World Federation of Engineering Organisations

The Committee on Engineering and the Environment

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Engineers have an inherent obligation to examine the technological options needed to reduce atmospheric GHG emissions.

By Darrel Danyluk, P.Eng. FEC, FCAE, FEIC, FCSCE

Darrel Danyluk chairs the WFEO Standing Committee on Engineering and the Environment (CEE).

Climate change, greenhouse gas (GHGs) mitigation, sustainable energy, energy efficiently, green energy, and energy innovation are all interrelated and relevant to engineers and engineering worldwide.

The impact of climate change is increasingly observed in developed and developing countries around the world. Whether this is caused by human activity or is part of the earth's natural cycle, this warming has serious implications for the well-being of humanity. Climate science is unequivocally indicating that increasing concentrations of GHGs in the atmosphere are a contributing factor. Anthropogenic contributions of GHGs are of growing concern, and unless mitigated, will likely accelerate and magnify the impacts of the changing climate. Engineers, who design, develop and build the technologies that release GHGs to the atmosphere, have an inherent obligation to examine the technological options needed to reduce atmospheric GHG emissions.

Climate Change Task Group on Mitigation Forms an Important WFEO-CEE Initiative

Lost in Political Debate

Expectations were high that the 2009 United Nations Framework Convention on Climate Change (UNFCCC) meetings in Copenhagen would bring the United Nations members to an agreement on addressing GHGs into the future. For these meetings, the Future Climate –- Engineering Solutions (FC-ES) initiative (Phase 1 - led by the Danish Society of Engineers and including 13 participating national engineering associations) had produced compelling information indicating that through planning and the use of existing technologies, significant GHGs reductions were feasible at the national level. This important and relevant information was lost in the “noise” of the political debate.

Given the importance and relevance of these topics to global society as evidenced by the UNFCCC negotiations and the increased attention from international organizations, global conferences and multilateral development actors, the WFEO-CEE has initiated a Task Group on Mitigation. This task group is led by the U.K. and through collaboration with the FC-ES initiative creates a broad international engineering alliance to address mitigation alternatives of GHGs at a national level by carrying on the FC-ES initiative. WFEO has observer status at the UNFCCC meetings and since 2008 has focused upon the adaptation theme as it relates to climate change. Creation of this task group broadens the engineering contribution to the mitigation debate. As such, WFEO and CEE can capitalize on this opportunity to engage with other influential international organizations, and ensure the engineering message is heard in the global climate change debate.

WFEO-CEE encourages national member participation in this task group's activities by carrying out a national assessment on GHG mitigation as part of the FC-ES initiative, and welcomes participation and contribution of interested parties and individuals. This newsletter highlights the new task group, FC-ES and its activities.

Climate Change Mitigation Task Group Update

Future Climate – Engineering Solutions (FC-ES) Project

By Hayley Coleman, Alison Cooke and Daniel Kenning

Hayley Coleman is Area Manager for Europe at the Institution of Civil Engineers and Commonwealth Engineers' Council Secretary, and CEE Climate Change Mitigation Task Group Manager; Alison Cooke is former chair of the FC-ES project; Daniel Kenning is current chair of the sustainability panel at the Institution of Mechanical Engineers (IMechE).

This Yorkshire, England, flood can provide lessons relating to climate change mitigation.

The Climate Change Mitigation Task Group (CCMTG) within the WFEO-CEE aims to promote the key role of civil engineering and clean technologies to mitigate climate change and thus reduce greenhouse gas (GHG) emissions. The group strives to create an international pool of knowledge and collaboration, building upon the extensive network and resources of the Future Climate – Engineering Solutions (FC-ES) Project (http://www.fc-es.net/).

While the CCMTG is confident in its links to the FC-ES project, this element of the task group is in a state of transition. Alison Cooke, who has been chair of the FC-ES project for a number of years and who would have been responsible for the links between FC-ES and WFEO, has resigned from her position as chair of FC-ES. As such, the on-going governance structure for the project is in the process of developing. Daniel Kenning, who has been working on the FC-ES project for a number of years and currently chairs a sustainability panel within the Institution of Mechanical Engineers (IMechE) in the United Kingdom, has agreed to take on the intermediary responsibilities within FC-ES. Professor Paul Jowitt, chair of the WFEO-CEE Climate Change Mitigation Task Group, will look after the linkages to the FC-ES governance structure, and, as such, the connection to WFEO will be maintained.

