Bioenergy Dialogue Toolkit

Resources

An initiative by BBSRC (Biotechnology and Biological Sciences Research Council) to explore public hopes, concerns and aspirations about the future role of bioenergy
Introduction

The resources provided here have been produced by BBSRC to help you run a public dialogue event around bioenergy. They have been developed to encourage discussion around bioenergy with a wider audience and to identify public views so that BBSRC bioenergy strategy and policy will be responsive to public hopes, concerns and expectations for the future of bioenergy.

There are four future scenarios and associated discussion tools, which were developed through detailed research into bioenergy science and associated issues. The scenarios are projections of what the future might look like in 20-25 years if particular decisions are taken, regarding the use (or non-use) of bioenergy in the UK energy market. They are intended to encourage debate around the kind of future that would be socially acceptable, so they are deliberately provocative. For example they explore the trade-off between changes in land use and the need for bioenergy, or the balance between controlling CO₂ emissions and personal freedom and mobility. These are not the only possible scenarios, nor are they meant to represent the most likely or feasible scenarios, although they are plausible examples. The scenarios and exercises used here are based on the report “BBSRC Sustainable Bioenergy Scenario Tool”, authored by R Dingwall, A Balmer and M Goulden (2011).

Guidelines for using the resources can be downloaded from BBSRC bioenergy dialogue website or you can email us to get a hard copy in the post.

Marta Entradas
Biology Dialogue Co-ordinator
marta.entradas@bbsrc.ac.uk
http://www.bbsrc.ac.uk/bioenergydialogue
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Using the resources

The following pages describe the resources: how to use them, the approximate time required to complete them, the outcomes (what does it achieve) and the outputs (what do participants produce). There are also outline plans indicating how they might be used to fill two and four hour sessions. Also included is a glossary designed to provide some simple definitions that will enable participants to understand the terminology used in the resources.

The future scenarios are the core materials for use in dialogue events and they should be central to your event. There are several activities, which will be helpful to use alongside the scenarios to encourage a dynamic group discussion.

The resources presented here are not prescriptive. You are welcome to adapt them, or create your own.
1.1. Scenarios

The scenarios are intended to reflect the impact on the future (20-25 years ahead) of decisions made in the near future (1-5 years) and have been developed around fictitious characters. They are necessarily speculative and incomplete but are plausible. Users should avoid getting into a debate about the technical feasibility, or likelihood of any particular scenario, as they are deliberately provocative to encourage discussion.

Purpose of the activity:

• Encourage individuals to reflect on how new bioenergy technology might affect the future and to express their views, concerns and expectations.

• Generate discussion and debate.

The resource:

There are four future scenarios:

• Scenario 1 – ‘No change of course’ (Appendix 1)
• Scenario 2 – ‘Bumping along the bottom’ (Appendix 2)
• Scenario 3 – ‘How green is my valley?’ (Appendix 3)
• Scenario 4 – ‘Riding along on the crest of a wave…?’ (Appendix 4)

For each scenario, you will find the following materials:

♦ Background information – description about the technology and socio-economic context on which each scenario is based. You may find it helpful to familiarise yourself with these and to have them to hand when running a dialogue event. It is not intended that you share this background information in its entirety with the participants.

♦ Scenario – Each scenario is provided in two formats – text and a script for a short play. You should use only one format within each group.

  o Scenario text – The descriptive text gives the most complete outline of the scenario and will be a familiar and comfortable way to introduce the discussion. NB many participants may find it intimidating (if not actually difficult) to read large amounts of text.
0 **Scenario script** – The script provides a less dense presentation of the scenario. It is intended to be read out by the characters and is not really suitable for reading as a piece of text. It does not have to be ‘acted’. Volunteers from the participants, or the team running the event, could play the characters. The script could be pre-recorded, but will be less engaging than when ‘performed’ live.

If participants read out the script in a role play format, it is important to make clear during the discussions whether they stay in character or come out of character, to express their own views and concerns.

♦ **Cue cards** – these cards build on the scenarios to encourage discussion and present factual information on issues raised in each scenario concerning the climate, the environment, the economy, etc.

♦ **Character cards** – role play cards that introduce the characters in the scenarios, their positions towards bioenergy and factual information to help spur discussion on issues raised in the scenarios.
Using the resource:

The scenarios can be used in several ways, but in every case they should be used to promote and structure group discussion and debate. See pp.25-27 for proposed outline plans on how to use the resources to fill two and four hour sessions.

The facilitator will need to decide how to encourage discussion of the scenario, whether to use the Character cards, Cue cards or some other discussion tools e.g. ‘Picture cards’ or a tool of their own design.

Sufficient copies of scenarios, glossary, Character cards and Cue cards will be required, depending on the precise structure of the event.

- Distribute a copy of the scenario (either text or script) to each participant. Make clear that although the scenario is plausible it is not necessarily a likely scenario and is deliberately written to provoke discussion.

- Distribute a copy of the glossary to each participant and explain that they can use it during the discussion to help them understand any unfamiliar terms.

- If participants are reading the scenario text, ask them to do it individually. If participants are reading the script, you can ask for volunteers to play the characters.

