AMPERE Newsletter

Trends in RF and Microwave Heating

http://www.ampere-newsletter.org

Issue 121 **January 7, 2025**

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ISSN 1361-8598

Capenhurst 2024: end of one era, beginning of another

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Introduction

Autumn 2024 saw significant changes for two companies based at the Capenhurst Technology Park, U.K: C-Tech Innovation went into liquidation while EA Technology announced a partnership with the Swedish Company Summa Equity. So ended on the one hand almost 60 years of pioneering R&D in industrial electro-utilisation while on the other hand a new chapter began in the expansion of EA Technology as a solutions provider for monitoring and management of electricity grids and assets.

This article sets the scene and outlines the key factors that led to these developments.

The nationalised UK Electricity Supply industry (ESI)

In 1958 the newly nationalised UK electricity industry was re-organised. Electricity was produced by the Central Electricity Generating Board (CEGB) and transmitted via the high voltage National Grid to regional electricity boards (Area Boards). These companies sold and distributed electricity (at lower voltage) to industrial, commercial and domestic customers within their geographical area.

A central body, the Electricity Council (EC), representing the CEGB and Area boards was responsible for policy making, links to Government, financing, industrial relations and general marketing and communications.

The CEGB invested significantly into R&D for generation and high voltage transmission. In 1965, under the auspices of the Electricity Council, a new facility, The Electricity Council Research Centre (ECRC) at Capenhurst, Cheshire was set up to provide complementary R&D for electricity distribution within Area Boards and the utilisation of electricity, principally industrial. The aim of the latter was to provide opportunities for Area Boards to sell electricity through the introduction of clean, efficient electric technologies, often challenging processes using gas heating. Funding of ECRC was provided by a levy imposed on the Area Boards.

ECRC was the forerunner of equivalent centres in Europe, for example, Laborelec in Belgium, KEMA in the Netherlands and Les Renardieres in France as well as the Electricity Power Research Institute (EPRI) in the USA.

The founding Managing Director of ECRC, Dr Trevor Churchman, had a clear vision for the future: an all-electric society. Consequently the expansion of utilisation R&D was readily embraced. Distribution research remained equally important, dealing for example with the critical issues of an ageing transmission network.

In parallel with the creation of ECRC, the Electricity Council expanded its marketing and educational activities for electro heating, supporting the setting up of the British National Committee for Electroheat (BNCE).

Life at ECRC

A flavour of the role of a research officer at ECRC may be seen from the experience of past President of AMPERE, Ricky Metaxas who worked in the electro-physics group before moving to the Engineering Labs at Cambridge University in 1982: "I was employed as a Research Officer at ECRC and my first assignment was to devise a method for measuring the dielectric properties of paper and board as a back-up to the engineers, such as Peter Jones, within the electro-physics group who were at the time designing equipment for industrial pilot scale trials. During my time at ECRC I fostered many relationships with industrialists, the most notable being Roger Meredith who headed Magnetronics Ltd and with whom a joint book Industrial Microwave Heating resulted, dubbed. "the Bible" for technologists who are working with microwaves.

It is important to stress that the 1970's was the decade which highlighted the problems associated with diminishing fossil fuels and the need to look for alternative techniques for carrying on out many processes in industry. The volatile nature of oil costs coupled with gas unavailability in some parts of the

world had compelled many industrialists to consider novel electrical techniques.

In the U.K. a large number of the enquiries about the use of electricity in manufacturing and other industries emanated from Area Board engineers who would visit their industrial colleagues and bring back to base requests for trials and purchase of equipment. The BNCE, based at the EC headquarters, was cooperating with the Area Boards in mounting short courses and seminars and liaising with ECRC, resulting in my colleagues Peter Jones, David Hodgett, Bob Perkin and myself troubleshooting in industrial premises.

Manufacturers of equipment in the UK such as APV-Magnetronics (Roger Meredith eventually selling to APV), Radyne, ROTAX, Strayfield, Petrie, all had strong connections with BNCE and the Area Boards and in monetary terms the Electricity Council had a key role in funding the BNCE and in encouraging such collaborative work. It saw it as its mission to introduce clean and efficient electrical systems in industry and commerce in order to eradicate the inefficient use of conventional fuels. The heyday of such collaborative work in the UK was throughout the 80's. This came to a thundering halt with the privatisation of the Electricity Supply Industry in the early 1990's".