The FC-ES Project was established in 2008 and is a multi-national, multi-institution global engineering alliance working with national governments to develop and share best practice in the creation and implementation of national energy plans. As such, FC-ES aims to create a global alliance of national engineering organisations which can help each other step forward to help their own respective governments in dealing with the technological challenges of climate change. Countries need to write national energy plans, which, in turn, beget national climate-change plans and engineers can be pivotal in this process.

The FC-ES Project partners represent more than 23 countries – with links to over one million engineers. The partners strive to produce the priority project deliverable: National Climate and Energy Plans, where possible, collaborating with their national governments.

There can be difficulties at the engineering organisation/civil service interface as different bodies learn to trust each other and to overcome the "not invented here" syndrome. One aim of the alliance is to learn from the collective experience, for example: who needs to see the data-based plans? And how can the plans be standardised to enable national arguments to be integrated into the global context?

Another purpose of the FC-ES that is slowly dawning is how useful such an alliance could be when faced with some of the grim scenarios which are becoming increasingly plausible – a sort of triage argument. We will be a network of learned societies in touch with those developing technical solutions; those used to working and collaborating with each other; and also in touch with those that could replicate any good solutions and innovative technologies that are developed.

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The project currently comprises engineering associations in the following 23 countries, working to deliver high-quality national energy plans by 2014: Australia, Belgium, Brazil, Canada, China, Croatia, Cyprus, Denmark, Finland, Germany, Honduras, Hong Kong, India, Ireland, Jamaica, Japan, New Zealand, Norway, Russia, South Africa, Sweden, the U.K. and U.S.A.


Daniel Kenning


Paul Jowitt

The project was launched by the Danish Society of Engineers (IDA) in 2008. Phase 1 (2008-09) was led by Denmark, included 13 participating engineering associations and resulted in 10 national energy plans, and the publication of a joint report available online at http://www.fc-es.net.

Phase 2 (2009-11) was led by Denmark in collaboration with IMechE in the U.K., and resulted in 11 national energy plans.

Phase 3 (2011-13) is being led by the U.K. (Daniel Kenning, Fellow of IMechE, and Paul Jowitt, Past-President and Fellow of ICE, supported by the Institution of Civil Engineers) with a global team of 23 national engineering organisations working on new national energy plans.

CEE and FC-ES Collaboration

Currently, the CCMTG is working with the FC-ES project to create a third framework. Norway and Finland have already offered support in drafting this third framework. FC-ES has currently identified the World Engineering Summit (WES) in Singapore as their next major international event. As such, they are hoping to "publish" the Third Framework at WES, and will hopefully be presenting at some point during the conference. The FC-ES and CCMTG joint presence at WES in September will help to gain more international members for both projects, and hopefully produce some national reports and make additional resources available to WFEO members.

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At present, the task group has the following objectives and goals:

- To produce additional country reports for FC-ES;
- To advocate engineering solutions for climate-change mitigation to the United Nations and WFEO member countries;
- To inform and educate policy- and decision-makers;
- To facilitate the engagement of WFEO member countries to participate in FC-ES;
- To develop presentation and training materials for use and delivery by CEE members and WFEO member countries to inform and educate policy- and decision-makers;
- To collaborate with fellow Professional Engineering Institutions (PEIs) and any other partners to form FC-ES's third framework;
- To successfully host an event or present at WES 2013 in Singapore;
- To send a delegation (or at least some representatives) to COP-19.

Climate Change Mitigation Case Studies and Exemplar Projects

On this and in the following pages, we profile several examples of climate change mitigation in various contexts. We present a case from Doha and two from the United Kingdom, as well as two examples of climate change mitigation in Africa. The case studies and exemplar projects from the developed and developing world illustrate the importance of climate change mitigation across the globe.

