need to be reducing our global emissions to limit temperature rise to 1.5C as we agreed to in Paris. In the UK, from 1990 to 2014, gross CO2 emissions from **biomass** in the energy sector increased 998 per ...

**Prime Minister opens BCA biomass facility**

Windsor Express

The UK’s first **biomass** training facility at a further education college was opened by the Prime Minister on Friday. The Energy Centre at the Berkshire College of Agriculture (BCA) is the result of a collaboration between the college, the Thames Valley Berkshire Local Enterprise Partnership (LEP) and LC ...

**Debate Continues Over Carbon Neutrality of Biomass**

Energy Collective

However, designating energy derived from the burning of **biomass** as carbon neutral is in line with the wishes of many in the industry. ... bill introduced in March of this year encouraged officials to “reflect the carbon-neutrality of forest bioenergy and recognize **biomass** as a renewable energy source.

**Novel approach for photosynthetic production of carbon neutral biofuel from green algae**

Reducing carbon emissions in order to prevent climate change requires developing new technologies for sustainable and renewable biofuel production. Molecular hydrogen is regarded as one of the most promising energy carriers due to its high energy density and clean, carbon-free use. A research group has discovered an efficient way for transforming solar energy into the chemical energy of biohydrogen through the photosynthesis of green algae that function as cell factories.

**EIA: Biomass power capacity to increase in 2018**

Biomass Magazine

Wood **biomass** is expected to be used to generate 119,000 MWh per day of electricity this year, increasing to 120,000 MWh per day next year.

**'Hugely exciting': Drax to test carbon capture technology at North Yorkshire biomass plant**

www.businessgreen.com

The other three units still run on coal, although the company recently said it ... and clean growth minister Claire Perry hailed today’s news as “hugely exciting”.... Unlike coal, biomass generation uses wood pellets which naturally ...

**Efficient Hydrogen Production by Direct Electrolysis of Waste Biomass at Intermediate Temperatures**

acs.org
Making efficient use of biomass
Phys.Org
The torrefied biomass is water repellent and has significantly improved combustion properties, since it is composed purely of hydrogen and carbon.

EU researchers develop biomass torrefaction process
Biomass Magazine
A new steam drying technique for wood developed through the EU-funded SteamBio project could significantly reduce transportation costs for ...

Indexing belt filter extracts reusable substances from biomass and significantly streamlines the ...
Creamer Media's Engineering News
For example, the specialists for solid-liquid separation were commissioned by a Swedish company with extracting valuable substances from biomass.

New Steam Drying Technique Could Make Efficient Use of Biomass
AZoCleantech
However, the major challenge is to find out novel ways to treat biomass so that sustainable products and manufacturing processes can be achieved.

The UK’s move away from coal means they’re burning wood from the US
KERA News
The 12 cooling towers at the Drax Power Station have dominated the flat North Yorkshire countryside since the plant was built to burn coal from local ...

Burning Wood as Renewable Energy Threatens Europe's Climate Goals
InsideClimate News
By counting forest biomass, such as wood pellets used in power plants, as carbon-neutral, the new rules could make it impossible for Europe to .

CO2 RELATED

Converting CO2 to store renewable energy
Phys.Org
Formic acid as sustainable fuel. Eventually, Birdja focused his research on the production of formic acid. This liquid fuel is easier to use than, for instance, hydrogen, since storage and transport take place under simpler conditions. "My task is to produce chemicals for the storage of sustainable energy.

Carbon dioxide as a raw material
Researchers have found a way to turn climate-damaging CO2 into an alcohol that could serve as a raw material for the chemical industry - without producing large amounts of salt waste that usually arise.

DME As An Alternative Fuel Produced From CO2-enhanced Gasification Of Biomass
Science Trends
The use of CO2 as a gasifying agent in biomass gasification has gained interest over the past few decades. One advantage to using CO2 is that by adjusting its levels the H2/CO ratio will also change which therefore allows for the water gas shift reaction to being avoided. Another benefit to the process is ...

New Technology Cleans Up Fossil Fuels
R & D Magazine
Scientists may have discovered a way to efficiently utilize coal, shale gas and biomass as energy sources, while consuming the carbon dioxide before it can enter the atmosphere as a greenhouse gas. A team from The Ohio State University has developed new technologies that could economically...

**The case for burning our way to a cleaner planet**
Popular Science
Nevertheless, it's an intriguing idea that algae — made with some of the carbon dioxide emitted by burning biomass — can be used to shore up the...