1990's Privatisation of the ESI - consequences for the promotion of electro- technologies

The reorganisation and revised business strategies following privatisation meant, essentially, that the Area Boards no longer had a direct interest in promoting electro technologies. The Area Boards at the time had development centres all equipped with the most modern electro-heat equipment and all these without exception were forced to close signalling in effect the end of the long collaboration between BNCE and the Area Boards (the plc's as they are all called following privatisation).

After organising the UIE (Union Internationale de l'électricité) Congress in 1996 in the UK, BNCE had scaled down its operations and having failed to meet the fee for belonging to UIE it subsequently ceased to exist. It is fair to say that with the privatisation of the ESI, the back-up that BNCE and the Area Boards received, all but evaporated and it was left largely to small university groups to take up the challenge of convincing industrialists to switch to electricity for their multifarious processes. This is evidenced by the groups that are still active in the field at the universities of Aberdeen, Cardiff, Edinburgh, Hull, Loughborough, Nottingham collaborating with industrial colleagues such as John Bows, formerly at Unilever Research and now at Pepsico, Jennifer Marshall-Jenkinson at the Microwave Technology Association, and colleagues at the EMMA Group at the National Physical Laboratory.

1990's Privatisation of the ESI - changes at ECRC Capenhurst

In anticipation of privatisation changes had been made, one of which was the name of the company, now EA Technology. While the Area Boards no longer had any interest in utilisation R&D they maintained their support for distribution work.

However, the funding by levy was replaced by funding on a project specific basis. Alternative funding sources were sought, for example, through contract R&D with industry. After several years, however, the position of the utilisation work became untenable. In 2000 this resulted in the closure of the "industrial" division and the hiving off of selected technologies into a private company ,C-Tech Innovation, owned by the Directors and staff, former employees of EA Technology. Eventually ownership of EA Technology was likewise transferred to its Directors and staff.

1900's Privatisation of the ESI - creation of C-Tech Innovation (C-Tech)

After an initial difficult couple of years, the Management team led by Ged Barlow created a successful, profitable, stand-alone contract R&D business offering experimental and development facilities, and technical expertise primarily in electro-heat, electro-chemistry and environmental issues.

Over the years many large industrial heating projects were undertaken resulting in significant achievements in plasma, ohmic, RF and microwave processing. Due to confidentiality these remain largely unsung. Participation in EU Framework research programmes, however, introduced C-Tech's capabilities to a wide scientific and

engineering community. Led by the Directors Mike Harrison and Ian Dalrymple, C-Tech was highly successful in gaining funding to lead and participate in a wide range of collaborative projects. For the FP7 programme, for example, the company was judged the highest ranked UK SME participant and in the top 25 in Europe.

Later, in addition to the contract R&D, a range of products were developed: C-flow, C-joule and C-wave for electrochemistry, ohmic heating and microwave chemistry applications respectively.

In 2018 with the retirement of the last founding Director there was a Management buy-out followed by a rebranding of the business. The year 2020 brought Brexit. Sadly in September 2024 C-Tech filed for liquidation.

1900's Privatisation of the ESI - expansion of EA Technology

In 2016, at the 50 year celebrations commemorating the creation of ECRC, the CEO of EA Technology Robert Davis commented "The evolution from a publicly funded research institute, to a commercially focussed technology solutions business, required real change to the culture, leadership and skill sets within the company. The growth we experienced was significantly due to developing our international footprint".Prior to recent developments, after privatisation of the ESI the distribution business had been patiently grown to the point where it had reached £48 million in annual revenue, a significant increase from pre-privatisation days, and had some 300 employees. A sizeable portfolio of incoming projects and consultancy had been built up.

EA Technology has become embedded in the operations and managing of electricity grids and assets. The company's industry-leading product suite of smart grid hardware, software and services today serves a global customer base across five regional offices, with a mission to promote the development of decarbonised, resilient, accessible and low-cost energy networks

The culmination of all these efforts was the announcement in October 2024 by the Swedish firm Summa Equity, based in Stockholm, of a huge investment and controlling stake in EA Technology.

