Transition Engineering Workshop

Ideas Beyond Targets

Engineering Students Brainstorm for Big Change

University of Bristol, UK, 29 October 2015

A project to eliminate oil use and improve quality of life

More than 50 undergraduate Engineering students attended a brainstorm workshop on Transition Engineering. The students were joined by academics and professional engineers. The workshop started out with a shared lunch and carried on to dinner at a pub and continued conversation. The workshop lasted for 5 hours and started with a review of the issues of climate change and resource constraints. Some data was presented showing the biggest fossil carbon fuel use in the UK is oil, followed by gas and coal. Many people commute into and out of Bristol by train at the Temple Mead station, and affordable housing is an issue. In the Bristol area, coal and gas are used in processing food, and manufacturing packaging for food, paper, and airplane components. Other data was provided on the university's carbon emission reduction efforts for improving buildings. The students were taught about brainstorming techniques, and broke up into groups to choose a sector and a specific topic for their project, then brainstorm the concepts and develop a project design brief for a trigger project. Unique in the UK, several teams chose to focus on food for trigger projects. The participants were very enthusiastic about the workshop and results. Professor Chris McMahon, Dr. Paul Harper and Daniel Kenning of GATE also contributed to the workshop.

Student Housing Extreme Make-Over:

Affordable and decent quality student housing is a problem in many university towns. In Bristol, one particular problem is old Georgian houses which have been divided into multiple student bedrooms, and have not be renovated to bring them up to the current standard. Students often use very little energy for heating because the condition of the building is so poor that a comfortable temperature can't be achieved. Thus, the problem is not so much with the energy use or the type of heating technology, it is with the condition of the houses.

The extreme makeover project is a challenge to develop a renovation solution for old English houses. The project brief is to develop a renovation plan that can be replicated in most houses, may preserve historical features, use sustainable materials, take advantage of economy of scale, and improve the living conditions as well as energy performance. The project should eliminate gas or coal heating, and match passive house standards for electricity consumption.

Food Without the Factory or the Fossil Fuel

Reconnecting the Farm and the City: The UK does not produce enough food for its population, and yet at least 15% of edible food is wasted. The scope of the project is to characterize the rural areas around towns and cities and how communities are connected through food chains. The objective is to study how fossil fuel could be eliminated from the food chain, and how healthier communities both rural and urban, could be created while eliminating long-distance transport and energy intensive processing. The agricultural production potential of a region would have to be characterized and the geographical relationships with population centres mapped out. It appears that many more people would be employed in agriculture, but the project would need to conduct research on organic farms and the harvesting rotations and transportability for different produce and model the labour requirements and production for conversion of different land areas around different cities to organic farms. Obviously, many types of food have always been processed to preserve food values for storage and later consumption. The project aims to model the quantities and energy inputs in production, processing, storage and preparation for different kinds of foods, which can be grown in the area around Bristol. Perhaps through application of a "sim farm/sim city" type of modelling approach, the transition to zero fossil fuel food systems could be understood.

Transition the Supermarket: Another related project brief called for design of a new kind of food market to supersede the supermarket system. The current supermarket system that moves produce all over the country for processing, packaging and distribution would have to be re-designed to optimize for distance and production diversity.

The transition idea was that a new system could connect people and local food producers. This new connectedness could also facilitate re-use of packaging and return of food waste to the farms. The project emphasized the reduction of packaging, and accelerating the growth of products offering local food and low food miles. Exemplar projects were consignment, subscription and community – based agriculture. The direct market connection between farmers and consumers seems to reduce waste and improve the economics for both parties where it has been developed. The project would also investigate any opportunities for producing food in the city through edible landscaping or hydroponics. Again, these types of ideas exist, but the actual engineering of the transition for Bristol is the subject of the project.

Repeal the Throwaway Culture: A third team chose to focus on the food system for their transition project. Their emphasis was on packaging. The objective of the project would be elimination of disposable packaging, particularly plastic. Looking at history, it is clear that the current packaging practices are less than 30 years old. Any of our parents could tell us how glass containers used to be re-used, many other foods were either wrapped in paper or not packaged, how life works without frozen foods, and how people managed without the profligate use of disposable plastic bags.

The first part of the project would require a substantial

research project to characterize the current land-to-landfill lifecycle of various foods in the supermarket supply chain. The engineering project would then need to look for where value could be added by design, marketing, sales and management of a re-useable container system. For example, could customers shop for or order custom re-useable containers that fit with their current kitchen space, lifestyle and décor? It is becoming increasingly popular to have glass-fronted or open cabinets. The opportunity to have decorator containers in glass, ceramic, metal, and wood – and engineering the containers to preserve food quality could be a new business. Design and testing for washing, moisture and oxidation would need to be carried out. Other containers would need to be returned for re-use, but the team considered that the exploration of green packaging might also mean the end of low-nutrition, over-processed food – like Coke.

