

# The Future Cities Project

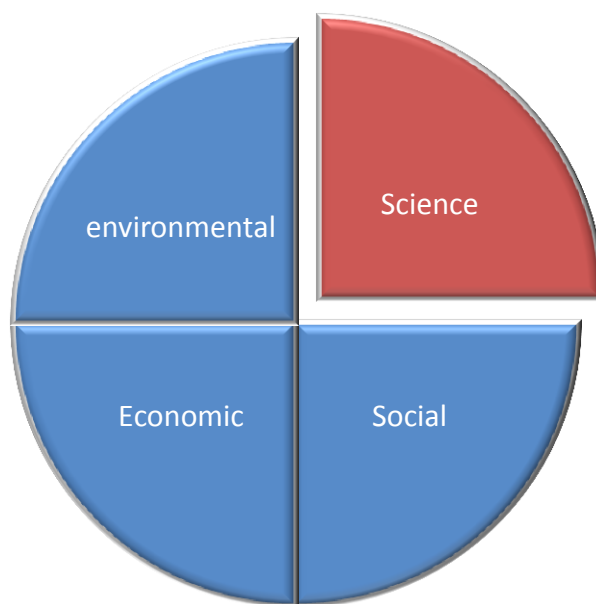
A Problem-based Case Study in Sustainable Development

## Tutor Guide

By

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# The Future Cities project

## Aims of the Case Study

This problem-based case study sets chemistry within the 'real' context of a sustainable development project.

The activity is designed so that all students are not working on exactly the same project with exactly the same data. Dynamic elements are introduced at three stages. Firstly, students have a choice of four projects. Alternatively, the tutor may like to choose one project to assign to the whole class. Students must use data provided and their own research to produce a detailed project plan, a design if appropriate and a budget. Secondly, at the outset student can select a team of 'experts'. Each expert brings with it specialised information in the form of a URL of a research paper or report. Thirdly, events cards are used half way through the project to change the conditions of restrictions under which the project is working.

## Who is the case study aimed at?

The case study has been used with students at level 4 i.e. first year students in the English HE system. Problem-based learning is inherently flexible and the resource could work equally well with higher level students.

## How long does the case study last?

The minimum contact time required is 4-5 hours and will require the students to spend approximately 40 hours in associated independent study and group work. The activity is worth approximately 5 credits.

## How can the activities be assessed?

Students can be assessed in various ways including group or individual final report, design summary, town/site plan, oral presentations, and individual contribution to the group effort.

## What are the learning outcomes?

Students must apply appropriate knowledge to tackle an extended and open-ended problem. The nature of the activities involved ensure that, in order to complete the case study, students must develop a variety of transferable skills).

Communication skills	Oral presentations and report writing.
Improving learning and performance	Using feedback to reflect upon group and individual performance. Drawing on the experience within the group.
Information technology	Word processing reports and preparing material for presentations.
Planning and organisation	Managing a project, individual judgement, decision making and time management.
Working with others	Brainstorming, discussion, division of tasks and feeding back to the group.

## Suggested schedule

### Session 1

Organise students into groups of 4-5. Introduce activity and concepts of sustainable development. Let each group select a project. Give out set of handouts for that project. Give out *Scientist Cards*.

Students complete request form. Either give out version of cards with URL or email to students later.

### Session 2

Students meet with tutor to report on progress.

**Session 3**

Students meet with tutor to report on progress. Give each group 4-6 *Events Cards*. Try to choose ones most relevant or most impact on specific project.

**Week 4**

Students meet with tutor to report on progress.

**Week 5**

Students hand in final report. Students give 5-10 minute presentation of a summary of their design, recommendations etc. Students assess each individual's contribution to the group effort.

