

Going low carbon through innovation and collaboration

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AIE Lunch Seminar, Perth, 18th April 2013

Overview

- A bit about me
- Introducing UCL Australia and the IEPI
- Energy policy meets climate policy
- Innovation, innovation, innovation
- Social factors in innovation
- Collaborative and Open innovation
- Current projects

About me...

- Professor of Chemical Engineering, University College London (Fellow of the IChemE)
- Founding Director, UCL Centre for CO2 Technology, developing low carbon innovations in energy and manufacturing processes (<http://www.ucl.ac.uk/centre-for-co2-technology/>)
- Director, Carbon8 Systems Ltd., multi-award winning company treating wastes with carbon dioxide (www.c8s.co.uk)
- RAEng Global Research Award recipient “Accelerating the Transition to a Low Carbon Future: Open Innovation and Disruptive Technologies”; Berkeley/Melbourne
- Founding Dean, School of Engineering at Nazarbayev University, Astana, on secondment from UCL (2009-12)
- As of 1st September 2012, inaugural director of the IEPI

Particle Technology

- Minerals processing
 - Flotation, flocculation, sedimentation, granulation
- Colloid and surface engineering
 - Micro-manipulation of colloid particles
- Process tomography
 - Cosmic-ray muon tomography

Centre for CO2 Technology

- Low carbon chemical processes
 - Low energy synthesis in molten salts
 - Electrochemical refining
- Carbonation of wastes and cements
- Energy storage and Fuel cells
- Energy from waste and biomass
- Clean coal technologies
- CO2 transportation
- Nuclear waste reprocessing and disposal

Carbonation of Wastes



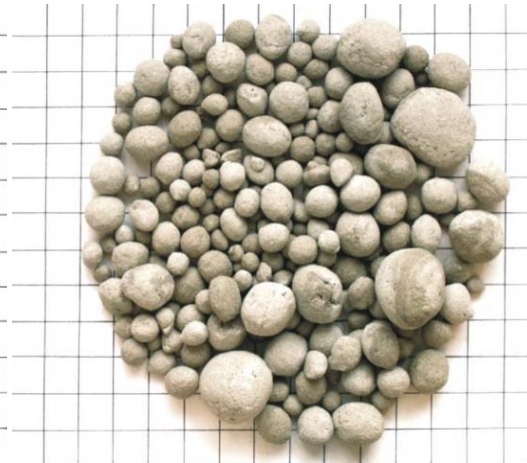
Carbon8 Systems Ltd: www.c8s.co.uk

Formation of Aggregates

Paper ash



Coal fly ash



Rock crushing fines



Kiln dust



Silt pond residues



About UCL Australia

UCL's first international campus

- Located in the International University Precinct in Adelaide
- Home to the School of Energy & Resources (SERAus) – opened in 2010
- Home to the International Energy Policy Institute (IEPI)
- Home to the Mullard Space Science Laboratory office in Australia (MSSL (Australia))



The IEPI

- An academic unit of UCL Australia, Adelaide
 - Founded on a donation from BHP Billiton Sustainable Communities
 - Began operation 1st September 2012
 - Core themes:
 - Adding value to energy resources
 - Fossil, nuclear and RE futures
 - Community engagement
 - Climate strategies
- Open innovation
towards the transition
to sustainable energy
futures

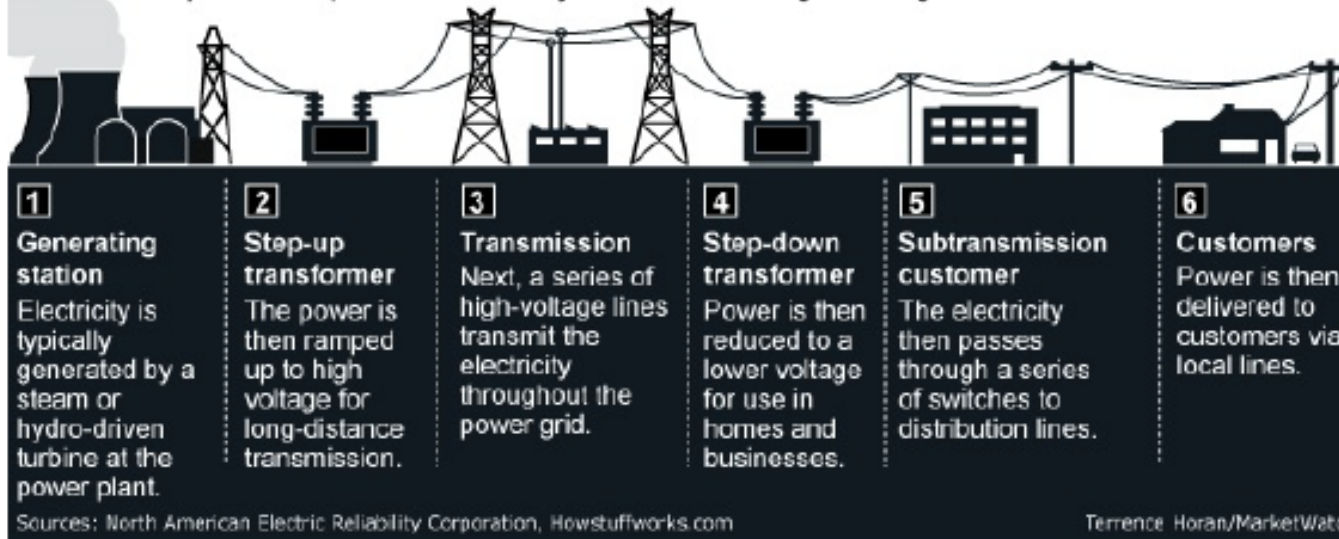
Where energy policy meets climate policy

