Irish Manufacturing Research
Research & Technology Organisation
ADVANCED MANUFACTURING IRELAND

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# ENERGY SYMPOSIUM 2017

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# Introduction

Another very successful IMR Energy Symposium was held in Cong on the 19th and 20th October 2017. This was the second year of Energy Symposium and it aims to establish itself as an annual mechanism for industry professionals to share their insights and knowledge. The symposium enables a dialogue between Industry and Government to define the research and innovation required to support Ireland's Energy Transition.

## Energy Symposium Themes

The two main themes for Energy Symposium 2017 were Climate Change and the Circular Economy, the importance of both having been brought into focus by recent events currently affecting Ireland.

The adverse weather pattern, from Hurricane Ophelia that affected Ireland during the week of the symposium brought home how changing climatic conditions affect us all. Additionally the uncertainty arising from Brexit means that all Irish businesses need to look again at how they do business, as traditional trading and partnership arrangements come under threat, and this was an underlying theme during the discussions on the circular economy.

The concept of the circular economy, whereby we need to transition from an economy where waste is acceptable, to one where waste is designed out, means that businesses need to consider not just how they do business as an individual entity but to consider how their overall supply and value chains need to evolve. Considering how business may adapt new business models, re-design product and services for on-going rather than singular use, selection of new materials to avoid further damage to the environment, are all parts of a circular economy approach. The challenge of Brexit and the need to find new customers and business partners resonate with these circular economy principles as they both share the core objectives of creating new business opportunities by opening up to their suppliers and other industrial partners.

Under the main theme of Climate change, this symposium looked at four main topics; (i) the social and behavioural barriers to the energy transition, (ii) energy efficiency opportunities on the demand side, (iii) new technology and innovation on the supply side and (iv) optimisation of existing industrial systems. These themes relate directly to the Governments national strategy and roadmap for energy research in Ireland and support the ambition to establish Ireland internationally as an 'Energy Innovation Hub'.

## Energy Symposium Participants

The attendees at this year's Energy Symposium comprised a broad cross section of Ireland's industrial ecosystem, ranging from academic institutions, government agencies, large energy users, technical consultants and product manufacturers. Bringing together all the major actors in Ireland's industrial energy system provided a unique opportunity to discuss, debate, learn and to instigate actions that otherwise would not happen.

# Energy Symposium Proceedings

The Energy Symposium commenced on the Thursday evening in the setting of Ashford Castle. IMR CEO Barry Kennedy, opened the proceedings by welcoming the participants, setting the scene and introducing the keynote speakers.



Bob Hanna, Chief Technical Advisor to the Minister for Communications, Climate Action and Environment, provided insights around current government policy and relayed a message from Minister Naughton on the importance of the Energy Symposium, reiterating that his department is looking forward to receiving the symposium outputs and translating them into specific actions related to energy research. Bob finished by advocating the advancement of the circular economy as a means of direct action to address climate change.

The keynote speaker on Climate Change was Raoul Empey, who was personally trained by former U.S. Vice President Al Gore. Raoul delivered a thought provoking Climate Reality presentation which was well received and set the scene for the context of further discussions during the symposium.

Providing the keynote speech on the Circular Economy was Louis Roy, a highly praised entrepreneur and global leader. Louis provided insights from his journey and set the scene for the new thinking required as we transition towards the circular or sustainable economy.

Friday saw the start of the main symposium activities in the village of Cong. The unique setting of Cong and the innovative coffee shop approach to get people talking should not be underestimated. There is a long tradition going back to the 16th century of coffee houses being synonymous with conversation, debate, and politics. Historically these were meeting places that provided an equality of status and opinion not common in other parts of society.

Participants at the Energy Symposium were organized into discrete huddles around the village and discussions were divided into three sessions over the course of the day. Between each session participants moved around the coffee houses, networking, meeting others and identifying new business opportunities. Each huddle lasted approximately an hour and a half, chaired by expert facilitators with the outputs being recorded by dedicated rapporteurs. During these sessions, participants were invited to present on their previously submitted papers, following which peer group discussions took place. In addition, thoughts and opinions were solicited on the symposium themes. These discussions were captured and will form part of policy paper submissions to government.

# Energy Symposium Findings

The detailed findings of the Energy Symposium are contained in the Energy Research and Circular Economy position papers. However, some of the main findings are summarised as follows;

## 1. Social and Behavioural Aspects to Energy Transition

### Barriers to adoption of new technologies / systems

A common view that was expressed by those present was that technology and systems aren't the big barriers to making progress but rather it is the multiplicity of players/agencies/departments – each with their own angle/agenda – and that there is no single player with overall driving responsibility.

### Utilisation of Data

It was felt that in order to change current reactive behaviours, towards desired proactive behaviours, that there is a need for the availability of more real time data sets. In addition it was highlighted that there is a skill shortage related to the availability of data scientists and the use of applied math in relation to energy conservation.

### Corporate Policy and Social Responsibility

A two-year business payback window was again highlighted as a barrier. This short-term view is at odds with supporting future generations. There is a missing "link" between long-term thinking to address climate change and getting past the two-year corporate payback policy.

## 2. Demand Focus - Energy Efficiency

### Heating Systems- Spatial Planning

A discussion area was the impact that spatial planning has on Energy demand. Topics discussed included power generation locations, one-off housing, heat mapping, viability of district heating, and existing and future planning legislation. The 2040 National Planning Framework was highlighted as an opportunity to address legacy issues and to match supply or heat wastage with demand requirements. The increase in data centres and the potential to capture waste heat as done in other EU countries was also discussed.

### Energy Management - Project Barriers

Risk aversion is seen as major issue and where benefits are not black and white, it often difficult to persuade operational personnel. Additionally if top management are not supportive of the project, then the projects are unlikely to be successful. The need for motivated personnel and appropriate organisation structure was identified as a key success factor.

### Building Management systems

A need for greater knowledge around monitoring and measuring was discussed and that existing BMS (Building Management Systems) were not always helpful for Energy Management. A cross-functional group comprising indus-

try and academia that addressed operational efficiency, control systems and energy management was suggested as a means of increasing knowledge around energy demand management.

## 3. Supply Focus

### Government Policies

It was identified in discussions that there is a danger that Government engages in a number of supply initiatives, that whilst holistic in nature, may distract from prioritizing specific supply initiatives that give the largest benefit for Ireland in terms of climate friendly sustainable supply e.g. Wave and Wind may require a bigger capital investment at Government level but the four years cycle of political change does not favour strategic investment decisions.

### Education & Training

Participants proposed that the introduction of more advanced training and education in energy in design engineering and trades needs to be propelled to ensure the skills and best practice emerge as de-facto standards of certification. The national education and training curricula needs to be examined to look at concepts like IOT and energy savings as one example where technology, energy and cost savings and carbon reduction are required.

## 4. Systems Optimisation

### Planning / Legislation

Participants also felt that the applications of technologies (providing greater efficiencies / decarbonisation) are being held back by the lack of legislation and compromised planning. There was a view that a significant number of the technologies that currently exist could go a long way to reducing carbon emissions if retrofitted or introduced at the planning stage.

### Innovation / Design

An issue raised was that there are huge difficulties for new entrants (both generators and demand customers) looking to come into the market; this applies to large internationals looking to locate their plants as demand customers here – particularly in the Dublin area. It was also suggested that demonstration projects should take place on the grid to show its capabilities and case studies were requested.

## 5. Circular Economy

Participants identified the following Irish Industrial Sectors as having the most potential for advancing the Circular Economy;

- Pharmaceutical
- Automotive
- Packing
- Food
- Data Centres
- Transport

Current barriers identified by participants included;

- Lack of joined up thinking
- Risks related to transparency and sharing of data
- Regulations related to transportation of waste

The suggestion to establish an industrial national steering committee to advance a circular economy was put forward and was unanimously welcomed. Further information on all of the above is contained in the Energy Research and Circular Economy position papers prepared by IMR.

## Reflections on Energy Symposium 2017

All respondents rated the event either 'good' or 'excellent' and suggested IMR hold this event again next year. Testimonials provided included the following;

- *"The most engaging conference format I have attended"*
- *"Excellent, innovative and interactive event"*
- *"One of the most novel and effective formats for smarter energy thinking"*
- *"Very informative - hearing from people outside your niche"*
- *"Critical thinking at citizenship level"*
- *"These testimonials echoed the message received from Minister Naughten prior to the Energy Symposium where he stated "It is really valuable when industry takes the initiative to facilitate consideration of some of the main issues of the day."*

We will also be providing the Department of Communications, Climate Action and Environment with the findings from the Symposium as well as engaging with them on national policy options going forward. An important element of this process is to provide the policy makers with a coherent view point from industry, academia & related partners on how we need to move forward as a country, rather than a series of unrelated vested interest groups.

# Energy Symposium 2017 Submissions

**Article:**

Aiden Cawly

SIEMENS
Ingenuity for life

The global energy transition is largely driven by political targets of Decarbonisation, Sustainability, Energy Efficiency and Resilience and now being accelerated through breakthroughs in technologies in Wind and PV power generation, Energy storage and digitalization.

This is placing electricity as one of the significant keys to reaching a sustainable Energy System. Large scale renewables are now being integrated into electricity systems in the form of Wind, PV, Hydro; distributed energy systems are being used to maximize energy system efficiency, local renewable integration, resiliency and the quickening of electrification of consumption such as e-Cars, heat pumps, etc.

This shift introduces new risks/ opportunities and in particular for the electricity system the terms being used are Cybersecurity, Power Quality and reliability of supply, Stability challenges, digitalization of energy and automated operation, Cheap storage disruption, Regulatory uncertainty and public acceptance.

The Irish Electricity system is not unique in this regard and is indeed being challenged to move quicker than it has ever moved in the past in the area of electrification:

- New loads requesting connections to the Dublin system is doubling the existing networks load for the city area in the next 5 years. These industrial loads in turn will build quickly and the global scale of their plans will put pressure on the global supply chain to meet said plans.
- New renewable generation in solar PV has an application for connection in the order of the current Wind generation in operation on the system
- A changing power flow environment in the low voltage distribution network with the quicker adoption of eVs into the transport system is likely moving into 2020.
- The newly defined Systems services market under DS3 puts a greater emphasis on resilience and flexibility over capacity making the rise of new business models and storage of power attract significant investment attention.

There is a greater demand for Agility in Energy to meet the increased Electrification, Automation and Digitalisation and the following 3 examples are solutions that Siemens are applying to assist the market to meet the same.

Modular High Voltage electrical substations (up to 400kV GIS) that comes completely factory prefabrication with off-site Integrated FAT. Such an approach supports lower health and safety risk during site activities, based on standard GIS technology and configurations quicker delivery times as produced in a factory environment.

# Energy Symposium 2017 Submissions

The most significant point of failure in any connection to the Grid is through the power transformer. Siemens has developed a a transformer resilience concept called PRE-TACT that creates solutions in dialog with the customers to prevent operational risks, protect against vandalism & excessive heating and more importantly to be able to react to emergencies through mobile solutions, rapid installation methods and a versatile device to meet a number of installation voltages in the customers system.

Power storage (utility and distributed) at scale in the electricity system creates the opportunity to optimized performance of conventional assets and opens new opportunities for grid and ancillary services. Siemens have recently launched Storage as a Service offering in a number of European markets where the investor is only interested in supplying the service to the market and does not want to own or operate the battery system.

The demands for the Electricity System to be more agile and deliver its many stakeholders expectations will be significantly important as we move to 2020. Ths shift will be towards Agility to deliver, flexibility to meet market requirements and over all a very high level of resilience.

# Energy Symposium 2017 Submissions

## Energy engagement is not business as usual

Ben Austen

Seagate

**Synopsis:**

Energy Management is a complex process with both internal and external business influences and extends far beyond any business as usual scenario.

Business is principally focused on selling product and reducing cost. Energy management rarely coexists with these two finite business components, usually only forming part of environmental compliance. Enabling business and management to understand this complex subject, provide sound engineering decisions and show tangible gains are paramount for business engagement.

Barriers to achieving engagement and integration of energy management are a lack of a clear management process and commitment, poor monitoring techniques, lack of knowledge and resources and critically lack of ability to identify project & maintenance work that generates real opportunity for the business.

**Introduction:**

Energy Management is a complex process with both internal and external business influences and extends far beyond business as usual.

External influences include energy markets and legislative compliance. Market structures are highly complex and require knowledge and advise from many external parties in making decisions on energy expenditure. Legislative compliance is also extensive including the Climate Change Agreement and adherence to European directives.

Business is principally focused on selling product and reducing cost. Energy management rarely coexists with these business components. Energy projects are generally not justifiable on their own merits either because of poor return on investment or potential risk to the business model thus affecting internal decisions on energy initiatives and reduction targets.

Enabling business to understand this complex subject and identifying opportunity is essential to influencing internal decision making and hence development and advancement of any energy reduction programme.

Barriers that affect the successful outcome of this programme include the extent of the monitoring & measurement system, level of knowledge, resources and mechanisms to identify project & maintenance works. Whatever solutions may exist; they must be easy to integrate to existing systems.

**Monitoring & measurement system**

Measurement of data, development of analytical tools and how this is extrapolated is key to unlocking many of the day to day operational issues and hence excess use of energy in industrial applications.

### About Ben Austen:

Ben Austen, C.Eng,M.Eng, B.Eng, CEM
Senior Staff program manager

Seagate Technology Ireland for last 10 years in Facilities Engineering & Equipment Support Group
Specialist areas - Energy management, Project Management, Business Continuity

Previously:
Pharmacuetical Design & Commissioning Engineer, DPS Engineering
Process Technician,School of Biotechnology, Dublin City University

# Energy Symposium 2017 Submissions

Building management systems have developed but not in line with advanced manufacturing facilities. Energy monitoring requires reliable and robust hardware & software solutions to capture and highlight use of energy.

Research focus should be on particular facilities and tooling systems that are known significant energy users including chilled water systems, HVAC, and fan systems. However, advancement needs to be made in the developing the monitoring and diagnostics platforms including integrated tools for energy analysis and comparative modelling tools on design verses actual operation. However, any application must not be onerous but ease to use and practical in the real world environment.

**Knowledge and resources**

Experience has shown a significant knowledge deficit when dealing with equipment operating parameters and energy related problems. This has been seen for example in the use of air handling units and the relationship to the space it is supplying. Little understanding of the use of energy in equipment translates to a poor overriding energy assessment.

There is a deficit in knowledge and understanding of key process inputs (KPI's) or Energy performance indicators (EPI's), identification of areas of significant energy use (SEU's) and ultimately how those systems are assessed for energy use.

Translating theoretical knowledge to actual live systems has always been the main challenge for employers. Opportunity exists to develop analytical tools and/or improve teaching techniques so that energy performance indicators can be determined.

**Maintenance opportunities & project work**

Effective preventative maintenance programmes are essential to sustain the efficiency of plant. This needs to extend down the operational chain as ultimately it is technical personnel that maintain the equipment. Good asset management software is essential for maintaining assets to their original state. Preventative maintenance packages tend to be a glorified timetabling package, not used to their full potential and generally do not encompass energy management.

Research opportunity may exist in the development of integrated maintenance & energy planning application with teaching tools.

Driving down the return on investment (ROI) is essential to enabling energy projects. Opportunities are becoming more difficult to find and hence good ROI's (<5 years) less achievable. Energy efficient equipment in general is more expensive to purchase. Research opportunity may exist in collaboration with suppliers to either develop engineering solutions for existing plant eg. motor, fan chiller plant upgrades or finding cost effective replacement solutions.

# Energy Symposium 2017 Submissions

**Seagate Technology profile**

Seagate is a global leader in data storage solutions, developing amazing products that enable people and businesses around the world to create, share and preserve their most critical memories and business data. Over the years the amount of information stored has grown from megabytes all the way to exabytes, confirming the need to successfully store and access huge amounts of data. As demand for storage technology grows the need for greater efficiency and more advanced capabilities continues to evolve. Today data storage is more than just archiving; it's about providing ways to analyse information, understand patterns and behaviour, to re-live experiences and memories. It's about harnessing stored information for growth and innovation. Seagate is building on its heritage of storage leadership to solve the challenge of getting more out of the living information that's produced everyday. What began with one storage innovation has morphed into many systems and solutions becoming faster, more reliable and expansive. No longer is it just about storing information; it is about accessing and interpreting information quickly, accurately and securely. Since the establishment of the Springtown facility in 1993, Seagate has become one of Derry-Londonderry's largest employers with a headcount of just under 1,400. The factory develops and manufactures a highly complex component for hard drives called a recording head. The heads are engineered on a nano-scale, which requires that they are manufactured in clean-room conditions using some of the most advanced technology in existence. Twenty five percent of the world's recording heads are produced in the Springtown plant.  To date, the company has invested over £770M  in equipment, land and buildings.

# Energy Symposium 2017 Submissions

**Article:**

What do GE, JP Morgan Chase, Ryanair, Goldman Sachs and 67% of the Fortune 500 companies have in common.

They all claim to be technology companies and that the rapid pace of technological change was their biggest challenge. Cloud Computing, mobile computing, internet of things and Artificial Intelligence (AI)/Machine Learning were all seen to be transforming their industries.

Any company that starts up today has to change the industry it's competing in in order to excel.

The biggest transformation is taking place in non-tech companies who are on pace to surpass tech investments surpassing that of tech corporations for the first time with 51% of investments into private technology companies coming from Fortune 500 companies, up from 29% in 2014.

It is not about building the new breakthrough technology but the real winners are those who focus on the smart application of technology into their business or market. Apple, Amazon, Google and Facebook have succeeded not by building a new widget but by transforming logistics, accessing data or connecting people. IBM still produces more patents per year than all the top 5 new tech companies together and Goldman Sachs employ more software engineers than Facebook or Twitter.

What these companies have done is to align their people and processes to adapt quickly to new technologies in order to gain a foothold on the market, as they know companies that wait for a second or third wave stay at the back of the pack. We think that transformation is achieved 20% by the technology that enables the change and 80% via improvements to people and processes.

So how does an organization align its people and processes to embrace new technology and see the rapid pace of technological change as an opportunity to succeed rather than a threat.

**1. It starts at the highest level of leadership**

Leading a transformation to become a successful technology company is not a job that can simply be tasked to the CTO or CIO. The level of engagement and investment to lead a successful transformation requires the CEO and board of directors to not only be fully bought in but to be the main drivers of the change.

**2. Talent is the most important asset of a technology company**

While workers in the industrial era were largely interchangeable, today's most valuable jobs, require a specific set of skills not easily found in the market. There is a generational change in employee's mind-sets as they now come from a perspective of

Brendan Crossey

Healthcare Analytics Limited

About Brendan Crossey:

Over the last 25 years, the CEO of Healthcare Analytics, Brendan Crossey has gained extensive knowledge of deliver innovative technology solutions into the manufacturing, healthcare and energy sectors.

Brendan has spent the last 3 years establishing several start-up businesses and has spent time working with Investors and Innovation Labs in Ireland, UK and the US.

Previously Brendan spent 9 years building and developing EMC's presence in Northern Ireland with a strong focus on service transformation using Data Analytics, He also spent 7 years with Sun Microsystems and 8 years with Fujitsu Services.

Brendan was involved in several projects working with the government, universities and other commercial organisations to increase the awareness and use of Data Analytics technologies to transform the Energy, Health and Manufacturing sectors.

Brendan was a member of the Northern Ireland Matrix panel which advised the government on its policy to support the growing Digital Economy over the next 7 years.

inclusion and need to understand not only what their job is and their task, but how that job and task impacts their department and the overall organization.

Competitive advantage in talent acquisition remains elusive. Increasing perks and lofty wages does not work, a proven strategy is “transparency, transparency and transparency” but promoting total transparency at work, including around employee compensation, can be painful. The core strategy is around information, improving communication and making the organizations data available to all and not on a “need to know basis” to improve their decision-making.

Organizations should train and invest in their talent, tapping their entrepreneurial spirit, passionate push for change and ability to think beyond traditional corporate norms should be atop executives’ talent strategies. People should always be the priority as it is the people who create the new ideas and it is the people who create the culture.

**3. Technology needs to be at the core of company culture, not an afterthought**

For companies to successfully make the transition, cultures need to change to take into account the unique way that innovation and to highlight the importance of technology and the people who manage and build it. It is important to keep in mind that building a technology-driven culture is not just about free lunches and massages.

**4. Companies need to move fast and adopt agile practices**

The pace of technology adoption is getting faster and faster every year, this underscores the importance for companies to continuously adopt new technologies that can enhance productivity and also to continuously experiment with new technologies that have the potential to be disruptive to the business.

Agile development practices enable you to continuously deliver better experiences for your customers and traditional project management methodologies area relic of the past.

**5. Companies need to look forward and avoid getting caught in doing everything “right”**

Companies do not fail because they do not innovate and in most cases, they do everything “right”. Businesses reject innovations based on customers’ current needs while innovative upstarts develop products in a way that meets customers’ future needs. The tech companies would rather fail, and fail fast and learn from these mistakes than do things right the first time.

In conclusion, the companies, young or old, that use technology to best create competitive advantages for themselves will win.

Technology needs to be a fundamental fabric of the company’s DNA and culture as companies truly internalise that “Every company is a technology company”.

Brendan founded Healthcare Analytics in September 2016 who have developed a partnership with the Northern Ireland Health Service to build an innovative, scalable and secure platform using advanced Machine Learning (ML) and Internet of Things (IoT) technologies for the management of Healthcare Assets including Beds, Instruments, patients and staff.

# Energy Symposium 2017 Submissions

## Data - the key to achieving a low carbon future

Brendan Ring

**Synopsis:**

One of the most critical factors required for a low carbon economy is to reduce energy demand and increase renewable usage. High-quality, real-time data is the one thing that all decision makers require to enable a clear understanding of what is currently happening, what happened in the past, and what is likely to happen in the future. This article considers how to capitalise and extract value from the data generated in entities such as manufacturing companies, data centres, oil refineries, etc. A data centre is explored and research topics proposed under the suggested categories of societal, demand, optimisation and supply.

**Takeaway:**

- Reaching a low carbon economy requires constant efficiency improvements.
- These improvements can only be achieved with access to high quality real-time data.
- Powerful tools now exist to enable efficient and effective collection and analysis of data.
- Companies can benefit greatly by maximising the value of this analysis and acting on the results to implement positive change.

**Article:**

One of the most critical factors required to reduce energy demand and increase renewable usage is data. High-quality real-time data. Data is the one thing that all decision makers require to enable a clear understanding of what is currently happening, what happened in the past, and what is likely to happen in the future. This article considers how to capitalise and extract value from the data generated in entities such as manufacturing companies, data centres, oil refineries, etc. Developing a deeper understanding of how to capture and use this data is critical to meeting the needs of a sustainable future, where goods and services can be provided to meet the ever-growing needs of society.

Social Aspect: Significant effort is required to educate all stakeholders on the benefits that can be gained from the improved use of data. Research should be targeted at determining the attributes that trigger individuals to learn more about how to capture and use data.

Demand Focus: A simple example to consider is the challenge faced by Microsoft in managing the power usage with their data centres. They had disparate systems (HVAC, chillers, power monitors etc.) that required integration into one system. They also had a separate billing system for each location. The solution was to implement a

About Brendan Ring:

Over twenty years' working in and selling into the pharmaceutical, med device, energy and semiconductor industry. Graduate of Dublin City University Engineering and MBA from University of Cambridge, now working as Senior Account Executive at TQS Integration.

Company Description TQS Integration provides strategic competitive advantage for customers via advanced visualisation and data analysis of real-time and historical data. The strategic mission is to provide first class services to our valued customers worldwide by bringing together accurate and efficient advanced state-of-the-art techniques. Developed from TQS Integration's unmatched knowledge, with the latest technologies in global information technology and process control integration, we provide our global customers the competitive advantage they need in an ever changing, highly competitive world.

centralised reporting system, they chose the PI System ™ from OSIsoft ™. Clear benefits were observed through the use of real-time data to improve system reliability and uptime. Conducting research projects on how to integrate, link and associate large volumes of real-time data from multiple sources and in multiple formats in an efficient manner and that provide information in a clear and coherent manner to those that need it.

System Optimisation: For a data centre, the key factor for optimisation is Power Usage Effectiveness (PUE). PUE is calculated by dividing the total power coming into the site by the power used to run the computer equipment, 1.5 or below is considered world class. Accessing real-time, granular data from the building management system and the energy management system is critical to establishing a baseline and enabling changes to be made across the system to improve PUE. Combining this with external environmental data is very powerful. Research projects in the area of machine-learning to optimise the operational parameters and push PUE ever lower would serve not only this industry, it would have a positive impact on any industry using air conditioning.

Energy Supply: One of the primary challenges with expanding the use of renewables is the volatility and unpredictability of supply. This weakness requires energy providers to have redundancy available, which is often from fossil fuel sources. Research projects that consider how real-time high-speed data from widely distributed sources can enable dynamic load balancing and manage both the demand and supply side to ensure optimum operation and a stable system for all. This would require analysing terabytes of data and decision execution at millisecond speed across a national footprint.

In summary, without data, it is impossible to optimise the energy being used. Any research that improves how data is captured, analysed and displayed will have direct benefits to multiple sectors and industries. And to end on a quote from Professor W. Edwards Deming, “In God we trust, all others bring data”

# Energy Symposium 2017 Submissions

**Article:**

Brian Meldon

About Brian Meldon:

Society of Chartered Surveyors Ireland

Royal Institution of Chartered Surveyors

Registered Valuer

Outgoing Chair of Commercial Agency Committee

Governing Council member
Education Committee member

APC Committee member

Green leases align the financial and energy incentives of building owners and tenants so they can work together to save money, conserve resources, and ensure the efficient operation of buildings.

The research and published papers on the rationale behind green leasing, or building performance leasing as it is also called, has been ongoing for over a decade and the case is well made as will be seen from the findings below. My own interest in the topic began by chance when I attended a daylong seminar in Google headquarters hosted by the Irish Green Building Council. At that, I sat in on a paper on green leases given by an environmental research professor from Oxford. Her name was Katy Janda. What struck home to me as a commercial property consultant, primarily dealing with landlord and tenant matters, was that there was no cross over between the academics and the practitioners on the street. This matter was too important to ignore so I set up a working group in my capacity as Chair of the Commercial Committee to spread the word. This is relevant to all surveyors especially those in;

- General Practice
- Building Construction
- Quantity Surveying
- Facility Management

And of course, the legal profession who are the lease drafters.

**So why has this become so important now?**

Leaving the legislative imperatives aside for a moment consider the following;

- This we call the 90% rules;
- We spend 90% of time indoors in work places.
- 90% of employees say there is a direct link between their attitude to work and the quality of their office space.
- 90% of business leaders worldwide are changing their approach to workforce rights and wellbeing in response to changing stakeholder expectations. (PWC's 19th Annual Global CEO Survey 2016)
- Office-based businesses typically spend 90% of their overhead costs on their employees and the remaining 10% on building operation and maintenance costs.

# Energy Symposium 2017 Submissions

Just taking that last point. If between them the landlord and tenant can improve energy performance by 10% it results in a 1% saving of costs. But, by improving the health, wellbeing and productivity of the workers by 10 percent they can save a business nearly 10 percent of costs. This is not only a very significant saving it makes the building more attractive for the tenant as a business space and a better investment opportunity for the landlord. Both win!

**So how are buildings evaluated?**

Generally, by the voluntary certification systems LEED & BREEAM. LEED or the Leadership in Energy and Environmental Design is US based. BREEAM stands for Building Research Establishment Environmental Assessment Method is the older and UK based standard.

LEED certification, which is most commonly used goes from simply Certified through Silver to Platinum. Recent Platinum awarded buildings in Dublin include Miesian Plaza, Baggot Street, Central Bank, north quay, Cumberland Place, Fenian Street and Oracle Building, Block C, East Point. These join the 204,000 square metres certified every day in over 90,000 projects in 165+ countries.

These buildings have also attracted top level tenants; the Irish Health Authority in the case of Miesian, Twitter for Cumberland Place and of course Oracle. An example of a BREEM certified development is the Mahon Shopping Centre, Cork.

