COGNISABLE CARAMBOLES: MAKING YOUR RESEARCH AND IMPACTS CLEAR

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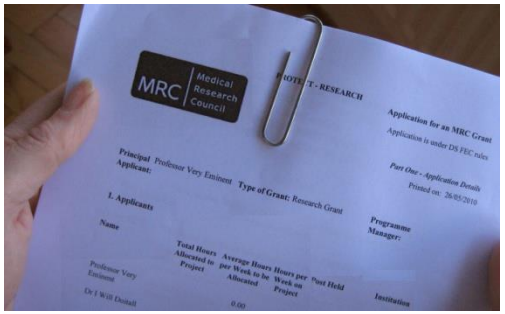
Introduction

Making your research and impacts clear:

- Why?
- How?
- What difference can we make?



We will focus on adding value and encouraging good practice in:

- Lay summaries
- Impact summaries and pathways
- Press releases

… more than just taking out the big words …

Lay summaries – why?

- One of the skills every researcher must learn is how to present complex ideas and technical or scientific terms to a "lay" audience.
- That audience is heterogeneous, it includes
  - the general public (including taxpayers …)
  - patients and users of health services, and carers,
  - politicians and other decision makers,
  - researchers from a different academic background.
- It's a requirement of most funders…

Lay summaries – what are they?

"a brief summary of a research project or a research proposal that has been written for members of the public, rather than researchers or professionals. It should be written in plain English, avoid the use of jargon and explain any technical terms that have to be included"

(S Buckland et al (2007) Public Information Pack. How to get actively involved in NHS, public health and social care research. INVOLVE Public Information Pack 4 available at http://www.invo.org.uk/pdfs/pip44jargonbuster.pdf)

"*A brief summary…*

"*…of a research project or a research proposal*"

The UK Research Councils permit 4,000 *characters* in a grant application lay summary.

By contrast research charities often use *word* limits that vary widely: the Stroke Association allows 1,000 words but the British Heart Foundation merely 100.

So it has to be persuasive in a modest space.

"written for members of the public,…

"…rather than researchers or professionals."

MRC advises this it should be written "*for a reader of a middle-market tabloid newspaper*"

BBSRC simply says write "*in a way that could be publicised to a general audience*".

EPSRC has said the lay summary should suit "*an interested 14 year old*". (whatever that is)

Arthritis Research UK: "*The lay summary should be written as if it were to be published in the science pages of a major broadsheet paper or a journal such as 'The Economist'.*"

But, also for the 'informed' layperson?

- Some peer review processes use representatives of service users and carers.
- eg NIHR requires involvement, and some charities such as the Cystic Fibrosis Trust have both parents and patients on their Research Advisory Committee *alongside science and medical experts*. Their input and opinions are seen as very, if not equally, important.

And also for the professional?

- The lay summary is useful to policy makers and politicians in raising and justifying research funds from government. It may appear for years on funders' websites and in public documents.
- It may attract new collaborators from different research backgrounds, and industrial partners too. It may also attract follow-on funding.
- The lay summary is probably the first, *maybe the only* part of a grant application that a busy peer reviewer will actually read!

And also for the professional?

The lay summary is also very useful for individuals within the University:

- Research managers: easily transferred into case studies for promotional purposes
- Knowledge Transfer/Business Development: clear, publically available summary to generate business interest.
- Press officers: the summary can effectively be translated into material suitable for press/public engagement.

"It should be written in plain English…

"…, avoid the use of jargon, and explain any technical terms that have to be included."

ESRC says: "*Write in plain English. Your proposal is likely to be seen by many people, including some who will not be familiar with your particular specialisation. Detail and specification may necessitate the use of disciplinary or technical terminology and this will be clear to peer reviewers, but the ideas you wish to convey and your reasons for doing so should be apparent to a wide audience.*

(Writing a good proposal, ESRC)

How "plain" should your English be?

Prostate Cancer Charity says the lay summary "*should be pithy and jargon free as far as possible*".