- The priorities of energy policy are:
 - Security of supply (access to energy resources)
 - Access for all, at an affordable price
 - Environmental protectionall within the context of liberalised markets and economic growth.
- Geopolitics and increasing energy demand mean that energy security is often the main priority.
- But avoiding dangerous climate change is the defining challenge facing humanity today.
- So now we have a conundrum – meeting our energy demands in a carbon-constrained environment.

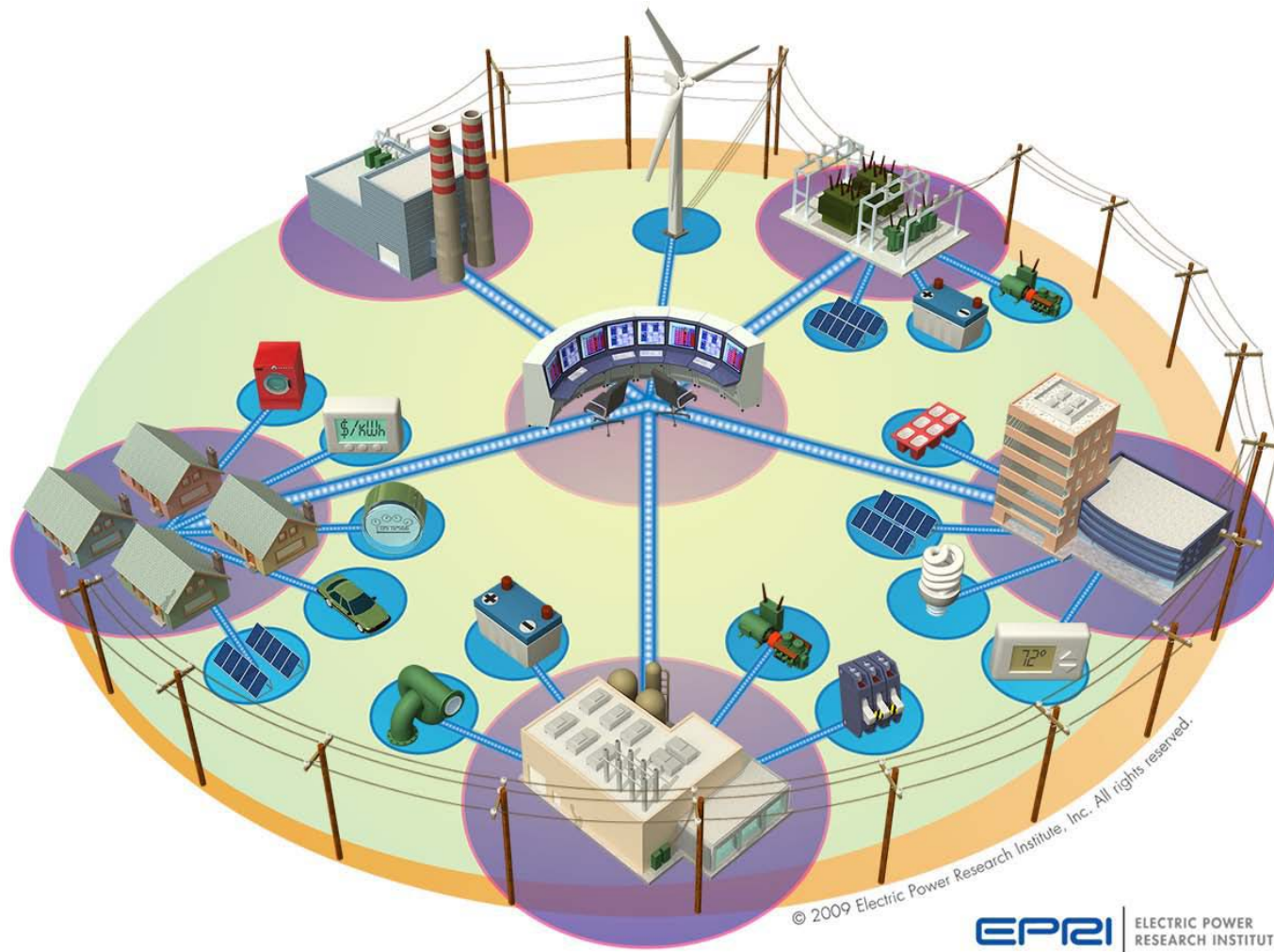
Transforming the energy system

The power grid

Below is a simplified example of how electricity is distributed throughout the grid.



From this..



..to this!

Main influences on CO₂ emissions

$$\text{CO}_2 = \frac{\text{Emissions}}{\text{Energy}} \cdot \frac{\text{Energy}}{\text{GDP}} \cdot \frac{\text{GDP}}{\text{Popln.}} \cdot \text{Population}$$