The term NZEB or Nearly Zero Energy Building is now becoming commonplace in our conversation. In order to qualify as an NZEB it must have very high energy performance. This means energy from renewable sources, including renewable sources produced on-site or nearby.

**The Legislation**

The European Energy Performance of Buildings Directive Recast (EPBD) requires all new buildings to be NZEB by the 31st December 2020 and all buildings acquired by public bodies by 31st December 2018.

The Irish Government, to comply, intends to move directly to NZEB standard from the current regulations. This means that under the Technical Guidance Document coming into force during 2017 buildings will be required to use 40% to 60% less energy than current regulations.

**Future of Leasing**

Globally green leases are now widely used by large organisations and the initiative was led by landlords, their agents & facility managers. Now corporate culture is the primary driver.

# Energy Symposium 2017 Submissions

In future leases will not be called green but will typically contain green clauses as a matter of course as in Sweden at present. They will oblige both landlord and tenant to maintain the building to its certification or better.

**The built environment is our environment**

As surveyors the onus is on us to educate our clients both landlords and tenants as to the benefits both financially and environmentally of green leasing.

# Infrared Energy for All

Cathal Wilson

**Synopsis:**

Over one hundred years after its discovery the world of Infrared (IR) heating – a spectrum of radiant energy - is still much misunderstood and misapplied. The opportunities for clean and green IR technology are simply waiting in the wings; t he current challenge is to raise the world's adoption of this valuable energy source – firstly in industry and in society at large. Sometimes described as 'sunshine without light' the IR sector , although ubiquitous, has perhaps suffered from popular misconceptions. IR energy efficiency will be outlined in the article which will argue that th e technology is on the cusp of being fully realized for industrial and social benefit.

**Takeaway:**

Infrared heat energy is different in kind from conventional/convectional heating; has its own rules and science and is not sim ply measured or controlled via temperature.

Infrared heat energy also behaves differently than conventional heat. Its radiant energy can be measured more precisely in its effects upon 'target bodies' – be these materials, persons or the environment generally.

Infrared heat energy consumes less energy than conventional heating typically 30-40% in most manufacturing processes.

Infrared heat energy – in contrast to conventional sources - is cap able of superior manufacturing results; not only altering temperature but a lso altering the chemistry of target bodies in order to achieve annealing, curing, bonding and other process aims.

**Article:**

Ceramicx Ltd has been established for over 25 years in West Cork and has been providing Infrared (IR) energy efficient solutions from 1994 – mainly for industrial users but also for consumers in the form of IR heating for the built environment, for modern sauna and in livestock care.

Ceramicx exports IR heating to over 62 countries and contributes to the international IR heating community via our HeatWorks magazine – now in its 7th year of publishing. We sponsor University research into the effects of IR energy, we contribute to Ireland's science and technology futures committees, and we are now in receipt of our 5th Innovation Partnership from Enterprise Ireland – with TCD as academic partner. We have also co-created a world first in IR test instrumentation (also with TCD).

Our test instrument machine is called 'The Herschel' and it maps and measures the previously invisible IR energy field in 3D space.

In March 2017 our 'Herschel' helped Ceramicx and TCD win Ireland's Collaborative Research Impact Award under the Knowledge Transfer Ireland (KTI) initiative. It was

## About Cathal Wilson:

Cathal Wilson holds a degree in Manufacturing Engineering, a PhD in Wealth Generation in Owner Managed SMEs, is an Adjunct Assistant Professor in the College of Engineering, Trinity College Dublin and a Director of Ceramicx. Cathal has worked for Ceramicx Ireland from an early age and is familiar with a great number of aspects of infrared component and system manufacturing. He works primarily in the areas of Commercial and Research undertakings. He led the development of applications winning over €2.5million in research funding over the last 7 years from both E.I. and Horizon 2020. Ceramicx current academic partners include the Institute for Manufacturing, Cambridge University, Trinity College Dublin, Belfast Metropolitan University, IKTS Fraunhofer, Dresden. He has led the company to winning a number of awards including the 2017 Collaboration award with Trinity for the development of the Herschel, a piece of lab equipment for characterising infrared energy. He currently sits on the national steering group for the "Digitalisation of the Manufacturing Sector and Policy Implications for Ireland".

a tough field – competing against Intel Ireland, Microsoft Ireland, Croke Park, C&F Group, DCU and Dublin Institute of Technology – but the win was testimony to the ground-breaking technology, and, above all, to the real-world results for our customers.

I present all of this background – not to praise our achievements but to show the painstaking work involved in building a body of applied IR heating know-how. It has needed to be a unique blend of irrefutable science that has been proven through empirical manufacturing experience. And right now Ceramicx is introducing much of this detailed IR energy know-how into mainstream manufacturing through the world.

Proof of this aspect was recognized last year when Ceramicx founders Frank and Grainne Wilson travelled to London's Hilton Hotel to be honored as finalists in the annual Plastics Industry Awards.

Ceramicx had been assisting in a capital equipment upgrade plan at international giant, Linpac Packaging, specifically the company's St Helens, UK site. Our IR energy technology was designed to help Linpac achieve substantial production and energy/cost savings through the application of infrared energy in the plastic thermoforming of packaging items

We undertook a substantial amount of study work prior to, and during, the St Helens upgrade process: The heat and energy performance between two identical thermoforming lines was monitored. The comparisons between the IR and non-IR thermoforming lines were undertaken using identical tools, products and cycle times.

Under test, the IR heating systems showed a decrease in the average power drawn from 56.16 kW to 32.85 kW, representing a 41.6% reduction in energy

The new Infrared energy contribution helped Linpac Packaging to ensure a world-first reduction in the energy cost of expanded polystyrene (EPS) packaging; slashing the carbon footprint of the products and reaffirming EPS packaging as a fit-for-purpose packaging solution – with greatly reduced environmental impact.

The implications from this project go way beyond a single company usage. The adoption of IR (Infrared) heating in plastics thermoforming - particularly via similarly retrofitted solutions - now offers that industry the proven opportunity to reduce cost and to improve environmental performance right across the sector.

And in the last 18 months Ceramicx has been pursuing similar gains and benefits for the international composites industries, where double digit demand for lightweight materials and structures is helping drive aerospace, automotive, construction and many more sectors.

Aerospace industries in particular offer Ceramicx technology very particular opportunities and gains. The sector continues to revolutionize the world's business, trade

and global societies and will be pulling our world further together over the coming twenty years when more than 33,000 new passenger aircraft will be required to cope with coming demand.

Ceramicx's role is to help revolutionize the manufacturing supply side of the industry; helping design and supply new Infrared heating systems that will make some of the more complex and light-weighted components creating wing sections; interior furniture and components, often substituting for metal parts at much lowered energy inputs and cost.

Carbon based composite materials mean that not only is the net weight of the aircraft component reduced – the cost to the environment the carbon footprint is thereby also reduced – sometimes by as much as 40%.

And although the world's automotive industries are much more mature, the need for energy saving and light-weighted components throughout the world is identical. Cramicx IR heating systems are currently deployed in all corners of the automotive industry and are usually bespoke. Applications range from heat shrinking millions of miles of cabling and harnessing to gluing, annealing and bonding complex automotive structures together.

Plastic thermoforming remains a large part of the automotive sector and Ceramicx ovens help mould large components such as bumper covers; boot liners, door panels and other structures, including one recent order to a Japanese supplier based in Wales.

Tier One automotive suppliers worldwide are the key to Ceramicx business. The automotive sector places high demands on fault-free process throughput, reliability and low energy consumption.

Considerable ingenuity is often required to bring the pieces of a modern automotive car together and Ceramicx IR heat solutions are no exception. Techniques of annealing, shaping and heat forming can all play their part from the construction of the humblest hatchback to the top of the line luxury car.

Recent work from Ceramicx is helping bring an important mid-range saloon order in the USA to fruition. We are supplying a leading automotive marque with bespoke IR heat systems in order to bond leatherette materials to the interiors of automotive passenger doors.

The manufacturing process at the client involves the heating of already formed parts, with quartz tungsten tubes. There are 8 platens in total which all fit onto one machine as required. The heaters are facing in two directions across the part. The construction is made from aluminium profile with custom made stainless steel brackets holding custom shape and size heaters in place.

# Energy Symposium 2017 Submissions

Wherever you choose to look in today's manufacturing world Infrared (IR) heating is in the ascendancy – and rightly so. Infrared-based heating is a clean and green technology for today's times. Only a lack of understanding and engagement with the science and its applications

The Ceramicx view is IR energy futures are essential and inevitable. There is a window of opportunity to help shape such an R&D programme, themed around Infrared for Industry; one that will engage the resources of all participants for the benefit of all. We look forward to discussing it at the Cong energy summit this year, 2017.

**Article:**

A Big Data solution to a Big Climate problem? Industry can lead the way in reducing climate change by leveraging data analytics to find hidden energy efficiencies. From the smallest to the largest companies, truly understanding where energy is consumed across assets and processes has long been a puzzle. But with new technologies such as cheap sensors & sub-meters, cloud computing and Big Data analytics it's become much easier to gain intelligence on energy consumption in real-time. This gives industry the simplest solution to rapidly reduce energy consumption without replacing any assets.

Dan Mitchell

About Dan Mitchell:

Dan Mitchell is Co-founder and COO of Cognition, Ireland's leading Big Data Energy Optimisation firm for the Manufacturing sector. Dan is an experienced data analytics and technology delivery specialist building on his experience leading energy optimisation projects across Europe. At Cognition, he's designed and delivered a unique IoT and Big Data solution that measures and monitors energy consuming activities in real-time; directing improvement recommendations straight to staff.

# Energy-efficient vacuum supply for food packaging


Daryl Kingston

For many foodstuff manufacturers, energy-efficient vacuum supply for foodstuff packaging is increasingly being seen from the standpoint of economical processes. Chamber packaging machines, tray sealers or thermoforming packaging machines use vacuum technology to package fresh foodstuffs hygienically and with a long shelf life. The more such packaging machines are used in a company, and the longer the operating times, the more intensively the energy required and the operating costs of the vacuum supply should be investigated. It is important here that the entire packaging process is examined and is not limited to the vacuum technology alone. For this purpose, the vacuum supply must be analysed together with the entire packaging process and all parameters must be optimally suited to fit one another. Busch offers this service in the form of a special “VacuumAudit” The goal of this audit is to achieve optimum energy efficiency for the packager. During this VacuumAudit, the current state is evaluated and suggested solutions are developed for the customer.

**Vacuum supply**

The vacuum pump is the core of a packaging machine's vacuum supply. Busch unveiled the newly developed R 5 RD vacuum pump for the first time at the IFFA trade show. The R 5 RD requires 20% less motor power than the previous models. The new vacuum pump is based on rotary vane technology that has been proven through decades of use and was further optimized to make these energy savings possible.

For example, if a thermoforming packaging machine is equipped with the new R 5 RD 0360 A (fig. 1), the annual electricity costs saved during two-shift operation at ten cycles per minute with a chamber volume of 20 litres are EUR 850 (price of electricity = 0.18 euros/kWh).

*Fig. 1*

**Reducing thermal load**

As a general rule, vacuum pumps generate waste heat that can negatively affect production and processing rooms or their air-conditioning systems. The waste heat can not only be drastically reduced. It can also be utilized.

An oil/water heat exchanger on an R 5 rotary vane vacuum pump can significantly reduce waste heat and thus reduce the energy costs for air conditioning. Furthermore, the heat exchanger can be used to generate warm water, which can in turn be used as warm water during operation. R 5 rotary vane vacuum pumps can be retrofitted with heat exchangers.

If four packaging machines operate in one packaging room and each is fitted with an R 5 rotary vane vacuum pump with 5.5 kW of motor power, the energy required for cooling is approximately 6.0 kW. If the vacuum pumps are operated with a heat ex-

About Daryl Kingston:

Daryl Kingston is Managing Director of Busch Ireland Ltd. Daryl was appointed to restructure the Irish branch and to help bring Busch’s expertise in energy efficient vacuum technology to its key Irish markets of Food, Pharma and Medtech. Daryl has over ten years of commercial experience and was previously Sales Manager at Lennox Laboratory Supplies and Lab Manager at Alcontrol Laboratories. Daryl is a 2001 science graduate of Maynooth University.

changer, the energy requirement for cooling is reduced to approximately 1.5 kW. During an operating time of 4,500 hours/year and an assumed electricity price of 0.18 euros/kWh, this results in annual energy cost savings of approximately EUR 5,000. The use of warm water is not taken into account in this example.

**Controlling packaging processes**

If one observes one cycle of the packaging process more closely, it turns out that the actual evacuation time in which the vacuum is required only accounts for one third of the cycle time. The rest of the time is taken up by transportation, sealing, ventilation and, sometimes, treatment with gas. Using intelligent technologies in the vacuum supply – from an optimized control system to frequency control through to use of a vacuum container – there are several options for optimization. Busch is also able to discuss these with customers in a VacuumAudit. Energy savings of up to 60% can be achieved.

**Central vacuum supply**

Any company that packages foodstuffs on several thermoforming packaging machines, tray sealers or chamber machines should consider using a centralized vacuum supply. Busch is the largest manufacturer in the world of these kinds of centralized vacuum systems (fig. 2) and therefore has the most experience. With centralization, energy cost savings of 50% and more can generally be expected. This is possible because fewer vacuum pumps are required for this than for a decentralized vacuum supply. Furthermore, performance control can be precisely adjusted to fit the requirements of overall operations. Normally, not all packaging machines run at peak load, so all of the vacuum pumps are not always in operation. Also, centralized vacuum systems offer maximum reliability and safety as all systemically relevant components have a redundant design. If a vacuum pump fails or needs maintenance work, full vacuum power remains intact. Busch central vacuum systems can be equipped with various vacuum pumps. In addition to oil-lubricated R 5 rotary vane vacuum pumps, dry Mink claw vacuum pumps or COBRA screw vacuum pumps can also be used as components. The investment costs can be reduced during purchasing by including already existing vacuum pumps in the system installation. Figure 3 demonstrates one practical example. In the process of centralizing the vacuum supply, one manufacturer of meat products realized energy savings of EUR 151,000 per year.

*Fig. 2*

**Practical example:**

Meat processing plant with
- 9x thermoforming packaging machines, volume/machine: approx. 13.9 litres
- 9x rotating chamber machines, volume/chamber: approx. 34 litres
= total volume of all sealing tools: 159.1 litres

- Thermoforming packaging machine cycle rate: 10 cycles/min
- Rotating chamber machine cycle rate: 20 cycles/min

| | Vacuum supply | |
|---|---|---|
| | Distributed | Central |
| Power consumption (incl. cooling power) | 1,269,000 kWh/year | 430,000 kWh/year |
| Energy costs (at 0.12 EUR/kWh) | 228,500 EUR/year | 77,400 EUR/year |
| **Energy cost savings with central vacuum supply** | **151,100 EUR/year** | |

Busch Vacuum Pumps and Systems
Uli Menke - 12 May 2016

*Fig. 3*

# The Vision of the Smart Energy Grid - are we there yet, are we there yet?

Dave Clarke

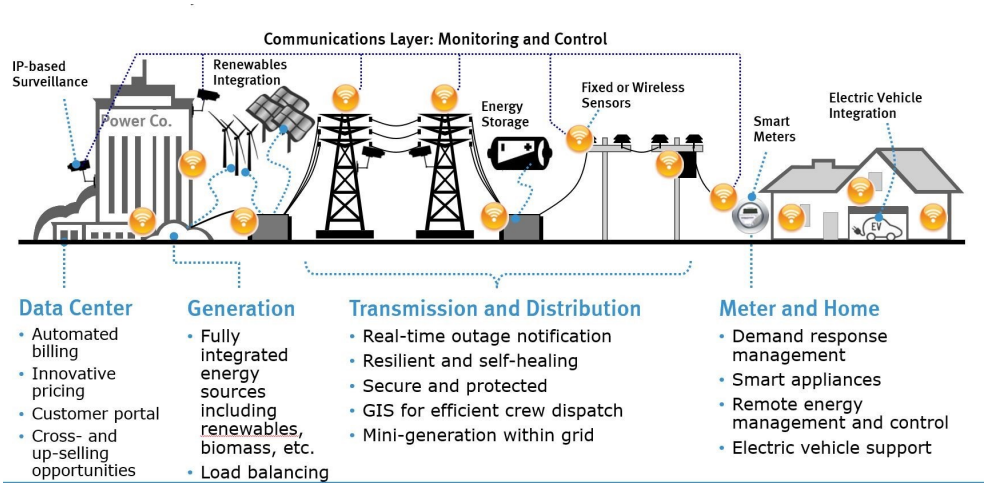
CLARKE ANALYTICS
Leading Digital Transformation

As I look forward to my second year attending the IMR/I2E2 Energy Symposium in Cong, I take a look back at my past interactions with the energy sector. While not my primary business sector of interest, I have had opportunity to work in the sector over the years. Firstly, while with PwC, I was on the initial team that helped the ESB successfully de-regulate the electricity market back in early 2000 with the set- up of EirGrid. The market actually was able to go live, and stave off EU fines for the Irish Government, based on electricity generating and supply nomination file specifications that I was responsible for creating. A pressure cooker project if ever there was one! A few years later, while with EMC, I worked on validating global solutions in the smart metering space with Silver Spring technologies and our Greenplum Appliance.

Both the market de-regulation and spread of automated metering infrastructure across the world have been driven on by the promise of more efficient use of the worlds energy generating assets and more cost effective and resilient service for end customers.

The figure below is one of my favorites in depicting this utopian end to end connected eco-system of entities and infrastructure. A cursory research into the state of the current energy market in the EU notes the huge costs of connected infrastructure implementations and some feedback from business folks in the energy space on their frustration with the lack of ROI (Return On Investment) in the large data infrastructures that have been put in place to act as the back bone for analytical insights.

As the symposium at Cong approaches, it would be great to get some feedback on 3 of the key areas that I think are still challenged in making the utopian vision a reality from a data analytics perspective.




## About Dave Clarke:

Dave Clarke is the Founder and CEO of Clarke Analytics Ltd, which is a wholly owned Irish consulting company specializing in the area of data analytics development and data science consulting and training. The company was set up in October 2016 by Dave and his wife Helen. Dave brings many skills in key areas for customers in the data analytics space:
Dave has worked in the IT industry for 25 years in software consulting, management consulting, project, program, and engineering team management, solutions architecture, technology evangelist, software development and data science roles.
Over the last 10 years, Dave has been primarily focused on the data analytics space in Ireland, working with global pharma, med device manufacturers and health care research sectors primarily in the areas of data analytics strategy development and data analytics proof of value and research initiatives. His company provides professional services to companies in these areas, not just in the market sectors above, but also in supply chain, logistics, utilities, finance and insurance industries. Check out Clarke Analytics on www.clarkeanalytics.com and

# Energy Symposium 2017 Submissions

**Data & Infrastructure Fluidity**

Over the last 10 years, there has been massive changes in the data infrastructure landscape. Having a consistent technology stack or architecture to support has been challenging. With recent announcements of smart metering roll outs still not fully in place, there is obviously still a way to go for the hardware infrastructure to support full smart metering to be in place. The software technologies to support data being available in a single, albeit distributed, memory space to support advanced analytics have been moving and adjusting also. Many a data lake has turned in to a data swamp, as fundamental functionalities required to make those lakes work like data governance and data lineage are only recently being added to many available complete lake stacks based on bitter experience. Is this your reality?

**Business Focused Agile Delivery Methodology**

Agile, Sprints, Stand-ups, Backlogs, Test-driven Continuous Development, Done-Done Burn up/down checklists are all the latest buzz words in relation to getting quality software delivered fast & to spec. But, I wonder if the product management function of the agile framework is sufficiently cognoscenti on the ultimate business goals and value realization utopia envisaged to the smart energy grid. This is hard, yet fundamental to gaining fast competitive advantage. Is this your reality?

**Seamless Organizational Collaboration**

This is fundamental to ensuring that any data analytics effort does not go off the rails. Most importantly, it must be sponsored loudly and championed from the very top of the organization. That is because, it is hard and takes effort. I have some anecdotal evidence that this change agent can be hard to find in Irish organizations filled with 55+ aged senior execs not wanting to rock the boat or take the risk closer to retirement. I hope that is not true. Is this your reality?

please contact for a quote on our services.

# Social & Behavioral Aspects to Energy Transition

Dr. Will Barton

**Synopsis:**

Countries around the world have been signing up to challenging targets for reducing the impact of our activities on climate change. The Paris Agreement (2016) has come back into the headlines recently due to the position of the Trump administration. At the heart of the concerns of both governments and companies is international competitiveness and the uneven playing field that will inevitably come about due to wide potential variations in speed of adoption of the necessary changes. Are there ways to break the logjam and make early adopters the winners?

**Article:**

Countries around the world have been signing up to challenging targets for reducing the impact of our activities on climate change. The Paris Agreement (2016) on greenhouse gas emissions, signed by 195 members of the United Nations, is probably the largest target-setting agreement ever in this field, but here I wanted to think about the problem in the context of the "three-legged stool" of Sustainable Development, where environmental, economic and social impacts need to be looked at equally.

I always like to tell the story about the approach to exhaust emissions from motor vehicles where changes in standards were established well in advance of the planned years of implementation. The legislation left time for innovative thinking – when first proposed the automotive industry expected they would need to work on significant changes to the internal combustion engine, but thinking more broadly about the potential for novel technology, the catalytic converter was born, creating a whole new industry sector in catalysts (as well as driving more quickly the adoption of lead-free fuels, due to the adverse impact of lead on the catalysts – as well as on humans). So successful has been the catalytic converter that it is now raising new concerns around the sustainability of the precious metal supplies needed for the catalysts.

This story is valuable because it shows how an innovative approach to problem solving reduced environmental emissions, enabled a reduction in the impact of motor vehicles on human health, and created a whole new industry whilst preserving another.

So how can we learn from this valuable lesson? Wind and solar power are, today, expensive forms of stationary power for consumers unless subsidised; lithium batteries are similarly an expensive option for mobile power: both vs hydrocarbon alternatives. Adopting expensive solutions in any field is going to make a company less competitive unless its competitors are being forced in the same direction (e.g. by legislation or shortage of supply) – back to the uneven playing field where companies lose business, people lose jobs and governments lose (corporate and income) tax

About Dr. Will Barton:

In 2016 Will was awarded an OBE (order of the British Empire) by her Majesty the Queen for his services to Innovation & Manufacturing. Will started his 40+ year career in the chemical industry with ICI where he progressed to the level of Manufacturing Director in the USA, ultimately with Zeneca. He joined the Technology Strategy Board (TSB) on a part time basis in 2009 as Head of Technology, then Head of Manufacturing and was responsible for the development of a highly regarded High Value Manufacturing Strategy and also led the set up and became the first board member of the High Value Manufacturing Catapult. He is now Chairman of Oxford Biotrans Limited, of Amalyst Limited and of Irish Manufacturing Research Limited, a Non Executive Director of NiTech Solutions Limited, of ZuvaSyntha Limited and of IfM Education and Consultancy Services Limited, Chairman of Advisory Board of the EPSRC Centre for Innovative Manufacturing in Additive Manufacturing, and a member of the Ventures Board of the University of Bath; he also assists other potential technology spin-outs, universities and investors through his own company, WillB Consulting Limited.
Will has a first class honours degree in Physics and D Phil in Theoretical Physics from Oxford, and a Certificate in International Business General

revenues. On the other hand, innovating to find ways of reducing energy usage per unit of output and / or reducing the cost of the energy input can reduce or even eliminate the loss of competitiveness. So, on the input side, companies around the world, often with government support are:

- working on programmes to develop off-shore wind turbines of increasing blade diameter (solving fibre-reinforced-polymer-composite structural strength problems and gearbox strain issues) to exploit economies of scale;
- looking for step increases in efficiencies of the collection and conversion of solar power to electricity;
- developing next generation battery technologies with step increases in storage capacity for use in storing renewable energy when it is in excess, and in mobile applications where a step reduction in weight is also required; etc.

These initiatives will ultimately, if successful, provide rich rewards for the winners, and help make the transition to more environmentally friendly technologies more palatable to users. However, there will also be ways of reducing energy usage potentially available to users – again the most innovative, step change approaches are likely to result in competitive advantage and rich rewards for the winners as well as benefits to the environment. Some radical approaches being taken include:

- replacing high temperature / high pressure chemical processes with biological processes to produce the same (or equivalent in application) chemical intermediates and / or finished products; or,
- using additive manufacturing to produce significantly lighter components with geometries impossible to achieve with traditional machining techniques.

More radical still, however, is the ability to intensify processes to the point where economies of scale are much less significant. Once this is achieved, the need for world scale manufacturing plants in countries with the lowest labour costs is eliminated and we can move to a “distributed manufacturing” model where products are made close to the source of raw materials and / or end market, allowing companies to exploit savings across the whole supply chain and further minimising environmental impact by reducing transport of goods.

My guess is that there are still a myriad of opportunities to be exploited in this latter area, and that those with the courage to invest in the innovations required will be well rewarded for leading the charge to a securing a healthy environment for future generations!

Management from INSEAD. He is a Fellow of the Royal Society of Chemistry, a Member of the Institute of Directors, and a member of the Council of the Chemical Industries Association and of the Industrial Biotechnology Leadership Forum.

## Breaking down one behavioral barrier to the uptake of technologies, systems and practices to help progress towards a low-carbon future

Duncan Hurlstone

IfM Education and Consultancy Services

Of the 2.11 million manufacturing Enterprises in the EU1, almost 99.5% are classed as SMEs. Overall, these SMEs are thought to produce nearly €750,000 million of value add. Over 96% of manufacturing SMEs are made up of micro and small enterprises.

In Ireland, according to a survey conducted by Ibec2 in 2015, there are 4,000 manufacturing enterprises, with 79% of those surveyed employing less than 250 staff (i.e. are SMEs). The manufacturing sector is the second largest employer in Ireland.

If accelerated progress is to be made therefore towards more sustainable manufacturing, then SMEs in particular need to be appropriately engaged, not only in Ireland, but across the whole of the EU.

But what does 'appropriate' mean in this case?

Typically, manufacturing SMEs see 'doing more with less' as the key to achieving competitive advantage and thereby improving their chances of sustaining their survival into the future.

It is therefore relatively rare that manufacturing SMEs' regard sustainability as anything other than the need to sustain their business beyond their current planning horizon. The inclination for SMEs to engage effectively is therefore often absent unless there is a clear tangible 'economically competitive' benefit in doing so.

It has been said many times that a key factor in holding back manufacturing SMEs from taking up the latest tools and approaches is that the key decision makers are pre-occupied with working 'in' the business and so do not find the time to work 'on' the business. The commercial cost in both time and money in engaging with external service providers is therefore often deemed to be too high, unless there are significant and easy-to-access funding mechanisms available to help.

Defining appropriate support mechanisms is also not easy, and there can then be a tendency to shoe-horn businesses into a programme of support that does not appear to align with their immediate priorities. This can also adversely affect the uptake.

SMEs therefore often do not have the time or resource available to engage fully.

Together these two factors form a behavioural barrier that is restricting the potential implementation of the latest technologies and systems, but also, of practices.

There are, however, two approaches that, if used together, could help with both the inclination, and the time barriers highlighted above as well as enabling manufacturing SMEs to develop an understanding of their own 'value opportunities' that can better

About Duncan Hurlstone:

Duncan Hurlstone worked for over 16 years for a leading international manufacturer of technology for the dry mortar industry with roles in international business development and over 7 years as Managing Director of the German Group's UK subsidiary.
This international experience, coupled with that gained in setting up and running a UK-based manufacturing SME, are what originally attracted Duncan to the toolset and highly collaborative delivery methods that the Institute for Manufacturing at the University of Cambridge had developed specifically for manufacturing SMEs.
IfM Education and Consultancy Services Ltd. disseminates IfM research to Industry and Government in a form of highly collaborative consultancy. It is wholly owned by the University, with all profits being gifted back to the University to help both support and inform future manufacturing research.
Since early 2010 Duncan has, with IfM ECS, worked successfully with many manufacturing SMEs as well as larger groups and PLCs across a range of market sectors, most recently as part of IfM's Prisms project in the East of England, the SMART Innovation programme in Wales, and the ongoing Sharing in Growth Pro-

align with the triple bottom line (People, Planet & Profits) 3 and thus support the journey towards greater industrial sustainability. These two approaches are:

- The Prioritisation Diagnostic Used with more than 800 manufacturing businesses in a range of sectors, it places the identification and addressing of true priorities of the business at its heart.
- The Value Mapping tool Used with more than 160 companies it identifies new opportunities for additional value creation through new activities and relationships such as utilising identified waste

Further details of these two approaches are given below. The main contention in this article is therefore that:

- The wider engagement of manufacturing SMEs and associated value chains with sustainable manufacturing is needed in order to maximise desired progress towards a low carbon future.
- The priorities as perceived by manufacturing SMEs frequently do not appear to align with priorities at the policy level for driving towards sustainable manufacturing This can sustain a 'behavioural barrier' to the adoption of new technologies & systems, but also, of practices.
- A value-adding diagnostic together with an insightful structured approach to 'Value' could together provide a strategic approach to help break down this barrier.

