

Energy Research Development and Demonstration

UCC's Response to DCMNR's Consultation Paper.

University College Cork (UCC) welcomes DCMNR's *Consultation Paper on Energy Research, Development and Demonstration* (RD&D) and shares DCMNR's wish to see a more coordinated and structured approach taken to the creation and maintenance of RD&D capacity on the island.

UCC shares the belief that in Ireland we must be more focused on research in the energy field generally, both from a technology and policy perspective and in particular in the areas of renewable energy, energy efficiency and other supporting technologies.

This is evidenced in our track record in energy research which began in 1978 and constitutes over 250 published papers and since 2000 represents over € 5 million research income. Currently UCC has leading edge energy expertise across 6 Departments and 2 Research Centres, in key areas of strategic importance to Ireland, the European Union and the developing world. This level of cross-disciplinary expertise makes UCC unique amongst 3rd level institutions in Ireland.

In 2001 the strategic area of energy, environment and sustainable development was recognized in *UCC's Institutional Strategy for Research*¹, as being of "paramount importance in UCC". It is further stated² that "..... UCC has in-depth awareness of major international trends in Science and Technology and has led to the development of new strategic objectives of national importance as inEnergy, Environment and Sustainable Development."

This response is structured in a manner that mirrors the consultation document itself. It concentrates on responding to the statements at the end of each section that specifically request the views of stakeholders. It incorporates a discussion of the Annex to the consultation document, *Strategic Review of Energy RD&D Activity in Ireland*. It does not include recommendations regarding the energy research themes and subjects that should be prioritized. UCC has submitted these in a separate response to DCMNR's call regarding the Statement of Strategy 2005 – 2007.

1. Introduction

UCC believes that an essential ingredient of a *more coordinated and structured approach taken to the creation and maintenance of RD&D capacity* is consistent funding, which has been lacking in this field. In this regard, UCC agrees with the conclusion of the Strategic Review that *continuity of work and developing appropriate national capacity is very vulnerable to the absence of consistent funding over a number of years*.

¹ Submission by UCC to the HEA Programme for Research in 3rd Level Institutions 1999 – 2001. Vol 3 pg 20.

² Ibid. pg 6.

UCC welcomes the opportunity to update the inventory of energy RD&D activity and is submitting the necessary information to Sustainable Energy Ireland (SEI) for the years 2003 and 2004 in a parallel exercise.

2. The Policy Context

The *Technology Foresight Ireland* process (Autumn 1998 – Summer 1999) had a key influence on the structure and focus of Ireland's research activities since 2000 but is not mentioned in the consultation document.

UCC was involved in the *Energy Panel* and the report made some useful points that remain relevant today. In particular, the Panel agreed two strategic questions that should inform the focus of an energy research programme, namely

1 How should we maximise the benefits to Ireland of innovation in the energy sector?

This question relates to maximising the gains to Ireland from exploiting new and emerging energy technologies, skills and expertise. Emphasis on this type of innovation will position Ireland to respond to growing domestic energy needs

- *seek out international energy markets*
- *participate actively in new and emerging energy markets*
- *close the balance of energy trade deficit.*

2 How should we manage and meet Ireland's energy demand up to 2015 ?

This question examines the technology options, research and development needs and the suggested mechanisms for managing and meeting Ireland's energy demand to 2015. The question examines energy supply, management and demand. It takes into account the impact of two key developments in the period - our legally binding limitations on greenhouse gas emissions under the Kyoto Climate Change Protocol and the liberalisation of the gas and electricity markets.

In addition, it is worth noting that the Energy Panel deliberated on who should coordinate and deliver the research programme. Due to the relatively low interest in energy research amongst the research funding institutions, the Panel recommended that the Department champion the programme, secure the funds and deliver the programme in collaboration with an *action panel*.

The net result of this was that the research programmes recommended by the seven other Technology Foresight Panels were subsumed into Science Foundation Ireland's remit, whereas sustainable energy research is currently being funded separately within the National Development Plan's Energy Programme and administered by SEI.