Arthritis Research UK suggests that: "*Bill Bryson's book, 'A short history of nearly everything', is a stunning example of how everyday objects and activities can be used to describe complex areas of science including nuclear physics and astronomy.*" ARUK says the writer should consider "*using simple analogies to give the reader the sense, if not the detail, of what you are planning to do*" (Tadman J (2008) People Power; ARUK website (http://www.arc.org.uk/news/142_2.asp) and Arthritis Today 142, 2008).

“Plain” is not always understandable

- EC FP7: *“Titles should be understandable to the non-specialist in your field”*
- Abstract should *“at a glance, provide the reader with a **clear understanding** of the objectives of the proposal … it must therefore be short and precise and should not contain confidential information … use plain typed text, avoiding formulae and other special characters.”*

Clear layout is also important

ESRC: "*By the same token, do take the trouble to check spelling, grammar and punctuation. These are all part of the quality of presentation and presentation matters!* " (Writing a good proposal, ESRC)

English phrases may not be widely understood, eg "the lion's share of the work". Where are the lions??

Double negatives must be avoided, eg "it is not inconceivable that the project will result in…"

But this can be easier said than done…

"An important work by Khovanov and Rozansky constructs a homology theory reproducing (again via its Euler characteristic) the SL(N)-specialisation of the HOMFLY polynomial. In subsequent work they produce a homology theory whose Euler characteristic gives the two variable HOMFLY polynomial." *(summary extract from an EPSRC proposal)*

This is what we can be up against!

What can we do?

"The academics write the applications, so what can we do?"

Working in a research office it is likely that you will have seen and read as many research applications as your academic colleagues – but you have the advantage of being able to review the document from a lay/general/non specialist perspective.

You actually add value for them just by reading it…

A quick fix you can do - layout

Original Layout:

Mosquitoes are important vectors of diseases to humans and domestic animals. Dengue fever is a viral infection transmitted by mosquitoes of genus *Aedes* and is considered one of the important problems to the world public health. This disease has a high incidence in tropical and subtropical countries and it is estimated that approximately 1.3 billion people are at risk to be infected by the dengue virus. Chemical control of vectors remains a main resource for the prevention and control of vector-borne diseases. Due to the development of insecticide resistance and risks to human health and the environment of synthetic compounds, the search for alternative pesticides is encouraged .Numerous plants have been demonstrated to produce pesticide compounds. The aim of the present project is to determine the insecticidal activity of mix two extract one from black seeds and other from ginger against *Aedes* mosquito in different stages .The black seeds and ginger have been studied from a chemical point of view. Nevertheless, no information about the activity of crude plants extracts which mix together on the *Aedes* mosquito in different stages. The black seeds an herbaceous plant, has been used for thousands of years for culinary and medical purposes. The seeds of *Nigella sativa* L., commonly known as black seed, have been used in traditional medicine by many Asian, Middle Eastern and Far Eastern Countries to treat headache, coughs, abdominal pain, diarrhea, asthma, rheumatism and other diseases. The seeds of this plant are the most extensively studied, both phytochemically and pharmacologically the aqueous and oil extracts of the seeds have been shown to possess antioxidant, anti-inflammatory, anticancer, analgesic and antimicrobial activities. . The rhizomes of ginger *Zingiber officinalis***,** which contains essential oils, have been used in Chinese Medicine as a powder for treating indigestion, cold, pectoral and abdominal pains, headache and toothache Botanical insecticides are prepared in the form of the crude plant material, extracts or resins. More specifically we intend to reach the following objectives from this project :(1) To study the larvicidal effects of black seeds and ginger extracts on the late 3rd instars larvae or early 4th instars as,(2) to study the ovicidal effects of herbs extracts ,(3) to investigate the chemical component of herbs extracts which cause high mortality rate in larvae &eggs ,(4) to investigate the delayed effect of extracts on adult fecundity &sterility , (5), To test the stability of products under controlled laboratory conditions .