Case Study 1 – London 2012 Olympic Park

The Project

While the London 2012 Olympic Park has been designed to meet the requirements of the Olympic and Paralympic Games, the main focus has been on post-2012 use. The aim has been to only build permanent venues where there is a long-term use, not leaving "white elephants", and being creative in the use of temporary venues and seating.

The Olympic Village, the sporting venues, new transport services, supporting facilities and the Park itself have been designed to leave a lasting social, economic and environmental legacy, while minimizing any other adverse impacts during the design and construction.

The challenge of climate change has been addressed through minimising the carbon emissions associated with the development.

The remediation of the site involved bringing existing land back into public use and creating significant improvements in the quantity and quality of green space in east London. One hundred hectares of green spaces have been created which are designed to reduce the risk of flooding in the river valley and enrich the biodiversity of the Lower Lea Valley (45ha of biodiversity-rich parkland). The contribution of having sustainability at the heart of the project brought tremendous benefits, not only in terms of environmental and social benefits, but also in terms of cost savings.

The Benefits

The examples below show how environmental, social and economic benefits have been achieved, and how these are complementary rather than mutually exclusive:

- The decision to remediate heavily contaminated soil on site, rather than send it to landfill saved approximately £68 million;
- In the velodrome, the cable net roof design is lighter weight, uses around a tenth (150 t) of the steel used in more traditional options and is quicker to put up (six weeks vs. several months). It has enabled other parts of the structure to be designed for reduced loads, producing a saving of approximately £1.5 million due to a reduction in the depth of foundations needed;
- Using gas generators, (manufactured and supplied by a Scottish company) instead of traditional diesel generators, reduced CO2 emissions by 10,552 tonnes (22.2%) and provided a cost saving of around £13 million;
- With over 2,800 homes constructed in the Olympic Village, there is an average carbon emissions reduction of around 83% when compared to a typical building-regulations compliant apartment. This equates to an average annual saving per apartment of 1.5 tonnes CO2 or £237 saving at current energy pricing;
- As a part of the Olympic Village concrete procurement strategy, 257,000m^3 in total of concrete was poured, reducing embodied carbon emissions by approximately 50% and avoiding approximately 35,000 lorry (truck) movements from local highways; equating to a 40,000 tonne reduction in vehicle CO2 emissions over two years of operations;

London Olympics point the way.

- People have undertaken bespoke employer-led training linked to jobs on the Athletes Village and BeOnsite has delivered apprentice-ships within these areas and other core trades. The on-site brokerage team also filled 535 jobs for local people.

The Process

The principles that led to the success of the project:

- Buy-in from the top and consistency of leadership – senior management believed in it, owned it, and kept it on the agenda;
- Specific, clear, and challenging sustainability targets were set from the outset in pre-procurement, tender documents and contracts, that allowed for innovation;

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London 2012 (continued from page 4)

- Time taken at the start to plan rather than rushing in to the actual build or "doing" phase – including the importance of design and aesthetics as much as thinking about sustainability;
- Defining the scope, budget and funding early and sticking to it, making sustainability a key core driver at the same level as meeting budget and delivery objectives;
- Getting the right people with the right practical skills (delivery capability) on board fast;
- Embedding sustainability values throughout the delivery organization – at all levels;
- Identifying, sourcing and using environmentally and socially responsible materials;
- Creating an environment to challenge the client and contractors while maintaining a collaborative approach which allowed delivery partners to deliver;
- Sharing of resources and knowledge between projects;
- Employing a reliable and independent assurance body – increasing transparency and credibility;
- Maximising opportunities and setting challenging targets for sustainable materials and resource efficiency, including carbon, water and waste.

Key Learning Points

The Olympic Park and its construction has been a huge success. It provides a first-class example of a publicly-funded programme delivered on time and within budget, at the same time as delivering a collection of world-class, highly sustainable, venues.

Drawing on the Olympic Delivery Authority's knowledge and expertise from industry and academia, the lessons on how this was achieved have been distilled into the 12 principles highlighted. The majority of these principles will be readily transferable to most other major infrastructure projects, and the more of them that are applied, the greater the chance that those projects, too, will deliver on time and within budget.