- Once they have read the scenario, ask groups to briefly discuss their first impressions/reactions. You might want to prepare 3 or 4 open questions to encourage the discussion. Ideas for questions might include ‘What struck you most about the scenario?’ ‘How would you feel if the future turned out like this?’

- If the discussion dries up, or becomes too focused on one topic, you can then use the Cue cards or the Character cards to explore other issues in the scenario. You can use Character and Cue cards with both the script and the text.

**If you choose to use the Cue cards you can EITHER:**

- Ask the group to form pairs and distribute one Cue card to each pair.

- Ask each pair to discuss their card.

- Ask each pair to share their card topic and their key point with the group to prompt group discussion.

**OR**

- Read out one of the cards and ask the group to discuss.
If you choose to use the Character cards:

- The Character cards involve the same characters as the scenarios. If you are using the character cards with the script, you could distribute them to the ‘characters’ before they read the script. This will help them get a better picture of their characters.
- Otherwise, distribute the Character cards to participants.
- Ask participants to read about their respective characters.
- Ask characters to introduce themselves to the group and discuss their ‘question’ (concern) with the others. Make clear that participants can stay in character in the discussion or can come out of character to express their own views if they want to.
- As you discuss the cards, it may be helpful to try to record key points on a flip chart. This reminds the participants of what has been said and is useful for collecting feedback – this is best done by an assistant rather than by the facilitator.

Extending the activity

Using more than one scenario

Asking a group to consider more than one scenario simultaneously is ambitious. However, some interesting discussions might result from comparing and contrasting two scenarios. If you run an event using two scenarios you should consider using the script approach for one or both of them as the amount of reading will be a significant barrier to some.

The groups should read (or hear) their first scenario and then spend a few minutes discussing their immediate reactions. They should then read (or hear) their second scenario and spend a few minutes discussing their immediate reactions to that.

The facilitator should prepare three or four questions to provide some initial guidance for the discussion. These could focus on the differences between the scenarios, the differences in people’s lives, the acceptability of different elements of the scenarios and the trade-offs required to get a more balanced or acceptable scenario. The Cue cards could be used as inspiration for questions.
1.2. Picture Cards

Purpose of the activity:

- Promote reflection and discussion about individuals’ perceptions of bioenergy.
- Allow quick identification of initial reactions to bioenergy, serving as a good icebreaker.
- Provide hard copy for collecting feedback. You should retain the selected picture cards or take note of the number on each card selected by participants and return them to BBSRC.

The resource:

- 36 picture cards (Appendix 5). Each picture card is marked with a single issue. The issues are varied, some are rather specific others very general, some positive and some negative, some may seem to be duplicates of others. The issues on the cards are deliberately ambiguous. You can either use all 36 picture cards or a smaller set -- cards 1 to 14.
- Pens or pencils.

Using the resource:

This resource could be used as an icebreaker or later on in an event to prompt further discussion.

- Spread out the picture cards on a table
- Ask participants to have a quick look at the cards and select one that resonates with them. You could ask them to think about what concerns them most, what their hopes are or just a first reaction to the topic
- Ask participants to share their card with the group and explain their reasons for selecting that card
- If there is time, encourage the group to identify any common themes that come up.
Purpose of the activity:

• Encourage individuals to express their views on issues that they are presented with or that arise from their discussions.

• Provide hard copy for collecting feedback. Single sheets of flip chart paper should be returned to BBSRC.

The resource:

• Single sheets of A3 paper (attached to walls/doors or laid on tables around the room)

• A4 sheets of paper

• Coloured sticky dots

• Floor markers

• Pens

Using the resource:

This resource can be used at any point in the dialogue event, to vote on main issues that have been identified by participants or that are being presented by the facilitator(s). For instance, to vote on important issues identified from the ‘Picture cards’ exercise, or the scenario debates. However, you might find it particularly helpful to use towards the end of the event, to summarise the main issues identified during the whole discussion.

Vote using sticky dots

• Ask the group to identify the main topics that were of interest to them and write them down on the A3 sheet of paper

• Give one sticky coloured dot to each participant

• Ask participants to stick the coloured dot to the issue they consider the most important.
Other options for voting using sticky dots:

- If you have lots of issues, you could give participants three sticky dots and ask them to identify the three most important issues

OR

- Give each participant two sticky dots of different colours and ask participants to stick them to the issues they consider the most important and the least important. You will have to agree ahead of time which colour represents most important and which least important.

Vote using ‘Here I stand!’

You can also vote for issues using the ‘Here I stand’ activity. This activity will allow participants to use physical movement and change the pace of the event.

Using the resource:

This requires the facilitator (or assistants) to photograph, or otherwise record, the outcomes.

- Write the main issues identified by participants on A4 sheets of paper. Ask participants to stand next to the issue they consider most important. This can be repeated, with the participants re-assorting themselves for the ‘next most important’ or ‘the least important’ of the issues.