A quick fix you can do - layout

Revised Layout:

Mosquitoes are important vectors of diseases to humans and domestic animals. Dengue fever is a viral infection transmitted by mosquitoes of genus *Aedes* and is considered one of the important problems to the world public health. This disease has a high incidence in tropical and subtropical countries and it is estimated that approximately 1.3 billion people are at risk to be infected by the dengue virus.

Chemical control of vectors remains a main resource for the prevention and control of vector-borne diseases. Due to the development of insecticide resistance and risks to human health and the environment of synthetic compounds, the search for alternative pesticides is encouraged .Numerous plants have been demonstrated to produce pesticide compounds.

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- To test the stability of products under controlled laboratory conditions .

Another quick fix – paragraph order

Original text:

Human lung Surfactant Protein-D as a potential anti-viral agent against avian and human Influenza A virus.

In 1918 the Influenza A virus caused the deaths of an estimated 70 million people worldwide and continues to infect and kill people today. In 2009 a similar flu virus hit the planet - causing worldwide panic. A molecule in our lungs, Surfactant Protein-D (SP-D) is able to recognise and bind a number of bacteria and viruses, and protect us - including the flu virus. It is, however, reduced in premature babies and in certain diseases such as cystic fibrosis. SP-D is a protein, made of long chains of links called amino acids, which help its ability to recognise these germs. Some of these amino acids in SP-D can be 'swapped' for others by a scientific technique called 'site-directed mutagenesis' and can make it even better at recognising the flu virus, and stronger at binding it - clearing it from our bodies more effectively. To understand which amino acids need swapping, pictures of the virus and SP-D are taken, but at a very high magnification, so you can actually see the individual atoms that make up the protein. From here we can decide how to make our protein even better at doing its job - and perhaps use it as a vaccine for people whose bodies cannot fight off the flu properly, like the elderly or people with certain diseases - much like the 'flu jab' that people have in winter .

Another quick fix – paragraph order

Basically the same text, re-ordered to start with the problem:

In 1918 the Influenza A virus caused the deaths of an estimated 70 million people worldwide and continues to infect and kill people today. In 2009 a similar flu virus hit the planet - causing worldwide panic.

A molecule in our lungs, Surfactant Protein-D (SP-D) is able to recognise and and attach, or “bind”, itself a number of bacteria and viruses. It is an anti-viral agent which has the potential to protect us from flu and other viruses.

Human lung Surfactant Protein-D is, however, reduced in premature babies and in certain diseases such as cystic fibrosis. SP-D is a protein, made of long chains of links called amino acids, which help its ability to recognise these germs. Some of these amino acids in SP-D can be 'swapped' for others by a scientific technique called 'site-directed mutagenesis' and can make it even better at recognising the flu virus, and stronger at binding it - clearing it from our bodies more effectively. To understand which amino acids need swapping, pictures of the virus and SP-D are taken, but at a very high magnification, so we can actually see the individual atoms that make up the protein. From here we can decide how to make our protein even better at doing its job - and perhaps use it as a vaccine for people whose bodies cannot fight off the flu properly, like the elderly or people with certain diseases.

We hope the result will lead to SP-D being used as the basis of anti-viral treatments, in a similar way to the 'flu jab' that given to people in winter.

Another quick fix – jargon busting

Examples of undefined and unexplained terms (including *Latin*) spotted in a couple of lay summaries last year:

"improve transfection efficiency"

"*in vitro*"

"modified magnetic nanoparticles"

"cationic lipid transfection agents"

"charged polymer coatings such as polyethyleneimine and polyethylene glycol"

"electroporation systems and gene guns "

"SQUIDS"

(and all these were in the first paragraph of each summary).

Another quick fix – jargon busting

Identify the point in the summary at which the reader's eyes glaze over! Or the moment they start going back and forward over the text trying to pick up the meaning.

This is the point the writer "lost" them, and it is usually due to unexplained or poorly introduced scientific terms. Sometimes it is also due to poor sentence construction.

Plain English alternatives are needed.

Selling the research..

- what is the story you are telling?
- what is the audience?
- why does it matter?
- why now?
- why you?