**Technique doubles conversion of CO2 to plastic component**
Fossil fuels have long been the precursor to plastic, but new research has detailed a technique for doubling the amount of carbon dioxide that gets converted to ethylene -- an essential component of the world's most common plastic.

**New catalyst upgrades greenhouse gas into renewable hydrocarbons**
Engineers have designed a most efficient and stable process for converting climate-warming carbon dioxide into a key chemical building block for plastics -- all powered using renewable electricity.

**CO2 from Dutch Waste to Energy Plant to be Used in Horticultural Greenhouses**
Dutch waste recycling and waste to energy firm, AVR, will start the construction of a large-scale CO2 capture system as it seeks to reduce its...

**How to suck carbon dioxide from the sky for fuels and more**
Someday, the gasoline you buy might come from carbon dioxide pulled out of the sky rather than from oil pumped out of the ground. By removing emitted carbon dioxide from the atmosphere and turning it into fresh fuels, engineers have demonstrated a scalable and cost-effective way to make deep cuts in the carbon footprint of transportation with minimal disruption to existing vehicles.

**Scientists at a company part-owned by Bill Gates say they've found a cheap way to convert CO2 ...**
Canadian clean energy company Carbon Engineering, in partnership with ... It cleans up the environment, and produces eco-friendly liquid fuel at the same ... "Until now, research suggested it would cost $600 per ton to remove CO2 ..."

**MOF material offers selective, reversible and repeatable capture of toxic atmospheric gas**
Scientists have developed a metal-organic framework material with a selective, fully reversible and repeatable capability to remove atmospheric nitrogen dioxide gas in ambient conditions. The discovery, confirmed by researchers using neutron scattering, could facilitate air filtration technologies that capture and convert targeted gases, including carbon dioxide and other greenhouse gases, for long-term sequestration to mitigate air pollution and global warming.

**'Government must provide more certainty': Drax, biomass CCS, and the end of coal**
Of the six coal-fired power units at the North Yorkshire station, three have already been converted to run on biomass, which - long-running arguments ...

**COAL & FOSSIL FUEL RELATED**

**Burning coal may have caused Earth's worst mass extinction**
The Guardian
Burning coal may have caused Earth’s worst mass extinction .... Lead and mercury aren’t associated with volcanic ash, but they are a byproduct of burning coal. Burger also ... And unlike many news organisations, we haven’t put up a paywall – we want to keep our journalism as open as we can. So you ...

**UK’s coal output fell to record lows in 2017**
Energy Live News - Energy Made Easy
The UK’s coal output fell to a record low level of 6.7% of the generation mix in 2017. That’s according to new data from the Department for Business, Energy and Industrial Strategy (BEIS), which shows output from oil and nuclear also fell slightly. Total energy production over the year was 0.4% higher ...

**Britain powers on without coal for three days**
BBC News
Britain has not generated electricity from coal for more than three days - the longest streak since the 1880s. The new record comes just days after the last record of 55 hours was set, National Grid said. The coal-free period began on Saturday at 1000 BST and has continued into Tuesday afternoon.

**Africa’s big carbon emitters admit they have a problem**
The Economist
AN HOUR east of Johannesburg, on the rolling highveld plains, six massive cooling towers sit around two belching smokestacks. The Kendal power station (pictured) is among the world’s largest, producing 4.1 gigawatts (GW) from burning coal. A few kilometres down the road there is another coal-fired ...

**Natural gas prices, not ‘war on coal,’ were key to coal power decline**
Steep declines in the use of coal for power generation over the past decade were caused largely by less expensive natural gas and the availability of wind energy -- not by environmental regulations.

**The Coal Plant Of The Future**
OilPrice.com
The U.S. Department of Energy (DOE) wants to develop so called “Coal-Based Power Plants of the Future” according to a recent Request for ..

**Drax switches off coal unit ahead of biomass conversion**
Utility Week
Drax has switched off one of the three remaining coal units at its power station in Yorkshire as it prepares to convert the unit to run on biomass.

**Insight | How UK power plants are going coal-free**
New Civil Engineer
Within the next seven years the UK will phase out unabated coal generation, and energy companies will have to either close power stations or adapt ...

**Cementless fly ash binder makes concrete ‘green’**
Engineers have developed a composite binder made primarily of fly ash, a byproduct of coal-fired power plants, that can replace Portland cement in concrete.