CEO Robert Davis welcoming the news said: "Our partnership with Summa will help us scale and enhance our offerings, ensuring we remain at the forefront of smart grid technologies. This investment aligns perfectly with our mission to support the energy transition and drive innovation in the sector. We are well-positioned in several markets through our leading product portfolio, industrial know-how and unique cross-disciplinary competence".

Gisle Glück Evensen, Partner at Summa, said: "Transitioning from a fossil fuel-based system to renewables presents a significant challenge to today's electricity grids, driven by rapidly increasing electricity demand, intermittency and multi-directional flows. Solving these challenges is essential to achieve energy decarbonisation and presents a multi-generational investment opportunity to upgrade and modernise grid infrastructure".

Concluding remarks

The decision almost sixty years ago to create ECRC and associated organisations to develop and promote industrial electro technologies was farsighted. The founding Director, the late Dr Trevor Churchman, would likely be impatient with the pace at which we are moving towards the "all electric society". Doubtless, he would view the loss of C-Tech Innovation with much regret but equally would feel deep satisfaction at the way EA Technology has launched out into the world to promote the effective and efficient management of electricity distribution.

About the authors

Ricky Metaxas is past President of AMPERE and a Life Fellow at St John's College, University of Cambridge, UK.

Bob Perkin studied physics at London University and obtained a PhD in Gas Discharge Physics. He joined the electro physics group at ECRC, Capenhurst in 1975, working on RF and Microwave applications. With the restructuring of ECRC he

joined the commercial team within EA Technology responsible for seeking external funding from industry, the UK Government and EU. After the closure of the industrial division of EA Technology he moved to Petrie Technologies, later returning to Capenhurst to work part time at C-Tech Innovation in a technical role, working principally on RF and microwave processing until his retirement in 2015.

UIE congress 2024 - "Electrification of industrial thermal & manufacturing processes"

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Following a long tradition of UIE (International Union for Electricity applications), the 20th UIE Congress was organized in Nice (France) from 8 to 11 October 2024 by the Centre for Material Forming of the Ecole des Mines de Paris.

UIE congresses started more than 80 years ago in the Netherlands, and after the recent congresses taking place in Hannover (Germany) 2017 and Plsen (Czech Republic) 2021, in this 20th edition the focus was on the electrification of industrial thermal and manufacturing processes.

The audience was constituted by 60 participants (**Figure 1**), half coming from academe and half from industry. Participants were from 14 countries with a strong representation of France, Germany and Italy. 45 presentations were given, including 3 keynotes at the beginning of each day of the congress.

Fig. 1: UIE congress 2024 - ~60 participants.

Sessions discussed decarbonization of thermal and manufacturing processes by electrification, including induction heating, plasma heating, and dielectric heating (**Figure 2**).

Fig. 2: UIE congress 2024 – Session on decarbonization of thermal & manufacturing processes by electrification.

Sessions on numerical modeling showed the way to further optimization of electromagnetic processes. Also the quite new topic of machine learning was presented by speakers who became already real experts in this new field of study.

Besides keynotes and ordinary presentations, two round tables were organized bringing together academe and industry. These round tables triggered vivid interactions with the audience on the topics of decarbonization (**Figure 3**) and the usefulness of artificial intelligence in the design of industrial processes.

Fig. 3: UIE congress 2024 – Round table on decarbonization of industrial thermal & manufacturing processes by electrification.

For the sake of having some order of magnitudes for different figures and other factual information on industrial practice, I noted among many other things, the following:

- Currently, 15% of CO_2 emissions in Germany are caused by thermal processes in industry
- 38% in industrial heat demand is on the account of process temperatures higher than 1000°C
- 24% of natural gas consumption in Germany is used for process heat
- Neural networks seem to be more efficient for interpolation, but less for extrapolation (for extrapolation physical knowledge is needed)
- The cost reduction for photovoltaics is much larger than the cost reduction achievable in the manufacturing of wind turbines
- Thanks to the direct microwave interaction (i.e: without heat transfer) with material, the chemical reaction in cementation can be reduced to 1400°C (instead of 2000 °C needed for the heat transfer by gas burners).