Impact…

- The Impact Summary may be published to demonstrate potential impacts of Research Council funded research.
- The Pathways to Impact requires a *clear description* of how the applicant intends to reach and engage with the beneficiaries of the research, including *clear* deliverables and milestones.
- Do ask a colleague within your department or an enterprise/knowledge transfer professional to comment on or help you prepare your Pathways to Impact – *RCUK Top 10 Tips*

Why? – additional benefits

- Public engagement/support
- Press/marketing and promotion
- Attracting follow on funding
- Engaging key stakeholders

Press release

EPSRC Publication Partnerships for Public Awareness Good Practice Guide states

When preparing a release there are some important things to bear in mind:

- *Avoid jargon, use plain English.*
- *The title must grab the reader's attention. Your release is one of a pile, make it stand out.*
- *Get the most interesting bits in at the front. If your title has grabbed attention, don't lose it with a dull opening,*
- *detail can come later. Remember that the media like: scoops, conflict and links with other topical or local issues.*
- *Include 'Who, What, When, Where and Why'; these form the basis of a story.*
- *Keep it short, one page of A4 is ideal, if you've got a few useful facts and figures include them, but don't overload with these.*
- *'Notes for Editors' can be included; this is where to put the extra detail.*
- *Include a good, brief quote from someone involved in the work.*
- *Include a good quality picture if possible or state what photo opportunities are available.*
- *If there's an event – give all details about where, when, etc.*
- *If you've got big names, at either the local or national level, involved in your project, don't be afraid to play on this. "TV personality, Professor X" is more likely to grab people's attention than "Professor X of 'Somewhere University'".*

Translation… magnetic nanoparticles!

Using the real example given, provide some key sentences for each of the groups below:

- Interested 14 year olds
- A Popular newspaper
- Lay Audience (adults)
- Professional Audience

Magnetic Nanoparticles

KEELE UNIVERSITY

- *"This project will use a biotechnological approach to engineer the magnetic properties of nanoparticles in order to enhance their performance as therapeutic tools for biomedicine…."*
- What does this mean? We have found a possible way to treat brain cancer and other diseases by using very small particles. W need to understand how to make them, and to understand more precisely how they work when put in the body.

Magnetic Nanoparticles

KEELE UNIVERSITY

- *"By making the particles small enough they can attain an unusual property known as superparamagnetism whereby they can become strongly magnetised in a magnetic field, but do not retain any magnetisation when the field is removed. This stops the particles clustering together and thus prevents undesired and potentially harmful side-effects when used for biomedical applications…."*
- What does this mean? We can switch the magnetism on and off by putting a magnet outside the body. This will be very useful in treating brain cancer and avoid some side effects when the particles stick together.

Magnetic Nanoparticles

KEELE UNIVERSITY

- *"these tiny nanoparticles can act as individual remote controlled shuttles that can be steered towards a target area in a patient …()… by the use of a magnetic field. This enables them to deliver drugs or genes to the target cells…."*
- What does this mean? We can attach a drug or a gene to each particle and push or pull it to where we need it using magnets outside the body. ("shuttles" could be good use of an analogy).

Magnetic Nanoparticles

KEELE UNIVERSITY

- *"The additional use of a rapidly oscillating magnetic field can cause a kind of internal magnetic friction around the nanoparticles leading to the generation of heat. This heating effect, known as magnetic hyperthermia, is particularly important as it is possible to induce death in cancerous cells ...."*
- What does this mean? By switching the magnetism on and off very fast, the particles heat up a few degrees, enough to kill brain cancer cells.

Magnetic Nanoparticles

KEELE UNIVERSITY

- *"The ideal choice for biomedical applications is iron oxide nanoparticles and the control of their magnetic properties requires the substitution of iron atoms at very specific sites in the crystal structure, with other metal atoms such as cobalt, manganese and zinc. This is not easy to accomplish ...."*
- What does this mean? To make particles that behave the way we need them to, we will find the best way to combine the metals within them.