**Top nitrogen researchers imagine world beyond fossil fuels**
At the invitation of the U.S. Department of Energy’s Office of Basic Energy Sciences, 17 top experts in nitrogen research gathered to discuss nitrogen activation chemistry and the field’s future.

**Could Nitrogen & Renewables Spell The End Of Fossil Fuels?**
CleanTechnica
It really prefers to stay in the form of nitrogen gas — N2 to you organic ... the Northwestern Solar Energy Research Center at Northwestern University.

**Big four banks quit coal only to invest in other fossil fuels, research finds**
The Guardian
Big four banks quit coal only to invest in other fossil fuels, research finds ... less into fossil fuels but still more than on renewable energy projects.

**The Shift from Coal to Biomass Is on in Europe**
POWER magazine
With rising carbon prices, some big utilities are repowering with sustainable biomass. The European Union (EU) is preparing to fully generate 20% of ...

**How long before the world runs out of fossil fuels?**
ZME Science
Fossil fuels are the main source of energy in the world, powering much of ... In 2006, however, the Cambridge Energy Research Associates (CERA) ...

**GAS**

**How bacteria could help turn a potent greenhouse gas into renewable fuel**
Phys.Org
As part of the Future Energy Systems research initiative, University of Alberta biological sciences researcher Lisa Stein and chemical engineering researcher Dominic Sauvageau are genetically engineering non-hazardous bacteria that consume methane, one of the most potent greenhouse gases, and ...

**Confined gas research could expand natural gas market**
Researchers are developing new ways to store, separate, and transport gases.

**30 percent of the UK’s natural gas could be replaced by hydrogen, cutting carbon emissions**
Almost a third of the natural gas fueling UK homes and businesses could be replaced by hydrogen, a carbon free fuel, without requiring any changes to the nation's boilers and ovens.

**New material for splitting water**
Solar energy is clean and abundant, but when the sun isn’t shining, you must store the energy in batteries or through a process called photocatalysis. In photocatalytic water splitting, sunlight separates water into hydrogen and oxygen, which can then be recombined in a fuel cell to release energy. Now, a new class of materials -- halide double perovskites -- may have just the right properties to split water.

**GENERAL**

**University of Nottingham to withdraw from £3m fossil fuel investments**
The Business Desk
Vice-chancellor Professor Shearer West said: “Fossil fuel divestment is an important part of our global outlook, ethical values and commitment to environmental sustainability. “Our research has a well-deserved reputation for supporting a more sustainable planet in greener sources of energy, food supply ...

**New materials for sustainable, low-cost batteries**
Posted: 30 Apr 2018 04:56 AM PDT
A new conductor material and a new electrode material could pave the way for inexpensive batteries and therefore the large-scale storage of renewable energies.

’From coal to clean’ – UK does not need to turn to gas, says WWF
The Guardian
The UK has no need to build new large gas-fired power stations to replace the coal plants that the government has pledged to switch off by 2025, the..

Lignin -- A supergreen fuel for fuel cells
EurekAlert (press release)
Researchers from the Laboratory of Organic Electronics at Linköping ... Researchers at the Organic Energy Materials group at LiU, led by Professor ...

UK could end up with power stations with NO fuel after Brexit, says nuclear industry boss
Express.co.uk
... the transportation of radioactive materials needed in nuclear energy and research— could result in no fuel for British power stations after Brexit.

Power station boss warns against reliance on electricity imports
The Guardian
... said Gardiner, who wants to build a vast new gas power and battery storage plant at the company's North Yorkshire coal and biomass power station.

Can we get 100 percent of our energy from renewable sources?
Some researchers doubted the feasibility of many of the recent scenarios for high shares of renewable energy. Now scientists have hit back with their response to the points raised. They demonstrate that there are no roadblocks on the way to a 100 percent renewable future.

Advanced biofuels can be produced extremely efficiently
Phys.Org
A chance to switch to renewable sources for heating, electricity and fuel, while also ... The Swedish Energy Agency has funded energy research and ...

Brexit uncertainty threatens fusion-energy research
Nature.com
Brexit uncertainty threatens fusion-energy research ... of two hydrogen isotopes, deuterium and tritium, to mimic ITER's planned eventual fuel mix.

'Carbon bubble' coming that could wipe trillions from the global economy
Unlike current expectations, new research suggests that the prospects of the fossil-fuel industry are not bright, and that its demise may have profound economic and geopolitical consequences. Relying on ground breaking modelling techniques, researchers show that the consumption of fossil fuels will slow down or decline in the near future, as a result of ongoing technological change, potentially exacerbated by new climate policies.