Given the experience of both SFI and SEI in delivering research programmes it is opportune to review this arrangement and establish the most appropriate way forward.

3. Institutional and Governance Options

UCC broadly agrees with DCMNR's preference for a *Research Council* operating through Science Foundation Ireland (SFI) for the following reasons

- SFI has a track record in successfully administering large scale research funding

- SFI has developed and implemented suite of structures, methods and processes in place and has a strong ethos in capacity building that would meet the goals of DCMNR's programme.

UCC does have a number of concerns to be addressed, which are not dealt with in the consultation paper.

- UCC's main concern is how the funding for energy RD&D can be ringfenced consistently and secured in this arrangement.
- The focus of SFI is on R&D – how will the demonstration aspects of the energy RD&D programme be incorporated into SFI?
- In the interim, while these arrangements are being developed UCC recommends that the Higher Education Authority (HEA) prioritise energy research in its Programme for Research in Third Level Institutions (PRTL4)
- UCC also recommends expanding the capacity building programmes in the short term by extending the SEI Embark scholarships and including post doctoral researchers, senior researchers and research professors. There are currently 2 – 3 issued per year of which UCC has secured 4 in the last two years.

4. All-Island Perspective

UCC favours collaboration on an all-island basis particularly in the context of the development of an all-island energy market. UCC has worked in collaboration with research institutes in Northern Ireland, most notably with Queen's University Belfast.

UCC is concerned however that this does not disadvantage either party. In particular, research groups in Northern Ireland have access to significant UK funding while access to national funding for research groups in the Republic of Ireland is very limited

5. EU Perspective

UCC feels that Irish researchers have been disadvantaged relative to other EU researchers in accessing EU funds due to the absence of a consistent national programme, which provides critical mass and in some instances matching funding.

UCC recommends aligning national priorities with EU priorities where appropriate in a clear and coherent fashion in order to maximise EU funding potential. National priorities should also be fed into the debate on FP7 to inform EU priorities.

National Energy Technology Platforms should be established in key research areas and should mirror and feed into EU Energy Technology Platforms.

6. Links With Environment

UCC is very conscious of the close interlinkage between energy and environment and feels there are clear crossovers with other sectors also, which be incorporated into the debate. Examples include energy and marine (wave, tidal, oil and gas exploration), energy and forestry (biomass), energy and agriculture (energy crops for bioethanol and biodiesel).

It is important to recognise that there are a number of bodies currently administering research funding (that involve energy research projects) in the areas of the marine (Marine Institute), environment (Environmental Protection Agency). It is essential that these bodies are included in the deliberations regarding a single co-ordinating agency for managing an energy RD&D programme to ensure a smooth transition.

7. Long Term vs Short Term Goals

The Technology Foresight Energy Panel strategic questions provide a useful starting point for considering short term and long term goals, namely

- The short term goal is to deliver an energy technology response to Ireland's commitments under the
 - ❖ Kyoto Protocol on Greenhouse Gas Emissions
 - ❖ National Emissions Ceiling Directive,
 - ❖ EU Directives relating to RES-E, Energy Performance in Buildings, Biofuels for Transport and other energy related legal instruments
- The long term goal is to maximise the benefits to Ireland of innovation within the energy sector. For example, Ireland is uniquely placed to develop solutions to the challenges of accommodating high levels of wind energy within the electrical power system.

8. Funding

The document is severely lacking in specific detail regarding funding levels and timeframe. For significant capacity building, a sufficient and sustained level of funding is a key requirement. In this regard, UCC shares the conclusion in the Strategic Review that *Unlike biotechnology or ICT, there are few sustained support mechanisms to attract and retain key skills in the energy area.*

9. Capacity Building

In order to build significant capacity in energy research UCC believes that resources are required at second level, under-graduate, post-graduate, senior researchers and Research Professors. The following list of actions touches on the areas requiring attention.