Magnetic Nanoparticles

KEELE UNIVERSITY

- *"… a natural process for inducing nanoparticle growth using metal-reducing bacteria will be exploited. This biosynthesis method has the benefits of being low-cost and environmentally-friendly as it does not produce unwanted toxic chemical waste."*
- What does this mean? We have found a natural way to get enough iron in the right place in the particles, by passing them through bateria first. We call it "biosynthesis": it's cheap and it's 'green'.

An example : lay summary

Hydrogen is the most abundant element in the universe, **a very clean energy source and the most efficient fuel for fuel cells (FC)** and can be produced from a variety of resources / coal, natural gas, biomass and water. At the moment, about 95% of the hydrogen comes from reforming natural gas; the remainder from water electrolysis, using electricity generated mainly by burning fossil fuels. **Development of a clean and sustainable energy future based on a hydrogen economy could solve pollution problems and secure needs for abundant and affordable energy.** However, hydrogen storage remains a major challenge for hydrogen economy. Hydrogen may be indirectly stored in light chemicals such as ammonia, methane, methanol etc. Hydrogen from reforming of natural gas may be further used to produce ammonia fertiliser. Cheap ammonia fertilizers are potential energy vectors as well. Adblue, a urea solution developed by Europe's AdBlue urea-SCR project is available across Europe. AdBlue is the major target fuel for the proposed ammonia **fuel cells to power electric vehicles in the future**. Already there are more than 200 locations in the UK holding stocks of GreenChem AdBlue. The current price for AdBlue is **45p** per liter. The price may further drop on mass-production. The current price of fertiliser urea is 185/ton in UK although purer urea is required for fuel cell. This application is to study the feasibility to use ammonia fertilisers particular urea as an alternative energy vector. Whilst mature technologies to convert urea to ammonia exist, there is no technology available to use urea, such as AdBlue, to power electric vehicles. The major target is to demonstrate intermediate temperature fuel cells directly fuelled with ammonia (or indirectly from urea) to power electric vehicles for transport application in the future. CO2 for production of ammonia fertilisers may be collected and stored through CO2 sequestration technologies. Therefore urea fuel cell is an important complementary technology for carbon abatement. The as-developed fuel cells may potentially be fuelled with hydrogen and methanol as well. It is also a biofuel related technology if biofuel is used for the as-developed fuel cells.

which led to a Follow on Fund

This project aims to demonstrate a prototype fuel cell technology using low cost catalysts, an alkaline conducting polymer membrane and a non-toxic easily distibuted renewable fuel source. **Fuel cells are a high growth multi billion pound market and find application within vehicles, mobile and stationary power generation and off-grid applications**. **Fuel cells operate by reacting a fuel such as hydrogen, ammonia gas or an alcohol such as methanol with an oxidant material (usually atmospheric oxygen from the air) to give water, carbon dioxide, nitrogen and electrical power.** The drawbacks of such fuels are that hydrogen gas requires storage at low temperatures or high pressures making it difficult to distribute in bulk; ammonia and methanol are toxic to humans and animals. Urea offers a potential alternative fuel source; it is a **low cost, mass manufactured, easily transported, non-toxic** solid used as cheap fertiliser, is a major component of human and animal urine and is already sold as a pollution reducing additive for diesel vehicles, providing a readily accessible distribution network. Fuel cells typically comprise several components; a fuelling system, catalyst layers and a conductive membrane material sandwiched together forming a membrane electrode assembly or MEA. Multiple MEA are then assembled together forming a fuel cell stack that can be integrated into a vehicle etc. Within this project the funding will be used to optimise a fuel cell system described in our GB patent application (filed May 2009) focusing on developing novel economic catalyst materials and polymeric electrolyte membranes suited to non-toxic fuel for application in MEAs operating below 100oC. Existing polymer electrolyte membranes (PEM) such as the fluoro-polymer Nafion are proton conductors and are optimised to use hydrogen gas or methanol as the fuel source. It was shown in previous research that acidic proton exchange polymers do not work with basic fuels as they are chemically incompatible. Within conventional PEMFCs the catalyst materials are often of precious metals, such as platinum or rhodium more common in jewellery than power systems. These materials can be very expensive (>30000/ kg) and although used in small amounts in fuel cells they are a major contributor to overall cost, creating a barrier to mass uptake. Platinum catalysts can also be poisoned (de-activated) by fuel contaminants such as carbon monoxide causing cell failure and although alternate, non-platinum metal catalysts are in development they are some time from commercial application. In addition to developing a prototype fuel cell that overcomes the above problems our initial evaluation of our market competitors and IP position indicates opportunities to develop the technology in a number of unique market sectors within renewable energy, mobile & stationary power and water treatment both within the UK and overseas. During the funding period a comprehensive freedom to operate study will be undertaken and business plan for technology commercialisation developed identifying areas of commercial exploitation enabling the work to be carried forward into a commercial activity on completion. The follow on funding will allow the retention and development of key research personnel with specialised skills in electrochemistry who will gain additional experience of commercially driven product development.