“Schizophrenia” of the UK Government on Bioenergy
Natural Resources Defense Council
UK policymakers have spent billions in British taxpayer resources subsidizing coal plants to convert to burning biomass—a fancy word for ...

New system recovers fresh water from power plants
A system devised by engineers recovers fresh water from power plants. It could provide a low-cost source of drinking water for parched cities around the world, while also cutting plant operating costs.

RECYCLING & PLASTICS

Scourge Of The Seas: How China Is Tackling The Ocean’s Plastic Problem
Forbes
China, in turn, was recycling waste plastic to supplement its feedstock of virgin resin to make plastic, of which it was the world’s largest producer (at ... streams for waste-to-energy and capturing plastic bottles and other high-value recycling plastics that are currently not pulled out by garbage pickers, that ...

**New enzyme nibbles on nasty plastic waste**

Energy Live News - Energy Made Easy

It is able to reverse the manufacturing process and reduce polyesters to their building blocks, from which they can be reused. Originally discovered in Japan, the enzyme is produced by the Ideonella sakaiensis bacteria, which uses the plastic as its main source of energy. UK consumers use around 13..

**Engineering a plastic-eating enzyme**

Scientists have engineered an enzyme which can digest some of our most commonly polluting plastics, providing a potential solution to one of the world’s biggest environmental problems.

**Costa Coffee pledges to recycle 500m takeaway cups by 2020**

Energy Business Review

“We have set our own target to recycle the same volume of takeaway cups we use every year and call on other cup retailers to join and help to build a dynamic market for takeaway coffee cup recycling.” UK waste collection companies Veolia, Biffa, Suez, Grundon and First Mile are cooperating with ...

**Five myths about recycling**

gulfnews.com

1: Recycling uses more energy than making something new. This myth has been kicking around for decades. Daniel K. Benjamin, a senior fellow at the Property and Environment Research Centre, recently told Big Think, “In most cities across the nation, recycling of household trash is, in fact, wasteful, ...

**Greener way of making plastics**

A new catalyst allows for the conversion of the green house gas carbon dioxide to an industrial precursor for many plastics as an alternative to using petroleum raw materials.

**Soils help Scotland boost recycling to 60%**

letsrecycle.com

However, incineration of waste from Scotland in 2016 increased. There were 527,082 tonnes of waste recovered by incineration with energy recovery ...

**Plastic recycling dilemma in the EU**

EURACTIV

The EU is in a desperate search for a sustainable circular economy. But critics warn that the imminent adoption of waste recycling targets for 2035 is ...

**Better recycling of electrical and electronic waste**

euronews

Many of these precious materials can be recycled and used again. Producing goods using recycled materials is often less energy intensive than using ...

**WASTES**

**Why Recycling and Waste Reduction Matter**

Earth911.com

Recycling can minimize the rate of global climate change by reducing the extraction of raw materials from the earth and the amount of fossil fuel burnt in the manufacturing process. Waste prevention is even more effective — like recycling, it diminishes the need for raw materials, saves energy and fossil ...
Not all e-waste recycling is created equal.
Mashable
According to Earth 911, more than 70 percent of a gadget can be recycled. That’s because they’re made of valuable substances like plastic, steel, aluminium, copper, gold, and silver. The more these items are re-claimed, the less electronics manufacturers have to use energy to create substances like ...

EU must not count burning waste as renewable power
Energy Live News - Energy Made Easy
A group of environmental organisations and businesses involved in recycling, forestry and bioenergy have called on EU policymakers to prevent the burning of unrecyclable waste being counted as renewable energy. Organisations including Zero Waste Europe, the European Environmental Bureau and ...

Worries mount over waste incineration as ‘renewable energy’
EURACTIV
Waste-to-energy industries say incineration can play a role in recovering energy from waste that cannot be recycled, in line with the waste hierarchy. Modern technologies are available that address air pollution issues associated with burning, which is a better option than landfilling anyway, the industry ...

Shell, British Airways working with waste-to-fuel company to produce sustainable jet fuel
JWN
Shell, British Airways working with waste-to-fuel company to produce ... fuel research project coordinated by Italy's RE-CORD (Renewable Energy ...

Scientists calculate impact of China’s ban on plastic waste imports
Scientists have calculated the potential global impact of China’s ban on plastic waste imports and how this policy might affect efforts to reduce the amount of plastic waste entering the world’s landfills and natural environment.