Whilst the explicit focus upon business-level priorities of the diagnostic combined with the time efficient but value adding nature of the delivery can help to overcome both the 'inclination' and the 'time' aspects of the behavioral barrier mentioned above, it is also likely that some degree of funded support at the front end will be necessary to win the initial engagement needed from the business.

One additional closing thought is that the Value Mapping tool could also help to unlock some major opportunities if it were applied across a range of stakeholders at a higher level in the industrial ecosystem. In this case the 'unit of analysis' and the key stakeholders to be involved would need to be defined (and engaged) at an early stage.

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3. First coined by John Elkington in 1994: http://www.johnelkington.com/archive/TBL-elkington-chapter.pdf

gramme that is supporting manufacturing businesses in the Aerospace and Civil Nuclear Sectors across many parts of the UK.
Some of his work is also being used as an example to support the latest IfM led research into strategic technology and innovation management.

Duncan has a Masters Degree in Manufacturing Engineering from the University of Cambridge, an MBA from Warwick Business School and is a Fellow of the Institute of Leadership and Management. He is based in Manchester.

# District Heating, Cooling and Energy Recovery

Refrigeration, Heat Pump and Air-conditioning systems have been in commercial use for over a hundred years now, and used for a huge variety of purposes eg: Food Storage, human comfort, and production of a wide variety of goods in manufacturing processes.

The relatively recent commercialising of heat-pump technology has opened many new applications and uses. These applications have been somewhat limited by the maximum temperatures on the high side, being in the order of 50°C depending on working fluid (refrigerant) employed.

Go too high and Coefficient of performance is impacted. However still very useful in under floor heating systems or systems designed for low grade heat.

1 electrical Kw in will generally move 3 to 4 Kw of thermal energy from one place to another. So, with these machines we can move energy into or out of a space or product.

Heat pumps are now classified under part L as a renewable provided they meet minimum efficiency criteria which is relatively easily met, and are a positive contributor to meeting the Primary energy goal as a result of their ability to move 3 to 4 times their thermal energy Kw equivalent. We are likely to see much more of this technology employed into the future.

**Thermal Balancing**

Where we can match loads for heating and cooling such as in De-humidification applications where simultaneous heating and cooling is required then the COP will double to as much as 7/8 to 1.

There are many other applications that exist for example swimming pools where the heat extracted from the moist air in order to de-humidify the air is very often used to heat the pool water.

Many applications already existing in Ireland where heat pumps are used to both heat and cool, the issue of balancing the load can be met by dumping heating water or coolant when a difference of load exist between heating and cooling demand the excess can be dumped to an aquifer or even an air-cooled source.

Other areas are now opening up with higher Temperatures of up to 130°C possible using Co2 as a Refrigerant in a trans critical cycle. Now being employed in Japan where a million of these units are used for Domestic hot water production from air-source.

Frank Caul

About Frank Caul:

Frank Caul is the current managing director of Sirus Air Con and is one of the two senior partners who created the Sirus group of companies now employing more than 100 people across the country. He has over forty years' experience in the heating ventilation and air conditioning business (HVAC) and has operated in this energy sector space for all of his working life.

Frank started his career as an apprentice in Dublin, later worked for a company called Temperature Controls and spent some years in the commissioning department in HA O'Neill's before heading off to work as a HVAC engineer in Saudi Arabia. On his return to Ireland in the mid nineteen eighties opportunities for employment in this sector were thin on the ground so Frank started his own company, "Temperature Ltd".

A number of years later Frank Caul and James Byrne merged their two companies to create the Sirus Group giving them national coverage with business units in Cork and Dublin. The company's main services are the installation and maintenance of building energy management systems (BEMS) and HVAC services to many different sectors including pharmaceuticals, education & healthcare.
The group of companies also has a very strong focus on energy. Several years ago they created "Ecocute", a company dedicated to energy re-

# Energy Symposium 2017 Submissions

Heat pumps could also be used to extract waste heat from Data centres and feed into a district heating grid for example. A data centre load of 10MW can heat close to 20,000 homes.

Some schemes to attract this type of business are providing free cooling to Data centres in exchange for the waste heat. If we are going to have Data centres let's have them in our city's where the waste energy can be usefully used.

So what we need is planning foresight to design and build. Cities and urban areas of high Density, high rise apartment schemes, Office blocks, public buildings, library, clean tech industry, Data centres, Smart Grid and connected buildings and systems. Use renewable energy combined with, Storage to include electrical battery, and thermal, build heating and cooling capacity into each building, and charge at nigh to help smooth out load. No car parks instead use the space for Thermal storage, obligatory connection to heat networks

**Some questions:**

1/ where do we build these heat transfer net works. 2/ who will fund this work. 3/ who will own them and operate them. 4/ can any of this happen without the policy makers and legislators through the departments of energy / environment working through the many problems and planning issues this will present.

Can we identify brown field sites and pilot a development what incentives can be put in place to encourage?

duction projects, which has partners Frank and James working with Dr Paul Sikora, a highly respected energy physicist and Tony O'Keefe, Master of Science in Energy, to deliver energy saving and CO2-reducing projects to the Sirus group customer base. Frank and his colleagues are innovators and are responsible for bringing new technology to Irish shores in terms of CO2 heat pump technology.

Frank recently completed a module in "Energy and the Environment" in CIT in Cork and continues to take an active role in all energy related projects and opportunities in Sirus. Recent examples where Frank's direct involvement with Sirus customers has helped to dramatically reduce the energy consumption would include Tesco, Primark and Dunnes Stores, UCC and Avocent.

Frank is member of the committee level of Energy Cork, an industry led cluster launched in 2013 which is promoting the energy industry in the Cork Region.
In 2015 Frank was elected President of the first Ireland ASHRAE Section which aim is to promote HVAC&R engineering excellence through innovation, collaboration and knowledge sharing.

# Energy Symposium 2017 Submissions

## Social and Behavioral Aspects to Energy Transition - How Social Policy, Education and Standards can engineer Energy Transition outcomes

Frank Murray

**Synopsis:**

Climate change is a scientific fact and despite the naysayers it is the most pervasive challenge that mankind faces in the next twenty years. We are witnessing the prolonged delay by several governments to change social policy, educate their people and introduce standards to push the carbon free society.

To encourage society to transition to new energy forms we need government initiatives in communications, education and standards that relate to real measures to reduce energy consumption. These initiatives must be in the form of structured models and programs targeting different levels of society to engage with the energy and climate change discourse.

It would be beneficial to examine these initiatives in these areas that have proven to be successful in other countries so we can optimize and close the timeframe for faster transition to new energy systems and forms.

**Takeaway:**

1. What are the communications initiatives that Government can push to promote energy transition for citizens, corporates and SMES?

2. What small changes in standards could be introduced to promote transition activity and what incentives can be identified?

3. Can Ireland do a better job to engage at all levels of the education communication to promote transition? What are other counties doing?

4. Is there a need for a more formalised program to connect common themes to citizens as consumers and employees?

**Article:**

The social and behavioural aspects to Energy Transition need to be considered globally if the world is serious about the survival of mankind as fossil fuels and carbon destroy the planet. Ireland is a small part of the global problem yet it can show leadership to achieve its goals and targets in energy use, carbon reduction and lead in many alternative modes. In writing this paper Ireland is behind in embracing renewables and whilst the wind and wave capacity of Ireland ranks one of the highest in Europe, we don't seem to be able to advance the energy debate at pace, Denmark has a target for 2050 to be zero fossil fuel dependent. Ireland spends 50% of its' energy costs on oil with millions of euros leaving our shores when we have the assets available.

### About Frank Murray:

Frank Murray is Managing Partner of The Linkage-Partnership a n international business development consultancy based in Ireland and Switzerland. Frank is Chairman of Piercom Limited an Irish advanced technology solutions company which focuses on IOT, Information management for companies like GE, Analog, SES, Hi-Life, ARISTA networks to name a few. Piercom were awarded the Smithsonian Medal for Innovation. In 2017 Frank was elected Chairman of the Swiss-Irish Business Association. Frank holds a B.Sc. in Science from the National University of Ireland (NUIG) in Analytical Techniques & Instrumentation, Chemistry and Mathematics and his postgraduate studies were at INSEAD, Paris, IMD Lausanne and IFL, Sweden where he completed the five-year program in International Advanced Management.

Frank Murray has over thirty-five years international business experience working with Swiss, Japanese, US and Irish companies. The Linkage-Partnership (TLP) was found-

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Investment in Energy Transition programs must be long term, sustainable and deliver meaningful outcomes with a fully engaged society and behaviour that matches. To promote any behavioral change in society can be daunting at the best of time and it is most encouraging to see the Government appointed Citizens Assembly begin to tackle Climate Change and to see this engagement take shape with particular focus on transitioning to new energy forms. see www.citizenassembley.ie

The expected positive behavior of any society to embrace change must be encouraged by such initiatives but there must be dedicated communications program and energy programs that show value, which we should all embrace through a sense of good citizenship and see ourselves as leaders and not followers of metrics laid down to under achieve.

There are some initiatives worth noting to support energy transition through behavior in society:

1. A communications program across all parts of society to disrupt our apathy and get children to embrace changes in the home through our education system. This has started through the Citizen Assembly see www.citizenassembley.ie and the Government Communications Department are leading this and must be encouraged.

2. A curricula at schools to adopt environmental protection as a core pillar of all our children's education.

3. A proactive program to push for energy provision away from fossil fuels to renewables through a fast pace wind and wave energy initiatives and planning applications without red tape. This is the macro transition approach that is required.

4. A consumer program that engage society to change behaviour in terms of use of energy, saving energy and incentivising for energy improvements to transition to new ways of using devices and tools and measuring energy consumption.

5. Adopting and enforcing standards would be a good start to forcing the changes and ensuring a skilled workforce can be trained to adapt existing buildings where 50% of our energy is consumed and lost.

6 A Corporate sector with SMEs aligned with Local authorities to sponsor and collaborate in centres of smart specialisation like the Advanced Manufacturing Research Centre and affiliate institutions to focus on technology fixes but also expand engagement to local initiatives that are visible to citizens and bring the energy discussion to relevant visibility. e.g. joint work programs for Corporates interested in say lighting or heat systems can work with Councils to retrofit street lighting as part of their R&D corporate initiatives thus reaching out to academic institutes to collaborate or house incentive programs to encourage transfer to energy positive housing with tariffs to sell back energy to the grid.

ed in 2014 to provide a dedicated service to companies to expand their business network. "Innovative enterprises need access to value partnerships" The Linkage Partnership are focussed on building such relationships says Murray. Building relationship teams and channels for product, services and knowledge enterprises is where TLP add value. Frank has worked in all aspects of the digital market, in pharma, industrial engineering and supply-chain management and with councils and government initiatives with extensive senior executive experience with Multinational and SMES sectors. Frank was European CEO of POWERCOM industrial engine software division in Fribourg Switzerland and head of Digital Equipment (HP) European Software business operations a €4Bn business in Geneva. Frank managed the software manufacturing operations for Digital Galway (now HP) and led the international business development for KAO of Japan across Europe Africa and Middle East. His formative career training was in the US and UK and later career in Switzerland and Ireland.

Frank participates on a number of voluntary boards and is the Knowledge and Technology Officer for the County Clare Local Enterprise Office and a member of the Swiss, US, European Chamber movements. He is interested in the power of collaboration and in facilitating and engineering the right networks for companies to leverage their strategy.

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**Summary Conclusion:**

The behavior of a society to change to new energy forms is a major challenge but our initiatives on energy savings away from fossil fuels would make a significant change to our economic standing. There is a need for investment in communications, roll out of programs and also benchmarking against proven models in other states to expedite our ground game in energy.

# Energy Symposium 2017 Submissions

## The Future of Energy Efficiency in Robotics & Automation

Gerry Horan

Horan Automation & Consulting

About Gerry Horan:

Gerry Horan possesses over 20 years experience in designing and implementing robotic arms and industrial automation projects, enabling Horan Automation & Consulting to provide unrivalled knowledge of automated production and packaging systems.

**Synopsis:**

A project called AREUS was commissioned by a leading university in Italy to design a system that would allow robotics and automation systems to run in an environmentally friendly mode in a manufacturing environment without affecting the quality or output of the machines. A grid was successfully designed and tested resulting in 20-40% less energy wastage and a saving of up to €120 million a year. The grid is currently being adopted for commercial use in both multinationals and SMEs.

**Takeaway:**

1. Energy efficiency is important to stakeholders so suppliers need to strive to include solutions into automation and robotic systems.
2. A project called AREUS was commissioned and carried out over 3 years at a cost of over €6 million to find a solution.
3. The AREUS project successfully designed and tested a grid system which resulted in energy savings of 20% - 40% and potential financial savings of up to €120 million.
4. The AREUS system is now being commercialised to be adopted for industry.

**Article:**

With manufacturing production in Ireland having increased by almost 30% since 2013, the focus is most definitely on automation and robotics. As sales demand increases, factories begin to employ automation solutions. There is a buzz in the industry regarding Industry 4.0 which would enable Europe to remain at the leading edge of technology. However, due to the nature of energy intensive robotics and automation, environmental and financial sustainability issues have arisen in maintaining Europe's status.

To address such sustainability issues, a study entitled AREUS or "Automation and Robotics for European Sustainable manufacturing" was undertaken by the Universita Degli Studi Di Modena E Reggio in Italy. The study spanned three years from 2013 to 2016 and cost over €6,000,000. The AREUS project was coordinated by Marcello Pellicciari who explains the reason for the study; "Manufacturers are very concerned about the sustainability of automatic assembly processes, in particular, energy efficiency is strategically necessary to give European manufacturers a competitive edge. The factories of the future have to be smart and green."

The objective of the AREUS project was to marry the concept of the SMART factory with the GREEN factory, integrating modern technology machines and systems with environmental sustainability.

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This was carried out by designing a new innovative integrated technology and engineering platform. The following areas were employed to allow the AREUS team to achieve their goals:

Energy Consumption Reduction: The system was required to exchange, harvest, store and recover energy at factory level improving the use of renewable energy sources Design and Simulation Eco-Efficient Environment: An environment was designed to focus on the simulation of energy flows to allow the team to monitor and improve eco-efficiency Manufacturing Process Optimisation Environment: An environment was designed to simulate optimal sustainable production scheduling under a control engineering approach so that the team could discover potential energy and cost savings Assessment of both Environmental and Economic Costs: The team analysed flows of Material, Energy and Waste of co-evolving products and processes realized with robotic production systems through the use of their simulated environments.

The outcome of the project was that the team created new methods, tools and algorithms to achieve sustainable robot manufacturing. An innovative direct current-based industrial smart grid was developed that can exchange and recover energy at factory level. The smart grid can also seamlessly integrate renewable energy sources. The AREUS project was tested in seven manufacturing facilities to demonstrate its capabilities and to test its limitations in different situations.

The seven manufacturing centres are detailed below:

1. Virtual production design demonstration lab (owned by DAI) for new robotic production process eco-design, simulation and optimization

2. Demonstration cell (owned by DAI) with 4 high payload latest generation ro bots with respective tooling at DAI. The prototype production unit will be based on novel power supply system and will demonstrate the maximum re source and energy savings by the combination of all AREUS approaches, both related to hardware or control method improvements.

3. Demonstration cell with 5 industrial robots and conveyer system at CHALMERS (owned by CHALMERS) will be used to demonstrate the intelligent production scheduling methods and idle mode control.

4. Demonstration cell with 3 various payload robots at SIR (owned by SIR) will demonstrate and assess the performance of AREUS re-design and readaptation of existing plants.

5. Virtual robotic production system optimization demonstration test bench (owned by DELFOI) to demonstrate system-wide improvement of existing co-evolving product-process-robotic production systems.

6. Industrial robot test bench at RTU (owned by RTU) will demonstrate the electrical energy exchange modules – prototype units for electrical drive systems and any other equipment with DC link, energy storage approaches and direct integration with renewable energy resources.

7. Virtual lab (owned by DTU) for LCA/LCC determination of robotic production units and eco-efficient re-design to improve sustainability at DTU. The demonstration facility permits to evaluate an environmental impact and economic appraisal of robotic production plants of any dimension

The energy saving results of the simulated environments proved a success and achieved energy savings of up to 20 %. The team then also developed several smart grid products, including industrial robots. Optimised robot trajectories and various optimisation tools were developed and considerably reduced the energy consumption of the robotic process without compromising their productivity or their output quality. According to Mr. Pellicciara, AREUS project coordinator, manufacturers who adopt the AREUS grid could potentially generate up to €120 million in extra revenue per year.

Following the success of AREUS project, the team are developing new tools to adopt the grid for industrial use. There will be different versions of the grid designed and adapted for multinationals to SMEs. The grid will be prepared for commercialisation taking into account product standards and licencing.

Mr. Pellicciari comments “We are starting a revolution,” says Pellicciari. “This is a disruptive change to the electrical power supply architecture of factories and to digital manufacturing simulation tools, I am proud to see that we are improving both the environmental and financial sustainability of the Factories of the Future.”

So how does the AREUS project affect us, Horan Automation & Consulting, an SME specialising in robotics and automation and based in Ireland? Should our market be customer demand driven or should we strive to supply products that are energy efficient? Our outlook is simple and ultimately feeds into our company vision; we strive to offer products that are at the forefront of technology while maintaining our high standards of quality. In other words if this new AREUS grid technology is made available to us at a factory level we will offer this eco-efficient product to our clients and demonstrate to them how an investment in this system can save them both money and contribute to more environmentally friendly manufacturing. We conclude that the customer is more likely to adopt environmentally friendly practices in automation and robotics if they are properly educated on their benefits by the supplier.

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# The "perfect" energy source for the future

Ian Ryan

Wyeth Nutrition

About Ian Ryan:

My working life started with a four year Electrical & Instrumentation apprenticeship with ESB power generation; then two years training electrical apprentices with ESB training services. I then had roles within the pharmaceutical and food industry, including commissioning and production improvement projects. Following that, I spent two years as a field service engineer with Honeywell control systems, installing and maintaining instruments and control systems, while studying for a degree in "Electronics and Computer Systems" from DIT. I obtained my Masters in Energy Management from IT Sligo, while working in Huntstown Power Station as a Lead Operations Technician. I worked for five years in ResourceKraft Ltd. where I held the position of Field Operations Manager, managing projects and customer support. I am currently working as an Energy Engineer with Wyeth Nutrition in Askeaton.

**Synopsis:**

Future energy needs will require a multi-stranded approach, combining renewable energies for example, solar, wind, hydro technologies and bio fuels. If you think about these energy sources they are all derived directly from the sun. Plants use photosynthesis to produce chemical energy from the sun, hydro technologies, excluding wave, are produced by solar evaporation causing rainfall and wind is produced by uneven heating of the earth's surface by the sun causing air to move from higher to lower pressure regions. Renewable energies are relatively non polluting, sustainable and efficient. They reduce global CO2 emissions' and the emission of greenhouse gases.

**Takeaway:**

- Future energy needs will require a multi-stranded approach, no silver bullet.

- The potential in Solar technologies.

- Solar energy, storage solutions.

- Infrastructure requirements.

**Article:**

To establish what the perfect energy source for the future may be, we first need to look at the meaning of "perfect". The Merriam-Webster dictionary defines "perfect" as; "corresponding to an ideal standard or abstract concept" (Merriam-Webster), so we are looking for an energy source that is abundant, reliable, sustainable, environmentally sound, produces little or no pollutants and is cost effective.

Future energy needs will require a multi-stranded approach, combining renewable energies for example, solar, wind, hydro technologies and bio fuels. If you think about these energy sources they are all derived directly from the sun. Plants use photosynthesis to produce chemical energy from the sun, hydro technologies, excluding wave, are produced by solar evaporation causing rainfall and wind is produced by uneven heating of the earth's surface by the sun causing air to move from higher to lower pressure regions. Renewable energies are relatively non polluting, sustainable and efficient. They reduce global CO2 emissions' and the emission of greenhouse gases.

So let's focus on just one of these renewable energy sources, solar! The potential form solar energy is enormous, as little as 1% of the worlds deserts could produce all the energy required by the planet at present. (Sunshine the Perfect Energy Source). It is estimated that life on the earth can survive for the next 1-2 billion years at which time the heightened activity of the sun will evaporate the oceans on planet earth. So

it is safe to say that the sun will amply supply our energy needs, to a point at which that, which made life possible on this planet, the sun, will cause our extinction (Risks to civilization, humans and planet Earth).

With this in mind I believe we should focus our efforts on harnessing the enormous amounts of energy the sun has to offer. We are already focusing much effort in this direction, with solar evacuated tubes, photovoltaic cells and concentrating solar power (CSP).

It is with out doubt that as fossil fuel sources run out in the not too distant future and the ever increasing demand for energy (Energy Bulletin), especially as third work economics develop; there is a need to develop these sustainable and renewable technologies.

There are however hurdles to be overcome and many engineering challenges to solve, but we must tackle these head on as our existence as a species depends on it. We are so reliant on abundant energy for survival that if this vital commodity was not available many millions would perish.

So what are our options and what might the future bring for solar energy? Many solar energy technologies are very much in their infancy and have lacked investment, this mainly due to availability of cheap fossil fuelled energy, but now as these resources are becoming scarce there is a move towards renewable energy sources. The climate is now right for these green enterprises to be financially viable. Let's now take a look at what is on offer.

As you drive through our country side there are many new homes built and a distinguishing feature of these are their solar evacuated tubes on their roofs. They extract radiant energy form the sun and transfer it via heat exchangers to the domestic hot water tank to supply the hot water needs of the household.

Photovoltaic Cell or PV cells covert sunlight into direct electrical current, this electricity can be used to operate electrical equipment via a converter which converts this direct current into alternating current similar to that supplied to your home by an electrical utility company. Alternatively if there is no demand within the building for electrical energy, the energy can be stored in batteries, utilised to charge your electric car or be placed on the grid for others to use. The European Photovoltaic Industry Association suggests that solar power could provide enough energy for 1 billion people by 2020 and 26% of global energy needs by 2040 (European Photovoltaic Industry Association). According to the US National Renewable Energy Laboratory, "The Sun bathes us every day with more energy than humans could use in 30 years" (Putting Sunlight to Work).

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There is work ongoing in Massachusetts Institute of Technology on modifying viruses so that they can store energy, these modified viruses are then graphed into bacteria for mass products, it is hope that this technology can be incorporated into laptop batteries, solar cells and fuel cells for transportation (A Tour Of The Energy Future).

Both of the technologies mentioned above are being scaled up to commercially viable power production plants. Another example of this is the development of concentrating solar power (CSP) plants, these plants utilise arrays of mirrors to focus the suns rays onto a central tower collector, this can produce temperature in excess of 3000□ C, which can in turn produce steam to drive turbines with electrical generators attached. There is also a design which operates on a thermal updraft of heated air principal to drive a turbine. One major advantage of this plant is the low grade water heat which they produce can be utilised to desalinate water (Combined Solar Power and Desalination Plants).

So I can hear you saying what happens when the sun goes down? Do we sit in the dark? Well the answer to this is an emphatic NO! If we are to depend on solar or any renewable energy source in the future we will need the infrastructure to support it. The ambitious goal being set by the Irish government of having Ireland operating on 40% renewable by 2020 will require massive infrastructural investment in the current electrical transmission grid. This is in a work in progress with the Eirgrid, Ireland's electrical transmission grid operators, "Grid 2025" study and deployment (Grid 25).

The complete solution to utilisation of solar energy is not so much the harnessing of this energy but the issue of storage. An obvious choice is solar batteries, this will I believe only serve to be practical in the domestic market with large scale costs being prohibitive, batteries are bulky, require periodic replacement and maintenance.

A technology that is being utilised in CSP power plants is to store the energy in large salt baths the energy is then released as required to provide power to the grid (Thermal Energy Storage).

A novel idea for storage although it is not a new one, is to construct pumped storage similar to Turlock Hill pumped storage power plant in Wicklow. This facility utilises excess power on the grid to pump water to an artificial lake. During times of high electrical demand on the grid it releases this water through hydro turbines to produce energy as required. I understand that Eirgrid, have proposed in their "Grid 2025" study that Ireland builds 10 more such facilities to cope with the vast amounts of renewable energy anticipated on the grid by 2020 (Grid 25).

Many new low energy homes are designed incorporating the concept of solar thermal gain, similar to the greenhouse effect, to capture radiant energy from the sun during the day and store it for use during the evening and night. This is achieved by use of

high efficiency glazing and south facing windows to capture as much of the sun light as possible.

This however is only the beginning of the story. What is required is a global high voltage direct current (HVDC) super grid to transmit this renewable energy throughout the world, with different parts of the planet supplying our energy demands at different part of the day. The premise is that each home would be almost self sufficient and industry and commercial enterprises would get their energy requirement from the super gird fed with industrial sized renewable power plants. This is no doubt a monumental challenge, not only on an engineering scale but in the co-operation required between nations, never seen before. No doubt many nations will find it difficult to be dependant on each other for their energy needs but this is what is required if we are to have reliable, sustainable, power in the future. The Irish renewable energy company Airtricity is supporting the European super grid strategy (About the Supergrid).

Essentially, we are only attempting to copy what nature has being performing quietly for billion of years in photosynthesis, indeed much work is underway in this area, utilising semi biological photovoltaic cells to manufacture hydrogen which can then be used for fuel cells (Semi-Biological Photovoltaic Cells). Can you imagine fields of biological PV cells in the future?

Polymer based flexible PV cells and photoconductive fibres when perfected will make it possible to manufacture photovoltaic cells that are flexible. Imagine being able to charge your iPod as you go for a walk from the clothes your are wearing (A Tour of the Energy Future).

There is much research going into “smart” power control within industry. The basic principle is that when energy is not abundant consumers reduce their energy demands automatically. One novel idea is “smart” refrigerators that sense when the electrical grid is at peak demand and switch themselves off during this time, then run when the grid is relatively unloaded. This technology will inevitably feed in to other applications.

There is an Irish company leading the way is this type of “smart” load management controller technology for homes. Coolpower have developed and have patents pending on there “EMMA” controller which controls the electrical usage in your home to maximise efficiency. Any surplus electrical generation can be used to heat domestic hot water via an immersion heater or feed onto the electrical grid (EMMA).

I believe that in the future as smart metering becomes more widespread we will have to pay a premium for using electrical energy at peek periods and will be rewarded with low cost electricity utilised at low demand periods. This fits in nicely with the charging of our electric vehicles overnight, when gird demand is greatly reduced (Grid 25).

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The benefit to the environment with these types of solar energy systems is immeasurable. Virtually emissions free, clean, sustainable energy. Renewable energy technologies will remove the need for fossil fuels in the future and this will circumvent the depletion of our natural resources, aid in the recovery of ecosystems on the planet as mining and power plant air emissions cease (Environmental Benefits of Renewable Energy).

In conclusion as Eric McLamb the founder of ecology.com suggests;

"*No single solution can meet our society's future energy needs. The solution instead will come from a family of diverse energy technologies that share a common thread -- they do not deplete our natural resources or destroy our environment*."