and then the press release:

extracts from HWU press release

Fuel cells are electrochemical devices which convert chemical energy into electricity with heat generated as a by-product, via an electrochemical process that does not require combustion. Traditional fuel cells usually involve hydrogen or methanol at one side and oxygen or air at the other, separated by a specialised ionic-conducting membrane.

The Carbamide Power System involves far cheaper membrane and catalysts, and can be run on Urea (also known as Carbamide), a mass manufactured industrial fertilizer and a major component of human and animal urine. Carbamide Power Systems would thus offer a non-toxic, low cost, easily transportable viable alternative to high pressure, highly flammable hydrogen gas or the toxic methanol currently used in fuel cells. As Urea solution is increasingly being used in heavy goods vehicles to reduce nitrous oxide emissions, a global fuelling infrastructure already exists.

Another example lay summary:

- Carbon dioxide (CO2) is considered to be a greenhouse gas. The concentration of CO2 in the earth atmosphere is an important control on earth surface temperature, and hence climate. CO2 dissolution in the oceans is also being recognised as an important factor in making surface seawater unusually acid / this severely affects ecosystems and species from algae to fish and whales. Increased CO2 in the atmosphere is recognised as being partly caused by burning of fossil fuels, such as coal and gas, in power stations. Carbon Capture and **Storage is a suite of technologies which enables CO2 to be captured at power stations, liquefied by increasing the pressure, transported by a pipe, and injected deep underground in to pore space of deeply buried sedimentary rocks such as sandstones.** This can effectively remove CO2 from the power cycle of fossil fuel use, and store the CO2 for tens of thousands of years, which enables the earth atmosphere to return to normal. Because of the very large CO2 volumes involved, it is not possible to build surface stores. Because of the acid effects of CO2, it is not possible to inject CO2 into seawater. By contrast, the Intergovernmental Panel on Climate Change (IPCC) have calculated that more than 25% of world CO2 emissions could be stored by geological CCS. This could be a vital technology for the world's future. There is a great deal of interest worldwide in CCS and, because of the offshore oil industry, **the North Sea is one of the world's prime areas for CCS to be rapidly developed.** However, there are only three full-scale projects at present in the world. For UK power generating companies to become commercially interested the chain of technologies must be both demonstrated to work reliably, and must be capable of cost-effective development. This project is trying to identify aquifer sites deep underground which are close to power plant in the U.K., where CO2 can be safely stored, but sites are quicker and cheaper to develop than offshore in the North Sea. **This can enable power generating companies to develop CCS over a period of years, on a medium scale, and learn to conduct the industrial operation. If this project is successful, it could lead to take up of CCS in the U.K. 10 or 15 years earlier** than waiting for an infrastructure of large North Sea pipelines to be developed for CO2. When those pipes become available, UK power companies will be completely ready to connect power plant to store CO2 in large redundant hydrocarbon fields offshore. **This could save many tens of million tons CO2 per year being emitted into the atmosphere from the U.K., and place the U.K. in the forefront of carbon reduction nations.** The universities and companies involved in this 2.3M consortium are all experienced in investigating the deep subsurface for oil and gas production. Edinburgh, Heriot-Watt and BGS already have 1.6M from the Scottish Executive to establish the UK's largest research grouping to investigate CO2 storage. This expertise will be transferred to exploring for CO2 disposal sites. Using the information held by the British Geological Survey, maps will be made of the subsurface deep beneath England, and deep beneath the Forth estuary. Heriot-Watt university will assess the potential chemical reactions of CO2 with rock, and how much CO2 can be injected. Electricity generators, led by Scottish Power, will make engineering designs for modified power stations to supply CO2. Schlumberger and Marathon Oil, will assess the subsurface technology required for safe and reliable injection and monitoring. The University of Edinburgh will make computer simulations to determine if CO2 will leak deep below ground, and will assess how specific site is storage sites will perform to safely retain CO2. Amec will evaluate transport of CO2 by pipe. Tyndall will investigate the public attitudes at the candidate storage sites.