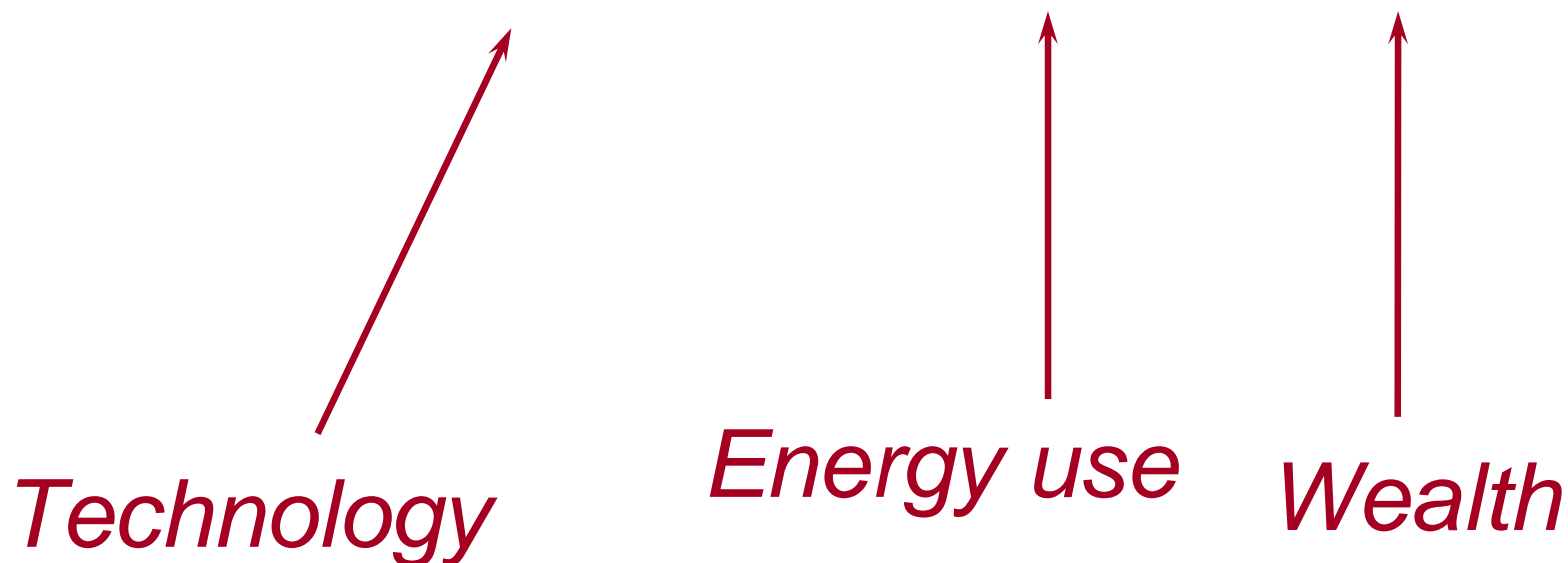
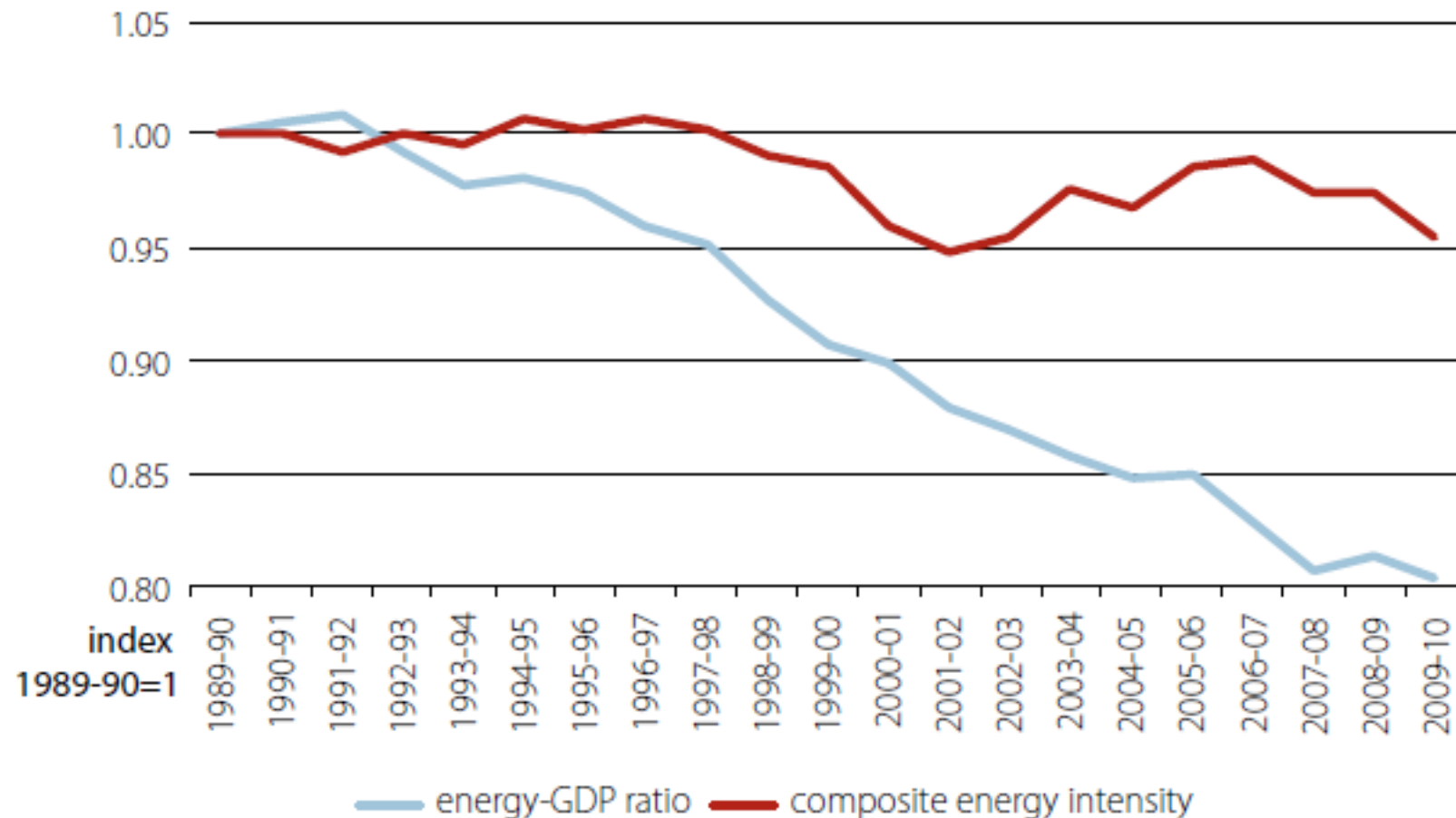