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# Nature provides the energy; we decide how to use it

James Byrne

sirus
Building Energy Solutions

Our planet has but two sustainable sources of energy; the sun, which is expected to continue burning for another 5 billion years; and the core beneath our feet, which is expect to exhaust itself due to radioactive decay in a similar timeframe. The forms that the sun's energy are available to us are varied; from the more immediate solar thermal, wind and photosynthesis, to the long-term forms stored as fossil fuels.

The planet has processed this energy for more than 4 billion years, using complex physics, chemistry and biology that we have been challenged to understand and emulate. These processes have been responsible for shaping the landscapes we have learnt to enjoy and exploit as well as managing the natural resources we need to survive. We live on an amazingly complex planet that can handle enormous quantities of energy from both these sources and still maintain a relative equilibrium.

Our hunger for energy seems insatiable; when you consider that in 1820 world energy consumption was of the order of 21 ExaJoules per annum, by 2010 it had risen almost 40-fold to 800 ExaJoules per annum and while the growth rate has slowed in recent years it is projected to exceed 1,200 ExaJoules per annum by 2035. This growth in consumption has coincided with our discovery of some of natures hidden treasures, we cannot sustain this growth without an imaginative use of the available sources of energy.

Wood is probably the oldest of natures products to be used for energy. Charcoal was once the most important of all wood products, dating back to 30,000BC. The Egyptians used charcoal to smelt ores as far back as 3,750BC due to the high temperatures that can be achieved. However, the large scale deforestation resulting from our ever growing need for energy and building material has already seen civilisations shrink or disappear.

What is referred to as the Age of Oil dates back to the production of Kerosene from coal in 1854, followed by the discovery of crude oil in 1859. We realised that these fossil fuels, the by-product of decomposition of plant and animal materials, provided an abundant source of energy. Oil exploration and production became the bywords for wealth and development. Back in the 60s we were all convinced that if we could just find some oil off our coast that we would become a wealthy nation, just like the Texans or the Arab states.

Natural Gas was used by Chinese as early as 500BC, yet In the early days of oil production it was burned off as it was considered prohibitively expensive to pipe to po-

## About James Byrne:

James Byrne is the founder and chairman of the Sirus Group. He began his career in the family engineering business and went on to study Plumbing and HVAC technology in Bolton Street College (now DIT). He spent a number of years in the early 80s working as a consultant designing HVAC systems and during this period elected to specialise in the application of Building Management Systems (BMS). His interest in BMS, HVAC and energy has led him to establish a number of companies over the past 30 years dealing with many aspects of building technology. He led one of these companies to win the SEAI Sustainable Energy Innovation Award in 2012, has led Sirus in EU FP7 and H2020 projects and is currently treasurer of the Geothermal Association of Ireland.

tential consumers. Now most of the developed world benefits from a complex infrastructure which distributes it to our cities, helping to reduce the pollution associated with most other fossil fuels.

But, this Black Gold and its by-products has a small, but not insignificant problem; it takes 300 to 400 years to produce and while we have become increasing more ingenious at ways of discovering and extracting it, we can expect to have serious depletion of the reserves that nature stockpiled by 2040. Even focusing on shale gas; which has resulted in the US becoming the largest gas producer on the planet, only postpones this inevitability.

Thankfully nature provides us with so many examples of how energy can be consumed in a sustainable way; the snowdrop and daffodil bulbs whose flowers we long to see every spring are akin to permanently recharging batteries, converting the suns energy by photosynthesis and reproducing in the process. The weather we so often bemoan is at its simplest an important large scale distillation process that separates the water essential to our survival from the earth's surface, fuelled by our sun's energy. The enormous energies generated by this process enable us to harness mechanical and electrical energy in the form of wind, wave, tidal and hydro generation. Biogas, a by-product of everyday digestion by bacteria of plant and animal matter (including human), can be piped into our existing infrastructure and fuel our cities. Historically we have dumped these materials, causing unnecessary widespread pollution as a consequence, destroying the most valuable natural commodities on the planet; air and water.

Then there is the heat beneath our feet; the geothermal energy that results from both the shortterm recharging of the upper levels of the earth's crust by solar activity, to the deep energies fuelled by the radioactive decay of the earth's core. These energies are some of the most untapped sources on our planet, with the ability to heat, cool and generate electricity.

So our challenge is to study nature, move on from the age of oil and aim to develop more efficient and sustainable processes. We also need to be more aware of conservation, to focus on the elimination of waste and learn to emulate natures understanding of recycling excess. When we consider that in Ireland we dump up to to 50% of the energy used in most of our electrical generation in the form of waste heat, rather than use basic planning and the technical know-how available to conserve and recycle this excess energy.

# Energy Symposium 2017 Submissions

Energy security and the sustainable use of our planet's resources are key issues that have a wider impact than most people can comprehend. We don't lack the technology to ensure that we deliver on both, but all the signs are that we lack the social, political and economic will to do so. We are already seeing signs of the negative socio-economic impact of our failure to address these issues. While we might use a variety of different labels to explain the impact of our policies, the historians of tomorrow will distill the facts and name and shame us for our obvious failures; unless of course we start to refocus and address our responsibilities before it is too late. Ireland needs to realise that it has an abundance of natural resource and can therefore become a world leader in the development of sustainable energy technology. While other technologies will come and go, energy technology will always be a part of our landscape.

# Energy Symposium 2017 Submissions

## The cheapest and greenest KWH is the one you don't use

Jerome Bletterie

Allergan

**Synopsis:**

Allergan PLC is a global biopharmaceutical company headquartered in Dublin, Ireland. Allergan is committed to sustainable operations and in this regard are cognisant of the consumption of energy by both Manufacturing Operations and Supply Chain and especially how energy derived from fossil fuels is related to greenhouse gas emissions and consequential changes in global climate.

In early 2016, Allergan set an ambitious goal to reduce our environmental impact by committing to a 20% reduction in energy consumption by 2020 (our 20/20 challenge). Arising from this corporate target we developed an aggressive roadmap to realise the energy reduction goal. Throughout 2016 and 2017 we continued the journey to improve our performance on this mission to become a more sustainable company.

**Takeaway:**

Energy awareness among Senior leader team Energy awareness among employees Environmental responsibility and sustainability Focus on reducing Greenhouse GAs emissions and energy

**Article:**

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Working with our Corporate Energy Director, Allergan Westport adopted the Energy Treasure Hunt process as a best practice methodology. The Energy Treasure Hunt is a three-day event that engages employees and key stakeholders in identifying low-cost energy savings opportunities from behavioural, operational, and maintenance actions. In 2016, Allergan conducted its first Energy Treasure Hunt at the company's Clonshaugh, Ireland facility. The event brought together site personnel with pharma industry peers, technology experts, and equipment suppliers along with members of the GENIUS (Global Energy Network for Improvement in Usage and Supply) team Leads from other Allergan plants. The Energy Treasure Hunt identified savings of

### About Jerome Bletterie:

Jerome has a First Class Honours degree in Energy/Mechanical Engineering from GMIT and has worked on significant international turn-key Energy projects such as Renewable (Biomass) Energy centre and district heating for the village of Castle Ashby (Northampton, United Kingdom), installation and commissioning of 3MW biomass for the London Olympics 2012, Renewable energy centre for the NHS in Inverness Scotland.
In the past two years Jerome has successfully delivered on major energy infrastructure projects at Allergan Westport, including the long-awaited CHP installation as well as LED lighting which contribute more than $550k in savings, annually. Other pipeline projects include the Chilled Water Upgrade, Steam Boiler efficiency and Demand Side Unit which will bring site savings to in excess of €1m per annum. Jerome will be responsible for the Energy Treasure Hunt, Energy Monitoring system and liaising with the Business Unit technical Leads on projects to reduce overall site energy consumption and CO2 emissions, thereby achieving the Corporate goal of a 20% reduction in Energy consumption, by 2020.

almost 24% of the site's current usage thereby exceeding the goal that was set for the event. The next Treasure Hunt event is planned for the Westport plant in December 2017.

In Allergan Westport, the largest opportunities to achieve the 20/20 challenge are to improve the energy efficiency within our facilities and to ensure that new buildings or facilities are built in accordance with the best energy efficiency technology available. Allergan Westport identified key projects to reduce greenhouse gas emissions and improve the efficiency of the existing facility, such as:

- Re-engineering the LPHW system by adding additional efficient LPHW boilers and a mCHP;(achieving 1.2MW savings, and 1.8 tonnes of CO2 Savings).
- Re-engineering the Chilled Water System with new technology using algorithms; (Potential savings of 3.9MW savings and payback of 3 years).
- Complete refurbishment of existing lighting to high performance LED lighting
- Installation of Photovoltaic solar panel onto new Biologics Two facility.

Allergan Westport is also aware of the importance of monitoring energy consumption. Since June 2017, Allergan have engaged a third party to monitor more closely site energy consumption and resulting from this a report is generated on a weekly basis with actions for different site teams.

We already know that the energy demand breakdown for pharma plants is as follow:

- 65% on HVAC
- 25% on Equipment
- 10% on Lighting

Therefore the focus on energy monitoring on the HVAC is a very important task as it will help the company to achieve its goal, Allergan is already in the process of re-engineering the Chilled water System, by linking two separates building to centralized their chilled water plant, but the second major task will be the set back on the air changes on the Air handling unit, this is major as almost all Air Handling Unit are in a validated environment therefore very challenging to change so a lot of design work and effort will be necessary to achieve this.

Resulting from the 20/20 challenge, Allergan PLC is committed to ensure current and future energy consumption is used in the most effective, efficient and sustainable way possible.

# Harnessing Energy from Wastewater

Joe Shinkwin

**Takeaway:**

- Innovative new wastewater treatment technology.
- Ambient temperature operation and energy-positive operation with biogas.
- Technology proven at full-scale with commercial operation.

**Article:**

For many food & drink producers, wastewater is a problem, an expensive problem – environmentally and financially. Depending on site location, a food & drink producer typically flushes their wastewater into a sewer, pushing the treatment burden down the sewer line to the local municipal treatment plant, paying significant trade effluent charges for the convenience. Alternatively, in the absence of a sewer, an on-site wastewater treatment plant must be built, at significant capital cost with continuous operating cost and maintenance, to consistently and confidently meet EPA discharge consent limits.

NVP Energy delivers the first-to-market high rate anaerobic digestion wastewater treatment technology that can treat this wastewater at ambient temperatures as low as 4oC. Unlike typical anaerobic systems, no heating of the influent wastewater is required. NVP Energy has exceptionally low operating and maintenance costs and generates high quality biogas as a by-product which can be utilised on-site for heat and electricity generation. By producing more energy than is required to run the system, NVP Energy has shown its potential to be a major disrupter in the wastewater treatment industry, making a significant contribution to the circular economy with decreased costs and energy generation to the end-user, offsetting the use of fossil fuels. Food & drink industry sites typically have a high demand for heat and electricity. The biogas produced by NVP Energy can be used directly on-site through existing gas boilers for heat, or if available, a combined heat and power plant (CHP), providing heat and electricity. This delivers revenue in the form of energy for the end-user, reducing their site's reliance on fossil fuels for their energy needs.

The heart of NVP Energy's wastewater treatment technology is the modular reactor, which makes the solution easy to deploy for new plant and retrofit installations. The compact reactor module is 4.5 m in diameter and 12 m high with all required controls and instrumentation delivered in an adjacent containerised package. Both elements are manufactured off-site and feature a short on-site installation period. Ultimately, this modular solution is ideal for industries with space constraints thanks to its small footprint when compared with conventional wastewater treatment solutions that require substantial space for installation. Additional modules can be installed to efficiently meet production increases and increased volumes of wastewater.

# Energy Symposium 2017 Submissions

Meeting the demands of the food & drink industry, NVP Energy provides an easy-to-operate wastewater treatment facility with a simple user interface that requires minimal training to operate irrespective of the size of the plant. Also, the solution is feature-rich, unlike competing products, with the ability to remotely monitor and diagnose from off-site in case of operational problems. With its innovative features and significant cost-saving benefits, NVP Energy offers the food & drink industry an average three-year return on investment.

NVP Energy's first full-scale commercial installation has been operating in the meat processing industry since March 2016 with ABP Food Group in Northern Ireland and a second plant opened in April 2017 with dairy processor - Arrabawn Co-Op, Co. Galway. With its sights firmly set on international expansion, NVP Energy secured a project with a major international brewing brand, delivering a four-module system at a large UK production facility.

For the municipal treatment market, NVP Energy again offers an alternative to existing outdated treatment methods with its low operating cost, modular, expandable solution. Struggling with aging, inefficient treatment plants, municipal treatment operators can turn to NVP Energy with its ability to retrofit into an existing treatment plant, instantly increasing capacity and allowing the operator to increase the life-cycle of their existing assets while coping with increased wastewater volumes.

# Significant Energy Reduction Opportunities (SEROs) in Manufacturing

John Cosgrove

LIT
LIMERICK INSTITUTE OF TECHNOLOGY

**Synopsis:**

Energy management in manufacturing companies, particularly in small to medium enterprises (SMEs), remains undeveloped due to competing priorities and a lack of specialist knowledge. The application of well established and low-cost energy conservation measures could cut a Companies energy costs by 20%. These savings can be achieved through leadership from management, changes in behaviour and low-cost monitoring and targeting measures.

**Takeaway:**

- The specific energy consumption (SEC) metric commonly used in manufacturing to track energy consumption is not sufficient where there is fixed baseline energy consumption.
- LIT have developed an approach to leadership and key performance indicators (KPIs), validated in two case studies, which have been shown to successful ly deliver measurable savings and employee engagement.
- Having accurate machine level data on the added-value energy consumed versus the total potential machine consumption will be necessary for Manufacturing Companies to continually improve their energy performance.

**Article:**

Energy management in manufacturing companies, particularly in small to medium enterprises (SMEs), remains undeveloped due to competing priorities and a lack of specialist knowledge, however considerable savings in energy consumption and greenhouse gas (GHG) emissions can be demonstrated where such companies take the initiative to investigate their energy use. To understand t he consumption of energy in a manufacturing company, changes required in practice have been identified through the analysis of the temporal consumption of energy at the Factory, Functional, Value Stream and WorkCell level and in the determination of the relationship between the energy consumption an d production activity. Significant Energy Reduction Opportunities (SEROs) and cost savings of up to 20% can be identified through fixed or temporary electricity monitoring and subsequent analysis and visualization of the empirical data to drive the engagement of the process owners and operators. The identification of auxiliary (non-value added) energy within production, such as idle energy consumption in machines, has been identified as an import ant area with potential for energy reductions through low-cost changes in operational behaviour and procedures.

## About John Cosgrove:

John Cosgrove, Technical Director, is the lead researcher in industrial automat ion, factory control systems and intelligent sensor networks. John is an experienced researcher, project co-ordinator (TEMPO, 2011-15), EU Reviewer an d Evaluator and was co-ordinator of the H2020 Research Roadmap “Factories of the Future beyond 2013”. In Academic terms, John has contributed to over 25 international conference /journal publications and has supervised 17 research postgrads. John was also the editor of the TechWatch Publication in 2004 on “Innovation in Automation” as part o f the EU Innovation Actions Programme.

# Energy Symposium 2017 Submissions

Research and demonstration projects run by the ACORN Research Centre in the Limerick Institute of Technology have shown how a product centric approach based on 'Lean' manufacturing principles can illustrate the relationship between the energy usage and production activities at the Value Stream level. The approach identifies the 'process' significant energy users (SEUs) where more targeted monitoring of electricity consumption would be beneficial. Quantification of the cost of auxiliary energy or waste has been shown to be a motivational factor for company management to engage with energy efficiency measures and to address the actions necessary to drive employee awareness in their factory. A gap in practice ha s been identified in the metrics used in manufacturing to track energy consumption which are predominantly based on specific energy consumption (SEC).

The development of Energy Performance Indicators (EnPIs) or Key Performance Indicators for energy (KPIs/e-KPIs) have been described in theory but the re is limited evidence of their successful application to production in practice. The adoption of an Energy Performance Co-efficient (EnPC) is propose d to compare actual performance with expected performance in order to highlight energy trends and out-of-control operations. Where sufficient energy and production data is available, it is shown how comparison with Best Practice (BP) can be used to set targets and drive continuously improving performance. The conceptual framework and key performance indicators (KPIs) have been validated in two empirical case studies in manufacturing companies in Ireland and shown to successfully deliver measurable savings and employee engagement.

**Example:**

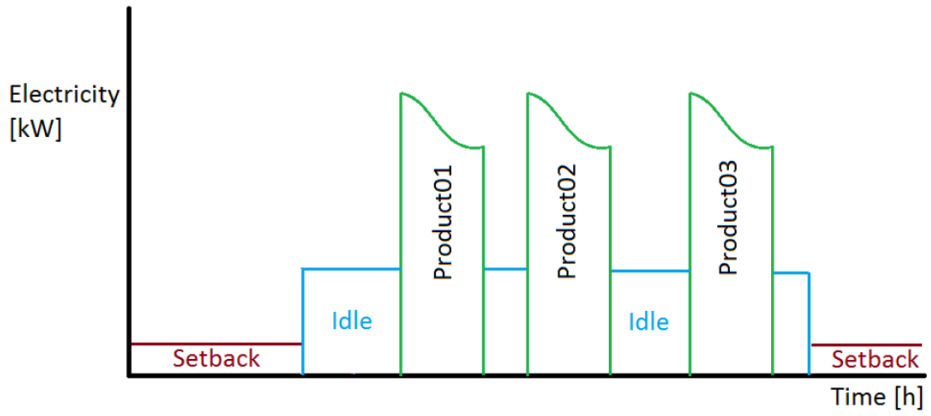
The milling or cutting of parts follows a well-defined energy profile which represents added-value or productive time. When the machine is no t in part-production, it waits in standby or idle mode, which can consume a significant amount of energy through coolant pumps and blowers remaining operational. Most machines have a setback mode through activation of the Emergency Stop (E-Stop) where only the incoming transformer and machine electronics remain powered.

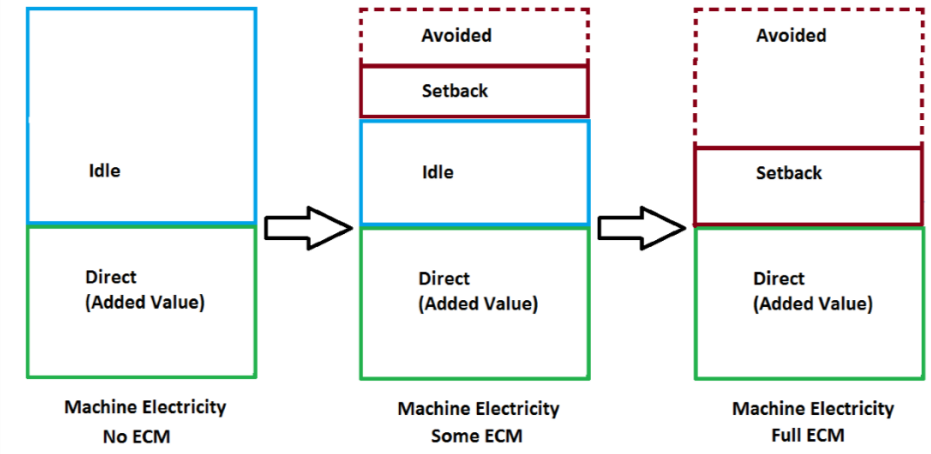
From empirical measurements taken by temporary electricity meters, the aver age electricity consumed during production, idle and setback can be identified. OEE data or machine logs can provide information on when production jobs were run, based on either start and stop time of each job, the start time and cycle time or the end time and cycle time.

The EnergyEfficiencyPerformance_WorkCell (EEP) metric represents the percentage of total electricity consumption in the WorkCell that is used to add value to production. As the parameters are based on productive time weighted by the average power use, the ratio will improve as machine utilisation improves. Thus, similar to the

SEC, increasing production volumes will has an indirect effect of higher efficiency, however as the metric is based on energy (kWh) values only, any measures to reduce the electricity wasted in id le running will also be highlighted. This approach could be considered to b e in-line with section 4.6.1 in ISO 50001 (2011) where EnPIs should evaluate actual against expected consumption.

The EEP for the WorkCell provides a metric that can highlight improving or disimproving energy efficiency based on reference measured electricity values and production volumes and cycle times. Product variations can be dealt with if the appropriate power profiles are available. Aggregated values from process SEUs across a number of WorkCells could be used to demonstrate overall Value Stream energy efficiency. Having accurate machine level data o n the added-value energy consumed versus the total potential machine consumption will be necessary for Manufacturing Companies to continually improve its energy performance.



# Unlocking the opportunity

John Walsh

ESB Energy for generations

What if someone told you there was an easy way to for industry to lower business overheads, and generate more revenue with a net benefit to the environment? Would you believe them? Question their understanding of modern business realities? Look around for a hidden camera? If your brow furrowed at the mere suggestion that all of these things could be achieved simultaneously, you wouldn't be alone. Rising competition and the rapid adoption of new consumer and supply chain technologies have seen many businesses around the world struggling to adapt to the pace of change. And long established businesses in Ireland and the UK are no exception. Indeed the more established the business and the larger the operation, the more daunting the prospect of change—even when innovating holds so much promise. So, what can today's business leaders do to ensure their company's continued ability to compete?

One solution is surprisingly simple, especially for organisations with significant energy bills: Engage a collaborative energy services partner with a proven track record to analyse your company's energy usage and help implement energy-saving, revenue-generating solutions.

**THE NEW CEOs**

Call them impartial advisors, project managers or Chief Energy Officers: the ESB is on a mission to innovate the business of energy consumption and management, helping large-scale energy consumers navigate the transition to a low carbon, environmentally sustainable future. Moreover, they want to ensure industrial and commercial organisations realise the rewards of saving energy in the process.

Using advanced monitoring technology to deliver detailed data and analytics on energy usage and assets, ESB offer expert insights and tailored recommendations, as well as innovative technological solutions designed to deliver positive returns quickly. Established in 2016, the ESB's energy consultancy has already partnered with over 50 businesses to reduce their carbon footprints and improve their bottom lines. Last year alone, the group delivered over €20 million in energy savings to commercial clients across Ireland and the UK. Next year, Smart Energy Services aims to help clients achieve over €50 million in savings. To ensure this and other ambitious targets are met, the group will be expanding its workforce from 20 to 35 this year, and plans to employ 200 people by 2021.

**MEETING TARGETS FOR 2020**

As a semi-state body, the ESB is committed to working toward the EU's renewable energy targets for 2020. These commitments have seen the group forge connections with agnostic suppliers and innovators to ensure Ireland meets its targets. Staying on track currently means increasing generation of wind, solar, hydro, geothermal and biofuels.

## About John Walsh:

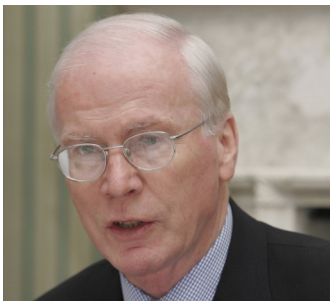
John heads up the Smart Energy Services team in ESB Innovation and has over 20 years experience within the building and energy sectors. He works with clients in the UK and Ireland to reduce the energy use of their buildings through low energy design and the optimisation of their ongoing operations. John qualified with a Masters degree in Mechanical Engineering and MBA, and is a Certified Energy Auditor (CEA).

# Energy Symposium 2017 Submissions

One such innovative collaboration is with Endeco Technologies, a company developing sustainable energy storage solutions. To date, the ESB has invested in Endeco's technologies and jointly offer their customers funded battery solutions. Battery Storage technology is not only essential to ensuring reliable supply in renewable generation systems, but generating revenue for the customer by facilitating the sale of power back to the grid.

Climate change is one of the key challenges for mankind but by collaborating with innovative partners it can also be an opportunity for industry to become part of the solution and to become more competitive.

# Don’t waste It , Tag it



John Whelan

Urban waste is being produced at a faster and faster rate ,according to the World Bank’s report What a Waste: A Global Review of Solid Waste Management. Annual worldwide urban waste is estimated to more than triple, from 0.68 to 2.2 billion tonnes per year over the next decade.

In 2006 Ireland was the second highest urban waste producer at 941 Kilograms per person behind New Zealand (1,3423Kgs) but ahead of the United States ,according to the World Bank in it’s last review of the developed world’s waste status.

But things have improved as related by the more recent Eurostat report which shows that Irish people produced 586 kg of waste per person in 2012 and is 22% above the EU average of 481 kg per person.

Well above the EU average, but a dramatic improvement on the World Bank report of six years earlier. Much of the improvement has been driven by EU legislation ,which ensured greater focus by the Irish Government in both campaigning for public awareness and funding for better waste management.

Was it all achieved by use of the carrot ? Environmental taxes have played a key role in driving progress in relation to waste management. The Irish landfill levy was introduced in 2002 at a rate of 15 euro per tonne of waste. Since July 2013, it has been set at 75 euro per tonne of waste; an increase of 60 euro over the period from 2002 to 2013. But the Government has shaken up the system again . A new framework for household waste charges was announced in June 2017. Under the proposed new arrangements, waste collectors will offer a range of pricing options, such as standing charges; charges per lift or per kilo; charges by weight band; weight allowance charges; or combinations of these elements.

And is it worth it? Certainly the Government is gaining as new revenue stream , which could keep on giving for some years to come . Recent EPA research estimates that if Ireland achieved a target of a 2% reduction in domestic material consumption per annum, this would yield savings of about €928 million in the first year and increased annual savings thereafter.

By 2020 this could lead to a 25% improvement in resource efficiency, yielding a total saving of approximately €7 billion over that period. Resource efficiency is about living better while using less – and for Ireland, this ambition has never been more relevant

The key to it all however, is to get us all to do more and more recycling. In comparison with the EU average of 28%, Ireland now recycles just over a third (34%) of municipal waste. However, Ireland still sends 42% of municipal waste to landfill, while composting accounts for 6%, and incineration 18%.

## About John Whelan:

John Whelan is a leading international trade consultant. He is chairman of Aeolus International Ltd , and Premier Publishing and Events Ltd he is partner with the Linkage Partnership consultancy and director of AVC Ltd .In a consultancy role he is the export industry adviser to the Allied Irish Bank group, assisting them to become the bank of choice for export industry. He is also the international business columnist with the Irish Examiner newspaper. He was elected to the RDS enterprise board in 2016 .

He was chief executive of the Irish Exporters association from 1999 to 2013, supporting exporters in driving exceptional growth up to 2007 and in handling the many challenges of the recessionary years to 2013. He has regularly presented on TV and radio on a range of international trade issues. He has been a guest lecturer at a number of international forums across Europe and Asia, including the UN International Trade Centre in Geneva and the World Customs Organisation in Brussels. He also currently lectures at UCD Smurfit College , DCU and Ryan Academy . He is well known for his many published books and papers on international trade matters including;

Working with Channel Partners—a guide to international sales channel management

Intellectual Property Management – A Guide for Exporters

# Energy Symposium 2017 Submissions

However, eaten bread is soon forgotten, the bar has been raised! The EU European Circular Economy Package has set the target for each member state at 65% recycling rate on all waste to be achieved by 2030.

The Irish Government's overarching objective is to implement EU and national policy on resource efficiency to break the link between economic growth and environmental impact. More specifically, they plan to have timely information on waste ''arisings'' which is seen as critical to the effective management and prevention of waste on a national basis. The main effort will be targeted at the prevention, recycling and management of priority waste streams. A critical part of this process is waste characterisation to profile waste ''arisings'' especially from smaller sources (e.g., households and small business).

Laudable targets and objectives, but help will be needed.

From working with a group of Internet of Things (IoT) companies across Europe last year who were involved in a waste recycling project call TagitSmart , I believe IoT can provide that helping hand to hit that 65% recycling target . TagItSmart is creating tools to create smart solutions for the whole value chain; manufacturer, transportation, retail, consumer and recycling, In the case of consumer engagement, direct access to production data gives the consumer more value and drive decision making process. Ultimately it makes it possible for the manufacturer of the product to receive more reliable and real-time consumer behaviour data.

TagitSmart don't have an Irish partner and are interested in bringing one on board this multi-state H2020 funded project.