Press release: extracts from HWU press release

- **Scotland can realise the employment, economic and environmental benefits of carbon storage. A consortium of Scottish Government, industry and researchers has shown that rocks deep beneath the Moray Firth are capable of storing decades of CO_2 output from Scotland's power stations. This emerging Carbon Capture and Storage {CCS} industry could create at least 13,000 new Scottish jobs by 2020.**
- These are key findings of the report, 'Progressing Scotland's CO_2 storage opportunities', which was unveiled today {Monday 14 March} at a media launch hosted by Scottish Carbon Capture and Storage {SCCS} and the Scottish Energy Minister Jim Mather MSP.
- Detailed research calculates that rock, known as the Captain Sandstone, buried more than half a mile beneath the Moray Firth could store at least 15 years, and potentially a century's worth of CO_2 output from Scotland's power industry.
- Professor Eric Mackay from SCCS said "This is an exciting and landmark moment in the development of carbon capture and storage. The Captain Sandstone is just one of many rock formations filled with salt water in the central and northern North Sea. We have shown that this is a feasible site that could store massive amounts of CO_2, helping the UK meet its targets for carbon emissions reduction. The future potential for this and other areas of the North Sea is immense."
- The SCCS research, funded by Scottish Government and a group of businesses within the energy sector, also showed that carbon capture and storage could create 13,000 jobs in Scotland by 2020, and another 14,000 elsewhere in the UK, spread across a wide range of skills. This would increase in subsequent years. Properly developed, the UK's share of worldwide carbon capture and storage business could be worth more than £10 billion a year by around 2025.

Press release: extracts from HWU press release

- Professor Mackay continued, "Our research indicates CO_2 output captured from a fossil fuel-fired power station, like the existing plant at Longannet or Peterhead or any future capture projects such as at Hunterston, could be stored beneath the North Sea. The unique combination of government, industry and research capability provides Scotland with the opportunity to lead the way in the development of CCS. We look forward to further assessment of this and other parts of the North Sea to maximise the economic benefits."
- Scottish Energy Minister Jim Mather said: "This latest research further strengthens Scotland's position as the number one location for CCS technology development and deployment in the world. In depleted oil and gas fields and in its natural geology, the North Sea has an amazing carbon storage potential - the largest offshore storage capacity in Europe - offering up the prospect of thousands of new low carbon jobs being created in Scotland as CCS technology develops. Today's report is welcome and underlines the need to move swiftly to seize the environmental benefits and economic opportunities from CCS."
- Scotland's potentially massive offshore CO_2 storage capacity is of European significance. The European Union has specified that three of the eight CCS demonstrator plants that it will fund under its multi-billion euro demonstrator programme must inject into saline aquifers. The results from this study place Scotland in a strong position to secure future EU support for more detailed assessment of CO_2 storage in saline aquifers.
- The study was funded by the Scottish Government and commercial organisations with operational interests in Scotland, including: Ayrshire Power Ltd (a Peel Energy company); Doosan Babcock; National Grid; RWE npower; Schlumberger; Scottish and Southern Energy; ScottishPower; Senergy; Scottish Enterprise; Shell U.K Limited; The Crown Estate; and Wood Mackenzie.

Discussion, comments, questions?

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