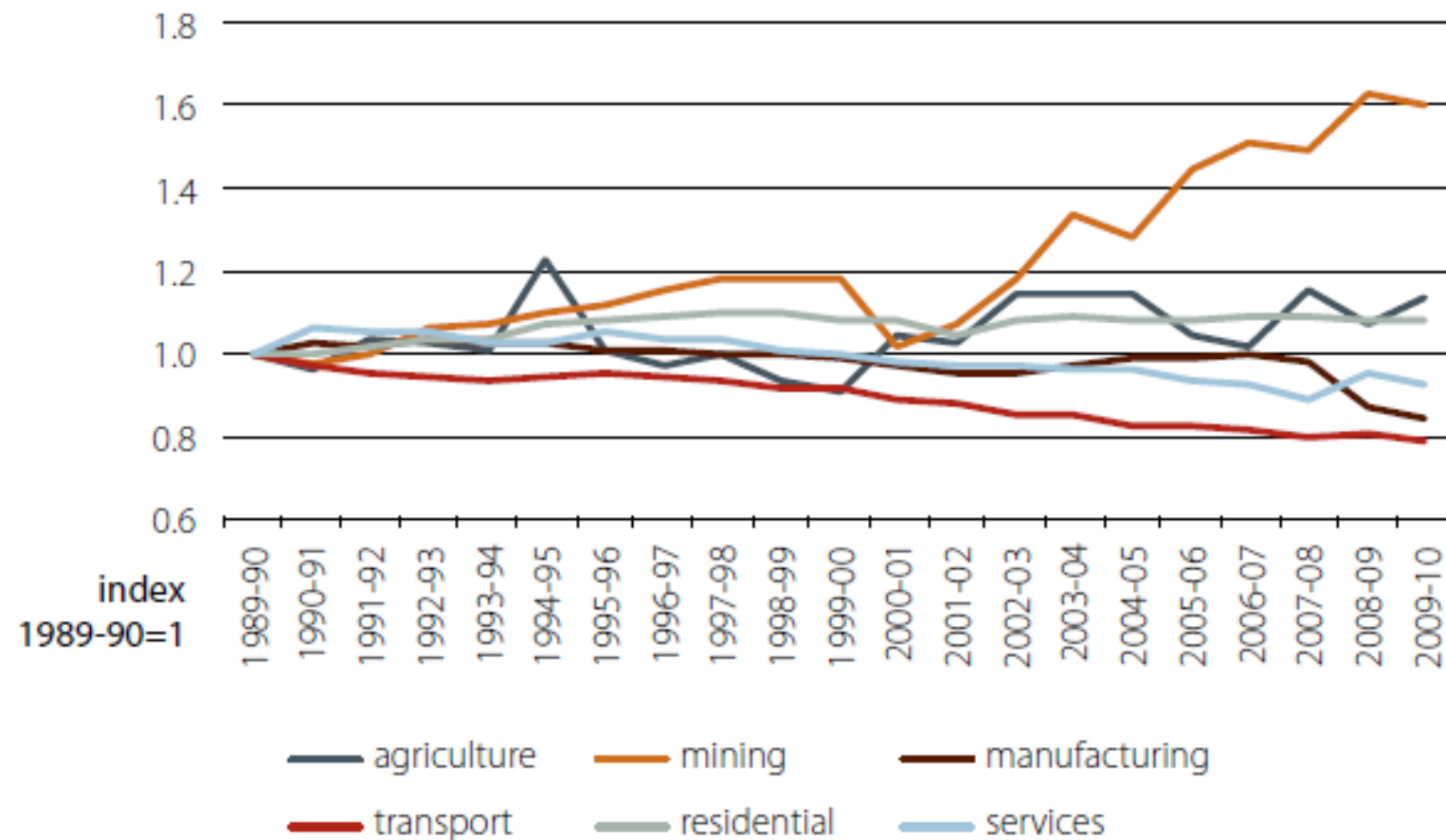