OR

- Describe an imaginary line across the room and ask participants to distribute themselves along it between the two ends (extremes) for any important issue identified. The extremes could be ‘extremely dangerous - completely safe’ or ‘very important – unimportant’ or ‘ethically acceptable – ethically unacceptable’, ‘I would completely support this – I would never support this’ etc.
1.4. Videos

**Purpose of the activity:**

- Introduce participants to various views on bioenergy. Encourage them to reflect on how, and what, information is presented regarding the future role of bioenergy in society.
- Provide hard copy for collecting feedback.

**The resource:**

- Video clips from YouTube.

The videos provided here present short introductions to bioenergy (some discuss new technologies, advantages and disadvantages, while others refer to the environmental, social and economic factors of bioenergy). They can be a good tool to introduce bioenergy to participants at the start of the event or to specifically discuss advantages and disadvantages of new bioenergy technologies.

If you use the videos at the start of your event you might want to show Video 3 (The problems of biofuels), which presents both positive and negative perspectives on bioenergy.

As the main focus of some of the videos presented here is on first generation biofuels, you should make clear to participants at the start that BBSRC policy is not to fund research on first generation biofuels.

**There are seven video clips:**

**Video 1**

‘Meet the algae’ (Cambridge University, 3:39 mins, positive perspective)

[http://www.youtube.com/watch?v=3K5-t6ew10I](http://www.youtube.com/watch?v=3K5-t6ew10I)

Scientists at Cambridge University take a closer look at algae and examine its potential as a renewable source of energy.
Video 2
‘Biomass. Maybe...’ (Kansas University, 3:30 mins, mainly positive perspective)

http://www.youtube.com/watch?v=kloBSpvxkJY&feature=related

Short introduction to biomass by Kansas University. The video briefly explains what biomass is and how it can be used to produce biofuels and considers need to examine the economic, environmental and social costs of biomass.

Video 3
‘The problems of biofuels’ (The Independent and SAAB, 3:47 mins, balanced perspective)

This video presents a series of arguments for and against biofuels. Its emphasis is on, but not exclusively about, first generation biofuels.

http://www.youtube.com/watch?v=PLTICLInPzI

Video 4
‘Bioethanol is a real fuel for the future’ (Abengoa Bioenergy, 3:16 mins, mainly positive perspective)

http://www.youtube.com/watch?v=PFxljC1g7Xk

This video contests the claim that bioethanol is the main cause of increased food prices using supported evidence. It clearly sets out to counter common criticisms of bioethanol, again the focus is mainly on first generation biofuel (bio-ethanol). (This video was produced for commercial purposes.)

Video 5
‘What are Biofuels’ (The Independent and SAAB, 1:47 mins, positive perspective)

http://www.youtube.com/watch?v=bYkCb64bxBGo

This video presents biofuels in a largely positive light – as renewable, carbon neutral and reducing dependence on fossil fuels. It describes the production of bio-ethanol from starch and sugar rich crops (grains, sugar cane and sugar beet) – so called first generation biofuels.
Video 6

‘Bioenergy and the future’ (BBSRC, 7:00 mins, positive perspective)

http://www.youtube.com/watch?v=y7BaNGujQqk

Professor Simon McQueen-Mason of the University of York talks about the need to develop new energy technologies and how bioenergy is a potential solution to respond to future challenges (population growth, food and energy needs).

Video 7

‘Meet the Gribbles’ (BBSRC, 4:51 mins, positive perspective)

http://www.youtube.com/watch?v=C8QJ-rpBV48&list=UUQDnaJNuMpSOVMVqhDAN-oA&index=3

This video shows Professor Simon McQueen-Mason of the University of York detailing how bugs could make liquid biofuels from woody biomass.

Using the resource:

The videos can be used in different ways.

As an icebreaker

This is a simple and relatively short (15 mins) activity around identifying advantages and disadvantages of new bioenergy technologies. You can use videos 1, 2, 5, 6 or 7. This activity can be used at the beginning of the event to introduce bioenergy and start discussion.

- Show the video clip to participants (you can show more than one video if you prefer)
- Ask participants to list the advantages of the new technologies that are identified in the video
- Ask participants to list the disadvantages. Can they think of other disadvantages to the use of use of technologies described in the video(s) to produce bioenergy?

OR

As a discussion tool -- Compare and contrast two videos
This is a longer activity (30mins) that compares and contrasts ‘debate’ and ‘counter argument’ videos. It encourages participants to think about their concerns about new bioenergy technologies and express their views on future research developments. Below are some examples of videos that you can compare, but you can select other videos.

- **Video 1 and Video 2**
  o Show the video clips to participants
  o Explain that these presentations were both prepared by university research departments to describe their research work. Ask participants how these technologies might affect their future.

- **Video 3 and Video 4**
  o Show both video clips to participants
  o Explain that both these videos were produced for commercial companies. Ask participants how these technologies might affect their future.

- **Video 3 and Video 5**
  o Show both video clips to participants
  o Ask participants what are the main criticisms of first generation biofuels, based on the video.
THINK ABOUT:

- Allowing plenty of time. Timings are approximate. Describing an exercise, dealing with questions and collecting feedback at the end can add significantly to the time taken to complete any exercise.

- How you can build flexibility into your event so that you can extend successful exercises and curtail unsuccessful ones, should it seem good to do so.