Learn More

http://learninglegacy.london2012.com

This case study has been generously provided by the Green Construction Board. For more about the Board and U.K. efforts to build and construct with low-carbon emissions, visit www.greenconstructionboard.org or email gcb@bis.gsi.gov.uk.

Case Study 2 – Cucumbers in the Desert – The Sahara Forest Project

During the meeting COP-18 last December in Doha, Qatar, the FC-ES team was invited to meet the Sahara Forest Project team, who are building a demonstration "greening the desert" project in Qatar. We were given lovely juicy cucumbers, the first harvest picked that same day from the desert outside Doha! The Sahara Forest Project (http://saharaforestproject.com/) is a system that uses sustainable technologies and systems to bring the desert back into agricultural productivity.

Qatar has in the past taken a high-energy development route, following the Western pattern and using its own extensive oil reserves. This has led to a dependency on water from desalination plants powered by fossil diesel, and thus to the highest per-capita CO2 emissions in the world.

The Sahara Forest Project aims to create new self-sustaining and non-fossil-energy dependent eco-systems, and starts with simple "evaporator hedges" that slow airflow and passively transfer any moisture in the air into the soil, to enable plants to grow. The system relies on two other key technologies: saltwater concentrated solar power (CSP) that generate electricity via steam turbine and saltwater-evaporative-cooling and humidification for greenhouses, driven by this solar electricity.

Sahara Forest Project is greening the Qatar sands.

The idea is that a modular approach comprising 1 km^2 units will enable large areas of the desert on hot sunny countries to be re-vegetated.

The first trial plot was started on site in February 2012, and the first vegetables were harvested in December 2012, grown in the desert, using moisture from the air and salt water that has been desalinated using solar energy.

Case study provided by Daniel Kenning.

Case Study 3 – Carbon Modelling in Sustainable Design

The Project

To mitigate climate change and to provide sustainable water and wastewater services to a growing population, the client Anglian Water – a major English water and wastewater services provider – set some challenging goals to reduce both embodied and operational carbon.

With @one Alliance providing principal design, engineering and contracting services, a clear strategy of measuring, managing and reducing emissions required a range of carbon models to be developed and a tool for design engineers to identify and optioneer between low carbon solutions.

Through 2007-08, around a thousand carbon models were developed ranging from complex treatment processes, reinforced concrete tanks, HPPE mains, pumps, valves, etc. The models were created taking into account the carbon/energy required to extract and fabricate raw materials into products together with transport and installation on site.

As part of business planning and capital investment of more than £2 billion in Anglian Water's infrastructure between 2010 and 2015, the models were used to create an embodied carbon baseline for each individual scheme.

In 2008, a proactive in-house carbon modelling tool was developed and introduced to allow Anglian Water and its delivery-partner framework engineers to calculate embodied and operational carbon impacts of designs. The tool can be accessed via the Internet and requires design engineers to select different items of equipment and process assets, building up the carbon impacts of proposed solutions.

The Benefits

With measurement and management of carbon now fully integrated into the delivery of all capital schemes, we have strong evidence of the correlation between embodied carbon and capital expenditure and operational carbon and operational expenditure.

The reductions in embodied carbon through design not only save costs but also reduce the use of irreplaceable finite materials and help with the provision of more sustainable assets for the future.

Design engineers have risen to the challenge of reducing carbon in their designs, moving forward from the singular focus on cost and released from following standard designs. Key framework partners and suppliers have also been energised to deliver low-

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Example 1: Great Rift Valley in East Africa

Energy experts, organisations involved in sustainable development and various news sources have been watching as the Great Rift Valley provides an opportunity to revolutionise the production and quality of energy in East Africa. The large amount of geothermal energy resources beneath the Great Rift Valley has come to fruition, and local populations have begun to switch to geothermal energy sources. This simultaneously provides energy and electricity for a population that has lived without basic energy infrastructure for years, and aids in efforts to reduce the amount of greenhouse gases produced in the region.