Figure 4: Trends in energy-GDP ratio and the composite energy intensity indicator in Australia



The physical energy intensity declines more slowly than the economic energy intensity.

Figure 5: Trends in composite energy intensity indicators in the Australian economy



Note: These trends in energy intensity do not imply any weighting of energy consumption by sector.

Source: Economic Analysis of End-Use Energy Intensity in Australia, BREE (2012).

Innovation, innovation, innovation!

“Without innovation, a positive energy future is unimaginable.”

ETH Zurich

- Policy focus: Transforming knowledge into economic value and commercial success.
- But it is low carbon innovation that is the priority.
- And it's not just about technology, but also about the *way* we do things.
- Hence, it depends on social and cultural factors, as much as technical and political.

Therefore, it involves everyone!

Two notions of community involvement

“Technology cannot be separated from its social context or from social values. Engaging with social values and concerns and embedding the complexity of governance within policy is crucial to successful governance and thus the successful implementation of climate change technologies”.

Governance of Climate Change Technologies Group, UCL, 2011

“No matter who you are, most of the smartest people work for someone else”.
Bill Joy, Sun Microsystems

There are good reasons for involving communities

- Encourage behavioural change
- Build trust and political legitimacy
- Dispel ignorance and misunderstandings
- Raise scientific literacy and support for scientific and technological innovations
- A resource of good ideas
- Collaborating can be more profitable than not
- The right to have a say on issues that affect them!

Moving away from the Pipeline Model of Innovation for Clean Technologies

- Most policies implicitly characterise innovation as a pipeline, where new technologies are developed, demonstrated and deployed
 - This is a flawed approach to innovation, as it does not consider the place of new technologies in society and the economy, or what needs to be done to allow new technologies to flourish
 - Social factors play a key role – feedback loops are important and previous choices have to be considered, which may influence basic research
- The same could be said about how we produce, distribute and use energy



Social feedback loops to innovation are essential

The Dafur Stove



- 700 million wood burning stoves in use today
- Benefits of higher efficiency stoves include reduced risks to women during fuel collection
- But the taste of the food is important, too!