- You can push the pace of an event, but if participants constantly feel they are moving on to something new before they have satisfactorily dealt with the previous thing they will become frustrated.

- It is sometimes better to drop an activity all together than to try and squeeze it into a time slot that is too short.
### 1.5. Summary of scenario specific activities

<table>
<thead>
<tr>
<th>Duration</th>
<th>Activity</th>
<th>Output</th>
<th>Scenario text</th>
<th>Outcome</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 minutes to read.</td>
<td>Scenario script</td>
<td>10-15 minutes to organise readers and read.</td>
<td>Audience are familiar with the scenario. Have had a few minutes to reflect on it.</td>
<td>Audience are familiar with the scenario. Have had a few minutes to reflect on it.</td>
<td>There is quite a lot of text to read, which may not be suitable for some audiences or some members of an audience. This provides the most detailed background to the scenario.</td>
</tr>
<tr>
<td>8-10 minutes to read cards.</td>
<td>Character cards</td>
<td>20 – 30 minutes</td>
<td>The cards encourage discussion of the scenario and some of the issues raised.</td>
<td>They encourage discussion of the scenario and issues. Picture cards or ‘Voting’ are effective ways to start to identify and focus on important issues and capture the discussion.</td>
<td>This presents the scenario in a less dense way than simply reading the text. It does convey less information. It is potentially a more engaging way to introduce the scenario.</td>
</tr>
<tr>
<td>Each card could lead to 10 minutes of discussion.</td>
<td>Cue cards</td>
<td></td>
<td>The cards build on the scenarios. They encourage discussion by directing participants to discuss specific issues it raises.</td>
<td>They encourage discussion of the scenario, by directing participants to discuss specific issues it raises.</td>
<td>Either ‘Character’ OR ‘Cue’ cards could be used with a particular group and scenario, but not BOTH as the exercises overlap one another.</td>
</tr>
</tbody>
</table>
### 1.6. Summary of scenario generic activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration</th>
<th>Outcome</th>
<th>Output</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture cards</td>
<td>15 mins</td>
<td>A quick way to gather some feedback on participants’ overall view of what the future might be like— are they hopeful/optimistic or dreading it?</td>
<td>Provides a hard copy for collecting feedback.</td>
<td>Good icebreaker activity. Best used early in an event, but could also be used at the end of the event to gauge the mood of participants after considering the future role of bioenergy.</td>
</tr>
<tr>
<td>Voting</td>
<td>10-15 mins</td>
<td>Allows individuals to vote on prioritised topics identified by participants or facilitator.</td>
<td>Provides hard copy for collecting feedback. Encourages discussion and reflection.</td>
<td>A good ‘change of pace/style’ exercise, because can be set up so participants have to get up and move around.</td>
</tr>
<tr>
<td>Videos</td>
<td>15 mins and 30 mins</td>
<td>Encourages discussion of what bioenergy advantages and disadvantages are.</td>
<td>Requires the group to note the main points of the discussion, possibly structured around the prompt questions on the Cue cards.</td>
<td>A good icebreaker activity. Also for a change of pace in a longer event. This activity can be used at the start of the event to introduce bioenergy technologies. It can also be used later in the event to discuss advantages and disadvantages of technology.</td>
</tr>
</tbody>
</table>
1.7. Outline event plans

The following tables outline event plans indicating how the resources might be used to fill two and four hours sessions (approximate times). They are not prescriptive, so you can adapt them or create your own. However, it would be advisable to have as part of your session, a short introduction on bioenergy – this could be either expert talks or videos underlining positive and negative aspects of bioenergy, an icebreaker activity to spur discussion among the group, a debate around a scenario and a feedback session to summarise the main issues raised during the dialogue. Collecting audience responses is an essential part of this dialogue process, so distributing and giving participants time to fill in the feedback forms should also be part of your plan.

### 2 hour sessions

**Event plan 1:**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hour 1</th>
<th>Hour 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picture cards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scenario script</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discussion using ‘Character cards’</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BREAK</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feedback session (using results of ‘voting’ and picture cards)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feedback forms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concluding remarks and thanks</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Event plan 2:**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hour 1</th>
<th>Hour 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Videos</td>
<td></td>
<td></td>
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<tr>
<td>Scenario script</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discussion using ‘Cue cards’</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BREAK</strong></td>
<td></td>
<td></td>
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<tr>
<td>Voting</td>
<td></td>
<td></td>
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<tr>
<td>Feedback session (using results of ‘voting’)</td>
<td></td>
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<tr>
<td>Feedback forms</td>
<td></td>
<td></td>
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<tr>
<td>Concluding remarks and thanks</td>
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Event plan 3:

<table>
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<tr>
<th>Activity</th>
<th>Hour 1</th>
<th>Hour 2</th>
<th>Hour 3</th>
<th>Hour 4</th>
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</thead>
<tbody>
<tr>
<td>Introduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picture cards</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>1st scenario script</td>
<td></td>
<td></td>
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<tr>
<td>Discussion using ‘Character cards’</td>
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<tr>
<td>Voting</td>
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<tr>
<td>Videos</td>
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<tr>
<td>2nd scenario text</td>
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<td></td>
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<tr>
<td>Discussion using ‘Cue cards’</td>
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<td></td>
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<tr>
<td>Feedback session</td>
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<td>Feedback forms</td>
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<tr>
<td>Concluding remarks and thanks</td>
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</table>