In addition, the price of solar energy has begun to drop. As such, African villages can begin to use their climate as an advantage, as solar lights have become a main source of light for approximately seven million Africans*. With the decreasing price, those living at low-income levels will be able to afford a sustainable energy source, shying away from polluting greenhouse gases and using natural sources of energy to mitigate climate change.

*Heap, Eric (2013). Energy revolution promises to transform East Africa. BBC Radio 4's Costing the Earth and Newsnight, 25 February (available at http://www.bbc.co.uk/news/world-africa-21549380

Example 2: Gabal el Asfar Wastewater Treatment Plant in Egypt*

The African Development Bank and the Egyptian government are currently working to increase the capacity of the Gabal el Asfar wastewater treatment plant. Serving as the wastewater treatment plant for around eight million people in the greater Cairo area, the Gabal el Asfar plant must increase its capacity at a pace that equals the growing population in the Egyptian metropolis. According to the African Development Bank, Phase II of this project will be constructing the plant's capacity extension, thus providing an additional wastewater treatment capacity of 500,000 m^3/d.

Greenhouse gas emissions are typically high at wastewater treatment plants, and thus an increased capacity of the Gabal el Asfar would, in theory, mean an increase in the amount of GHG produced. However, actors on this project are aiming to exploit one of the plant's main and most polluting by-products: methane. If methane were to be released into the air as normal – and as is done at wastewater plants – GHG emissions would increase. But, the phase of the project will capture the methane gas, thus supplying a large portion of the plant's energy.

* Information from: African Development Bank, Water and Sanitation Department (document available at http://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/Climate%20Change_OWAS_2011.pdf).

Carbon Modelling (continued from page 6)

Anglian Water is reducing its CO2 footprint using carbon modelling in sustainable design.

carbon solutions. A number of sectors, including the concrete industry, have worked hard to improve the measurement of carbon impacts of their products.

By April 2012, Anglian Water had achieved a remarkable 32% reduction in embodied carbon, delivered through intelligent design against the 2010 baseline.

The Process

Predicted changes in weather patterns, rising sea levels and meeting the needs of a growing population has meant that Anglian Water is one of the most vulnerable U.K. water companies to be affected by climate change.

In responding to this challenge the company set two clear goals, firstly to halve the embodied carbon impact of assets built in 2015 from a 2010 baseline and secondly to reduce operational carbon by 10% in real terms by 2015 from a 2010 baseline.

Internal conferences on climate change and a number of awareness and training sessions were held between 2008 and 2010 to highlight why managing and reducing carbon is important to Anglian Water and how emissions could be reduced. Design engineers were encouraged to follow a hierarchical approach to emissions reduction through avoiding building assets, re-using existing assets, using alternative low-carbon materials and building more efficiently.

In 2010 a robust governance process was put into place requiring all schemes to report embodied and operational carbon against the baseline on three separate occasions prior to work commencing on site.

The benefits of carbon reduction are being delivered through an understanding of the impacts of climate change and population growth, clear organisational goals, a carbon modelling tool to measure and manage emissions, and a team of design engineers focused and enabled to deliver reductions.

End-User Feedback

Design engineers using the modeller have not simply accepted the outputs of the carbon models. As awareness of embodied carbon has evolved through the organisation, a greater degree of challenge has been demonstrated from both engineers and suppliers. This has resulted in models becoming more accurate over time.

Key Learning Points/Best Practice

To effectively measure, manage and reduce carbon emissions:

1. Clear business drivers and goals are needed as to why reducing emissions is important;
2. Tools and a process are required to enable engineers to design out carbon;
3. Robust governance is required to reinforce the process and to measure and challenge carbon reductions.

This case study has been generously provided by Anglian Water.