Empowering communities to take-up low carbon behaviours



Involving native American communities in the design of housing incorporating clean technologies, at the same time satisfying cultural and traditional values.



Ryan Shelby, UCB, 2009

The Rebuilding of Christchurch: involving the community



The Central City plan, unveiled December 2011, was unanimously backed by Christchurch councillors, who sifted through more than 100,000 suggestions submitted by residents and interest groups.

Highlights include: “Build it back green” and the “Greenstar programme”.

Collaborative Innovation: The Manhattan Project



A meeting regarding the 184-inch **cyclotron** project, held at the **University of California, Berkeley**, on March 29, 1940.

The Manhattan Project –

- Secretive and closed, for obvious reasons
- Used selected people and places (at its height, involved 130,000 people at 300 sites)
- Cost \$24billion in today's money
- Led to the ultimate disruptive technology

Solving the climate change issue is not a Manhattan (or even Apollo) Project. The array of technologies we need to develop and the choices to be made between them are too diverse and influenced by too many factors.

Collaboration needs to be more open, with greater sharing of ideas and intellectual property, integrated with policy and regulation.

Disruptive Technologies



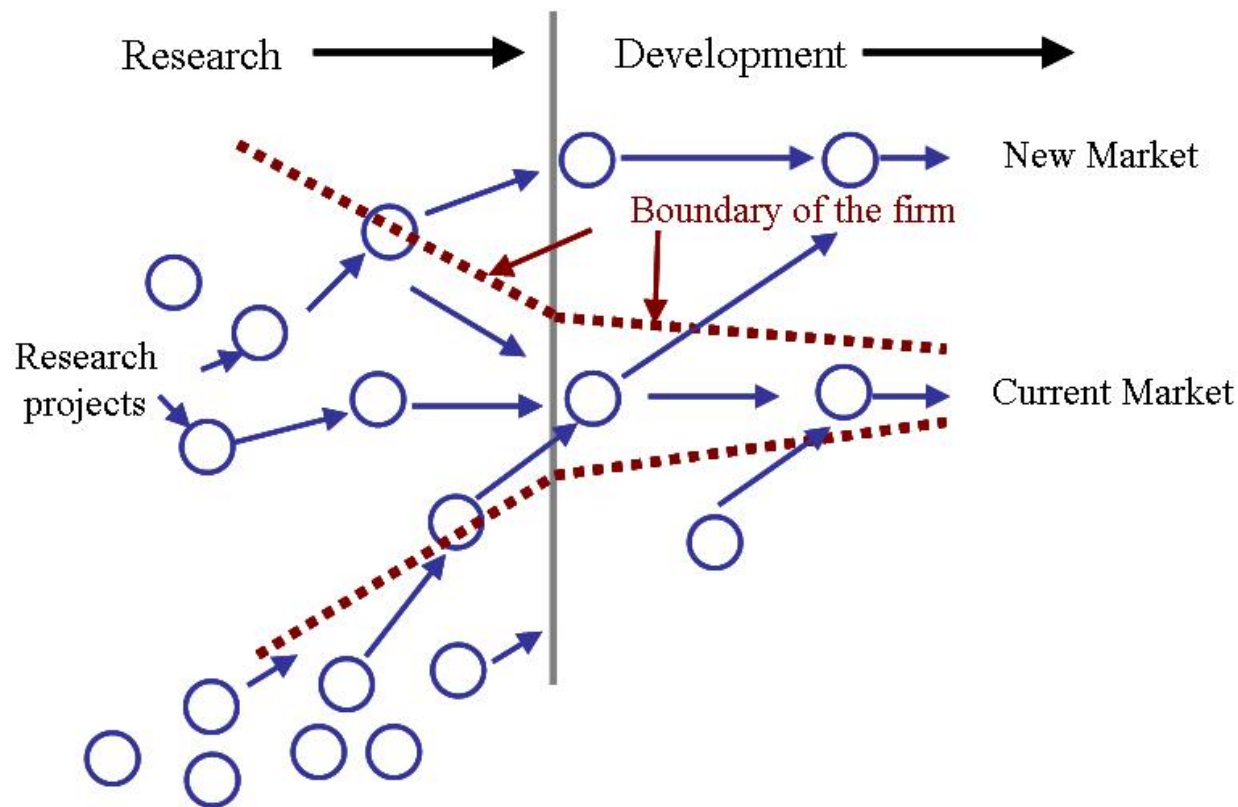
- Significantly change the way we do things
- Need not be low carbon in their own right, but lead to low carbon behaviour
- Can lead to the demise of incumbent technologies....

How can we achieve the 3rd Industrial Revolution?