4 hour sessions

BREAK

BREAK
<table>
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<th>Event plan 4:</th>
<th>Hour 1</th>
<th>Hour 2</th>
<th>Hour 3</th>
<th>Hour 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>Introduction</td>
<td>Videos</td>
<td>1st scenario text</td>
<td>Discussion using ‘Cue cards’</td>
</tr>
<tr>
<td></td>
<td>Videos</td>
<td>1st scenario text</td>
<td>Discussion using ‘Cue cards’</td>
<td>Voting</td>
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<tr>
<td></td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
<td>Break</td>
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</tbody>
</table>
1.8. Glossary

A glossary has been designed to provide some simple definitions that will enable participants in the dialogue events to understand the terminology used in the scenarios, to explain bioenergy research\(^1\). A copy should be provided to each participant (Appendix 6).

\(^1\text{Adapted from the Royal Society Sustainable biofuels publication, the Nuffield bioethics publication, the UK Bioenergy Strategy publication, and using www.biology-online.org dictionary.}\)
'No Change of Course’ Scenario – Background information

Scenario components

This scenario represents a hypothetical future situation, 20 - 25 years from now, where there is some biotechnological progress within a broadly neutral context as explained below. The scenario is deliberately provocative to generate discussion.

Technology

There have been some improvements in processes using microbes to breakdown lignocellulose to produce ethanol. Production of biodiesel from catering and similar waste plant and animal oils has expanded.

The genetic engineering of microbes and developments in enzyme chemistry make it possible for a greater variety of biomass feedstocks to be used in ethanol production, particularly plant stem waste and crops like perennial grasses and coppiced trees. However, continuing public resistance to GM technology means that GM has not been used to accelerate feedstock growth, but only in the closed environments where biomass is converted to ethanol. Ethanol is added in limited amounts to petrol for motor vehicles. The twin problems of corrosion and water attraction mean ethanol is used exclusively as a fuel in only a few applications like buses, where the relatively high initial investment in the vehicle and specialised fuel supply chain mean that the additional costs (of using resistant materials and technologies in engines and fuel tanks) are marginal, and can be recovered over the lifetime of the vehicle or its support facilities. Market incentives – rising hydrocarbon costs and waste disposal fees – have encouraged the development of an industry around the collection and refining of waste vegetable oils. This has resulted in revolutionary improvements where microbial, rather than chemical, agents are used in the reprocessing. There is growing optimism that the limited supplies of vegetable oils can be supplemented by using algae or yeast as the initial biomass. This could remove the need for plant-sourced feedstocks, but there is some concern that this might lead to problems in dealing with vegetable oils, which will still be required in (and produced as waste from) other applications.
Context

Competing Energy Technologies: Biofuels make a contribution to a diverse market.

Continuing improvements in the efficiency with which traditional hydrocarbon fuels are used, has limited the adoption of alternative fuels. Vehicle users and private households have responded to rising energy costs by demanding more efficient engines in private cars and light vans, and by improving the insulation of their homes. There has been some movement away from natural gas as a fuel because of supply uncertainties and a policy goal of diversifying supply. This has resulted in subsidies to expand both nuclear and renewable energy sources. Electric vehicle use has increased among residents and traders in larger towns and cities, where journeys are relatively short and some car pooling is possible in high-density neighbourhoods.

One showpiece high-speed rail line has been opened from London to Birmingham, but funds have not been made available to extend this. Within the transport sector, biofuels are used mainly as additives to hydrocarbon fuels which dilute diesel, aviation kerosene and petrol by up to 20 per cent. Only in a few areas have biofuels replaced fossil fuels outright. E.g. ethanol as an urban bus fuel, where specialist engines and supply chains have contained the technical problems of ethanol use. There has been some small-scale adoption of biomass for electricity generation in areas that are too remote for mains electricity connection. The biomass is mainly from renewable planting, particularly willow coppicing. Similarly, biomass feedstocks are beginning to displace hydrocarbons in some industrial applications, particularly where the industry wants to present a public image that appears responsive to environmental and climate change issues.

Climate and Environment

Climate: Neutral

Climate change continues to be a matter of social and political concern. However, in the UK, the containment of energy demand by increasing prices, and the substitution of renewable or nuclear sources for some gas-powered electricity generation, has lessened the perceived urgency of the challenge of climate change. The country is projecting a slow decline in carbon emissions, although remaining above the levels that some climate scientists regard as optimal. However, a lack of action elsewhere, particularly in the US, means that it is difficult to argue for more vigorous interventions. Global warming is following a low to median track in the IPCC estimates and is seen as a problem that can be managed by further technological developments, rather than major social or economic changes. As a result, new technology has largely been grafted onto an existing way of life.
Environment: Neutral

Climate change has had some impact on marginal subsistence agriculture, particularly in Africa and parts of Central Asia, and this has resulted in localised problems caused by population movement. It has also made some traditional southern European holiday destinations uncomfortably hot during the summer months. Despite the developments in second and third generation technologies, previous investments in first-generation technologies continue to generate demands for biomass that result in competition for land use between energy and food crops. It is still not clear whether this competition effect accounts for higher food prices and occasional shortages, or whether these are due to the continuing lags between population growth and agricultural development in specific global regions.