- Incorporate Energy into Undergrad Programmes capital investment required
- Develop more Masters and PhD Programmes in energy engineering, including the establishment of a National Energy Research Training Network at PhD level
- Fund Post Doc and Senior Researcher positions, examining the SFI Proleptic appointments mechanism
- SFI, HEA PRTL4 focus on sustainable energy
- Establish *National Sustainable Energy Research Institute* linking sustainable energy researchers in Ireland and co-ordinated by UCC

A useful model to explore in this regard is the *Programmes in Advanced Technology*.

10. Conclusions

UCC welcomes the opportunity to elaborate on the points made in this paper and to engage fully with DCMNR and others in the development of a co-ordinated energy RD&D Programme.

Appendix A: UCC involvement in Sustainable Energy Policy

UCC has been directly involved in all sustainable energy policy developments in Ireland in the past 10 years, providing

- Strategic Direction to SEI's *Renewable Energy information Office* from 1995 – 2000;
- Chair and Rapporteur of the *Working Group on Grid Connection Issues Relating to Renewable Energy 1997 - 1999*
- Vice-Chair and Technical Assistance to the *Technology Foresight Ireland Energy Panel* in 1998 / 1999;
- Draft 2 chapters (*Energy Trends in Ireland* and *Renewable Energy*) of the *Green Paper on Sustainable Energy* in 1999;
- Vice-Chair and Facilitator to the *Renewable Energy Strategy Group* in 2000;
- Strategic Direction to SEI's *Energy Policy Statistical Support Unit* since 2000
- Independent Expert Membership to DCMNR's *Steering Group on Grid Upgrade Programme for Renewable Energy*
- Membership of DCMNR's *Renewable Energy Development Group Short Term Action Group*

In addition UCC has inputted into a number of EU sustainable energy policy developments including

- evaluation of the *EU Altener I* programme a € 100 million programme to promote Renewable Energy
- the design and development of the subsequent *Altener II* programme
- *EU Green Paper on Renewable Energy Sources*
- EU 5th Framework Energy Expert Advisory Group
- representing Ireland on EUROSTAT Energy Statistics Working Group,
- representing Ireland on EU DGTREN's Energy Economists Expert Group
- representing Ireland on the IEA Energy Statistics Working Group
- participating in a State of the Art Review of Offshore wind energy informing the 6th Framework Programme

Appendix B: Current Focus of Sustainable Energy Research in UCC

1 Wind energy

The focus is on areas of strategic importance to Ireland, given the ambitious development targets, the barriers to accommodation of wind generated electricity, and the growing interest in offshore wind energy.

- *Development of a Short Range Ensemble Prediction System for Wind Energy Forecasting in Ireland*
- *Study of Electricity Storage Technologies and Their Potential to Address Wind Energy Intermittency in Ireland*
- *The Impacts of Increased Levels of Wind Penetration on the Electricity Systems of RoI and NI*
- *Renewable Energy Supplying Electricity to Customers in Liberalised Market*

2 Fuel Cells

The aim is to consolidate existing expertise in Chemistry, Electrical Engineering and Civil & Environmental Engineering. Ongoing projects include :

- *Wind Energy Producing Hydrogen for Fuel Cells*
- *Hybrid Electric Vehicles Power Systems at University College Cork Ireland.*

3 Solar Energy

The National Microelectronics Research Centre (NMRC) has an impressive track record in the research area of solar energy. The PEI Renewable Energy Group is responsible for RE research within NMRC. Projects include:

4 Wave energy

- Research is being carried out on the *Wave Dragon Device*, the *SPER Buoy* device and on tidal current energy in the *OPTCURRENT* project.
- Hydrodynamics of wave and tidal energy devices.

5 Energy in Buildings

- *New Energy Systems for Buildings.*
- IRUSE has established an international collaboration to support the concept of the performance-based approach to the assessment of buildings.