As a general synthesis of the presentations and discussions, I summarize my learnings in the following three points.

Firstly, it is interesting to notice the re-emergence of feasibility studies on the use of electromagnetic technologies in industrial thermal and manufacturing processes. In the seventies and eighties of last century a lot of exploring studies have been done to give orientation concerning the optimal electrical technique to realize industrial added value. The research question was whether resistance, infrared, induction, dielectric heating, or any other electroheat technology was eligible to give the desired result in the interaction of electromagnetic energy with materials. In the nineties and the beginning of the 21st century, these electroheat technologies became proven technologies. Now, in the current dash for decarbonization, a second round of exploration needs to be done to check which technology has the highest potential for CO_2-free production cycles. The electrical possibilities need to be put again on a broad horizon in order to perform adequately feasibility studies to identify the optimal solution. Maybe even the production paradigma have to be changed (e.g. big scale production paradigm to be substituted by small scale production on site of demand). For this multidisciplinary approach, UIE is well placed, integrating induction heating, as well as dielectric heating and many other expertises.

Secondly, with artificial intelligence (AI) an additional engineering tool (besides analytical calculation, experimental exploration, and numerical modelling) has come to the fore. It is not fully clear yet where the boundaries are for AI. To my mind, AI, in spite of the huge database that is used as a source for this "intelligence", the creative aspect, the emergence of something new, seems by definition to be beyond AI's possibilities. Anyhow, in the current state of affairs, common sense engineering, which has maybe a little bit been overshadowed by numerical modelling, will become of paramount importance. An intuitive approach (the way of Michael Faraday) will be more necessary again (together with the mathematical rigor of James Maxwell).

And thirdly, when electrification of industrial thermal and manufacturing processes is to be a response indeed to climate change, a scientific base for the basic assumptions of the different impact scenarios is badly needed. UIE intends to write a manifesto on the position of electricity in the energy system of the future.

As a conclusion, it can be stated that the UIE 2024 congress was an inspiring event. The rather limited scale of the audience, together with the excellent accommodation and catering, facilitated social interaction.

Evolutions are intense, and the stakes are high. Therefore, it has been decided to organize the next UIE congress already in September 2026, together, for this time, with the Heating by Electromagnetic Sources (HES) conference at the university of Padua (Italy).

About the author

Koen Van Reusel received the degree of Master of Electrical Engineering from the KU Leuven (Belgium) in 1985, and the degree of Doctor of Engineering from the KU Leuven in 2010. Since 1992 he is at LABORELEC (Belgium), a technical competence center in energy processes and energy use. As senior expert he is member of the Power Networks Department. His current focus is on electrification of industrial thermal processes, lightning protection in wind turbines, and measuring the effects of electromagnetic fields from a human health perspective. He is visiting professor at the KU Leuven, where he teaches "Electromagnetic Processing of Materials" and "Power Quality". Koen Van Reusel is Member of the Management Committee of AMPERE; General Secretary to UIE, the International Union for Electricity applications; Member of the Board of Directors of FISUEL, the International Federation for the Safety of the Electricity Users; and Member of the International Electrotechnical Committee n° 27 "Industrial Electroheating and Electromagnetic Processing of Materials".

Ricky's Afterthought:

Thoughts on COP29 and the climate change crisis

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Last November Bacu, Azerbaijan, hosted the 2024 Climate change crisis with most countries participating, with an estimate of some 70000 delegates taking part. However, not all the top leaders were present, notable absentees being the Presidents of the USA, Russia, France and the Peoples Republic of China, as well as the Chief of the European Union. It is very worrying when the incoming President of the USA threatens to once again pull the USA out of the Paris Agreement promoting fears that many other countries might follow his lead and reduce their commitment to net zero policies. "Paris is one of those agreements where you need a critical mass of economic powers and emitters, past and present, to actually be able to address this challenge", said Oli Brown, an associate

fellow at the London-based think tank Chatham House. What is more the President's Elect famous quote, of "drill baby drill" has reverberated throughout the meetings and seminars in Bacu increasing anxiety when he wishes to maximise profits through drilling for more fossil fuels. The only glimmer of hope was that the outgoing US administration promised to use their remaining couple of months in office to pull all stops to fulfil obligations that have been agreed. The leader of the US delegation in Bacu stated that the Administration is fully committed to meeting outstanding funding under the Biden Climate law.