Socio-Economic

Economic: Medium-growth

The UK economy has recovered from the 2008 economic crisis but resumed its historical path of somewhat slower growth than other European countries. As a result, UK living standards have not fully kept pace with those of Germany, France and the Nordic countries, all of whom have had greater resources to invest in infrastructure development, albeit often financed by British capital. The UK’s economic pathway has left a continuing problem of unemployment in some regions of the UK, particularly among younger and less-skilled workers.

Demographic: Medium-growth

The lagging economy has reduced the demand for labour. Inward and outward migration, mainly among the 20-35 year old age group, is more or less in balance. Immigration controls have been extended, but there has been limited immigration pressure. However, some European countries are struggling to contain climate-induced migration from Africa and Central Asia. The ratio of those of working age to those of retirement age continues to decline, although this has been countered to some extent by rises in the retirement age.

Location: Neutral

London continues to have a stronger demand for labour than most of the rest of the UK and draws young people from the provinces to meet this. As a result, there continues to be pressure at all levels of the housing market in the south east. Demand is relatively weak elsewhere and largely met by refurbishment of existing properties, rather than by new construction.
Culture and Values: Generally pro-market

At least since the 13th century, the English have tended to have a more individualist approach to life than their European neighbours, with occasional brief interruptions. The political culture continues to emphasise market-oriented values and to design social institutions around these
‘No Change of Course’ Scenario – Story

Alex Palmer and his friends

Alex Palmer steps into the shower at 06:30 on a damp Monday morning in Stratford, East London. Last night was a late return from a heavy weekend in Berlin, thanks to the European high-speed rail network. Next weekend he ought to go home and visit the family in Nottingham, which will take as long, and cost about the same as going to Brussels. The pressure-restricting valves on the shower reduce the flow to a bare trickle, but the water is reasonably hot and he can get through without irritating his flatmates by his energy consumption.

In the scruffy kitchen of the shared flat, Alex picks a cleanish mug and fills it with cold water to measure into the kettle. Alex yawns and thinks back to his weekend. The club he’d visited on Saturday night was powered by an energy recovery floor so every dancer did their bit for the light and sound system. Sometime around 03:00 he had gone home with a guy he had met at the club. Daybreak showed solar panels on every Berlin roof and his new friend had told him that the city government was planning to install energy recovery paving throughout the central pedestrian zone.

The Germans did not want to build nuclear plants, so pretty much all domestic and social energy use was now derived from renewable sources, with hydrocarbon fuels reserved for industrial and back-up uses. The integrated transport system of rail, tram, buses and electric taxis meant few people needed private cars. The German-built solar panels on the roof and the high insulation standards meet most of the users’ energy needs.

After coffee and an oat crunch cereal (maize-based breakfast cereals were too expensive because of supply shortages), Alex walks down to the pool car park under the building and joins his two car-share buddies. They all work at Thames Gateway Nine, one of the satellite hubs where poorer people have been rehoused because they cannot compete in the unsubsidised central London housing market. Alex works for a job-placement company, under contract to the social security fund that tries to find work for people. After a quick search they find a reasonably litter-free electric car from the pool and Alex swipes his card to rent it.

As they pull out of the car park, one of the capital’s fleet of advanced biofuel buses eases into the stop on the other side of the road. A few diesel buses are still used in the outer suburbs, but they all use a biofuel mix, produced from the Capital’s plentiful supply of waste cooking-oil. Alex and friends follow the Gateway Spine road.

The various hubs along the estuary are separated by willow plantations that provide biomass for the biorefinery and mixing plant at Canvey Island. The marshy land has
proved to be too contaminated for them to grow as well as predicted and public resistance has blocked the introduction of more tolerant GM varieties. Consequently, the real energy supply comes from the turbines visible out in the estuary and the distant nuclear station at Sheerness.

Thames Gateway Nine is a pleasant mixture of office park and low-rent shopping mall.

As Alex drives into the staff parking area and hooks up the charging cable on the car, his boss, Anwar Patel, gets out of his Swedish-built car. Like many of the people who have made money in contracted-out services, Anwar lives in an executive village on the Essex/Suffolk border. His car runs on biodiesel, imported in liquid form from countries with more successful systems for collecting and processing mixed urban waste, using Finnish microbial technology.

Alex’s clients mostly live in low-rise terraces radiating out from the centre. These are fairly dilapidated because the poverty of the occupiers means that their rent payments are too low for the landlords to fund routine maintenance and still make a return on their investments. For the same reason, there is little public transport. Fortunately, most people live within thirty minutes walk of the Hub.

Employment is difficult out here because the costs of travelling to low-wage jobs tend to make them uneconomic. Some large residential and nursing homes have been built locally, to take advantage of the cheap labour, but they are unpopular workplaces. A bioplastic factory was built to use some of the willow from the plantations, but the yields were never sufficient to sustain it. It was eventually relocated to Lithuania, where people were more accepting of fast-growing GM tree plantations.