At the heart of the project partner's technology is the Smart Tag which is context sensitive, printable QR code called Fun Codes. Once attached to a product such as a milk carton, beer crate, temperature sensitive medical supplies etc., the tags are able to convey vital information along the life-cycle of the product. The context sensitive tags along with widely available smart-phones enable the capturing, recording and transmission of these codes and the information they contain. Context information monitored includes but not limited to temperature and oxygen exposure.

For more information check on http://www.tagitsmart.eu/opencall

Partners are; Unilever (UK and Netherlands), Fujitsu Laboratories of Europe (UK), Siemens Srl. (Romania), Resonance Design (Netherlands), DunavNET (Serbia), Univerexport (Serbia), Lmental Sostenibilitat i Futur, S. Coop. (Spain), Thin film Electronic AB (Sweden), Durst Phototechnik Dig. Technology GmbH (Austria), Evrything Ltd. (UK), University of Surrey (UK), University of Padova (Italy), VTT, UPC Consulting Ltd. (Finland), Pôle des Industries du Commerce (France).

Irish Exporters Essential Handbook

Export Ireland Survey and International Finance Review

North Atlantic Trade and Transport Study

Selling Services Internationally – a guide to services exporting

Export Credit Insurance – a means to better exporting

He has acted on many Irish Government task forces reviewing the business impact issues, including the Export Trade Council, Revenue Customs Consultative Committee, Social Partnership Agreements, National Development Plans and the Euro introductory Task force .He has also given international trade training briefings to Department of Foreign Affairs and Trade staff, as well as Dept. of Finance staff.

John studied at University College Dublin for his BSc and also completed a Master's in Business Administration (MBA) at UCD Business School. He completed a post graduate Diploma in Business Studies in Newcastle upon Tyne University and was awarded a research internship to Liverpool University School of Management

# Energy Efficiency Services supply chain - What next?

Kevin Geoghegan

intel

About Kevin Geoghegan:

Energy Conservation program lead at Intel.

**Synopsis:**

Applied Research in delivery of energy efficiency is required to add capability to existing efficiency solution providers and mitigate risk for end users. How can energy efficiency be scaled if the roadblocks through the supply chain are not removed? Can the roadblocks be understood in such a way that a new supply chain for energy efficiency can deliver repeatable efficiency solutions. Who is best to commission such research?

**Takeaway:**

- Energy Efficiency Services supply chain - what should it look like
- What partnerships are required to scale up energy efficiency
- Are the roadblocks on the supply side and the end users requirements understood
- Is applied research the answer and who is best place to commission

**Article:**

Much of energy efficiency research has been focused on a product or analysis of solutions. This piece asks the questions of what could potentially lead to improved delivery of energy efficiency in Industry. How can the supply base be positioned to deliver with increased predictability and how can the end user be provided with the confidence that the energy efficiency improvements will be achieved?

There are many companies that want to sell their latest product that uses less energy. It is often pitched as replacement of an existing asset. Much of the integration of the product is left to the end user. There are so many questions for the end user .

Is this the best solution, are there alternatives, will the savings be attained, how can the savings be verified, will it be automated, will there be an impact on company resources, is it maintainable, is there a warranty, what data is available to demonstrate success, is there independent review of the solution, who has implemented before, are there other benefits, what is the maintenance impact, how many additional people are required either short term or long term.

Traditional ESCO performance contract or the development of lighting as a service provides a solution for many energy end users where the resources and expertise to deliver the projects are not available.

# Energy Symposium 2017 Submissions

Consider other areas of energy efficiency improvements and how they could be tackled in a similar vein. Industrial end users have many different resource models to support energy efficiency therefore any service industry would understand that it is not a one size fits all.

What does this mean for energy research? Is there greater value added in getting existing solutions to market?

What type of supply chain is required? Who are the partners in that supply chain?

What expertise is needed to understand the end user needs and deliver a solution? Where is the best deep expertise? How can the expertise be harnessed? How can projects be developed in order to meet end user's financial hurdles.

How can solutions be scaled so that a business can be developed in asset categories or a portfolio of related solutions. Can each part of the supply chain be scaled accordingly? How can the model supply timing of delivery taking into account end user and plant availability.

How can direct access for the product manufacturers be given to increase the speed of delivery of energy efficiency innovations? Can manufacturer's cover performance warranties.

How is technology changing the delivery of energy efficiency solutions? How can existing solution providers be up-skilled with technology solutions to allow improved service delivery? What technology solutions mitigate risk on delivery of energy efficiency and provide other reliability benefits.

What are the typical constraints to delivery within end users organisations and how can they be overcome. Should they be asset based or portfolio based solutions . How can the company supported from feasibility through to delivery.

There is a growing availability of finance for energy efficiency with the financial industry working to increase investment http://www.eefig.eu/. The associated DEEP De-Risking Energy Efficiency Platform https://deep.eefig.eu/viewcharts/industry/ is a welcome initiative.

Applied research in service delivery of energy efficiency solutions may be what is need to deliver the biggest impact.

Research is needed on delivery both within the industrial end user and the supply chain from the manufacturer or solution provider. Who would commission such research? How can it become sustainable?

# Energy Symposium 2017 Submissions

**Article:**

Context Manmade climate change is one of the most serious issues facing us in the next years and decades. The Paris agreement set a target to limit the effect to “less than 2 degrees C of global temperature rise”. The technologies to achieve this target already exist. The means of mitigation related to energy use include reducing all sources of greenhouse gases including:

- Renewable energy sources.
- Energy efficiency in all sectors of the economy.
- Nuclear power
- Fuel switching
- Carbon capture and storage
- Energy conservation meaning behaviour change, reducing waste, better operational control, etc.

**Where should we start?**

If rational decision making were employed we would start with the easiest and lowest cost solutions. These are energy conservation and energy efficiency. The International Energy Agency refers to efficiency as the “first fuel”. The “Energy efficiency first” principle is the acknowledgment that Europe's biggest domestic energy source is energy efficiency. It is a basis of EU energy and climate change policy.

Where is industrial energy efficiency (IEE) in Ireland’s National Mitigation Plan (NMP)? The NMP has 106 action items, none related to industrial energy efficiency (IEE).

**How is this possible that Ireland is apparently ignoring the easiest and most effective part of the solution?**

How can the easiest, lowest cost and possibly the solution with the highest employment potential and the highest potential for financial benefits to the economy be missing from the plan?

There may be a number of possible reasons.

1. Our decision makers do not know of the potential benefits of IEE, which seems unlikely.
2. IEE does not have a strong enough lobby to get onto the national agenda.
3. We have already reached a point where there further benefits from IEE are limited.

Liam McLaughlin

About Liam Mc Laughlin:

Liam Mc Laughlin is Chief Technical Officer of GEN Europe and Lead International Expert in Energy Management with the United Nations Industrial Development Organisation.

4. Our policy makers think we have reached a point where IEE improvements are not possible or are very limited.

There is evidence to support the last bullet above. If this were true, then it is a reasonable decision not to include it. But is it true? How can we measure industrial energy efficiency? The only significant reporting available of Ireland's IEE is contained in SEAI's Large Industry Energy Network (LIEN) annual report. This includes data from most large industrial energy users going back to the 1980's. It purports to show that considerable improvements have been made over those years by most of the companies reporting. It shows that this is a mature sector and is on a sustainable pathway already.

However, the metric that is used is specific energy consumption (SEC). This is the ratio of energy consumption per unit of output. This ratio has almost nothing to do with improving IEE, it is more affected by economic growth than by energy efficiency. It is widely accepted that this indicator is at best misleading and at worst a major barrier to improvement. If you read the comments from industry in the report, most say that increases in SEC are caused by reduction in production output such as after the 2008 crisis but decreases in SEC are quoted as improving efficiency.

SEC is a very poor and misleading indicator of energy efficiency in companies and of economies.

**Is Ireland energy efficient in reality?**

In the absence of relevant data to show whether we are efficient or not, what other means are there to judge where we are starting from? The author has over 15 years of experience working internationally in energy efficiency in industrial, commercial and public-sector organisations. This has included work in a significant proportion of Irish based multinationals as well as plants in Europe, Asia, Africa, North and South America. Based on my personal observations, Irish organisations have a long way to go and little direction in how to get there. There are a small number of exceptions who are world class. Effective energy efficiency is in its infancy in Ireland.

**What should we do?**

It is very easy to reinterpret the data already in the LIEN database to see the full extent of the problem.

**How can we do that?**

Adopt international best practice in measurement and interpretation of industrial energy efficiency. This is based on normalising the energy consumption data for the effects of variables that impact that consumption.

# Energy Symposium 2017 Submissions

Ireland needs to build capacity in the following areas:

1. The measurement and interpretation of energy efficiency data. This applies at both organisational and national level.

2. Energy conservation is the real “low hanging fruit”, if you know how to improve it. It is completely absent from our education system despite its pivotal role in a sustainable future. This is why it is so easy to identify no and low-cost energy saving opportunities in Irish factories, buildings and public facilities.

3. Energy efficiency is rare in our educational system. This is contributing to a lack of understanding of how to design, commission, operate and retrofit energy saving technologies in industrial and other processes.

# Water and energy nexus: modelling the impact of water quality on energy and resource consumption

Lorna Fitzgerald

**Takeaway:**

Water and energy are inextricably linked.

Energy requirements for water treatment vary significantly according to target quality.

Life cycle cost models reflect the broader costs of system ownership.

Environmental impacts should be considered holistically.

**Article:**

Water and electrical energy are essential inputs to most manufacturing and production processes. The two are interconnected: in the broader context, water is required to generate electricity, and, at the manufacturing plant level, energy is required to treat water to various quality levels for process use and/or for wastewater mitigation. Depending on the application, water quality levels can span a broad range, from the Ultra-Pure Water (UPW) used in the semiconductor manufacturing industry to the highly contaminated industrial wastewater generated and treated on site in many manufacturing facilities. Water may also need to be pumped, pressurised, throttled, heated, and cooled. The resource requirements to meet various water quality targets and to pump water around the plant can be considerable.

Reducing the energy and other resources required to treat water is key for operating cost efficiency, particularly as, if predicted, environmental regulations become more stringent and manufacturing processes more complex. However, taking a holistic view is crucial to capture neglected impacts, such as sludge treatment and other outputs, which are often overlooked, but which may in some cases be valorised.

The energy footprint of both process water and wastewater is a function of several parameters: influent water quality; treatment system technology; operational expertise; scale; and importantly end water quality requirements. Very often, these requirements are driven by policy and environmental regulations, as in the case of a wastewater treatment plant. At times, however, these requirements are based on rules of thumb or other less scientific methods. Understanding and modelling water quality requirements, the consequent energy and resource impacts, and producing water quality to match those requirements is key to ensuring operational efficiency.

DCU Water Institute and Advanced Processing Technology Centre researchers have significant expertise in developing life-cycle cost, life-cycle assessment and benchmarking models for water management, including detailed energy, chemicals and environmental impact models for water treatment technology options, see Figure 1. We also have the in-house expertise to build water treatment systems to serve as a

## About Lorna Fitzgerald:

Dr Lorna Fitzsimons (BEng, PhD) is a Lecturer in the School of Mechanical and Manufacturing Engineering, Dublin City University. She is a Principal Investigator with the DCU Water Institute (http://dcuwater.ie/) and the Advanced Processing Technology Centre (http://www.dcu.ie/apt/index.shtml). Current research projects and interests include energy efficient desalination and water treatment (http://www.saltgae.eu/), energy efficiency in wastewater treatment plants (http://www.alice-wastewater-project.eu/, http://www.epa.ie/pubs/reports/research/water/researchreport168.html), exergy analysis of water treatment and purification processes (desalination, semiconductor manufacturing Ultra-Pure Water plants, Wastewater Treatment Plants), Life-Cycle Assessment and Life-Cycle cost modelling of water treatment processes. She is currently coordinator of an EPA funded project (Optimisation of Small-scale Irish Wastewater treatment plants).

test bed for process development and optimisation. Current research projects include ALICE (http://www.alice-wastewater-project.eu/), ESIPP (https://esipp.ie/) and Saltgae (http://saltgae.eu/). Figure 1: Life cycle cost model for wastewater treatment technology

# Collaboration – key to delivering Ireland's energy infrastructure

Alan McHugh

kirby engineering & construction

Our day breaks at the insistence of a smartphone alarm, a power shower to wash away the weariness and the invigoration of a first hot cuppa.

We are energized by light, heat, gas, oil, electricity. To the last brew of the day, a chapter or two under a reading lamp and our devices left to re-charge overnight; we are consumers.

Every day, more than one million terajoules of energy are consumed throughout the world (International Energy Agency, 2016). This rate will only increase. Our voracious appetite for energy consuming industry and technology shows no sign of waning.

Growing energy demands bring about many challenges and opportunities. We are rethinking how we generate and consume energy. Alternative sources and efficient use of energy attract strong investment. We are creating a low-carbon future which guarantees energy security, sustainability and competitiveness.

Enthusiastic citizens are well versed in the numbers behind ambitious targets agreed through global and national politics. Business plans recognise and reward the financial and social benefits of protecting the environment. We, the consumers, demand greener energy solutions. Still, we need more innovation, the embracing of technological advances and a collaborative approach to delivering infrastructure. Developments in technology will give rise to projects of scope and scale unimaginable only a short time ago.

And whilst progress is indeed impressive, it is not without constraint. Energy and planning policies are a regular feature in civic discourse. Public acceptance, finite capital and political uncertainty have a major influence over the evolution of our industry.

If Ireland is to have a world-class, sustainable and competitive energy ecosystem, technological advances will need to be complemented by a new, joined-up way of thinking when delivering energy infrastructure. There will need to be greater interaction and collaboration between all stakeholders on both the supply and demand side.

At Kirby, we recognise the role we must play within the complex and interdependent system of policymakers, producers, suppliers and consumers. It is essential that we understand the big picture issues which affect their projects: from regulation to public planning to technology. To help overcome these challenges, we apply Integrated Project Delivery (IPD) and Early Contractor Involvement (ECI) processes to our projects. At the core of IPD and ECI is collaboration.

Kirby has been using IPD and ECI for many years, sharing the benefits with our cli-

## About Alan McHugh:

Alan is a qualified electrical engineer and an experienced power industry leader, currently managing the Transmission and Distribution Business Unit within Kirby Group Engineering. Previously he was a Senior Manager at the Irish transmission system operator, EirGrid. Over eleven years at EirGrid he led the delivery of major capital investment projects through separate appointments as head of New Connections and Interconnection, HV Transmission Projects and latterly Public Affairs and Corporate Communications. He began his career in the design and manufacture of control and automation systems. Alan's strengths include knowledge of power grid development, project design and management, leadership, communications and stakeholder management. He has extensive leadership experience in public, commercial and regulatory contexts.

ents. Early in the project lifecycle, along with our clients and sometimes with other suppliers we make a commitment to a common objective. This approach recognises and serves the needs of all stakeholders no matter how they are affected by the project. Setting aside competitive tensions, the biggest challenges – the ones that often need a multi-party solution – may be managed at a much earlier stage in project delivery when the greatest impact can be made.

We must carefully consider the policy that serves our objectives, bearing in mind the current Renewable Energy Support Scheme consultation. In the last number of years, a key feature has been the financial support directed at renewable electricity generation. Inevitably, the appetite amongst politicians and civilians alike for the continuation of such schemes is dwindling. It appears there is a demand for the industry to stand on its own without direct support. And perhaps that is fair enough.

So how should the industry respond? Collaboration.

We have shown we can achieve great things through IPD and ECI. Therefore, we should look for this to be reflected in public policy. Allow the expertise and experience of all stakeholders, with their various points of view, contribute to delivering the products and services needed to green our economy. Identify and remove inappropriate controls that prevent us from bringing about the efficiency and ingenuity that a multi-disciplinary team creates. Let our tender processes reward collaborative engagement. Avoid segmenting projects into defined stages of development in which decision-making capability is inherently limited - a common point of objection to infrastructure projects in public planning processes. Gate systems for grid access, short term support schemes and a failure to foster holistic, enduring approaches to the management of energy generation and consumption serve only to create a boom/bust business environment, setting the bar at the lowest common denominator.

We can do better. And we will.

# Carbon Footprint: What If We Knew the Impact of Our Businesses?

Louis Roy

OPTEL

The pressure is on as facts are starting to prove that human activity does indeed have a significant impact on our climate and environment. As sea levels and temperatures continue to rise, soils are degrading, and ground water is increasingly polluted or disappearing, some of us can't help but feel powerless before this reality.

What can corporations do and, even more importantly, what can individuals do to improve this situation? We all go about our daily lives, working hard to increase shareholder value and ensure the well-being of our families while thinking that as mere individuals we have little impact.

Yet we all play a part in the butterfly effect: a single, particular event that can have huge effects, such as change the course of a hurricane.

Even small changes can create major transformation, like the invention of electricity, the first iPhone, or a garage-made social platform now influencing billions and modeling government.

The butterfly effect can also be demonstrated by very simple systems. For example, the randomness of throwing dice is dependent on this exact characteristic; that is, amplifying small differences in initial conditions—the precise direction, thrust, and orientation of the throw—will lead to significantly different dice paths and outcomes, which makes it virtually impossible to throw a dice exactly the same way twice.

So yes, the actions of individuals could change the path of humanity and hopefully minimize the risks for our planet and our children.

As corporations, we have even more power to influence change. A company is always created based on a simple idea, a desire, and determination. It is the strength of this will that can totally transform your company as well as the mindset of your people. If your will is for your company to reduce its burden on our ecosystem, you can make it happen—just start small and keep this focus, the impact will be enormous.

In the 1980s, we had a linear economy; it was easy. Demand was so high that the need for optimization was not important. Shareholders were happy with the growth and we were blind to the environmental impact of our operations.

In the new millenium, globalization created a pressure to increase performance, so we started optimizing with lean methods, reducing errors and waste throughout the manufacturing process, but shareholder pressure still prevented us from fully noticing that our ecosystem was gradually being destroyed.

## About Louis Roy:

When he cofounded Optel Vision in 1989, after graduating from electrical engineering and physics programs at Université Laval in Québec City, Canada, Louis Roy wanted to push boundaries and find ways to make the world a better place for our children. As an engineer, world citizen and supporter of interdisciplinarity, he wanted to act as an ambassador for social involvement in the business and be an inspiring model for other entrepreneurs.
27 years later, OPTEL is now positioned as the global leader in inspection and traceability systems.
A highly-praised entrepreneur, f. Over the last 3 years, OPTEL has grown 337% and reached $100 million in revenue. To support this growth, the company now has over 1,000 employees in Canada, Ireland, Brazil and India to develop scalable solutions using common technologies, mainly in optics, computing, electronics and robotics.
OPTEL's mission of leaving a positive imprint on the planet is also represented in the way the company designs its personalized, future-proof solutions – as a partnership, with respect and integrity towards employees, customers and the environment, while also complying with worldwide regulations and contributing to the fight against counterfeiting in

# Energy Symposium 2017 Submissions

Now, in many industries, most competitors have already done Kaizen and 5S, and the incumbents are not the only black belts anymore. And, as a society, many of us don't feel good about the impact we've had on our environment over the years.

However, shareholders keep asking for more, so what should we do? What if we could offer them the retirement of their dreams as well as the dignity that goes with doing something good for our planet?

Your company can be part of this shift in mindset by becoming a black belt in what is known as the INTELLIGENT SUPPLY CHAIN. This is intelligence that will reduce waste, minimize inefficacies, save energy, lower our carbon footprint and most importantly for your business, help understand your customers with real business intelligence in real time.

Contrary to popular belief, profitability and sustainability are not mutually exclusive. Even in public corporations, these two notions can be combined to create untapped shareholder value, as an intelligent supply chain serves both financial and environmental purposes that will help keep customers' businesses alive in the long-term. This is real sustainability.

So I hope you will join me in building this intelligent supply chain and, together, we will have the strength and will to offer the gift of sustainability and make it a reality, for our children and for shareholders' children.

the pharma industry.
As a Certified B Corporation, OPTEL strives to be a model of positive impact. To do so, it continues promoting and supporting actions aimed at building a sustainable world for our children, and being involved in local non-profit organizations and in the communities where it operates around the world. Ever since OPTEL's inception, Louis Roy has always been acting as a leader of corporate social responsibility, working towards the welfare of future generations and hoping you can join in achieving this goal!

# Power your home and commute to work with a Zero carbon footprint


Mark Burkley

emutex
where software meets silicon

About Mark Burkley:

Mark is an electronic engineering graduate of the University of Limerick. He is co-founder of Emutex Ltd, an embedded software consulting company, and Ubiworx Ltd which creates IoT solutions with focus on edge device enablement. Mark has over 25 years of experience working in the embedded software and control systems field and has delivered software solutions for projects as diverse as automation of feed mills to tank monitoring to renewable energy management. In his free time, he is chairman of Limerick Flying Club where he flies a Cessna 172. He also rows with the masters crew at University of Limerick rowing club.

### Introduction

Today there are viable alternatives to consuming electrical energy from the national grid. Solar photovoltaic (PV) cells can generate electricity that domestic consumers can use to become more self sufficient. A key challenge has always been however matching the timing of supply and demand of energy sources like sunlight, which is not always available. Thankfully, battery technology has now improved to the point that generation and consumption needs can be more closely matched for domestic use. Add to the mix the increasing use of the electric vehicle (EV) and we have an opportunity to solve two problems with one solution.

### Batteries Requirements and Sizes

Batteries these days are usually lithium polymer or lithium iron phosphates. Flow batteries also exist that do not have anodes or cathodes. Even flywheel energy storage (FES) with rotors spinning at up to 50,000 RPM is being used to store excess energy to balance supply with demand.

Any storage method needs to be managed carefully to maximise efficiency and longevity and these requirements are not always in sync with each other. Take for example an electric vehicle (EV) battery. For maximum range and utility the battery management system (BMS) should allow state of charge (SoC) in the range of 20% to 100%. However for longer battery life this range should be limited to 30% to 70%. Using an intelligent IoT gateway running ubiworx™ we can achieve a balance between maximum utility and extending battery life.

Choosing a battery size is an important consideration. In the paper “Energy self-sufficiency, grid demand variability and consumer costs: Integrating solar PV, Stirling engine CHP and battery storage” (Balcombe et al, 2015) the authors found that for a typical household that consumes 3300kWh/yr and which utilises a 6kWp solar PV installation without a battery, only 28% of the energy produced would be consumed.

The report also found that “battery capacity has a significant impact on the amount of electricity imported from the grid” with import decreasing from 55% to 20% with a 5kWh battery down to 12% when a battery with a capacity of 20kWh was installed. Battery sizes in excess of 5kWh therefore produce diminishing returns for a typical household. In the paper “Storage Solutions for Renewable Production in Household Sector” (Bianchi et al, 2014) the authors found that the optimal battery size is 4 to 5 kWh for a 3200kWh/yr household so it is clear that a size of around 5kWh is optimal for a typical domestic installation.

# Energy Symposium 2017 Submissions

**Electric Vehicle Battery Sizes and Charge Requirements**

The Nissan Leaf is an example of a popular electric vehicle that has a battery capacity of 30kWh. According to the US EPA the Nissan Leaf can travel 172km on a full charge of its 30kWh battery, which works out at 17.4kWh per 100km. At a grid import cost of about 20c per kWh that's €3.49 per 100km. A diesel Nissan Note uses 4.2L/100km which at today's price of about €1.20 per litre would cost €5.04 per 100km. So there is definitely some saving in running costs but it is not as much as it could be (although it should be noted that EVs have other advantages such as using far less power when in slow moving traffic). The need for further savings are particularly relevant if you are using Irish grid electricity which is generated created using fossil fuels in the first place.

One way to further reduce your carbon footprint is to use a solar charging station to charge your EV. A 3kWp solar installation will generate about 3,000kWh per year in Ireland. At 17.4kWh per 100km this would power your EV to cover which would power an average of 17,000 km per year which is certainly adequate for most commuters. A disadvantage here though is that the rate of charge from a solar PV array is going to be quite slow and also limited to hours of daylight. Even at its peak output of 3kW it is going to take 10 hours to fully charge the EV, so a battery is clearly needed here to match the demand with the supply. The maximum charge the EV could use would be the size of its own battery (30kWh in the case of the Leaf) but the battery could be smaller if is only to be used as a top-up. If we aim to keep the EV in the 30% to 70% range then in theory we would need a battery with a capacity of 12kWh (this is assuming 100% efficiency of charge and discharge, which isn't the case of course but it gives a reasonable indication for our purposes).

Now if we then put both of these concepts together we can have a single solar PV array with one battery that both powers the home and charges the EV. We will need to double the PV size to 6kWp to create enough power for both the EV and the home but a single battery of about 15kWh should under almost all circumstances be able to power both. The problem of wasted excess capacity from the home is reduced by using the stored energy to top up the EV instead and the carbon footprint of the EV is reduced even further by availing of stored energy generated from solar. In this way the two can work together to make best use of each other's peaks and troughs in supply and demand.

**Artificially Intelligent Optimisation**

If we use an intelligent IoT gateway running ubiworx™ acting as an intelligent control and battery management system (BMS) to manage the state of charge (SoC) of the EV and the electrical loads in the home will create even further opportunities for optimisation. By performing this function we can also analyse individual cells within the

battery. Different cells may have different SoC values or may have different lifetimes. We can optimise charge rates and levels for each cell as well as alerting users of any potential problems down the road.

We could collect and analyse usage data per site as well as using the ubiworx IoT cloud to aggregate big data for mining for trends and patterns to identify other opportunities for optimisiation. We can use machine learning to predict failures, to learn how battery lifetime is affected by charging patterns and to also learn about usage patterns to predict upcoming energy needs. For example, it may be that a user has a short commute during the week but travels longer distances at the weekend. Or that the home energy use is lower at weekends than during the week. These patterns can be used to predict what SoC should be the target for the battery and for the EV. The SoC charge target for the EV could be increased from 70% to 80% at the weekend for example. Being able to anticipate the SoC the EV will have when the home owner returns from work or what the expected domestic electrical load will be allows the BMS

Another option is that we could even treat the EV battery as an extension to the household battery. If a large power demand is made by the house and the EV battery is at full capacity then the BMS could decide to draw some power from the EV instead of from the grid.

**Conclusion and Next Steps**

As we have seen combining a domestic PV installation with a battery and an inverter along with an EV battery management system using an intelligent IoT gateway can potentially yield significant reductions in the percentage of electricity imported from the grid. Optimal usage of power sources, intelligent analytics and predicted estimates of power requirements can reduce the grid import even further. Participation in peak demand shaving networks and becoming part of a smart grid are also very viable options.

A primary obstacle that needs to be removed is the high capital cost of installing solar PV. In their paper, Balcombe et al recommend a government subsidy of 24% to reduce the 4300kWh/yr break even threshold to the 3300kWh/yr level of a typical household. Ironically also a decrease in the feed in tariff would create a wider gap in the cost between imported and self generated energy which would make the capital cost easier to justify and absorb.

References:

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# The 'Look before you Leap' guide to EV charging

Mark Daly

Eninserv Ltd

**Synopsis:**

Electric Vehicles have become less of a novelty on the road. Even the most sceptical are beginning to accept that EV's will take their place with and eventually ahead of ICE vehicles. The early installations of charge points at company car parks have been undertaken more as pilot projects, giving little consideration to cost recovery or even future BIK responsibilities. Furthermore, once installed, hosts often fail to utilize data which can add to their environmental reporting. As demand for these facilities increases, charge point hosts need to be considering the long term sustainability on the systems installed.

**Takeaway:**

Electric vehicle charging infrastructure need not be a long-term cost.

Open protocols prevent vendor lock-in.

Charge points with communications, can facilitate cost recovery and energy management.

Think about the future when you install the first charge points.

**Article:**

Warning: Persons viewing this article should be aware that the author advocates the installation of Electric Vehicle charging facilities at workplaces. He even suggests that you pay more for them.

So now that I have got the health warning out of the way, I would like to explain that this is actually positive for your company budget…., if you do it right.

One of the newest members of the A-list of must have facilities is Electric Vehicle Supply Equipment (EVSE). Whether you are responsible for staff facilities at a company or for customer facilities at a commercial development, you are likely to be asked to look into EV charging.