6 Energy from Waste

- *A systems analysis of potential energy from waste in Ireland*

7 Policy Related Research

- *Economic Analysis of RES-E Support Mechanisms –*
- *Conflicts between energy policy objectives and the NCCS in Ireland*

Appendix C: Courses and Teaching Aids in Sustainable Energy in UCC

UCC has developed a multi disciplinary 1 year taught Masters Degree Programme in Sustainable Energy Engineering, which will commence in October 2005.

With regard to education and training in the area of sustainable energy, there are a number of sustainable energy modules being delivered to UCC's undergraduate students (mostly in the area of engineering), including

- CE3016 Energy and the Environment – Environmental impact of energy derived from fossil and nuclear fuels. World energy statistics and energy indicators. An introduction to energy policy. An introduction to renewable energy.;
- CE3010 Environmental Engineering Dry - Solar radiation and windows, heating and cooling loads, annual energy consumption and special topics. Heat generation and transfer equipment. Cooling equipment.
- CE3013 Traffic Engineering - Transportation issues and trends. Driver/vehicle/roadway system. Traffic studies; land use, volume, speed, travel time, parking and accidents. Public transport systems. Road safety engineering. Urban traffic management including traffic signal systems. Sustainable transportation policies
- CE4015 Environmental Hydraulics - Hydraulic Structures, Open Channel Design, Numerical Modelling, Pipeline and Pumping Systems including Hydropower plants
- CE4017 Heating, Ventilation and Air Conditioning II - Pressurised Heating Systems, Transient heat flow in buildings, Refrigeration plant, air conditioning, efficient use of energy.
- CE4020 Environmental Hydrodynamics - Hydrodynamics. Wave Theory, Wave Propagation, Random Waves, Diffusion Processes, Tidal Theory, Numerical Modelling, Wave Energy
- EE4001 Applied Power Electronics and Motion Control - Mechanical systems; DC machines; Power Electronic Converters; Power Semiconductors; Component Reliability; Feedback Controller Design; AC Machines Analysis and Control; Permanent-Magnet and Induction motors; Vector Control of Induction Motor; Modulation Schemes; Transducers; Electromagnetic Interference
- EE4010 Electrical and Electronic Power Supply Systems – encompassing every stage in the process of electricity generation, transmission, distribution and utilisation of electrical energy. The generation stage provides and overview of renewable energy based power systems and pumped storage plants.
- EV3905 Energy and the Environment - Traditional energy practices and their environmental impacts (wind, water, peat, wood, coal, oil, natural gas). Nuclear energy and its environmental impacts (fission, fusion, radiation, radon). Renewable energy resources (solar energy, wind energy, hydroelectric power, geothermal energy, tidal energy, wave energy, biomass energy).

In addition, UCC has been involved in following EU funded projects to further develop this area :-

- *A Multi-media Information and Training Package for the Promotion of Rational use of Energy* – EU THERMIE funded project DIS-0974-1996-IE
- *The Development of a New Degree Programme in Energy Engineering* – EU TEMPUS funded project S_JEP-12255-97/2000
- *Renewable Energy Course Materials Tackling Market Barriers* – EU ALTENER funded project AL-98-022

Appendix D: UCC Collaboration in Sustainable Energy

1. Collaboration with industry

UCC has existing linkages with research institutions and companies, including VESTAS (Denmark), Garrad Hassan & Partners (UK), Danish Metrological Institute, Nordex (Denmark), Nesa (Danish electricity distribution company), Celtic Wind Technologies, Airtricity, Irish Wind Energy Association, National Power (UK), , Kerry County Council, Aon Insurance (Ireland), German Wind Energy Institute, Enerdata (France), IMS (South Africa), Electrica (Romanian electricity company), ESB International (Ireland), ESB National Grid, Integrated Energy Systems International (UK), EKAN Gruppen (Sweden), Linden Consulting Partnership (UK), Instituto Nacional Meteorologia (Spain), Power Technology (UK), Powergen Renewables (UK), Institute of Energy- and Semiconductor Research (Germany) RTE (France), EWE AG (Germany), Eltra (Denmark), General Motors.