Alex calls in his first client of the day. While he waits he stares again at the poster on the wall – a large tree with the caption “from tiny acorns grow mighty oaks”. It might be supposed to inspire the clients, but this morning is definitely one for acorns rather than oaks…
‘No Change of Course’ Scenario – Script for a short play

Alex Palmer and his friends

Alex (walks into kitchen): Morning Simon

Simon (looking up from pouring water from a mug into kettle): Hi Alex. You were late back last night, any problems?

Alex: No, none. High speed rail Berlin to London was a dream, I just delayed leaving Berlin to as late as possible. You know, it will take me as long to get to Nottingham next week, to see my Mum and Dad, as it does to get to Brussels.

Simon (pouring second cup of water into kettle): …and cost as much. Good time in Berlin?

Alex (yawning and stretching): Yeah, fantastic. I hooked up with this really cool guy, Gunther, in a club on Saturday night and we spent Sunday wandering around Berlin.

Simon: Hence the delayed return?

Alex: Partly, I just didn’t want to come home. Berlin is such a great place, they seem to be really sorted. This club I went to had an energy recovery dance floor that fed power to the lights and sound system.

Simon: Neat…

Alex: …but small scale. Gunther said they are planning an energy recovery pavement to run through the main pedestrianised streets that will feed into the power supply for the central shopping area. And you know how long it takes to get anywhere by public transport?

Simon: Yeah… Forever…

Alex: Well in Berlin you can pick up an electric microbus within 5 minutes almost any time day or night. They run into the tram hubs that feed out to the suburbs and at the other end you pick up another microbus to get to your apartment. We went from the club to Gunther’s apartment in under 30 minutes, it’s only 5 miles, but it was 3 o’clock Sunday morning.

Chris (entering kitchen): And our solution to managing energy use …clapped out old buses running on ethanol that are expensive to maintain and smell of chip fat… And pressure restrictors that turn showers into a dribble. Morning both.
Simon: Oh hi Chris. You enjoyed your shower then. The restrictors keep the energy bills down, even if it makes keeping clean hard work.

Chris: Yeah, right, but still a complete pain. Are you going in to work today Alex, you were pretty late last night.

Alex: I’m due to meet Bethan and Cindy at the car pool as normal, which gives me just 15 minutes to drink this coffee and eat my cereal.

(15 minutes later at the car pool in the car park below the apartments.)

Bethan: Hi Alex

Cindy: Hi, how are you after the weekend?

Alex: Great, bit weary, but great.

Bethan: We’ve found a pool car that’s not too full of rubbish.

Alex: Why is it such a big deal for people to drop their old crisp packets and cans in the recycling bins over there (points), rather than leave them on the floor of the pool car?

Cindy (shrugs): Everybody does it .. and everybody moans about it… DOH! Have you got your swipe card to release the car?

(30 minutes later on route to Thames Gateway Nine where Bethan, Cindy and Alex work)

Bethan (looking at the passing landscape): What a dump. Look at the state of these willow plantations, they’re half dead.

Alex: That’s the pollution in the soil… stunts their growth. No wonder the biomass plant has never produced anything like the energy it was supposed to, not enough wood to feed into it.

Cindy: I worked in the bioplastic factory for six months when I first moved here. They never had enough willow to keep them going either. That’s why it closed and I had to start this job, turned out to be a good move for me.

Alex: It’s the new nuclear plant at Sheerness and the offshore wind farm in the estuary that keep the lights on now. Did you know the Germans don’t have any nuclear, it’s all down to renewable energy, with just a small proportion of fossil fuels for industry use. The roofs of Berlin are practically covered in solar panels.
Bethan: My, my, doesn’t travel broaden the mind… Speaking of solar panels… here we are.. Thames Gateway Nine with its sparkly roof panels humming away to power the machinery of enterprise and prosperity.

Cindy: …don’t you mean poverty and despair? About the only jobs around here are low paid care assistant jobs in the big residential and care homes. No one commutes out of the hub – it’s just too expensive.

Bethan: Not a good way to start the week Cindy. We are supposed to be helping people into work.

(Alex parks the car in the staff car park).

Alex: A fair few of my clients seem to be stuck in a revolving door. Their benefit entitlement runs out, I find them a job, they stick it for 6 months to reset their benefit entitlement and then get themselves ‘let go’. ‘Till the next time they need to reset their benefits’.

Cindy (pointing to a new Swedish-built car pulling into the car park): Here’s a commuter, but commuting in from his smart new gated executive development out in the countryside. Your boss Anwar is here Alex, better hustle.

Alex: Truly, where there’s muck there’s brass…

Bethan: What?

Alex: An old saying of my Gran’s. Anwar’s car runs on biodiesel that is made from fermented waste – its shipped in from Finland.