The first time you are asked to consider EV charging facilities in a car park, the probability is that you will think of this as a marginal service that will cost more than it's worth in good will. In the early days of EV's you would probably be correct. However the view should be more medium term.

Why should you install charge points?

- It helps promote sustainable transport
- It reflects well on the environmental footprint of the establishment

- It keeps staff and users happy
- It can pay for itself
- If you provide the service, then it will be used.

When deciding to install chargers there are a couple of rules to remember. Bigger is not always better, cheaper is sometimes more expensive and what works for one, doesn't always work for one hundred.

**Bigger is not always better**

The tendency of the eager is to install a fast charger or at least a 22kW charger similar to those on the streets around the country. In truth, for many applications these are not ultimately the best solution. In the case of staff parking most commercial or industrial companies work to an 8-hour shift, therefore the consideration should be the amount of energy which can be loaded into the vehicle over this time period. A 7kW charger can load 56kWh's of energy over the standard 8-hour shift if the vehicle battery is large enough to accept it. To put this in perspective, the vehicle can be expected to achieve over 300km of real driving. This is more than a reasonable expectation for commuting drivers.

There is an additional significant benefit of sticking with a 7kW charge point; it means you can install three of these for each 22kW charge point.

**Cheaper is sometimes more expensive**

Having just encouraged you to think of limiting the power of the charge point and therefore the cost, I am now going to suggest that cheaper is not always better. Apart from build quality, there are hidden factors that affect the list price of the charge point. The first is circuit protection; many of the cheaper units on the market do not include internal circuit breakers, which should be considered for equipment such as this. The second item is open protocol communications. This is an extremely important item as it opens the charge point up to energy management, usage & environmental reporting as well as cost recovery. Some units have closed protocol, which means, you will only be able to use the makers software with their charge points, thus limiting your options when the time comes to install additional facilities.

I strongly advocate sticking with an Open Charge Point Protocol (OCPP) unit, which will allow your charge point to work with a selection of back-office systems, managing energy and payments as well as gathering usage data.

What works for 1 doesn't always work for 100 When you start with the first charge point, you need to be considering the future. This means considering the scope for expansion, maybe installing additional ductwork when ground works are taking place,

maybe installing a local distribution board and a reasonable size feeder cable. However it also ties in with the two previous topics. If you install large charge points you are likely to run out of capacity on your distribution boards and possibly even increase the Maximum Import Capacity (MIC) for the site. To complement your choice of a 7kW charge, back office management systems can offer energy management and scheduling services that can further reduce the drain on energy resources. I should point out that these back office or charge point management systems are still evolving, providing yet another reason to stick with OCPP compatible hardware.

Most companies will also be comfortable with the idea of providing free power to those brave early adopters. After all, if it's only a couple of hundred Euro's a year, then its cheap PR. But lets look to the time when there are 20, 50, or >100 vehicles requesting the service. By this point you will have two considerations, how do we pass the cost through to the user and probably how do we manage Benefit in Kind reporting. The latter is not guaranteed to be an issue, however if you are giving energy to your staff free of charge, then it is likely to be a future focus of attention. On the other hand, if the energy costs the consumer a fair rate, then BIK is not relevant.

By charging the user a fair rate for the energy used, the customer is accessing energy at a time of high convenience and probably for a similar cost to what they would pay at home. For the host, the cost of the charge point as well as the consumed energy and O&M can all be recouped.

In summary, I believe you should consider installing charge points for staff or clients, particularly if you are undergoing any construction projects on site. I also believe you should install a solution which is sustainable in the long-term. This means, linking with a manufacturer who can offer OCPP and a back office solution.

# Climate Change- The greatest challenge facing mankind. What is industry's response?

Martin Murray

About Martin Murray:

Martin Murray is an architect / project manager, of 35 years' experience. He has contributed to the low energy agenda in Ireland by being a founding member, Director and Chairperson, of the not-for-profit Passive House Association of Ireland, which promotes research-based international low energy design initiative. He has taught, and acted as an external examiner at third level institutes; he has served on the council of the RIAI, and the AAI, and have been active in a wide variety of community initiatives. All opinions expressed are personal
I believe that the type of 'social capital' which can evolve from energy micro management, is critical to Ireland, in 2017.

The following paper is premised on the view that much official policy response to Climate Change, and the urgent need to reduce our carbon based energy use, envisages a societal response which does not fundamentally differ from the way that we do things at present. This paper suggests that this is not possible.

**Synopsis:**

This paper suggests that to address our ongoing energy needs and Climate Change issues we must address significant inequalities and inadequacies which are deeply embedded in our social patterns. In effect we need to micro scale our response to energy needs as opposed to the macro scaling which attaches itself to most policy positions. In effect we need to address

1. Our pattern of Taxation and income distribution

2. Our pattern of land use, exploitation and centralisation

3. Our pattern of rural poverty and fuel poverty

4. Our pattern of professionalism: (reflecting medical, legal and media controls).

5. Our pattern of Education

Two of the key conference topics which this paper wishes to address are the societal aspects of future energy research and the principles of a circular economy. In does so by emphasising that, just as there is no such thing as 'victimless crime' so also there is no future energy use without 'inherent social ramifications'; therefore to address the implications of energy use we must also address it's social context. This can only be done when the scale of the context is humane and responsible; the micro scale.

**Article:**

It is so much easier for human nature to change when it recognises in its neighbours, friends, family the direct implications of its actions. This multicoloured reality is so different, from the rather 'grey' anonymity which is creeping into the manner by which we conduct social discourse in the 21st century, particularly at the level of authoritative dictate and policy engagement. We thus lose the potential social capital inherent in energy change. How is this issue to be identified? How is it to be addressed and changed? Why is this realisation important?

It is important because we have a tendency to develop policy which is scaled at a national level, much of it involving macro planning and implementation framed within 'investment friendly segments'. In industrial terms we look continually for scaleable

solutions and minimising variables such as ‘employees’ and ‘high cost locations’. We can do this because we live in a world which has yet to consider problems and solutions globally.

Scaled-up macro solutions deal in economics, micro solutions deal in values. True global solutions would engage local initiatives allowing our patterns of social engagement to change. For this to flourish in Ireland we must address out current social patterns.

**1. Our pattern of Taxation and income distribution**

Our taxation system is a complex structure which ignores the fundamental use of other forms of taxations, such as resource tax, energy tax, wealth tax, transaction tax or land tax; land being a basic principle of creating wealth. (The Henry George principle). Our concept of land must now encompass the vast expanse of the internet, yet we choose not to tax it and therefore we choose not to bridge this social gap and we widen the income gap. We must tax as if we are part of a global community with nation partnering and planning; rewarding Low Carbon Technologies. As a society a ‘universal basic income’ would be a profound step toward the true reflection of democracy.

**2. Our pattern of land use, exploitation and centralisation**

We allow land to be exploited, we allow home building to be a tradable commodity and we have allowed our nationhood to be represented predominantly by an image of urban community as opposed to a rural one; we must find a balance in this equation which will also reflect a new energy balance. Decentralised energy agencies for example allow for knowledge of community dynamics provides energy awareness, training, technology insights and localised retrofit practicalities across communities. Local communities can invigorate key mission goals by questioning assumptions, and bringing industrial insights to the energy debate.

**3. Our pattern of rural poverty and fuel poverty**

Rising fuel costs, increased unemployment, reduced incomes, and poorly constructed houses all contribute toward the creation of very difficult social issues. ‘Fuel Poverty’ is by definition where ‘households are unable to adequately heat their homes, or spend more than 10% of their income on energy to maintain an acceptable level of heat throughout the home’. The ESRI have estimated that Fuel Poverty in Ireland rose 4% between 2006 and 2008, to 19.4% of households. Presently Irish fuel poverty is one of the highest in Northern Europe, and with growing unemployment, and probable significant rises in home heating costs in the coming years, there is a clear and obvious reality that fuel poverty will increase, leading to further personal and national indebtedness, health issues, depression, social isolation and even death. Cur-

rently 'fuel poverty' is addressed in policy terms by SEAI, however social cohesion would be best served by creating an understandable pattern of access and engagement at local level in regard to energy information, training, use and associated local employment opportunities.

**4. Our pattern of professionalism: medical, legal and media controls**

None of our key professional bodies prioritise social needs. Fuel Poverty is a silent killer. At 21.Celcius you might sit and read the paper. At 16.C you risk respiratory illness. At 12.C you can die from cardio-vascular disease and at 5C the risk of hypothermia is a reality. It is estimated that 'excess Irish winter deaths' from poorly heated housing, could run to over 2,000 people per annum. We must create a Central Clearing House for all aspects of fuel poverty issues, combining expertise and encouraging professionalism and research to engage across policy, practice and services provision both within communities, and as policy influencers in health, housing and energy poverty issues. Increased monitoring of the health benefits of retrofits including real-time interactive consultation between GP's and social workers nationally would ensure that at risk patients are identified early for 'interventive action'.

**5. Our pattern of Education**

Our education system has become a significant industry in itself where the students have become customers, the campuses have become industry centres and the outcomes are in service of short term economy needs as opposed to life skills. Our colleges have become victims of scale. Our students end up in debt to support an overly industrialised delivery pattern of education. The emergence of an apprentice based knowledge society deals in a very direct way with the nation's energy profligacy, and addresses the need for a society to protect the energy and health needs of its most vulnerable citizens, whilst also meeting international carbon reduction commitments.

Ultimately the potential of Micro-scaling energy is one of expansion and simplification, to cut through the confusion and 'commercial noise' of the energy and social services marketplace, allowing direct community access to appropriate technologies, address the needs of the marginalised and energy poor, and above all save lives and communities. Energy micro management deals in values, not facts and it is this very dichotomy that makes the issue so difficult to discuss and pin down.

# Demand side energy opportunities and challenges from I-SEM

Dr. Matthew Kennedy

About Dr. Matthew Kennedy:

Dr. Matt Kennedy is responsible for Strategy and Business within the International Energy Research Centre. Prior to this role Matt led national and international energy RD&D initiatives for the Irish Government as National Delegate for Horizon 2020 in Ireland and as R&D lead in SEAI. He chaired a collaborative group of 10 OECD countries that pooled finance for research collaborative activities. Internationally, Matt lead the technology negotiations for the UN at COP21, is the Chair of the UN's Climate Technology Centre and Network in Copenhagen, and the Chair of the Programme Board of the Renewable Every and Energy Efficiency Partnership ( REEEP) based in Vienna. Matt has a Phd (Engineering) from TCD and Masters' degrees from UCD (Business Admin) and NUIG (Development).

**Introduction:**

The island of Ireland has limited interconnection which places it in a difficult position in terms of maximizing market efficiencies, while maintaining security of supply at an affordable cost for consumers. Best practice electricity market design involves a number of components: high levels of integration of power system flows, very liquid forward markets, competition between suppliers in the retail market and opportunities for all players to engage. Efficient energy flows and price convergence can result from market coupling where low price areas service load in high priced areas through optimizing electricity across interconnectors.

The new wholesale electricity market (the I-SEM) replaces the Single Electricity Market in May 2018 and aims to deliver efficient trading between price zones via electricity interconnection across multiple timeframes and auctions. The original driver for the I-SEM change was the EU Third Energy package – giving birth to the Target model, or the market design where European electricity markets must comply. The existing single electricity market does not comply with this target model and so a bottom-up redesign was required, aimed at driving cross border trading across the EU bloc. I-SEM brings opportunities for business and in terms of a changing business model where trading could provide demand response opportunities for smaller generators and aggregators that have the flexibility to respond to changing market conditions. This ultimately results in the transfer of competitive prices to consumers.

**Uncertainties bring potential for innovation**

The challenge posed by integrated markets is to navigate the various markets to generate value for consumers, suppliers and generators. I-SEM reduces risks of high price volatility and market power and guarantees a more competitive price for consumers in the retail market. As it seeks price convergence between markets, it introduces new trading platforms to enable a coordinated scheduling of flows over connectors. Ultimately, I-SEM design brings change and uncertainty into the market as it strives for power markets flow coupling. A full implementation brings price equalisation, a utilisation of power plants and an exploitation of cross-border transport capacity.

The decarbonisation of our electricity system involves a high penetration of variable renewable generation on the system. Currently, system non synchronous penetration cannot exceed 55% without increasing curtailment or higher levels of system services. Our evolving power generation mix requires more innovation in terms of active trading and balancing markets. Integrated energy research can inform such trading and investigate approaches for a more efficient dispatch of energy, necessary for

accommodating higher level of renewable generation in the Irish market. This provides value to customers and opportunities for Irish businesses to reduce costs.

Generators are provided with opportunities to trade power and accumulate revenue through remuneration schemes. They manage their risk exposure through reliability options and hedge against price spikes from day ahead and intraday markets. While European markets have successfully deployed the day ahead market, there has been limited success in trading within the intra-day market and this is an opportunity for further energy research. The requirement for generators to be 'balance responsible' (generation must match demand) also provides opportunities in terms of integrated systems research. While renewable generators, especially wind farms, face challenges in managing their balance and imbalance risk exposure, they ultimately have significant opportunities for engagement in this intra-day market. Smaller player access is also enabled through the aggregator of last resort settlement arrangements, requiring new business models to respond to this complexity, liability and market risk exposure.

The I-SEM market design impacts all players but undoubtedly provides opportunities for renewable generators and aggregators. It delivers market signals to reduce curtailment and facilitates greater ex-ante trading opportunities for renewables. The manner in which renewable generators interact with the market will significantly alter as the markets for back-up supplies via dispatchable generation, storage and demand-side response will result in higher re-trading of volumes. Customers also gain as the increased competition in markets should put downward pressure on prices and promote prosumers and system flexibility.

# Millions of Euro up in smoke due to deficient boiler control

Michael Mc Crossan

About Michael Mc Crossan:

Michael has worked in various paid and voluntary roles since 1979. He served an Electrical Apprenticeship in Dublin and subsequent to qualifying from Thomond College (UL) taught PE for ten years for Department Health and held voluntary roles for St. Michael's House, Asthma Society of Ireland and PEAI as Editor of their quarterly journal. As an undergraduate Michael was the founding member of the UL Environmental Society. Michael has held sales roles for SmithKline Beecham and GSK. Since 2006 Michael has acted as Technical Director of GEM with specific focus on the deployment of M2G boiler load control for commercial and small industrial applications. GEM has completed works contracts for companies such as Bank of Ireland, Eir, Dell, EMC, Servier and HSE amongst others.

**What a waste:**

Hot water boilers normally operate as the heat centre of our buildings. It is a widely overlooked fact that boilers which lack the proper control will nuisance cycle on their own losses. Every boiler rest cycle has an individual heat loss characteristic (i.e. boiler convection and radiation losses and primary circuit losses). The boiler can fire up to replace these predictable losses when there is no system demand for heat or hot water. There are periods during the day and during the heating season when this unwanted boiler activity intensifies. Short boiler cycling reduces the rated efficiency (steady state) of the boiler. Nailing this boiler nuisance activity is a massive energy conservation opportunity. GEM estimates are that circa 90% of commercial boilers are adversely affected i.e. it is wholesale. This problem can be easily detected but unfortunately it goes widely over looked in the industry at large. Typical savings ranging 6% - 22% can be achieved with additional retrofit on-boiler control. The elimination of the problem will insure optimum efficiencies, Co2 savings and the extension of boiler plant lifecycles with reduced maintenance costs.

**A simple check:**

A simple check can be completed on boiler plant to ensure that the boiler is not nuisance cycling. Check that when there is a 'call for heat' on the boiler the return water temperature at the boiler manifold is not 'flat-lined' or sitting at a higher temperature set point compared with when the boiler stopped firing. There simply cannot be a genuine demand for heat if this condition exists.

**Boiler Sizing:**

Boiler plant is typically sized to service mid-winter conditions and transient external or internal building loads which seldom appear on the boiler.

**BMS control of boiler plant:**

Because of the presence of boiler oversize, a significant reliance is placed on BMS to control boilers efficiently. It is widely assumed that the BMS will inhibit boiler nuisance activity. Conventional BMS control is based on common header set point logic. Once enabled through the BMS, boilers can still nuisance cycle on their own losses and waste energy. The opportunity to identify and correct this is often missed by energy managers. The problem can be compounded if off-line (lag) boilers are not hydraulically isolated in which case they become akin to large boiler house radiators causing parasitic loads to appear on the lead boiler through dilution. Typical savings in the range 6% - 22% can be achieved with additional retrofit on-boiler control.

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**Modern Boilers:**

Modern condensing/modulating boiler units can also be prone to nuisance cycling due to their low water content, light weight steel alloy heat exchangers and the marked absence of any of thermal jacket. Condensing boilers are often not set up for optimum condensing efficiency. Modulating boilers will cycle onoff under low load conditions below their minimum turn down capacity. The

presence in some, of in-circuit time delays to control the boiler rest cycle, alludes to the fact that a cycling problem has been identified by the manufacturers.

**Boiler Specification:**

The marketing of new boilers often alludes to >100% efficiencies and this is particularly unhelpful. It should be noted that the quoted instantaneous combustion efficiency of a boiler tells us nothing about its heat loss characteristics during boiler rest cycles. If the boiler nuisance cycles then it is wasting energy albeit efficiently! Pre and post purge losses which accompany excessive boiler cycling compound the losses. Excessive boiler cycling can lead to early failure of boilers and increased energy use in buildings. Source: Damianos, Day Ratcliffe 2007.

**Complex problem …. Simple solution:**

**Do:** Check your boiler is not nuisance cycling.

**How:** Temperature data log individual boiler flow/return and cross- reference against boiler stop/start activity

**Fix:** Introduce retrofit on- boiler optimisation to eliminate this nuisance activity

**What is retrofit on-boiler optimisation:**

Almost all (90%) of commercial boilers lack proper boiler inhibit. Proper boiler inhibit can deliver untapped energy savings. This is achieved by measuring the drop off in temperature every second (temperature gradient) on the flow and return pipework to each individual boiler using digital temperature sensors. A flow temperature and an independent return temperature dead band are introduced using on-boiler retrofit controls through the boiler interlock or fail safe relays in series with the BMS/boiler stat circuit. This dead band logic can operate at any temperature and so does not conflict with BMS fixed or variable set point strategies. The BMS header set points will be completely uncompromised. Typical savings in the range 6% - 22% can be expected.

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**Barriers to uptake of this intervention include the following:**

1. Design engineers reluctance to specify. There is a lack of awareness or acceptance of the existence and size of the problem. There is an over concentration on quoted boiler combustion efficiencies which do not match post installation seasonal efficiencies. Alternative and innovative control strategies need to be promoted to design teams assisted by Government Agencies and Professional Bodies. 'Case study projects have demonstrated that savings available can range up to 50% improvement from a baseline design' National Mitigation Plan July 2017

2. A general lack of clear understanding as to exactly how the BMS controls the boilers: Energy and facility managers need to be more open to energy efficiency options outside the BMS. These options need opportunities to be promoted with backing from Professional Bodies and Government Agencies.

3. Scaremongering: Current and established building control companies and energy control suppliers can undermine innovative approaches. This is counter-productive to best efficiencies. Typically no genuine inquiry or approach for information is conducted. Promotional/Educational materials from Government Agencies and Professional Bodies should assist in alleviating this 'push back'. 'The Programme for a Partnership Government commits us to chart a course towards achieving a low carbon and climate resilient future by 2050, while also recognising that no one has a monopoly on good ideas' Leo Varadkar, T.D. National Mitigation Plan 2017.

4. Categorisation: The lack of categorisation weakens the ability of new and innovative technologies to gain a foot hold in the market e.g. ACA listing. This needs to be fast tracked and broadened.

5. Lack of supports: The lack of real supports to ensure that innovative technologies have a route to market.

**Recommendations:**

Check if your boilers are nuisance cycling . Retrofit on-boiler optimising controls which will introduce dead band logic on the flow and return to each individual boiler

# Rewards (Circular) Economy That Works

Murcin Kulkin

About Murcin Kulkin:

(BsC (Hons) Artificial Intelligence in Business Expertise Systems) is the CEO & CTO of Aravato. Voted Ireland's Best Young Entrepreneur Fingal 2016 and Polish Businessman of the Year (Ireland) 2017.
Steve and Marcin are co-founders of Aravato, an intelligent software platform empowering innovative companies to discover and deliver their sustainability potential. Aravato enables delivery of revenue driven circular economy.

The old 'take, make, dispose' industrial model has been blamed for everything from global warming to dodgy drinking water, from the hole in the ozone layer to the threatened extinction of whole species of wildlife.

Now some of this criticism is actually unfair as industry is merely responding to societal demands for its products.

Each of us can recognise the folly of the single use product, that drinks bottle or that cool coffee cup which we grab on the move in our busy working day, and toss in a bin when we are finished.

Besides, it's not as if industry has not been seeking a viable business model for remanufacturing for years; it's just that they have not prioritised it. Show an industrialist how to make money from the green economy and he will listen. And put it into practice if the public demands it — and it makes money.

So, instead of criticism, it is important to understand that to construct a viable circular economic model, collaboration, whether it be for industry, the consumer or governments, is essential, if we are going to respond to the mounting problem of waste.

Traditionally, waste is understood as surplus or unwanted materials arising from industrial processes or indeed consumer end of use. But, following the circular economy model, whereby products and processes are designed with multiple life-cycles in mind, waste actually represents wasted opportunity, energy, finance and time.

The problem is indeed global. Co2 growth knows no border, therefore we are all ultimately responsible, and we have to be made realise that a fully functional circular economic model will deliver tangible results for our benefit.

It is a matter of education, firstly, and industrial companies large and small being shown how the circular economy is financially viable.

We have to accept that the environment will always take second place, unless we transform environmental values from cost to revenue. A viable circular economy must redefine value, whether it be dollar or emotionally based, as it is perceived value that deliver customers. It is customer demand that directs industry to manufacture products.

Aravato has identified that there is a need for organisations that work within a circular economy model to be rewarded for their efforts. Delivering rewards drives organisation to re-evaluate their relationship to waste materials arising from their processes.

One vehicle for reward is the creation of a connection between waste and energy. For example, waste materials arising from manufacturing processes incur energy usage, as does collection and processing, such as incineration.

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Aravato has delivered a unique data first capture model, that identifies current energy values resulting from waste activities. Secondly, it has introduces standards and lean principles to drive constant improvement strategies.

Such strategies, empowered with data values, can, if organisations participate, provide a positive Co2 value for what has been to date, low priority waste.

Organisations can clearly recognise the legislative imposition of negative Co2 costs, as they are there in black and white on their energy bills. But what if positive, highly validated Co2 values could be captured from defined waste strategies?

What if such positive values could be deducted from negative energy values? Firstly, organisations could be rewarded. But also, they could, in parallel, advance their environmental ambitions to a collaborative and viable circular economy via Aravato.

The construct of Aravato is to recognise that economic matters take precedence over the environment. Delivering an intrinsic link between energy and waste that leads to rewards, can alter perceptions and lead to re-evaluating waste strategies, knowing that new values can be achieved.

Such re-evaluation achieves buy in, for the benefit of us all, and the environment.

The 2014 report Supporting Excellence in UK Remanufacturing pointed out some of the barriers to remanufacturing, including business model viability, lack of co-operation/information flow and poor customer awareness, ie perceptions of remanufacturing products being somehow inferior, or “second hand”.

The report, co-authored by the Knowledge Transfer Network (KTN), the High Speed Sustainable Manufacturing Institute (HSSMI), The Carbon Trust, and the Centre of Excellence for Remanufacturing (CRR), also noted the lack of developed IT systems for a remanufacturing context. It pointed to the lack of a software platform to support standardisation and information flow.

This is exactly what Aravato has set out to remedy.

The company’s ground-breaking SaaS platform, engaging cutting edge technologies including Artificial Intelligence, Big Data, Predictive Analytics and Blockchain, has been designed to support and deliver value to each link in the circular economy chain, Waste Producer, Recycling Company and Re-Manufacturer.

Aravato has devised a scientific waste classification platform that considers materials from the prospective of the remanufacturer. This lets him: Identify viable materials at source, Access technical specifications, Make decisions quickly.

In summary, Aravato has delivered a viable business model that enables the circular economy to flourish. For more information visit www.aravato.com.

# Energy is not our core business

Niall Aughney

With an ongoing increase in industrial energy demand anticipated in Europe over the next twenty years, energy efficiency continues to be an important focus within industrial environments. Despite this being widely known, uptake in working on energy efficiencies continues to be a challenge in Ireland. In this paper, 3 reasons are proposed as to why efficiencies are worked:

- Governmental regulations – compliance with the law and EU directives drive closure to avoid penalties.
- Enlightened management – Organisational leaders use the current societal concern to leverage their organisations and where its possible use this to highlight the benefit of their energy conscious products, highlighting less carbon consumption to manufacture, ownership of their CSR.
- Availability of turnkey solutions – recognition of a pain point, visible issue that requires an immediate fix with an off the shelf solution readily available. These solutions are generally market hardened in that reliability and verification are included.

Points 1 and 3 are already enjoy significant attention and are established vehicles within industry but the potential of organisations to help themselves to drive a low carbon future has significant potential. There are a number of areas to be considered by management to support their organisations in addressing this challenge:

- Fear and overcoming risk adverse approaches – change management processes need to be understood, quality systems tend be well established and allow a high degree of understanding of operational performance. Using this system to measure, monitor and verify @ a production tool level allows confidence to be built up.
- Resource constraint – too few people to do too many things. Energy is not our core business so individuals are directed towards more immediate and visually impacting metrics. Energy consumption has to be factored into TCO @ a tool level or production cost center as compared to pro-rata euro/ m² assumptions. This will enable effective prioritization.
- Knowledge gaps – Data and education to build an energy conscious organization requires time and investment in people and systems. Establishing this will allow an understanding of energy consumption and subsequent carbon emission performance ‘cradle to grave’ across the supply chain and product design.

## About Niall Aughney:

Niall is a product line manager with Intel Ireland Ltd working in the Internet of Things Group (IOTG). Niall manages the creation and design of edge of cloud devices across a range of applications such as industrial, energy monitoring, telematics & automotive and smart cities. Niall has working in technology management for over 27 years and has previously worked with IMR to create energy based technology for the benefit of the centers membership. Niall has experience working across a range of industrial environments including ICT, Pharma, Medical device and agri-food processing.

# Energy efficiency potential through SEAI's Better Energy Community Programme

Dr. Orla Nic Suibhne

A paradigm shift is underway to retire the current carbon based energy system, and this energy transition to a low carbon world will be the most difficult challenge that this generation will face. Ireland's 2020 renewable energy target is to increase the share of final energy consumption made up of renewable energy sources (RES) to 16%. This target is broken into three key sectors with individual targets for each sector: 40% of electricity supply (RES-E), 12% of heating (RES-H), and 10% of transport (RES-T). Through the National Energy Efficiency Action Plan (NEEAP), Ireland has a national target of 20% energy savings in 2020 (relative to the 2001-05 average), complemented by an additional target of energy reduction in the public sector by 33% by 2020. The third National Energy Efficiency Action Plan in 2014 identifies measures that could reduce annual emissions of around 7.3Mt and save approximately 31,955GWh of energy by 2020. In a recent report from the Sustainable Energy Authority of Ireland (SEAI) [1], it is evident that Ireland is not on target for 2020 (see table below), and that a focussed effort will be required to meet these targets.

| Measurement | 2020 Target | Where Ireland is at end 2016 |
|---|---|---|
| Renewables in Final Energy Use | 16% | 9.1% |
| RES-E | 40% | 25.3% |
| RES-H | 12% | 6.5% |
| RES-T | 10% | 5.7% |
| Energy Efficiency (Overall) | 20% reduction in demand | 10% Not legally binding |
| Energy Efficiency (Public Sector) | 33% reduction in demand | 21% by 2015 [2] |

*Table 1: Ireland's 2020 targets and current levels*

SEAI's Better Energy Community (BEC) Programme was initiated in 2012 as a pilot project with a budget of €3m; since then it has grown to a budget of €30m in 2017 supporting over €100m of energy efficiency projects throughout Ireland. The BEC programme objective is to support project structures that can be easily replicated, and hope to showcase retrofit project models that can be implemented without SEAI support in the future. The International Energy Agency (IEA) recommends that governments treat energy efficiency as the "first fuel" in their energy mix [3]. Energy efficiency is the first option within the BEC model so it is following best practice with the IEA. The most cost effective energy is the energy that is not used. IEA analysis demonstrates that EE has the potential to support economic growth, enhance social development, advance environmental sustainability, ensure energy system security and help to build wealth [4].