Dr David King, ex Chief Scientific advisor to the UK Government and an honorary Fellow of St John's was invited to offer his comments at a Climate Change Crisis seminar at St John's College, Cambridge. His brief remarks concentrated on his time when he was in constant talks with the Foreign Office and Foreign Government agencies and alluded to the fact that since the important meeting in Rio in 1992 when climate change issues came to the fore, successive US presidents, both Republican and Democrats, supported by the powerful fossil fuel lobbies, not only did very little towards climate change but were actively blocking any attempt to do something to alleviate the problem. "We are losing 30 million tonnes of ice per hour and that water goes into the sea causing its level to rise by meters and it is irreversible" he started in desperation.

The powerful lobby in the USA consists of people going against what scientists have been saying all along about climate change and global warming. The sad aspects of all this is that the present economic system although has improved our wellbeing enormously at least in the developed world, and many would say driven by consumerism, one can also say that the same economic system is very bad for our ecosystem. He continued by stating that a few decades ago when global warming was becoming a major concern, the conventional wisdom was that China was the prime culprit as far as exhausting greenhouse gases into the atmosphere to be followed perhaps by India and South American countries. However, China in recent years has done much more than any other country to curb greenhouse gases by carbon capture and introducing massive renewable projects involving solar panels, wind energy and hydropower as well as going strong on nuclear power. Apparently, there is no other country in the world that has done more to curb climate change than China, something that cannot be said about the biggest economy in the world, that of the USA. Of course, China needs to continue on such a path as it still is a big emitter of greenhouse gases.

Dr King concluded by stating that we cannot put a financial value on our ecosystem and we need a cultural revolution or cultural transition, that is, an ecological civilisation to succeed the one that was based on consumerism and if we are true to ourselves we ought to examine the damage we have done to our ecosystem*, why we have done it and how we should move forward.

Another worrying aspect of COP29 is that first Azerbaijan is a heavy user of fossil fuels, with the President and chairman of COP29 stating triumphantly that "oil and gas are a gift of god", but secondly, my understanding is that nearly 480 carbon capture and storage (CCS) lobbyists were granted access to the venue. This signifies the worrying aspect that we still have many systems that emit harmful CO_2 gases onto the atmosphere and these lobbyists will inevitably promote CCS which hasn't proved to be as reliable as it has claimed in the past.

ClimaTRACESlab

Another development emanating from my university entails the work of Dr Kamiar Mohaddes an Associate Professor at Cambridge Judge Business School and Fellow in Economics at King's College, who used the data from 174 countries to trace the link between temperature rise and income levels.

They modelled the world's economies under business-as-usual emissions, as well as a scenario in which humanity "gets its act together" and holds to the Paris Agreement and concluded that all countries will suffer economically under the current emissions trajectory, pointing to the fact that the US losing 10.5% of its GDP, and Canada over 13%, by the end of this century. Based on such research, a letter to the chair of the Federal Reserve was signed by 25 members of the US Congress suggesting that a link be established between climate risk and monetary policy. This year a new centre, the climaTRACES Lab was established with the view to spearhead data driven analyses at those who influence business and

policy. Mohaddes stated, "We want to work out how policy makers and businesses can best understand the cost of climate change and biodiversity loss. We need to take these communities with us through the right communications, and the right policy and product design." ClimaTRACESlab will cooperate with the Boston Consulting Group on issues relating to climate change and economic policy stressing that an upfront investment of less than 2% of global GDP in additional efforts to prevent global warming will limit the temperature increase to under 2°C, avoiding the loss of an estimated 11% to 13% of cumulative GDP by 2100.

Financial help for developing countries

Campaign groups suggest that the real figure needed should be around $5 trillion for the developing counties to assist them with their transition to curbing climate change, however, these groups will accept $1 trillion to 2030 followed by $1.3 trillion to 2035. Alas such sums did not materialise but during last minutes negotiations at Bacu, beyond the scheduled two weeks, it was agreed that the richer countries will contribute annually only £300 bn until 2035 but in addition there will be assistance in the form of low interest loans and grants.