This team also spent a good deal of their brainstorm time thinking about the way that the transition might be driven once the project was carried out. Placing a special carbon tax on disable plastic, landfill waste tax on disposable packaging, incentives and research & development funding. The team also thought that the food and beverage engineering field could be involved in setting standards for re-usable packages to ensure safety and to ensure returned containers could be re-used by all manufacturers and easily cleaned and certified for re-use.

The Green Transport Hub:

Like most cities in the UK, people commute to work in Bristol or even from Bristol to work in London, depending on the lifestyle they want and the house they can afford. Bristol Temple Mead train station is a major commuting hub, and the main arrival point for people coming to the University. For the past several hundred years, Bristol has been a major industrial and manufacturing centre, but people who worked at the factories would have lived in the worker housing within walking distance of work. The old workers housing areas are now being gentrified, and the increased commuter traffic has overwhelmed the old train station. There are also a huge number of taxis moving people from the station to the university and business meetings around the Bristol area. Many commuters cycle to and from the station and park bikes there, but the bike parking is vastly inadequate.

The project brief is to develop a green transport hub at the station. The team saw the opportunity to take advantage of the station is too small and not fit for purpose, to drive the re-development into a large, multi-purpose facility with engineering to meet the lowest energy consumption targets. The hub would have much bigger platforms and waiting areas, but the main creative feature would be a complex of meeting rooms and commercial space so that the hub could be used for business and activities without people having to travel across the city. There would be catering and restaurants and a hotel facility as well. It was felt that if the space above and around the tracks were well designed, that a good number of reasonably priced apartments could also be part of the development, which would help ease the housing shortage in Bristol.

Nearly all of the parking at the station would be eliminated and developed into buildings instead. The project proposes a research programme to study the transport geography of Bristol, so model the movements of personal transport and to look to invest in cycle ways, cycle infrastructure like parking and lockers, and electric trams to replace the diesel buses. The tram routes would have to be optimised depending on travel activity so that the km of tram could be kept to a minimum. As Mechanical Engineers, the team also wanted the project to include design of bikes, especially electric bikes to make riding in the hilly city more accessible to more people.

Fossil Fuel Free University of Bristol:

Nearly all of the buildings at the university are old, more than 100 years old in fact. The university currently uses tremendous amounts of natural gas, increasingly imported from Russia, to heat the campus. The historical CO_2 levels below 300ppm resulted in much lower ventilation requirements than today's 400ppm. The electricity use for fans is high and will increase in the future for high occupancy rooms. At the time that the old buildings were constructed, the walls were un-insulated, the ceilings were high and the windows single glazed metal frames. As far as we know, for much of the history of university study in Britain, students attending lectures would have endured very cold temperatures. In fact, the historical depiction of clothing indicates that scholars dressed in heavy, woollen robes, wore hats or hoods indoors, had long sleeves that covered their hands, and kept their feed off the cold floor by using a wool pillow or rug. The big windows were the only source of light.

The project brief called for cutting the fossil fuel use out of heating for university buildings. The era of coal heating is definitely history, and there is not realistically sufficient wood or other biofuel to replace the gas. The project would require major research projects to develop innovative ways to transform the old spaces inside the historic buildings into very well insulated and passively ventilated rooms, while preserving the historic features on the outside. It would be important to use natural daylight and sustainable materials. The space inside the current structure is quite large. If this space was treated as the defining outside dimension, essentially, a new passive building could be constructed inside the old structure. With super insulation and careful use of scheduling and a small amount of wood pellets for heat, the new building in the old building could be designated fossil fuel free – simply not actively heated, cooled or ventilated.

In the middle of the winter, the rooms could get very cold. Two possible approaches were discussed. The first involved re-thinking the school calendar. If the school semesters were spring and fall, with the hottest month of the summer as one holiday and the coldest two months of winter as the other school holiday, then the passive building would likely perform acceptably most of the time. The other approach was demand tolerance. There was a discussion of an engineering student project into "scholar's robes" – that is some kind of garment, which could be available for lectures or even for any desk worker to increase productivity in a cold environment. With modern merino wool and heat transfer analysis, it should be possible to substantially lower the heat in buildings and maintain productivity. In fact, the traditional men's office work-wear of a woollen suit and jacket is probably reflective of much colder working conditions in the past. Combining clothing science, fashion and engineering could be a very interesting and provocative project. In particular, when considering that women's work fashion tends to be much less warm and practical than men's.