About Dr. Orla Nic Suibhne:

In 2016, Orla was awarded a Postdoctoral Fellowship from the Irish Research Council. UCD are the academic hosts for the research project, and the Sustainable Energy Authority of Ireland (SEAI) is the Enterprise partner. The focus is the Sustainable Energy Community Programme that SEAI are currently championing. Orla completed her PhD at the National University of Ireland in Galway and this was also funded by the Irish Research Council. Her research investigated the implementation of Energy Management Information Systems into large organisations. Orla also coordinated a €3m smart grid project for Údarás na Gaeltachta entitled GREAT (Growing Renewable Energy Applications and Technologies). She is also a H2020 expert evaluator.

| | 2016 | 2012-2016 |
|---|---|---|
| No of successful projects | 37 | 298 |
| Applications received | 63 | 493 |
| Homes | 2050 | 12,400 |
| Non-Domestic | 405 | 1300 |
| GW hrs of energy saved | 67 | 306 |
| SEAI Grants | €18 M | €85 M |
| Estimated project costs | €45 M | €170 M |
| Average Grant Support | 41% | 50% |

*Figure 1: BEC Overview 2012-2016.*

Since 2014, Údarás na Gaeltachta has engaged with the BEC process. Throughout this period, almost €3m has been invested in energy efficiency and renewable energy upgrades throughout the Gaeltacht resulting in over €500,000 worth of energy savings. The upgrades involve the community (50% grant aid), public (30-50% grant aid) and private sectors (30% grant aid); with projects including all types of insulation installation, LED lighting upgrades, public lighting upgrades, doors and window replacement, industrial motor upgrades, PV installation, wind turbines installation, heat pumps, and boiler upgrades. Each year a percentage of the buildings are chosen for 12 month monitoring and verification (M&V) process to verify the actual savings. The table below shows examples of some of the 2016 projects and associated predicted and actual energy savings.

| Building | Predicted Delivered Energy Savings (kWh) | Verified Delivered Energy Savings (kWh) | % Difference | Verified Primary Energy Savings (kWh) |
|---|---|---|---|---|
| Building - Thermal | 25,925 | 35,517 | +37% | 35,517 |
| Engineering - Thermal | 25,637 | 20,936 | -18% | 20,936 |
| Motors installation | 132,499 | 132,499 | 0% | 132,499 |
| Bakery - Lighting | 87,817 | 141,552 | +61% | 141,552 |
| Engineering - Lighting | 35,235 | 32,148 | -9% | 80,370 |
| | | | | |
| Total | 307,113 | 362,653 | +18% | 410,874 |

*Figure 2: Actual energy savings verified as part of the M&V process for the 2016 Údarás na Gaeltachta BEC.*

Údarás na Gaeltachta will continue to engage with SEAI's BEC programme to support the client companies and the thriving Gaeltacht Communities in the West of Ireland.

Why are we not on target for 2020? The inevitable move from centralised, economically attractive, carbon based energy production to decentralised, low carbon, locally focussed energy systems needs to progress at a much faster rate. It is evident from the literature that a complex mix of policy instruments is required to force, incentivise and empower people to achieve sustainability [5] [6] [7]. The Renewable Electricity Support Scheme (RESS) public consultation that was announced recently (September 4th 2017) could be one of these policy instruments that will enable increased renewable electricity production; both at a commercial and a community scale. New roles are emerging for local communities, transitioning them from passive consumers to active prosumers with local generation, demand response and energy efficiency measures possible now at local levels.

Future Research? Moving forward, research will need to be focussed in the following areas to ensure both a just energy transition, and also a timely energy transition:

Role of communities in the transition. SEAI's Sustainable Energy Community (SEC) Programme and the BEC Programme playing a vital role for communities and needs further rollout and financial commitment from Government.

Ensure industry in Ireland is fully aware of the potential energy efficiency measures that are possible alongside the resultant energy savings and cost reductions. The most cost effective energy is the energy that is not used…

Barriers to renewable energy deployment, especially wind which has such an important role to play in Ireland's low carbon transition, need to be addressed. Barriers such as community acceptance, community engagement, community ownership, lack of local resources, lack of local expertise, availability of a neutral energy intermediary, local benefit frameworks and their governance, and the ability to navigate the political environment.

Microgeneration such as 1-2kW of roof mounted PV on every suitable house in Ireland playing a larger role in the future energy mix. Excess going to EV charging, or hot water buffer tanks or receiving a grid payment if RESS consultation is successful!

Rollout of smart meters is essential.

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# A New Way Forward

Owen McElroy

**Synopsis:**

C.A.P.O (compressed air power optimisation) is a unique development in the renewable energy space that you might, heretofore, be unaware of. A significantly disruptive technology, based on the reaction between compressed air and water, and assisted by gravity, is now poised to harness a valuable yet free resource.

Static Hydro Energy has developed a new technology, essentially a pressure to force converter, to capitalise on a potential $260 billion of waste compressed air generated by industry annually. Heretofore, there have been many attempts to utilise waste compressed air. These range from using it to dry paint… to cleaning and heating work spaces. Anything really, that will mitigate its prohibitive cost. Attempts have also been made to design turbines directly driven by compressed air. However, these have been largely unsuccessful because pressure, as a driver, is much less effective than force

**Takeaway:**

A totally new renewable energy space.

Utilising a waste material.

Off Grid generation.

Harmless to animals and plants.

**Article:**

C.A.P.O (compressed air power optimisation) is a unique development in the renewable energy space that you might, heretofore, be unaware of. A significantly disruptive technology, based on the reaction between compressed air and water, and assisted by gravity, is now poised to harness a valuable yet free resource.

Static Hydro Energy has developed a new technology, essentially a pressure to force converter, to capitalise on a potential $260 billion of waste compressed air generated by industry annually. Heretofore, there have been many attempts to utilise waste compressed air. These range from using it to dry paint… to cleaning and heating work spaces. Anything really, that will mitigate its prohibitive cost. Attempts have also been made to design turbines directly driven by compressed air. However, these have been largely unsuccessful because pressure, as a driver, is much less effective than force.

Five years in gestation, which includes an impressive body of academic research and a working “proof of concept” Prototype, has now led to the planned deployment of a full size C.A.P.O machine in a live industrial setting: and a number of deployment sites are currently being examined. Suitability will depend on many factors, the most

## About Owen McElroy:

Owen Mc Elroy is the inventor of C.A.P.O. (compressed air power optimisation) Coming from an engineering background he has spent most of his career in the Project Management of large construction developments. He is a director of Static Hydro Energy Company.

important being the amount and pressure of the waste compressed air being generated. Exciting and all as these developments are, other opportunities exists to develop the technology even further.

The explosive reaction between compressed air and water, and its value in generating electricity, has, heretofore, largely been ignored. Because of financial and resource constraints the current machine design is a result of research that has identified a “best –fit” set of parameters. It is certainly not an optimum configuration. By designing and constructing a working prototype Static Hydro Energy has effectively opened up a plethora of possibilities for additional research An infinite amount of variables exist pertaining to: machine size, aperture size, cycle times, pressure/water mix, head height, flow rates, liquid density, gas type. Indeed, even the type of material used to construct the machine opens up exciting avenues of research. Opportunities also exist relating to buildability. The modular composition of the machine, both as a unit and a composition of individual components, needs to lend itself easily to maintenance, repair and replacement.

But perhaps the most exciting opportunity going forward is the development of C.A.P.O. as an efficient, stand- alone electricity generator. All the research to date indicates the machine can utilise some of the energy it generates to manufacture the required amount of compressed air to maintain the machine running efficiently… therefore making it suitable for deployment in remote, off-grid locations. (www.statichydroenergy.com) However, a lot more work need to be done in this area.

This area of research is ready made for an established industrial partner. There is a clear and well defined path towards monetisation of what will without doubt, be one of the most lucrative investment opportunities of the century. Because this is only the start…the first baby steps in the development of this totally new and exciting technology, the path this technology might take in the future is not difficult to envisage Going forward, additional future research, using the same basic concept, might further develop the technology to deliver a small, efficient domestic machine, capable of generating enough electricity to power a single dwelling, thereby offering the possibility of the emergence of a grid-free urban environment. What is without doubt is the value of further research. Static Hydro Energy has opened up a new and exciting renewable energy space. All that is needed now is the confidence and the financial wherewithal to exploit this opportunity.

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**Article:**

The overall development in the commercial sector in terms of building construction methods has not kept similar pace with production and manufacturing methodology in other sectors, such as IT, pharmaceutical, agriculture and food production.

We believe that a high impact improvement area for our current economy is around commercial construction and long-term life cycle maintenance plans. We see this as a key area of contribution towards the transition in Ireland to a lower carbon economy.

**Modular Off-Site Construction**

In Ireland the move towards off-site construction of modular sections of building elements and substructures has not advanced as quickly as it should, compared to other areas in Europe. Delivery models such as pre-fabricated modules and pre-fabricated plant rooms, have obvious beneficial impacts in terms of economics, meeting programme milestones and enhancing build quality; however, the other obvious added value benefits for the carbon economy is the reduction of the on-site labour-intensive footprint and all of the associated attendances.

In tandem with this we know of the current (and forecasted) resource requirements in the Irish labour market, and the obvious concerns over the lack of availability of skilled and semi-skilled trades, and professionally qualified graduates to meet the demands of the construction market growth forecasts in the foreseeable future.

While targeting Ireland's contribution in the international arena for carbon improvements, the partial reduction in the requirements for skilled resources in off-site modular construction has a substantial contribution to make in the overall picture.

**Standards**

The building standards in the domestic construction market have advanced more quickly than the commercial construction counterparts. We can see this in the substantial improvements in house design and specification, aiming towards almost passive performance. Improvements of a similar nature in commercial specification, being driven by national standards authorities, will bring obvious benefits in terms of the carbon footprint performance in the commercial building market. Reductions in manufacturing and running costs and product lifespan and integrity are the obvious targets in this area.

**Efficient Building Services**

With a combination of modular off-site construction and a holistic focus on improved standards, we see in our sector demonstrable improvements that could be made around air handling and associated building elements. This can be led by standards authorities, specifiers and designers. Improvements in system design, based upon

Pat Walsh

WALSH GROUP

PANEL DUCT®

About Pat Walsh:

An Irish Businessman, entrepreneur, inventor & founder of the Walsh Group in 1986 and has led one of Ireland's leading commercial Building Services Engineering Company's. Mr Walsh's long career in the Building Services sector has brought a lifetime of in-depth knowledge to this very technical and complex market. Qualified as a Building Services Technician in 1983, A City & Guilds diploma in Building Services Installations followed in 1984. Pat continued to build his skills over the years with certification in Sustainable Energy Installations and Managing Safely in Construction followed by an executive education program Managing for Growth at DCU in 2015.
Pat's vision, energy & enthusiasm have been the driving force behind the phenomenal growth of the Walsh Group and its formidable market share in an extremely competitive market.
In 2009 Pat developed & created the idea of PanelDuct® and proceeded to invest heavily in research & development over a five-year period and in

enhanced product designs will see substantial advances around life cycle costs in the built environment. We believe that the industry, in the commercial construction area, can drive and lead the way for changes and improvements, to the benefit of the overall carbon footprint of the economy.

2013 launched PanelDuct® with its Global Patent into market. Ever the perfectionist Pat continues to continually expand & enhance the product portfolio with additional product features and together with his engineering team continue to lead the way with this revolutionary product.

**Improvements on the traditional methods**

We believe that there should be more focus towards modularisation and off-site construction. Particularly the concept of integration of building frame and envelope, and subsequent building services. Off-site pre-installation of cabling, ducting and fittings where possible with the building frame and envelope will lead to great advances in delivery time, with the added benefit of lower carbon footprint both in the manufacturing process (compared with on-site labour intensive works) and also in the installation and maintenance phases.

A continuous step-change is required in design, manufacturing and installation concepts, and we believe this can be driven by industry by keeping abreast of new concepts, designs and innovations, by ensuring that standards are continuously improved upon, adhered to, and are commonly adopted across the sector.

In our area of expertise, we focus on ducting systems, we know that traditional air handling, heating or cooling, or dehumidifying concepts have not fundamentally changed in design, manufacture or installation techniques in almost 100 years. Just focusing on energy efficiencies and carbon footprint, we outline below how improvements in ducting design, manufacture and installation can play a part in the transition of building carbon footprints to a higher standard.

- Air throughput leakage can be reduced by 15% in comparison to traditional systems. This is due to improved joint design, and avoidance of on-site installation problems with traditional systems, leading to leakage. These inefficiencies can result in increased energy consumption in air handling plants and boiler plants, to achieve the required design result.

- Insulation is integral with the product manufacture, so post-installation of insulation wraps on-site is eliminated. The thermal energy performance is enhanced in any event, compared to insulation wraps.

- Due to the quality and variety of the surface finishes of the pre-fabricated product, noise attenuation can be better managed. This also has the added benefit of allowing in some cases, better volume throughput for the same noise thresholds, which is itself an enhanced efficiency.

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- Pre-fabricated products are typically manufactured in flat pack modules, which in terms of transport and logistics, lead to dramatic reductions in transport bulk (in some cases a reduction of over 75%), and therefore subsequent efficiencies in all areas of transportation carbon footprint.

In conclusion we believe that innovative product design, encompassing modular off-site fabrication will enhance contributions to a lower carbon footprint in the commercial built environment, both at construction stage and through the life cycle of the building.

# Increased complexity in manufacturing - Increased complexity for technicians?

Patrick Liddy

**Synopsis:**

The workload and required knowledge base of technicians is increasing. Smart Augmented Reality Glasses can be used to assist a technician or engineer leaving them hands free to get the job done. This is an opportunity for Ireland to get ahead by embracing a new technology that will change the way we work

**Article:**

Manufacturing is changing. With an increase in additive manufacturing, increased automation, and increased systems complexity, there appears to be a need for more technicians, with the skill requirement on these technicians is also increasing. This change in manufacturing technologies offers Ireland a great opportunity as more flexible machinery, smaller lot sizes and less input of low skill workers reduces some of the advantages other regions have had over us in the past.

While the vision I have set out above is extremely captivating, it is obvious to existing practitioners that Ireland will struggle to provide the smart people to execute it. Systems which today we consider complex will appear simple when compared to our ever-increasing end to end onsite manufacturing production lines and the flexibility they will require. Ways to allow technicians and engineers to supplement their knowledge and experience will be required.

Furthermore, our success in this transition will be defined by our efficiency at managing this complexity. Energy efficiency and waste management is heavily influenced by the technician's efficiency in operating their equipment and failures or below par operation can be wasteful and damaging.

I believe that there is a great opportunity in using Smart Glasses and Augmented Reality (AR) to provide hands free supplementary information to onsite technicians. Using marker technology (similar to QR codes) smart glasses can recognise the machine or asset the technician is looking at and project specific information onto the inner lens of the glasses, visible only to the wearer. This can span from simple descriptive information on what the technician is looking at, to live meter data, or work procedures. The headsets can also be used to facilitate "Remote expert" video calls whereby a remote expert can (using the front facing camera on a headset) see what the local technician is looking at and can share their screen, write notes or draw on the visual the wearer is looking at to provide the expert advice the wearer needs to complete their task.

I believe that these sorts of technologies will allow Ireland to grow and become more efficient while minimising our need to supplement the workforce we have available to

INDUSTRIAL SIGHT

## About Patrick Liddy:

Patrick is a qualified Electrical Engineer BEng, CEM, MIEI. He is well know for bringing innovation to the electricity market by founding Activation Energy, Ireland's first DSU, which was acquired by world leaders in the space EnerNOC Inc in 2014. Previously he worked as a consultant for a diverse multinational and indigenous client base including SEAI.

Patrick has recently re-entered the consulting space advising energy companies, users and governments on energy matters. He is also interested in Smart Glasses and Augmented Reality and is working with companies aiming to roll out the technology in the Industrial and Utility sectors in Ireland and the UK.

us on the island. This will help improve the prospects of our current workforce without needing to import external expertise.

Functions of Smart Glasses and Augmented Reality Remote Eyes - The technology allows the technician to make a call back to a remote expert, allowing the expert to see what the technician is seeing using the forward-facing camera. The expert can then draw on the inner lens of the technician and talk them though the actions that need to be taken.

Work Procedures – With increasingly complex systems, technicians are asked to complete maintenance and other procedures on a growing number of assets. Some of this can be regular while other is irregular and therefore challenging to ensure correct procedures are followed. Smart AR glasses can be used to step a technician through a procedure hands free and while actually doing the work.

Asset Information and Data - Augmented Reality glasses use forward facing cameras to recognise markers on an asset when a technician or engineer looks at it. From there they will be able to see information relevant to the asset they are working on projected on the lenses of their glasses, leaving them hands-free to do their job. Relevant information might include drawings, data sheets, OEM documentation, usage metrics, safety warnings, environmental guidance or simply notes saved by a previous technician.

# Leadership and Change

Paul Butler

ENTERPRISE IRELAND
where innovation means business

About Paul Butler:

Dr. Paul Butler is a Snr. Commercialisation Specialist working with the Research and Innovation division of Enterprise Ireland.

**Synopsis:**

The world is currently going through a crisis of global democratic leadership. This has manifested itself in the potential for greater national insularity greatly hindering the global agenda on transitioning towards a low carbon society. In this article, the author proposes that we all can act as change agents and inspire new leaders to act and represent the collective conscience.

**Takeaway:**

- Over 86% of the respondents to a Global Agenda survey agreed that the world has a leadership crisis
- Democratic leadership is seen as the most desirable solution
- Leadership can come from many sources to inspire transitioning to a low carbon economy
- Social behaviour can be inspired through experiential learning

**Article:**

"*There is nothing more difficult to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things. For the reformer has enemies in all those who profit by the old order, and only lukewarm defenders in all those who would profit by the new order, this lukewarmness arising partly from fear of their adversaries … and partly from the incredulity of mankind, who do not truly believe in anything new until they have had actual experience of it.*"

— Niccolo Machiavelli

Nicollo Machiavelli was an Italian diplomat, politician, historian, philosopher, humanist, and writer of the Renaissance period. His book 'The Prince' contains several maxims concerning politics and leadership.

At the World Economic forum in 2015 a survey conducted by Global Agenda noted that a startling 86% of respondents agreed that the world had a leadership crisis. It noted 'the international community has largely failed to address any major global issue in recent years. It has failed to deal with global warming, then barely dealt with the failure of the global economy, which caused such severe problems in North America and Europe. Meanwhile violence has been left to fester in the Middle East, the region (the) Survey showed as most affected by, and concerned about this problem'.

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In response to this, there was a further question which asked ‘what skills do our leaders need to win back the confidence of their populations? The Survey respondents identified several virtues: a global interdisciplinary perspective; long-term, empirical planning; strong communication skills; a prioritization of social justice and well-being over financial growth; empathy; courage; morality; and a collaborative nature.

These virtues form the basis of democratic leadership where democracy requires minority rights equally as it does majority rule. Indeed, as democracy is understood today, the minority's rights must be protected no matter how alienated a minority is from the majority society; otherwise, the majority's rights lose their meaning. And there lies the rub, where do we find such worldly leadership given the cognitive dissonance displayed in recent times through Britain’s vote to leave the EU and the election of President Donald J Trump?

The answer I believe is ‘within us all’; conscience.  Our moral sense of right and wrong that guides our behaviour.  Summoning this basic judgement can in itself be empowering and the key to this is society, for there are many democratic leaders within society. For example, so many industry, state and country leaders responded to the US President pulling the US out of the Paris Agreement this year that it indicated a shift from central diktat, towards a more conscious driven motivation, where the moral compass provided by employees and citizens was channelled in the response.

We all have a role here; applying our conscience, promoting democracy and providing hope in our lives will bring us gradually to change the order of things. So, as we collectively address the transitioning to a low carbon society, the incredulity of human kind will be overcome by our leadership in whatever small way and provide hope for those that can be inspired to take action and experience it for themselves.

# Retrofitting EC fans – The future of energy efficiency

Paul Crawford

AUBREN

About Paul Crawford:

Paul encompasses a valuable blend of engineering and commercial experience and expertise. He holds an Honours degree in Mechanical Engineering and in 2014 completed a Masters of Business Degree, graduating with a First Class Honours from the University College Cork. In his role as Commercial Director at Aubren, Paul leads and manages projects to ensure the output is a product which delivers on both the clients' engineering and commercial requirements.

According to the European Commission, buildings are responsible for 40 % of energy consumption and over 36% of CO2 emissions in the EU. Within commercial buildings, it is estimated that HVAC equipment's account for at least 39% of energy consumption. Improvements in the energy performance in HVAC equipment is therefore a critical success factor the implementation of any RDD&D programme into energy efficiency materials, technologies and systems in Ireland. But what solution is available? EC fans are recognised as being the latest innovation in energy efficient air movement technology with specifications of EC fans and motors growing in popularity in many areas of Europe. This is driven by energy reduction legislations such as the NEEAP directive and more specifically to HVAC, the ErP Directive which enforces stringent efficiency requirements for fans in the power range between 125 W and 500 kW.

But what is an EC fan and what makes it so special? Plainly speaking, EC stands for Electronically Commutated and it refers to a mains fed, brushless, permanent magnet motor with electronic commutation. Fans within ventilation and air conditioning units are usually powered by asynchronous AC motors which drive the impeller by way of a belt. These take up considerable amounts of space within air conditioning device, making installation complicated. In addition, belt driven systems require ongoing maintenance and replacement due to the number of wearing parts over the course of operation. The efficiency of asynchronous drives is low with efficiency levels between 20% and 70% depending on the shaft power. This will have a negative implication on power consumption in most applications.

Considering these factors, innovative EC technology such as GreenTech EC technology developed by ebm-papst for fans with an electric drive are a superior alternative. Fans and motors that employ ebm-papst GreenTech EC technology attain an efficiency level of up to 90% meaning not only better utilisation of primary energy, but also reduced heat loss and longer service life. The perfect interaction of motor, electronics and aerodynamics, means that ebm-papst GreenTech EC fans not only exceed in energy efficiency capability but due to the optimised commutation technique and the aerodynamic design of the impellers, they operate extremely quietly. In addition, GreenTech EC fans have a controllable speed, so it is possible to adapt the air volume to the respective requirements. Rather than spending capital on buying brand new equipment, it is possible to place GreenTech EC technology into existing equipment as a retrofit installation. Thanks to EC technology, new air conditioning devices are more compact and so require less space at the installation location.

Many clients have benefited from the switch to GreenTech EC technology. For example, a major telecommunications provider required a trial retrofit installation of their existing computer room air conditioning (CRAC) units throughout a building to identify what savings could be achieved. To demonstrate the energy saving potential of ebm -papst EC technology, a comparative study was undertaken against the client's origi-

nal AC equipment. The power input and air flow of the client's existing CRAC units with AC centrifugal belt driven fans were measured. The AC fans were then replaced by a trial installation of three ebm-papst EC backward curved fans with integrated variable speed control. The installation required minimal modification and took an estimate of two hours to undertake. The power input of the trial unit was then re-measured over a period of 7 days, during which measurements were taken every 10 minutes. When compared to the data from the client original CRAC unit, the results confirmed that upgrading to EC technology delivered energy savings of 58%. Furthermore, by running the new EC fans at the same performance levels as the original AC fans, fan speed can be reduced representing over €500,000 savings each year.

As evident, low carbon technologies for heating and cooling commercial buildings need to be pivotal in the development of low carbon strategies in Ireland with EC fans playing an important role. ebm-papst GreenTech EC fans offer more than just energy-efficiency, low noise operation and longer lifecycles, they also facilitate the achievement of dramatic bottom line savings for customers. With reduced energy consumption, cost savings and minimal effort required in upgrades, there is no reason not to incorporate EC technology into future RDD&D programmes for energy efficient technology and systems.

# Urgent action needed to meet energy targets

Richard Manton

ENGINEERS IRELAND

**Synopsis:**

Ireland is on course to miss 2020 energy and emissions targets by a significant margin; we must learn from previous mistakes to achieve more ambitious targets towards 2030 and 2050. While significant progress has been made in setting Government policies and plans, the need for real action is urgent. One feature of this action should be increased investment in sustainable infrastructure - in recent years, infrastructural investment has simply been far too low. Engineers Ireland has published recommendations for key infrastructure projects to assist the transition to a sustainable energy system, maintain competitiveness and improve health and well-being.

**Takeaway:**

1. Urgent action needed to meet energy targets
2. Ireland faces particular challenges in decarbonising transport and heating
3. Increased investment required in key infrastructure projects
4. Education, skills and public awareness central to any transition

**Article:**

Climate change is our greatest global challenge. As part of our international obligations to future generations, Ireland is committed to a series of EU targets on renewable energy source, energy efficiency and greenhouse gas emissions by 2020. Achieving these targets is a necessary first step in a much more ambitious transition to a low-carbon society by 2050.

While we have made substantial progress in the area of renewable electricity generation, projections for the heating and transport sectors put us well behind targets – we are unlikely to meet our overall 16% renewable energy target by 2020. Similarly, our energy efficiency and GHG emissions reduction goals are likely to be missed, the latter by a very significant margin.

Missing these targets will mean that Ireland could incur fines of up to €610 million each year. We are also missing out on the opportunities arising from the co-benefits of climate action, such as cleaner air, more efficient manufacturing systems, and more secure energy supplies.

Engineers have a key role to play in the transition to a sustainable, carbon-free society. For example, UN Sustainable Development Goal 9 calls for the building of resilient infrastructure, promotion of inclusive and sustainable industrialisation and fostering innovation. Engineers also are to the forefront of developing and deploying renewable energy and other technologies.

## About Richard Manton:

Richard Manton is Engineers Ireland's Policy Officer. Richard is responsible for coordinating the organisation's research and policy development and engaging with members, partners and policy-makers. He holds a BE and PhD in Civil Engineering and prior to joining Engineers Ireland he was a postdoctoral researcher and lecturer at NUI Galway.

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Each year, Engineers Ireland, the professional body of over 23,000 engineers, publishes 'The State of Ireland', an independent review of Ireland's infrastructure (available on engineersireland.ie). This year, our expert team rated Ireland's energy infrastructure as "inadequately maintained, and/or unable to meet peak demand and requiring significant investment".

Our main recommendations to achieve a more sustainable energy system are:

1. Continue to diversify the electricity fuel generation mix and expand the renewables base, explore technology solutions such as energy storage and microgrids, and maintain investment in the transmission and distribution networks;

2. Progress the North-South Interconnector to bolster security of supply and reduce cost to the consumer, as well as exploring other interconnection options and energy trading facilities with a view to developing them if and when appropriate;

3. Incentivise the production of biogas from anerobic digestion plants to enable 20% of natural gas to be displaced by biogas from the distribution system;

4. Accelerate the purchase of electric vehicles (EVs) by expanding the superfast charging network and introducing further incentives such as the use of bus corridors for EVs, revisiting registration tax and exploring other financial incentives;

5. Introduce public transport and freight systems that utilise sustainable energy sources, such as hybrid, electric, compressed natural gas (CNG) and liquid natural gas (LNG);

6. Carry out a deep retrofit of Ireland's domestic dwellings and public buildings to reduce energy demand and increase energy efficiency;

7. Encourage energy-efficient and renewable technologies such as wood-burning boilers, heat pumps and solar water heaters, along with district heating systems, where appropriate.

8. Increase investment in third level education, R&D and public awareness campaigns.

Engineers Ireland welcomes the recently published National Mitigation Plan which contains a set of 106 policy measures to achieve the transition to a low carbon future by 2050. The Plan complements the progress made in the Energy White Paper and the Climate Action and Low Carbon Development Act. However, this policy and legislation must translate into real action in the short term – we must see climate action as a 'burning platform'.