It remains to be seen how to apportion the agreed sum so that it is spread fairly to many developing countries. These sums should not be regarded as charity money and in addition no provision is allowed for inflation. Some of this money will be used for protecting groups from the impact of climate change such as building defences against floods but the majority will be used for enhancing renewable schemes such as wind turbines and solar arrays for power generation. Most developing countries stated that this is a betrayal of promises made and with such relatively small sums they will not be able to keep temperatures to 1.5ºC as per the Paris agreement. They argue that countries like China, USA, the European Union who have caused the problem in the first place should contribute more.

Finally, what are the consequences of all this following the US Presidential election when the incoming President does not believe that there is a climate change crisis? We all await with trepidation any pronouncements following his formal inauguration.

*The ecosystem is an environment or a geographical area consisting of living organisms interacting with each other and the environment. It is limited to a specific area with local communities of living organisms.

**The variety of life in the world or in a particular habitat or ecosystem

AMPERE 2025 Conference: CALL FOR PAPERS

AMPERE (Association for Microwave Power in Europe for Research and Education) invites you to submit an abstract for the **20th International Conference on Microwave and High Frequency Applications-AMPERE 2025** (https://ampere2025.org/) to be held at Villa Romanazzi Carducci, **Bari, Italy, from 15 to 18 September 2025**. The online **submission of abstracts** opened on the **4th December 2024**. The deadline for abstracts submission is planned for 7 March 2025. Please note that each abstract will be uploaded by the presenter in a new website geometry that has been implemented to help elaborate the:

- The book of abstracts;
- The conference programme;
- The list of participants.

The sub frame of next year's conference will be **"Powering the next sustainable frontier"**, and the participants can choose to write an abstract on one of the following topics:

T1-Chemistry/biochemistry and processing
T2-Dielectric and magnetic materials properties
T3-Solid state technology
T4-Design of applicators and components
T5-Medical and biological applications
T6-Energy production (incl. renewables)
T7-Plasma phenomena and processing
T8-EM modelling and numerical techniques
T9-Measurements and metrology
T10-Material interaction
T11-Biomass and waste processing
T12-Process intensification & Food processing
T13-Industrial equipment and scale up
T14-THz and millimetre wave applications
T15-Agriculture applications

Early-bird registration is now open. The Regular Registration is 740 euros; Student Registration is 500 euros until May 6, 2025 when both rates will increase (https://ampere2025.org/). Registration fee includes: Welcome Reception on Sept 15th and Gala Dinner on Sept 18th, access to Exhibitors area, access to all plenary sessions from Sept 16th to Sept 18th, coffee breaks & lunches, electronic access to the conference proceedings and unprecedented networking opportunities. Delegates will also have the opportunity to add one or two Group Dinners (Sep 16th and Sept 17th) and/or a Short Course (Sept 15th) to their registration (details to follow). For an additional fee, it would be possible to select a 1-day tour from the range offered for Friday 19th Sept. Exhibition and Sponsorship Packages are also available (please contact: Cristina Leonelli, Conference Secretary: ampere2025@ampereeurope.org.
If you have any issues registering via our registration portal, please reach out to info@abmanager.com: we would be happy to assist you!
You do not want to miss this event!

Paolo Veronesi
Francesco Prudenzano

Conference Chairs

About AMPERE Newsletter

AMPERE Newsletter is published by AMPERE, a European non-profit association devoted to the promotion of microwave and RF heating techniques for research and industrial applications (http://www.ampereeurope.org).

New structure of the AMPERE Newsletter

At a management meeting during AMPERE23 it was decided that in view of the introduction of the new scientific Journal entitled "European Journal of Microwave Energy" supported by CUP, no technical papers will be published in future Issues of the Newsletter. Instead, AMPERE welcomes submissions for short bios on individuals, articles, research proposals, projects, briefs as well as news.

AMPERE Disclaimer

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AMPERE Newsletter

ISSN 1361-8598

https://www.ampereeurope.org/newsletter/