- Innovation – of disruptive technologies.
- Collaboration – on a massive scale, across all stakeholders.
- A systems approach to the energy, minerals, transportation, chemicals and agriculture sectors.
- New business models, to create and claim value of shared IP.
- Engage and empower communities to encourage low carbon behaviours, take-up of clean technologies and sustainable use of resources.
- Utilise the power of the internet and information technologies.

= Open Innovation

Open Innovation – Getting Value via Community Engagement



Hence, ideas generation and product development can be external to the traditional company boundaries. This requires new business models to handle the new ecosystem of “community” engagement.

Creative use of IP: Arcadia Biosciences

- Develops agricultural products to capitalise on opportunities that benefit the environment and enhance human health, e.g. nitrogen and water use-efficient crops.
- In 2009, set up public-private partnerships, with USAID, for technology transfer to India and donation of IP to African Agricultural Technology Foundation (for African rice).
- Also gave IP for free to China, in return for a slice of the value of expected carbon credits, if Govt. brings in such regulation (50% reduction in nitrogen use could lead to a potential \$30-40 billion/yr in carbon credits)
- Why did they do this?
 - Enables technology transfer
 - Provides links to potential new markets
 - Accelerates commercial development
 - Broadens collaborative networks
 - Engages broader range of stakeholders
 - Explores new business models

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Thu, Mar 28, 2013, 0:56AM EDT - U



U.N. Clean Development Mechanism Approves Arcadia Biosciences Methodology, Links Carbon Credits to Crop Genetic Improvements for First Time

-- Nitrogen Use Efficient Seeds Reduces Nitrous Oxide Emissions by Requiring Less Fertilizer Application --



Press Release: Arcadia Biosciences, Inc. -- Wed, Dec 19, 2012 8:01 AM EST



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Open Innovation: borderless enterprise

**“No matter who you are, most of the smartest people work for someone else”.
Bill Joy, Sun Microsystems**



The internet will allow us all to participate in the next industrial revolution, accelerating the transition to a low carbon future.

Getting people involved in Clean Tech. Development (and Deployment)

The screenshot shows a Windows Internet Explorer browser window displaying the Project 10 to the 100 website. The address bar shows the URL <http://www.project10tothe100.com/>. The browser's menu bar includes File, Edit, View, Favorites, Tools, and Help. The toolbar contains various icons for search, bookmarks, and other functions. The website content features the Google logo and the Project 10¹⁰⁰ logo. The main heading reads "May Those Who Help The Most Win." To the left of this heading are links for "Project 10¹⁰⁰", "Ideas", "Why this project?", "How it works", "Categories", and "FAQ". To the right, there is a paragraph explaining the project: "Project 10¹⁰⁰ is a call for ideas to change the world by helping as many people as possible. You submitted more than 150,000 ideas. We chose a handful of finalists and you voted on your favorites. We'll announce the winning big ideas in the near future." Below this text is a video player with a green background and the text "1000000000" and "Project 10¹⁰⁰". The video player has a play button and a progress bar showing 0:00 / 1:09. At the bottom of the browser window, the status bar shows "Done" and the taskbar includes icons for "start", "GVL meeting.ppt", "low carbon apathy.ppt", "stef", "Iomega HDD (E:)", and "Project 10 to the 100...". The system clock in the bottom right corner shows 12:23 PM.

Project 10 to the 100 - Windows Internet Explorer

<http://www.project10tothe100.com/>

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Project 10 to the 100

Google Project 10¹⁰⁰

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English (US)

Project 10¹⁰⁰ is a call for ideas to change the world by helping as many people as possible.

You submitted more than 150,000 ideas. We chose a handful of finalists and you voted on your favorites.

We'll announce the winning big ideas in the near future.