WFEO-CEE and Related Upcoming Events

- Sept. 9, 2013, Singapore City, Singapore – WFEO-CEE Face-to-Face Meeting #6
- Sept. 13-15, 2013, Singapore City, Singapore – WFEO Executive Council Meeting and General Assembly 2013

Meetings Relating to WFEO-CEE Themes

Themes 1 and 2 – Climate Change Adaptation and Mitigation

- May 27-29, 2013, Montreal, Quebec, Canada – 3rd Climate Change Technology Conference 2013 www.cctc2013.ca
- June 3-14, 2013, Bonn, Germany – UNFCCC Subsidiary Body Climate Talks www.unfccc.int
- Sept. 11-13, 2013, Singapore City, Singapore – World Engineers Summit 2013 – Innovative and Sustainable Solutions to Climate Change www.wes2013.org

Theme 3 – Engineering and Sustainable Agriculture

- July 6-7, 2013, Hong Kong – 3rd International Conference on Environmental and Agriculture Engineering – ICEAE 2013 www.iceae.org
- Sept. 3-6, 2013, Prague, Czech Republic – 5th International Conference "Trends in Agricultural Engineering 2013" www.conference.cz/tae2013

Theme 4 – Engineering and Sustainable Mining

- May 22-23, 2013, Aachen, Germany – 4th International Symposium on Mineral Resources and Mine Development www.aims.rwth-aachen.de
- June 30-July 3, 2013, Milos Island, Greece – 6th International Conference – Sustainable Development in the Minerals Industry (SDIMI 2013) www.sdimi2013.conferences.gr

FC-ES and Climate Change Mitigation at COP-18

By Daniel Kenning

Daniel Kenning is a Fellow of the Institution of Mechanical Engineers and founder of Splendid Engineering.

(Left to right) Rob Cooke (Buro Happold), Saurev Dhakel (British Council Climate Ambassadors), Andrew Picken (British Council) , Fethi Thabet (WFEO), Adam Poole (FC-ES & Buro Happold), Daniel Kenning (FC-ES & IMechE), Alex May (Mayden Foundation), Chris May (Mayden Foundation), Shalini Sharma (The Institution of Engineers, India).

At COP-16 (the Conference of the Parties 16 to the United Nations Framework Conference on Climate Change) in 2010, in Cancun, Mexico, the Future Climate Engineering Solutions (FC-ES) Project hosted an event which aimed to establish new national teams. Also in 2010, the idea of engineers working with governments to deliver solutions was given a fillip – after the Technology Mechanism was established in Cancun, in December 2010, UNFCCC Executive Secretary Christiana Figueres said: "The challenge we face calls for nothing less than a transformation of the world economy onto a green, sustainable pathway. Technology, both for adaptation and for mitigation, cannot but be at the very centre of this transformation."

By 2012, the FC-ES network had grown to include representatives of the national engineering associations of 23 countries, including key nations in the global energy system: India, China, Russia and U.S.A.

A small delegation from the project went to Doha, Qatar, for COP-18 in order, for the first time, to host an event at the conference targeted at government delegations. FC-ES organised a side event, sponsored by Shell U.K., at which we also launched a new website – www.fc-es.net.

Speakers from six countries came together at the event, including representatives from the World Federation of Engineering Organisations (WFEO), the U.K. Department of Energy and Climate Change (DECC) and the British Council. The development of the website was facilitated by the Mayden Foundation.

The main topics discussed were:

- The Indian Energy and Climate Plan – presented by Dr. Shalini Sharma, Chair, Professor, The Institution of Engineers (India) and Head, Centre for Climate Change;
- The UK Energy and Climate Plan – presented by Daniel Kenning, Fellow of the IMechE and founder of Splendid Engineering;
- The DECC Pathways calculator and the global calculator – presented by Jan Kiso, Senior Policy Advisor, U.K. Department of Energy and Climate Change;
- The FC-ES website – Introduced by Chris May, founder and managing director of Mayden and the Mayden Foundation, who are providing web design and hosting services pro bono and presented by Alex May, web developer;
- The role of WFEO and how it links to FC-ES – presented by Fethi Thabet, a theme coordinator within WFEO-CEE;
- The work of the CEE Engineering and Agriculture Task Group.

Since the event, Tunisia has also expressed an interest in participating in the project.

A video interview about FC-ES project with Daniel Kenning is available here: http://climatechange-tv.rtcc.org/cop18-energy-planning-too-complex-for-politicians/