Appendix 1 Scientists cards for students' requests

<p><b>Energy Consultant: Energy Dynamic Solutions</b></p> <p>Is a world leader in the production and manufacture of energy generation since 1942 and has grown to develop and sustainable development program.</p> <p>They are currently the only company that can provide power plant to grid solutions catering for all potential network development requirements, from large counties to individual projects.</p>	<p><b>Commodities Broker: Chris Botanic</b></p> <p>Provides an analysis about the behaviour of the market and can develop an understanding of a project and the its financial development based on the portfolio of information. Has written a paper discussing the energy security of the modern world.</p> <p>His main area of expertise is the diverse markets relating to raw materials such as precious metals and food sources.</p>
<p><b>Political Advisor: Monsieur Foyer</b></p> <p>Has been secretary of state for energy and climate change and responsible for creating some environmental reforms both as a minister and an opposition minister.</p> <p>He also attended the 2009 Copenhagen Summit which pledged \$10 billion a year to combat climate change and the development of a sustainable society.</p>	<p><b>Meteorologist: Professor Alan Cloud</b></p> <p>Has been a lecturer at the Midsummer University and chief executive of the National Environment Research Council. He was co-founder of the World meteorological organisation Cloud</p> <p>His research is predominantly in the field of basic dynamics of weather behaviour and the predictability of which certain characteristic features are form in the climate.</p>

<p><b>Insect and Ecology Expert and Explorer: Dr R Rachnid.</b></p> <p>Has worked at many institutions across the UK including, University of Oxford, University of Derby and Edinburgh University. Understands the complexities of ecosystems and their use to manage sustainability. Has been head of exploratory projects, especially in South East Asia in Papa New Guinea and Thailand where his team has discovered many new species, including new mammalian creatures.</p>	<p><b>Agricultural Solutions and Procurement: Kapow</b></p> <p>One of the worlds leading agrochemical and GM companies, based in Switzerland it has sought to develop a high yielding oil product for the use in Biofuels through both selective breeding and GM. Founded the Kapow foundation aimed at developing rural communities into sustainable developments.</p>
<p><b>Agricultural engineer and Fuel Pioneer: Professor Corn</b></p> <p>Chief researcher into Biodiesel at the College of Agriculture and Life Sciences at Midsummer University which is recognised as at the forefront of developing sustainable technologies for both industrial and personal applications. He focuses on the production and uses of biodiesel from both new and used oil sources including the production of a large biodiesel pilot plant at the University.</p>	<p><b>Logistic and global support: Sergeant Jones and 1 Logistics Support Regiment.</b></p> <p>Sergeant Jones is the a member of the royal logistic corp. of the British Army, founded in 1812 when the 1<sup>st</sup> Battlion required support from the Royal Wagon Train. Since then they have developed efficient methods of delivering equipment for war zones and peaceful operations. They are use to transporting anything from large tanks to an individual letter all around the world. Their current expertise is the development of maritime trade routes that can subvert the rise in Piracy in the Indian Ocean To quote a popular saying. "You Call, We Haul"</p>

<p><b>Bio-Civil Engineer Dr. G Erms</b></p> <p>Is accredited as being an expert in the field biomimicry. Using solutions that nature has created to problems through the adaptation of construction and chemical properties. He uses these solutions to develop problems within the Civil engineering business. His focus currently is the introduction of biomimicry into the design of ventilation systems of buildings and increasing the efficiency in tidal/wind turbines</p>	<p><b>Waste Disposal: Envirotreat</b></p> <p>Designs Reed beds for the processing of biological waste and industrial waste either from a central sewage system or individually within the confines of the property. They have also increased development of water purification technologies enabling the water to be suitable for human consumption. They are currently analysing the feasibility of using human waste products for the use as a fuel source.</p>
<p><b>Nuclear Physicist : Po Lium</b></p> <p>A scientist who has conducted research into the sustainability and development of the nuclear industry encouraging the development of safer protocols to prevent meltdown procedures, Her research also seeks to ensure new power plants that are built can be used for longer periods of time before being decommissioned. Her current research is focused on Gas Core EM Reactors which use the a gas core to create UV light which excites Photovoltaic arrays within the reactor chamber. In addition to this she is a public speaker in favour of developing fusion power.</p>	<p><b>Astrophysicist Dr. Nas Abraham</b></p> <p>Understands the principles of nuclear physics having conducted research into the efficiency levels of reactors. In addition to his nuclear power research he has also analysed data for the positioning of geothermal plants across the northern hemisphere. He is a brilliant mathematician and comfortable using statistics. Part of his current research in the development of small nuclear reactors to be used by space probes ensuring satellites can travel further without relying on solar energy.</p>