# CHP in the Energy Transition

Ronan Nevin

Fingleton White

About Ronan Nevin:

Appointed by Fingleton White in 2013 to operate its flagship Gatepower CHP plant on the St.James's Gate Brewery in Dublin, Ronan has extensive experience in the operation and maintenance of power generation equipment. After graduating from the University of Limerick in 2004 with an honours degree in mechanical engineering, he started his career as a Project Engineer during the construction of the 400MW Tynagh Combined Cycle Gas Turbine plant in Galway. Ronan built on this energy industry experience with a Master's Degree in Sustainable Energy from UCC. Ronan then further developed his power generation with overseas experience as a Generation Engineer at the Wairakai Geothermal Power Station in New Zealand.

**Introduction**

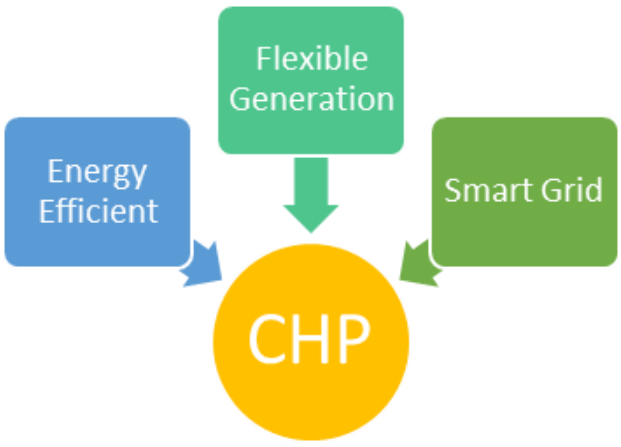
The continuing reduction in costs of wind, solar and battery technology are speeding up the transition to a low carbon economy. While battery storage helps to reduce the impact of the variability of renewables over a short time span, the energy system will need to become smarter and more flexible to fully utilise the carbon reduction potential that these renewables can offer.

What this remaining "flexible generation" will look like will go a long way to determining the overall carbon intensity of the system and the final cost to consumers.

Fossil fuels will continue to play a part during the energy transition but must be utilised in a smarter and more efficient way. Even with the most ambitious targets there will still be a need to use fossil fuels for heat, electricity and transport right out to 2050. It therefore becomes critical that these fossil fuels are used efficiently so as not to undermine the carbon reduction benefits that are gained from renewables.

As natural gas is the cleanest of the fossil fuels for both local air quality and global CO2 emissions it is the obvious choice for electrical generation, heating and heavy goods transport during the energy transition. It is internationally traded and from geographically diverse locations including Ireland. The ability for LNG storage will ensure it meets the country's security of supply requirements into the future.

Burning the gas in an open cycle gas power plant will have an efficiency of less than 40%. If the gas is burned in a combined heat and power plant (CHP) then the efficiency would be over 80%. It is clear then that as fossil fuels are required in the energy transition their use should be prioritised in CHP plants where the environmental impact is minimised.



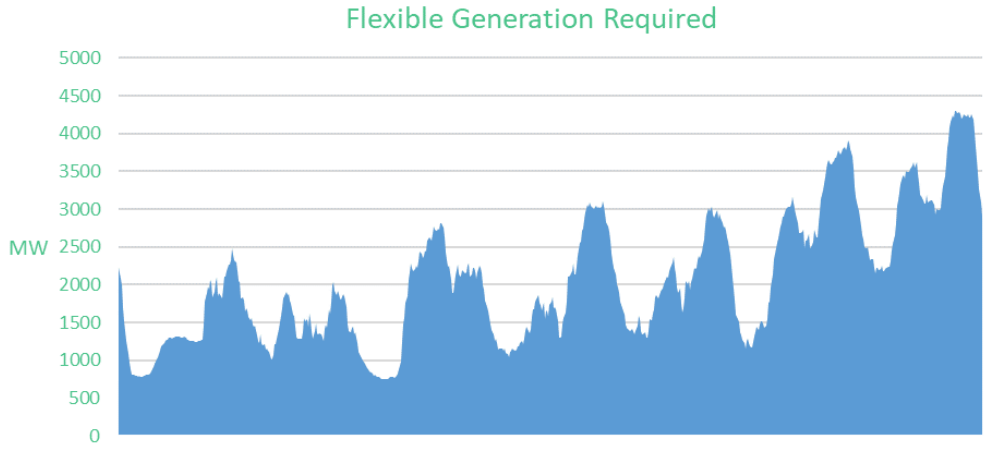

The flexible CHP plants would be located on or near sites with a heat requirement. The CHP plant can be sized to meet the needs of one individual site or linked togeth-

er as part of a heat network. There is also potential for micro CHP plants to be installed at domestic level.

The Irish gas network can be used for transmitting biomethane, as is already done in other countries. This will ensure that the CHP plants do not become stranded assets and can adapt as we move to a low carbon economy. A gas CHP plant will be able to utilise this fuel in the most efficient way possible to produce carbon neutral heat and electricity for industry and consumers.

**What is the advantage of CHP to the overall electricity system?**

The graph below shows a possible week in July 2022 based on July 2017 data. Installed wind capacity has increased by 50% and 2,000 MW of solar is connected to the grid. Demand has increased by 15%. The area in blue is the demand that is not met by wind and solar. The generation required to meet this ranges from 750 MW up to 4,300 MW. This graph clearly illustrates the scale of generation capacity required and how flexible it will need to be.




If we meet our RES-E targets, we will be getting 40% of our total electricity from renewables by 2020. But how do we meet the remaining 60%? This demand will need to be met with flexible generation and it will also need to be reliable. The carbon intensity and cost of this remaining generation is critical so that it does not undo the benefits we are getting from wind and solar.

Battery storage will help to reduce the peaks but some form of flexible generation will still be required. This flexible generation will also need to be available for periods when the wind and solar are low for a few days and battery storage has been fully discharged. If this generation comes from natural gas then it is logical that it should be used as responsibly as possible in high efficiency CHP plants.

Rather than electricity consumers paying for a small number of large standby generators to meet the capacity requirements of the grid. Industry and consumers should be supported to develop flexible CHP plants. These plants will allow them to meet their own energy needs in an efficient manner while also having the ability to increase electrical output to meet the needs of the grid.

CHP can also provide inertia to the grid and has the ability to ramp up rapidly when required. They will reduce the risk of grid instability, as they are numerous, distributed across the country and could be centrally controlled as part of the smart grid.

**What are the advantages of CHP to Industry?**

Embedded generation allows sites to become more engaged in the energy transition. CHP can meet the sites heat and electrical requirements more efficiently than conventional boilers and electrical imports.

The CHP plant can be the backbone of an embedded smart energy system with demand response, on site battery storage, solar and the electrification of heat. This will allow the plant to be optimised to the heat and electrical requirements of the plant and operate in the electricity market efficiently. Electrification of heat is not yet a viable option for industry on its own due to electricity prices but when combined with CHP, heat networks and heat storage, the carbon reduction potential could be realised.

The electrical export and grid service income earned from the flexible CHP plant will reduce the utility cost to industry and improve its international competitiveness.

The impact of climate change is expected to increase the severity and frequency of storms that Ireland will experience. This will put greater stress on our electrical infrastructure. Distributed and embedded CHP plants can allow sites to operate in island mode or as part of a micro grid, to ensure the continued supply of heat and electricity when the grid is unavailable.

**What could this flexible CHP look like?**

The importance of this design is the flexibility to import electricity when renewables are available and prices are low, and then export to the grid when renewables are not available and prices are high. To maximise the efficiency, the flexible CHP plant will require the ability to utilise the additional heat when the site is exporting and if the conditions allow, to also use electricity to generate heat when the prices are low.

This is an evolution on the current CHP design but the development of heat storage, heat networks and the integration of the system needs to be proven in Ireland. The research that is required in this area will be beneficial to both industry and the country, as it is a big part of the answer to where our flexible generation will come from.

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The current barriers to the development of CHP include the I-SEM suitability for small generators, support for behind the meter generation, PSO levy charging mechanism, ability for private developers to install heat network infrastructure in roads and grid connection costs to name a few The burning of fossil fuels in large, remotely located, inefficient, inflexible plant is not the smart answer in the energy transition. The barriers to CHP need to be removed to allow the most efficient solution for Irish customers, the environment and Irelands international competitiveness to grow.

# Circular Economy

Sean McConnel

Irish Manufacturing Research
Research & Technology Organisation
ADVANCED MANUFACTURING IRELAND

In Ireland, we enjoy a high standard of living the envy of many developing nations, this is in part due to the open nature of our economy. What this means is that we are highly susceptible to external economic and political forces, in both positive and negative ways. Given the inherent disruption coming in the form of developing nations beginning to consume more and resources becoming scarcer, countries like Ireland are extremely exposed. In order to offset these risks, we should look toward developing sections of our economy to be more circular. This will not only play a part in protecting us form the economic 'weather conditions' but will also serve to reduce the damage we are doing to the planet.

With new rules regarding the quality of materials we can export for dumping and recycling coming into play, we need to look at ways we can tackle the recycling problem in Ireland. This should come in the form of a mind shift from recycling to upcycling, not using materials for a lesser purpose than before but for an equivalent or greater purpose. Many initiatives such as Cradle to Cradle, try to increase the awareness of this problem while also increasing the value of the goods that are produced. It is done through the design and planning of the product life cycle that products can reduce the energy and material input. With the growth in awareness of the damage that various un-natural materials are doing to our bodies and environs, there will be a shift away from the highly processed and 'monstrous hybrid' products to a more natural single material approach.

Coming from a background in Additive Manufacturing, there appears to be great depth to which manufacturing can change and grow in the coming years. From producing items of multiple materials on large economies of scale to being able to produce goods locally in the quantities necessary. Some see the single material approach of most AM technologies as a negative, in the case of utilizing materials for recycling however, it can be seen as a positive. This is exemplified by the how developing countries have pointed out that multiple material recycling it is one of the major problems and are now working to ban the importation of our waste as pointed out earlier on.

Given the relative size of the Irish manufacturing industry, it is imperative that we are constantly increasing the value proposition of our products. Designing for a circular economy is one way in which we can future proof the industries that currently exist in Ireland.

## About Sean McConnel:

Sean is a design engineer working in additive manufacturing. Since gaining his B.Sc. in Product design, he has worked with various multinationals in multiple capacities. His areas of expertise are that of Designing for Additive, Reverse Engineering, Advanced CAD Generation and Process Development. Sean is currently working on various projects that take traditionally manufactured goods and redesigning them to be produced additively.

# Competency Analysis – key enabler for PS Cadence and Innovation

Tom Maher

**Synopsis:**

A completed Competency Assessment(s) by discipline gives you a snapshot analysis of key requirements and gaps for the selected process or system. The weighting system used in the analysis will clearly show where to prioritize to gain most from a focus which may (or may not) include training.

This valuable information will allow you to maximize the impact to your business by designing interventions that will give the fast, cost effective and robust solutions.

You need to complete separate Assessments at 3 Levels (Core, Advanced and Master) for all Disciplines – so for example Analytical Problem Solving, Innovation and Systems Thinking should be assessed separately. The Assessments need to be technically deep and by nature take time to design and complete.

**Takeaway:**

- To be successful in designing and implementing System Optimisation, your company competency profile across Key Disciplines has to be analysed at Core, Advanced and Master Level
- Competency should be measured at both an Individual and Business level (tied to a KPI)
- Competency is Skill (Task or Cognitive) + Knowledge (through Application) and these need to be measured separately as part of an Audit
- A weighted scoring system prioritizes high impact training and other solutions.

**Article:**

System optimisation is a key component of any organisations drive towards energy efficiency. The identification of the correct and most viable system optimisation strategies is dependent not only on having engineers and managers with the correct skills and toolsets but more so that they have the correct level of competency with those skills and toolsets.

The Competency Analysis is a means of identifying the key skills required by your organisation , understanding the required competency at each skill and also measuring the current profile of your organisation against these targets.

Often companies will assess skill instead of competency and although this is important and has merit it will not allow you focus on the right interventions to close key competency gaps.

SOCRATES WORKFORCE SOLUTIONS

## About Tom Maher:

Tom has over 20 years' experience working as a technician and an engineer across the marine engineering and semiconductor industries. Over the last ten years Tom has been part of a global learning organization within a leading multinational.
He managed an industry leading technical training lab, designing technical training equipment and programs to be delivered to a highly skilled global workforce. These programs covered a broad technical skill base including Mechanical, Electrical, PLC's, Microcontrollers, Electronics, Vacuum systems and more.
He has designed a number of QQI level 6 major awards that are being delivered through Educational Training Boards (ETB's) across the country. He has also being involved in the design and equipment selection of the new Kildare/Wicklow ETB training center in Celbridge, including acting as PM for the training center extension.
Tom has extensive experience designing and delivering training programs, not only to industry but also at University

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As an example, Analytical Problem solving is a powerful tool to use when you are searching for system optimisation opportunities within your organisation. Let us say we want to assess Model Building (at Advanced Level) as part of the Analytical Problem Solving Process.

The Skill might be articulated as – "Understand and use Tools for Model Building and Validation (Design of Experiments ; Failure Analysis etc)"

The Application and gaining of Knowledge might be – "Lead Model TD , Building and Validation for Task Forces and Factory escalations (includes using Model Validation Matrix and AR Templates) ; Synthesize data and make recommendations for models based on the data (using JMP, CB, SQL, etc.)"

Now the key piece once the competency is measured (on a scale of 1 to 5) is to have the required intervention to improve.

Often this may not be a training class or workshop – so in this example the engineer may have a good understanding of Model Building methodologies but they may need to improve on their DEA and Data Analytics skills. The best way to do this is often through a Skills Mentorship program where their mentor is a recognized Master in these skills. So this is the intervention (program) that needs to be designed.

The question then arises as to what competencies differentiate a Master in say Problem Solving from someone who is just competent at Advanced Level.

Here it is in essence the ability to use Critical Thinking, Inventive Thinking (TRIZ) and Systems Thinking techniques at an Advanced level to support and at times supplement gaps in the Analytical Process for complex integrated problems.

This takes years of training and practice and in any discipline, you will be fortunate to have even one Master practitioner. In reality, you may have none – and this in itself is a significant challenge for any business.

The good news is you can develop these Master skills and competencies in house – but you first have to understand what they are and who your mentors are going to be.

If you take the Critical Thinking skills (at Master Level) – you will most certainly have a practitioner(s) of these at Master Level in any company. In a small company, it may be the CEO or Head of Engineering, so they may need to be the Mentor for an identified individual who will become a Master over time.

It is important that competency improvement is measured at both an individual and business level. The individual needs to be able to see their improvement at a level that is impactful for them so that it builds their confidence and career satisfaction. The

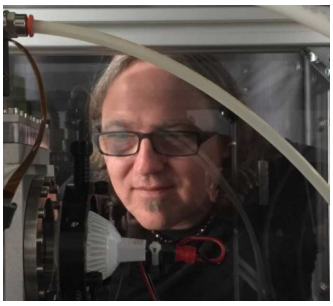
and IT College levels, including online learning. All of Tom's programs are based on a high level of practical application and are delivered in an engaging and enthusiastic style.
His Qualifications include - BEng (Hons) in Mechatronics, BEng in Marine Engineering, QQI level 6 Train the Trainer.

business needs to be able to see an improvement in some key metric that is impactful for the business.

So, for example if Problem Solving is improving across the company then ECOs will be closing faster as problems get resolved in a more timely fashion. You should also see an increase in Knowledge Capture and Sharing as new knowledge is created and shared – both of these can be measured.

Indeed, a key component in developing new knowledge and sharing it across the engineering population is a strong knowledge management framework, system and learning culture. This supports the companies IP, contributes to new IP and ultimately contributes to its technical leadership.

# Measure Twice; Cut Once: Adaptive Co-Design As a Means to an End



Tony Robinson

Trinity College | Coláiste na Tríonóide
The University of Dublin

Confluent Research

**Synopsis:**

Energy, in the context considered here, is a resource serviced by energy technologies for human consumption. Because we do not have laws and axioms to predict human behaviour and their interaction with energy technologies, we cannot predict how a technology or an intervention will perform in the 'real world' and we are left to take an educated guess and hope for the best. If engineers want or need to design technologies that reduce the consumption of energy, or to reduce the impact of the consumption of energy, we must use a design process that integrates the stakeholders and users into that process, and that this can be accomplished by adaptive co-design

**Takeaways:**

- Linear design models can be ineffective because there is an information disconnect between the engineers/designers, the stakeholders and the users.
- Many problems in engineering, energy and the environment require plans or systems to be created and developed in order to achieve specific user and/or stakeholder specified objectives.
- Designs are not static, they are adaptive and respond to the experiences of users, shifting uncertainty and changes to goals and objectives that are part of the real world.
- Design must operate in an uncertain world with multiple actors, necessitating the use of co-design and adaptive design in order to ensure the production of plans or systems with positive economic, social and environmental impacts.

**Article:**

Energy, in the context considered here, is a resource serviced by energy technologies for human consumption. Energy and energy technologies are tricky. This is not necessarily because the laws of thermodynamics are overly perplexing or because we cannot engineer technologies to design specification. In engineering we are lucky to have the laws of physics and axioms of mathematics to use as the tools to design energy technologies. Problems arise when people get involved. We simply do not have laws and axioms to predict human behaviour and their interaction with energy technologies; therefore we cannot predict how a technology or an intervention will perform in the 'real world'. This is the Achilles heel of the energy technology design process because we are frequently left to take an educated guess and hope for the best. Here is an example:

## About Tony Robinson:

Anthony Robinson is an Associate Professor in the Department of Mechanical and Manufacturing Engineering at Trinity College Dublin, Ireland. He received his PhD at McMaster University, Canada, in 2003 on the topic of Two Phase Flow and Heat Transfer in Microgravity. He joined the academic staff of Trinity College in 2005 and was made Fellow in 2015. His research spans topics ranging from the basic science of microscale evaporative processes to applied energy for international sustainable development. Professor Robinson has raised well over €4 million in research funding over the past 10 years and has published 84 papers in top tier international journals along with numerous conference papers, which have been cited over 1500 times and currently has an h-index of 23. As a prominent academic in the field, he is an invited member of the European Space Agency's International Topical Team for Two Phase Heat and Mass Transfer and was recently invited to act as Editor for Elsevier's Experimental thermal and Fluid Science journal. Professor Robinson also performs commercially relevant research and has filed 8 patents, has negotiated 2 successful license agreements

# Energy Symposium 2017 Submissions

*At Trinity, we recently performed a study on the Irish government's national grant scheme to encourage energy efficient retrofitting in private housing[1]. This was the Home Energy Saving (HES) scheme, later rebranded the Better Energy Homes (BEH) scheme. The idea was relatively simple; we monitored several homes immediately before and after cavity and/or external wall insulation retrofitting alongside discussions with occupants. The study showed some expected results. In particular, for the most part there was a reduction in the heat transfer through the retrofitted walls due to the increased R-Value. This was consistent with an earlier study for an unoccupied dwelling[2]. Despite the improved heat retention of the dwellings, it did not necessarily translate into equivalent overall energy savings. The reason why? The occupants increased the temperature of their homes and improved the dwelling temperature uniformity by heating previously poorly or unheated rooms; they wanted to be comfortable. In one exceptional case, the heat loss through the monitored wall actually increased by 40% because the previously cold living space was now heated to reasonable comfort levels. The take away from this study is that no matter how high performing an energy technology and/or energy intervention is, the drivers for using the technology and the human behaviour associated with interacting with the technology can significantly affect its overall impact. As it turns out, energy savings and environmental impact were not the drivers for implementing and using this particular technology; it was driven by comfort and improved quality of life.*

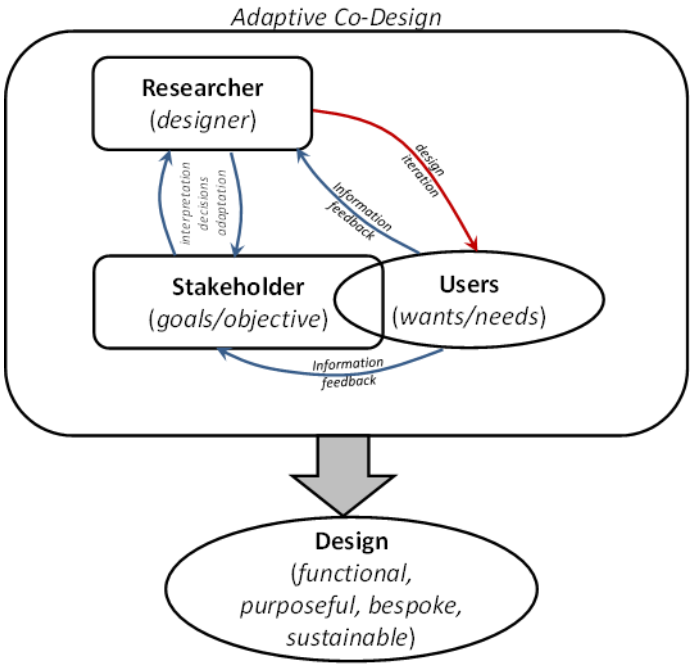
What we see in the example above is a linear design model wherein the designer assumes full knowledge of the system, has clear goals and objectives and with the appropriate utility functions, constraints and modeled processes can achieve optimal design solutions to a problem[3]. In this particular case, the linear design model fails to some degree because there is an information disconnect between the engineers/ designers (retrofit technology provider), the stakeholders (Irish government, SEAI) and the users (dwelling occupants). In our energy research at Trinity we have evaluated many energy technologies where this type of linear design methodology created technologies that, in the context of energy savings and/or environmental impact, did not perform well once 'in the wild'. The obvious question is: how appropriate, if at all, is this design model?

Design is creative. It generates a plan or system for achieving a goal or objective. Many problems in engineering, energy and the environment require plans or systems to be created and developed in order to achieve specific user and/or stakeholder specified objectives. These objectives may sometimes conflict. However, we live in a messy world riddled with wicked problems that confound this linear approach. Design must operate in an uncertain world with multiple actors, necessitating the use of co-design and adaptive design in order to ensure the production of plans or systems with positive economic, social and environmental impacts3.

with industry and was the winner of Ireland's 2017 Knowledge Transfer Ireland Impact Award for Collaborative Research with industry. Dr Robinson also runs a successful consulting company, Confluent Research Ltd. which performs academic level R&D for industries ranging from electronics packaging to automotive.

Feedback among researchers/designers, stakeholders and users/actors are a necessary part of the co-design process. Designs are not static, they are adaptive and respond to the experiences of users, shifting uncertainty and changes to goals and objectives that are part of the real world. Given the high level of connectivity within human society and between society and the environment, it is a real challenge to determine the domain and constraints of a particular problem; particularly with sustainability in mind. Another important challenge for researchers is to develop structures, tools and models that enable co-design and feedback to occur through the creation and enactment of a design. The opportunities of designing in this way come from creative tension between theory and application and the ability to make a difference to real world problems3. Here is an example:

*At Trinity we have recently implemented the adaptive co-design methodology for a Department of Foreign Affairs funded project in Malawi[4]. The goal of this project was to design an appropriate electrical generator technology that used low cost and high efficiency biomass cookstoves as the energy source for charging low powered mobile phones and LED lanterns for vulnerable rural and off-grid households. Right from the start we were admittedly ignorant, and the little information we had was ambiguous at best. The design approach we put in place established an information feedback loop between the designers (Trinity engineers), the stakeholders (Irish Aid, local NGO) and the users (volunteer families in Malawi). To start, a 'best guess' design was put in the field to several families. Importantly, the demonstrators were populated with sensors and data acquisition equipment, as were a host of non-generator baseline stoves. With the hard data we were able to immediately transition from ambiguous to explicit information. For example, our initial remit was to design for a specific net electricity production within a total of 3 hours of stove use, with the cooking time being gleaned from surveys. The measured data showed that not only was the actual active stove use between 2 to 5 times longer, but the net electrical energy target was significantly greater than that used by the participants for phone and LED lantern charging. Together with user feedback data, the electrical generator system was redesigned, re-engineered and subsequently sent back to a different demographic user group. Long story short, it took two more major iterations (and several minor ones), with information continually flowing between the designers, stakeholders and users, before the design converged to a viable prototype product. Notably, the final prototype was nothing at all like the first 'best guess' demonstrator.*




The lesson learned here is that 'real' information and information feedback can turn the design wheel towards a correct and appropriate technology that tightly knits the end user's wants, needs and behaviours into the design. The same holds true for the stakeholders.

The main take-away is that if engineers want or need to design technologies that reduce the consumption of energy, or to reduce the impact of the consumption of energy, we must use a design process that integrates the stakeholders and users into that process, and that this can be accomplished by adaptive co-design.

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# Climate Change – What's In It For Me?

Michael Doyle

Energy Conservation Options

**Synopsis:**

Business and politics are by their nature and construct guided by short-term priorities. The consequences of climate change are perceived as longer term and therefore often have difficulty in being seen as urgent, although in my opinion they will ultimately have very serious costs for human welfare as pressure on resources will cause hardship and spark conflict with all its effects. Why not invest in research and initiatives that can show short term benefits for decision makers so they can justify early action? There would appear to be a gap in the information available to make this case or in it reaching decision makers.

**Takeaway:**

- Business and political drivers are short term.
- Climate change measures have long term benefits.
- How do we make the link?

**Article:**

Until the mid nineties I had an open mind on climate change. I remember discussing the subject with work colleagues, doing some research – the second IPCC report on climate change had just come out – and coming to the view that there was enough evidence to conclude that human activity was in all likelihood having a detrimental effect on the climate. When the fifth IPCC report was published, the level of confidence and wealth of evidence was overwhelming. From an engineering point of view, increased energy in the earth's climate will lead to increased chaos and volatility. This is manifested as more frequent and larger extreme weather events. It also brings more uncertainty as what will happen as a result is less predictable – overall patterns are likely to change but how is not clear. A small shift in something like the Gulf Stream could have a huge effect for instance on Irish climate, and with it on the landscape, agriculture and in turn associated food industry.

While it's likely the majority of people now accept the validity of the IPCC's conclusions, there's reason not to do anything about it. The consequences are not immediate enough. The consequences are for people far away - both in distance and in time. Countries already subject to more extreme storms in the tropics and with poorer infrastructure to withstand this are first in the firing line. The consequences nearer home are for our children and grandchildren. As humans, I believe we are not programmed to think that far ahead. We try to provide for ourselves and our family. We subscribe to a social structure because it also gives us a framework to prosper – law and order, shared resources, etc. with some social empathy of course also. However, the response to climate change bears no relationship to the gravity of the situation.

## About Michael Doyle:

Michael Doyle's main role is to assist large energy user to manage energy more effectively as part of their ongoing business. He is a chartered engineer and has carried out technical and management roles in a variety of companies concerned with design, build and management of substantial energy using plant. He established Energy Conservation Options in 2004. Michael is also a Lean 6σ Black Belt and utilises these skills for energy performance improvement.

# Energy Symposium 2017 Submissions

John P. Cotter, an expert on change management suggests that the first step in change is creating a sense of urgency. There is some evidence of this but not enough yet. International agreements have been weak with a reluctance to take action. Despite the scientific evidence, there are some strong forces on the short term side – business interest in the fossil fuel industry which has a vested interest in not believing in climate change; the need for businesses to get “two-year payback”; the fact that the consequences are beyond the electoral term – i.e. short-term-ism. Witness the recent pull back of the US and its EPA and the ongoing European search for compromise on targets.

What international agreements there are have been translated to more short-term incentives either through legislative or voluntary targets in some countries with certain effect. This has mixed outcome because if business or consumers perceive this as a burden than can be lifted by lobbying, then lobbying will happen.

While there has been some success with measures like increasing energy efficiency and energy management - the area that I work in - because there is a short-term cost saving, I have recently noticed something that may just make the difference. A few multinational companies have started to feel a financial pinch due to business disruption caused by climate effects disrupting supply chains. Increased volatility in weather leads to economic inefficiency.  They are now starting to count the business costs.

Proposal: Fund research and initiatives that can show short term benefits for decision makers so they can justify early action. There would appear to be a gap in the information available to make this case or in it reaching decision makers. The effect on business continuity may be more effective than the environmental message. Industry could show leadership to address this barrier.

IPCC - Intergovernmental Panel on Climate Change – (United Nations body for the assessment of climate change).