2. Collaboration with other institutions

UCC has existing links with other universities including the Technical University of Czestochowa (Poland), Delft University of Technology (The Netherlands), Loughborough University (UK) and through the proposed *Network for Education on Sustainable Energy* (with Ecoservis (Spain), De Montfort University (UK), Swedish University of Agricultural Science (Sweden), Université Paul Sabatier (France), Université Catholique de Louvain (Belgium) 17&4 (Austria), University of Groningen (The Netherlands), Institute of Mechanical Engineering and Industrial Management (Portugal), National Technical University of Athens (Greece), Solapraxix (Germany), Technical University of Denmark, Centre for Energy Technology (Sweden), Politecnico di Milano (Italy), Utility Link (UK), Technical University of Catalonia (Spain), Open University (UK), University of Barcelona (Spain), Unione Italiana Consulenti Ambientali (Italy) Total Energie (France)).

3. UCC involvement in research networks

UCC has been involved in a number of research networks the *European Wave Energy Thematic Network* (with ETSU (UK), Rambøll (Denmark), SPOK ApS (Denmark), Instituto Nacional de Engenharia e Tecnologia Industrial (Portugal), Chalmers University (Sweden), Teamwork Technology (The Netherlands), CRES (Greece), Ponte di Archimede nello Stretto di Messina SpA (Italy), Edinburgh University (Scotland), Instituto Superior Tecnico (Portugal), Ecole Centrale De Nantes (France), ESB International (Ireland), Hammarlund A. Konsult (Sweden)) and the *Thematic Network on Offshore Wind Energy* (with SPOK ApS (Denmark), Delft University of Technology (The Netherlands), Garrad Hassan & Partners (UK), Tractabel Energy Engineering (Belgium), John Brown Hydrocarbons Operation (UK), CRES Centre for Renewable Energy Resources (Greece), DEWI – German Wind Energy Institute (Germany), Baltic Energy Conservation Agency (Poland), The Netherlands Energy Research Foundation, Espace Eolien Development (France), VTT Energy (Finland), Risø National Laboratory (Denmark), Gotland University (Sweden) ISES Italia (Italy), Tech-Wise (Denmark), 3E (Belgium), ESB International (Ireland), Germanischer Lloyd (Germany)).

Appendix E: Sustainable Energy Researchers in UCC

The following members of UCC staff are involved in sustainable energy research.

| | | | |
|-------|------------|--------------|---|
| Dr. | Eamon | McKeogh | Department of Civil & Environmental Engineering |
| Dr. | Marcus | Keane | Department of Civil & Environmental Engineering |
| Dr. | Donnacha | Ó Cinnéide | Department of Civil & Environmental Engineering |
| Dr.. | Brian | Ó Gallachóir | Department of Civil & Environmental Engineering |
| Mr. | Jess | Joergensen | Department of Civil & Environmental Engineering |
| Prof. | Robert | Yacamini | Department of Electrical Engineering |
| Prof. | John M. D. | Murphy | Department of Electrical Engineering |
| Dr. | Michael | Egan | Department of Electrical Engineering |
| Dr | John | Hayes | Department of Electrical Engineering |
| Prof. | Declan | Burke | Department of Physical Chemistry |
| Dr. | Gareth | Thomas | Department of Applied Mathematics |
| Dr. | Alastair | Allen | Department of Geology |
| Dr. | Alan | Mathewson | National Microelectronics Research Centre |
| Dr. | Bill | Lane | National Microelectronics Research Centre |
| Mr. | Mike | Meinhardt | National Microelectronics Research Centre |
| Mr. | Brendan | O Neill | National Microelectronics Research Centre |
| Mr. | Brian | Corbett | National Microelectronics Research Centre |
| Mr. | Nicolás | Cordero | National Microelectronics Research Centre |
| Dr. | Tony | Lewis | Hydraulics and Maritime Research Centre |
| Mr. | Brian | Holmes | Hydraulics and Maritime Research Centre |