<p><b>Electro-Chemical Engineer: Dr Cellcius</b></p> <p>Associate Professor at Midsummer University and partakes in the training of undergraduate students in the field of energy behaviour. She is also chief researcher into battery technology and energy storage.</p> <p>Her current research interests are the development of materials for electrochemical conversion and storage and the thermodynamics and kinetics of electrochemical reactions.</p>	<p><b>Civil Engineer Professor Green</b></p> <p>Lecturer at Midsummer University with a keen interest in environmental chemistry in particular analysing reaction pathways in nature and the fixation of nitrogen using bacteria.</p> <p>His main area of interest is the development of geothermal technologies, through the integration for both heat and electricity generation.</p>
<p><b>Solid State Chemist : Cuba Visage</b></p> <p>Researcher at the Institute for the Development of Solid State Materials looking at generating photocatalysts from the lysing of hydrogen from water and sits on the committee for furthering sustainable technology which seeks to develop alternative fuels.</p> <p>Main focus is the use of Solid state chemicals in the use of molecular sieves to reduce the environmental effects of waste products in manufacturing and energy production.</p>	<p><b>Chemical Engineer: Dr Plant</b></p> <p>The doctor works for a consortium of companies developing manufacturing procedures to reduce the wastage in industrial processes. The consortiums aim to cut the waste of catalysts by 90% and seek to develop practical uses for bio-products.</p> <p>Currently his research is the construction of ceramics at room temperature</p>

**Environmental Activist: Echo Rain**

**An activist and independent lobbyist for the development and compulsory use of greener technology in industry. A chief advocate to the sustainability of society and reducing the transport miles of materials.**

**She also hopes to develop policies to entice residential properties to reduce their emissions and wastage.**



Appendix 2 Scientists cards with URLs

<p><b>Energy Consultant: Energy Dynamic Solutions</b></p> <p>Is a world leader in the production and manufacture of energy generation since 1942 and has grown to develop and sustainable development program.</p> <p>They are currently the only company that can provide power plant to grid solutions catering for all potential network development requirements, from large counties to individual projects.</p> <p><a href="http://pubs.rsc.org/en/content/articlelanding/2011/ee/c0ee00731e">http://pubs.rsc.org/en/content/articlelanding/2011/ee/c0ee00731e</a></p>	<p><b>Commodities Broker: Chris Botanic</b></p> <p>Provides an analysis about the behaviour of the market and can develop an understanding of a project and the its financial development based on the portfolio of information. Has written a paper discussing the energy security of the modern world.</p> <p>His main area of expertise is the diverse markets relating to raw materials such as precious metals and food sources.</p> <p><a href="http://www.thecityuk.com/assets/Uploads/Commodities-Trading-2011.pdf">http://www.thecityuk.com/assets/Uploads/Commodities-Trading-2011.pdf</a></p>
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**<http://pubs.rsc.org/en/content/chapter/9781847552334-00017/978-0-85404-210-4>**

## Future Cities Project

Team name \_\_\_\_\_

### Scientist Team Request

Name of Scientist	Reason for choosing the individual/ What do you think they could provide to your research team?

Appendix 4 Events cards

<p>EVENT</p> <p>The price of steel is a steal.</p> <p>Due to a shortage in the refining of bulk metals such as steel and iron, any projects that involve more than 10 kg of steel or iron must increase their costs by 13%.</p> <p>If you chose Chris Botanic you can ignore this event as he was able to read trends in the market and advise you to stockpile.</p>	<p>EVENT</p> <p>He ain't heavy it's just water</p> <p>There is a new Resolution 254 of the Committee for Sustainable Development states that all water samples used for human consumption must be void of heavy metals.</p> <p>Research filtration and purification methods to remove heavy metals from water samples.</p> <p>How much will this cost?</p>
<p>EVENT</p> <p>Corny prices are beyond a joke</p> <p>The Corn crop across the US bread basket region has failed due to locust infestation, resulting in the price of corn to increase by 20%</p> <p>If you chose Kapow then your crops are resistant to the infestation and result in only a 8% increase.</p>	<p>EVENT</p> <p>Government pledges to reduce import bulge.</p> <p>Localised resolution passed on the use of local materials. No more than 60% of the materials used in the project can be sourced from outside the local area (no more than 100 miles away)</p> <p>If you chose Echo Rain, then it is assumed that 60% of material is sourced locally.</p>