EU’s proposed tax on burning plastic waste is counter-productive
EURACTIV
The CO2 emissions reduction achieved by plastic recycling are very costly when compared to alternatives like wind energy and solar PV, while much ...

---ooo---
## CALENDAR OF FUEL AND ENERGY RESEARCH MEETINGS AND EVENTS

<table>
<thead>
<tr>
<th>Date</th>
<th>Title</th>
<th>Location</th>
<th>Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd to 4th September 2018</td>
<td>45th Topic-Orientated Technical Meeting, (TOTeM45), “Gas Turbines for Future Energy Systems”.</td>
<td>Cardiff University, The Queens Building, Newport Road, Cardiff</td>
<td>Mr Philip Sharman, Director International Flame Research Foundation, (IFRF) Tel: 07976-847305 E-mail: <a href="mailto:philip.sharman@ifrf.net">philip.sharman@ifrf.net</a></td>
</tr>
<tr>
<td>Wednesday 5th to Friday 7th September 2018</td>
<td>12th ECCRIA Conference, The European Conference on Fuel and Energy Research and its Applications, (ECCRIA 12). Conference Website: <a href="http://www.eccria-conferences.org">www.eccria-conferences.org</a>.</td>
<td>Cardiff University, The Queens Building, Newport Road, Cardiff</td>
<td>Dr. David J.A. McCaffrey 12th ECCRIA Conference Chairman Secretary of the Fuel &amp; Energy Research Forum Tel: 01242-236973 E-mail: <a href="mailto:mail@tferf.org">mail@tferf.org</a> Dr Robert Berry 12th ECCRIA Conference Secretary Tel. 02058-331-9401 E-mail: <a href="mailto:r.j.berry@gre.ac.uk">r.j.berry@gre.ac.uk</a></td>
</tr>
<tr>
<td>10th to 14th September 2018</td>
<td>CHoPS 2018, 9th International Conference on Conveying and Handling of Particulate Solids</td>
<td>University of Greenwich, Greenwich Maritime Campus, London</td>
<td>Conference Secretariat Deborah Reed-Aspley at Constable &amp; Smith Events E-mail: <a href="mailto:deborah@constableandsmith.com">deborah@constableandsmith.com</a> 4, Vincent Avenue, Beeston, Nottingham, NG9 1GU Tel : 0115-922-9422 Website: <a href="http://www.chops2018.org">www.chops2018.org</a></td>
</tr>
<tr>
<td>11th to 13th September 2018</td>
<td>Cofiring 8 8th Workshop on Cofiring Biomass with Coal</td>
<td>Admiral Hotel, Copenhagen, Denmark</td>
<td>For more information visit:- <a href="https://www.cofiring-workshops.org/">https://www.cofiring-workshops.org/</a></td>
</tr>
<tr>
<td>10th to 12th September 2018</td>
<td>3rd International Conference on Energy Production and Management, Energy Quest 2018</td>
<td>New Forest, U.K.</td>
<td>Wessex Institute, Ashurst, Southampton. +44 (0)238) 029 2853. Email <a href="mailto:wit@wessex.ac.uk">wit@wessex.ac.uk</a></td>
</tr>
<tr>
<td>8th to 9th November 2018</td>
<td>IV Energy and Materials Research Conference – EMR2018</td>
<td>Torremolinos, Spain</td>
<td>Contact details: Enrique Torres EMR2018 Conference web: <a href="http://www.emrconference.org">www.emrconference.org</a> email: <a href="mailto:emr2018@emrconference.org">emr2018@emrconference.org</a> Phone: +34924258615</td>
</tr>
<tr>
<td>Provisionally, Thursday 6th December 2018</td>
<td>“New Realities for Power Generation in the UK; How the Market has Changed and What it Means for Research Priorities”, Inaugural Seminar of the FERF Advanced Power Generation and Gasification Interest Group</td>
<td>Provisionally, The Engineering Academy, Ratcliffe Power Station, Ratcliffe-on-Soar, Nottinghamshire</td>
<td>Dr Robin Irons, Advanced Power Generation and Gasification Interest Group Coordinator, University of Nottingham, Tel : 0115-748-4098. E-mail: <a href="mailto:Robin.Irons1@nottingham.ac.uk">Robin.Irons1@nottingham.ac.uk</a></td>
</tr>
</tbody>
</table>