Project 10¹⁰⁰
★★★★★

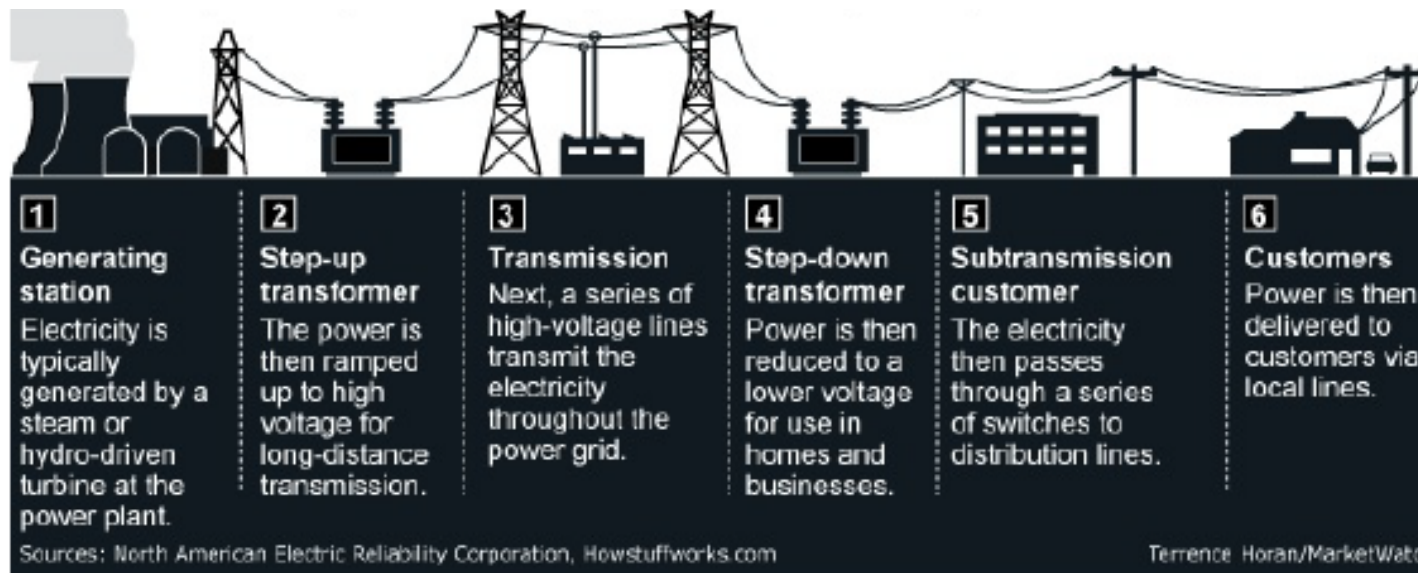
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YouTube

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Transforming electricity distribution – a clear need for open innovation



The Smart Grid, where community involvement is essential

An emerging eco-system (worth \$20 billion today, \$100 billion in 2030), with emergent interface standards and technologies, product markets, involving incumbents and public authorities as system integrators and customers as interactive users



Integrating sensors, meters and routers into a communication network akin to the Internet

Integrating a diversity of sustainable sources (wind and wave power, solar panels, biogas, etc.)

Making dynamic pricing possible (to create incentives to save in peak hours)

http://www.thaindian.com/newsportal/tech-news/open-source-software-boosts-indian-itschools-program_100222131.html

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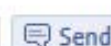
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Open Source Software saves Indian IT@schools program \$2 million

Friday, 24 July 2009 12:16:51 AM by John Le Fevre



Government authorities in the Indian State of Kerala will save more \$US2.27 million by using **Free and Open Source Software (FOSS)** on computers to be installed in schools throughout the state as part of an \$US11.7 million (Rs.57 Crore) expansion to its **IT@School project**.

An additional 11,065 laptop and desktop computers, along with a range of other technological teaching aids are to be installed under the program, expanding the current 1,016 schools involved to 3,055.

K Anvar Sadath, the project's executive director, said if proprietary software were used at least \$US2.27 million (Rs.11 Crore) more would have been needed to fund the project.

The **IT@School project** provides information communications and technology education to 1.6 million students per year in the state, and is the nodal agency for the EDUSAT network which runs the **Virtual Classroom Technology on Edusat for Rural Schools (ViCTERS)** education channel.

Pricing alone though was not the only reason FOSS was chosen.

Kerala State Minister of Education, M A Baby, said, the advantage of using FOSS is more than financial.

"There are a number of pragmatic considerations, such as the ability to share knowledge, which makes this a decision that other states can follow," he said.

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Being open can have profound effects....

- Kerala has moved from being one of the poorest provinces in India to one of the most affluent.
- Kerala has the highest rate of literacy, with the program having a profound effect on the status of women.
- The Total Fertility Rate (TFR) in Kerala has fallen since the early 1900s to the present-day, from 6 children per female to around the present day figure of 1.7, where it remains stable.

Perhaps we can start to deal with the elephant in the room – population!



Traditional forms of involvement have focussed on already formulated plans.

Collaborative processes, where the needs of all parties are met, nurture more benefits and enduring relationships.

Innovation can be used to address community concerns and manage resources sustainably.

Current projects at the IEPI

- Adding value to Australia's uranium resource
- The impact of climate policies on Australia's Steel Manufacturing Sector
- Energy epidemiology – demand response management
- Engaging regional communities in climate action plans and sustainable energy futures
- The prospects for a shale gas revolution in Australia
- Alternative uses for coal – do they make sense?

All treated as systems with “community” involvement

Alternative energy is the next

www.ucl.ac.uk/energy/en/



THE BANCROFT LIBRARY, UC-BERKELEY



FOSSICKERS IN THE CREEK, NERRENA.

Thank-you for listening.