<p><b>EVENT</b></p> <p>Private enterprise responsible for a surge in local investment.</p> <p>If you have an Engineer in your project then listen to the following message.</p> <p>Your project has attracted attention from a private sponsor and development company, they are willing to provide 21% additional starting budget money.</p>	<p><b>EVENT</b></p> <p>Market crash across Europe, has repercussions on others.</p> <p>If your site is located in Europe take a 17% cut in your remaining budget. If you are outside of Europe take 9% cut in your budget.</p> <p>There are no other exceptions.</p>
<p><b>EVENT</b></p> <p>Tensions build at the world's leading Sustainable Development Company.</p> <p>Members of your consultancy group are not happy with the direction the project is leading.</p> <p>You must change at least two of your team members. You cannot re-employ a member that you have just lost.</p>	<p><b>EVENTS</b></p> <p>Pirates in the Indian Ocean are causing problems with supply routes.</p> <p>To simulate the delay in resources and equipment everything from this point further costs 2% more.</p> <p>If you have Sergeant Jones Ignore this event.</p>



<p>EVENT</p> <p>Energy usage soars as the northern hemisphere is plunged into a chilling winter.</p> <p>Energy consumption is increased by 8%, therefore increase your prices by 8%</p> <p>No exceptions.</p>	<p>EVENT</p> <p>Government investment portfolios develop further energy research</p> <p>If you have chosen the following people for your team you can build the Biomass plant for free:</p> <p>Energy Dynamic Solutions Kapow Professor Corn Dr Plant</p>
<p>EVENT</p> <p>UN melts down over nuclear research safety</p> <p>The UN has voted in favour on Resolution 8759 stating that nuclear research must increase their security and safety.</p> <p>For each Nuclear Scientist take an 8% reduction to current budget due to increased safety costs.</p>	<p>EVENT</p> <p>China develops their power efficiency.</p> <p>China has increased the efficiency of its photovoltaic arrays and wind turbine generators.</p> <p>Research current technology for wind turbines or photovoltaic arrays.</p>

<p><b>EVENT</b></p> <p>Seismic activity at current location causes grave concerns to site.</p> <p>Either stop the implementation of geothermal energy or add 2% to the cost of each building.</p> <p>If you have taken Nas Abraham then you can ignore this event.</p>	<p><b>EVENT</b></p> <p>The desire to see the project completed outweighs the fee.</p> <p>Your team has agreed to waive their fee for the remainder of the project, meaning you can increase your budget by 14%</p>
<p><b>EVENT</b></p> <p>There is a breakthrough for localised Biodiesel.</p> <p>Immediately remove one of the members from your team and add Professor Corn</p>	<p><b>EVENT</b></p> <p>Photo reactive catalyst demonstrates true fuel alternative.</p> <p>Research how hydrogen can be produced through photo catalysts and how it could be implemented as an alternative fuel source.</p>

<p><b>EVENT</b></p> <p>New local resolution passed encouraging the use of the Sun</p> <p>You must use solar energy in some way as an alternative energy source within your project and it must account for at least 20% of your energy production.</p>	<p><b>EVENT</b></p> <p>Methanol fires at too visible to stop change</p> <p>The use of methanol in the production of biofuels has now been deemed too unsafe for use. Your team must research an alternative method of production of biofuels that does not use sodium hydroxide or methanol.</p>
<p><b>EVENT</b></p> <p>Air quality leaves a lot to be desired.</p> <p>You must suggest a sampling method and analysis methods for the levels of sulphuric acid and radioactive particles in the atmosphere.</p>	<p><b>EVENT</b></p> <p>Hostile take over.</p> <p>If you are working with one of the following companies, their scientists can no longer work for you and must choose someone else.</p> <p>Energy Dynamic Solutions Kapow Envirotrat</p>