Bethan: Waste? You don’t mean…

Alex: Yup, I do…

Bethan: Yuck…

Alex: Well it makes great biodiesel. Must rush, see you here at 6pm as usual.
‘No Change of Course’ – Character Card
Alex Palmer

Character: Young male. Alex works as an employment agent at Thames Gateway Nine. This is a satellite hub that mainly houses poor people who have moved out from central London because they are unable to afford London rents. There is very little employment and Alex is disillusioned with his work. Alex has no ties other than family in Nottingham. He travels frequently to Europe for the weekend night life.

Position: Alex is disappointed with the flat economy. It limits his opportunities to move into a better paid job and he empathises with those of his clients who are struggling to support families on low wages.

Fact: The flat economy is the result of the Government’s hands-off approach to the economy, relying on the market to determine the rate and direction of growth. Notably this resulted in it failing to support investment in alternative energy supplies, including biofuels, which might have helped keep England competitive with the rest of Europe.

Question: Would he be better off moving to Europe?

‘No Change of Course’ – Character Card
Cindy Cooper

Character: Young female. Cindy works with Bethan as an adviser for a company that provides working capital and business advice to promote start-up co-operatives in bioenergy services. She trained as an engineer and previously worked in a factory that manufactured plastics from willow biomass.

Position: Cindy is comfortable with science and technology. She understands the need for technical and engineering solutions to issues such as fossil-fuel depletion, climate change and energy security. She is frustrated that the UK has not capitalised on its strength in science and engineering.

Fact: Biomass is an excellent, carbon-neutral feedstock for the chemical industry, especially when harvested from GM varieties of willow and other fast growing trees that can be grown on marginal and contaminated land.

Question: If not biomass, then what? How do we supply the world’s energy and resource needs without large stocks of biomass and biofuel? Is nuclear really the only option?
‘No Change of Course’ Scenario – Character Cards

‘No Change of Course’ – Character Card

**Bethan Morley**

**Character:** Young female. Bethan works with Cindy as an adviser for a company that provides working capital and business advice to promote start-up co-operatives in bioenergy services. She studied Politics and Economics at the local University, because she was interested in ‘grass roots’ action to change society.

**Position:** Like Alex and Anwar she is comfortable with most technology, it pervades her life, but she is largely unaware of it. She is deeply concerned about the nuclear industry and somewhat concerned about the impact of GM crops on the environment.

**Fact:** The UK is heavily dependent on energy from French-built nuclear power plants.

**Question:** Is nuclear power the only option? Would there have been a better mix of energy sources if biofuels had received more, and earlier investment, and been better established before major investments were made in wind and nuclear plants?

‘No Change of Course’ – Character Card

**Anwar Patel**

**Character:** Alex’s boss. A successful middle-aged business man. His parents were relatively poor immigrants from Bangladesh who worked hard to put him, and his brother and sister, through University. He is disappointed to see so much young talent going to waste in a flat economy.

**Position:** Anwar uses, and relies on technology every day, but is largely unaware of it. He believes the way forward for the UK economy is not in trying to compete with Scandinavian, French and German technology and innovation (for which he has great respect), but in financial and service industries.

**Fact:** Scandinavia and the Netherlands are the primary producers of biofuels in Europe. The Germans have cornered the design and manufacture of solar panels and wind turbines. The French are selling most of the new nuclear plants in the world – except in the USA. The UK is not in a position to compete and should consider buying in technology and fuels.

**Question:** The energy market is global (or at least European and African as far as the UK is concerned), so why not buy the energy we need and not worry about local energy production?
High energy prices, some replacement of fossil fuels with renewables and new nuclear supplies have forced down UK energy demand and CO₂ emissions. Global warming is occurring, as forecast in climate models predict low to medium rates of warming. Governments believe this can be managed by technological solutions, rather than major social and economic changes.

- Do you think this scenario would have been any different if the UK government had invested in other energy sources such as wind, wave and solar power?
- How do you think this scenario might have been different if biofuels had come to market before major investments had been made in next generation nuclear power and offshore wind farms?
- How do you think the UK position compares with other nations?

Development and take up of second and third generation bioenergy crops has been slow. First generation biomass crops continue to compete with food crops for agricultural land and there is now evidence that this contributing to poverty and malnutrition. Global warming is making some marginal agricultural land unusable and this is contributing to food shortages.

- How do you think developing nations might benefit from biofuels and their production? What would be necessary to ensure energy needs are balanced with food security?
- Do you think biofuel technology could be used to reduce international poverty? How?
‘No Change of Course’ Scenario – Cue Cards

‘No Change of Course’ – Cue Card 3
The Economy

The majority of European countries have bounced back strongly from the 2012-14 ‘Euro crisis’, while the UK economy is under-performing by comparison. Weak economic growth, high costs of living and lack of government investment in education and critical infrastructure (based on a market driven, private investment model) has contributed to stagnation.

- Do you think the scenario would be very different if the UK had had a more positive attitude to science and technology? What might the pitfalls be of a more open and positive attitude to bioenergy technology?
- Do you think the scenario would be different if the public had been more accepting of GM willow and there were more plentiful local supplies of biomass? What do you think would have been the effect if biofuels and bioplastics had became commercially competitive with existing fossil oil-based products?
- What do you think would be the arguments for opposing GM willow in this scenario?

‘No Change of Course’ – Cue Card 4
Demography

Climate change is driving some migration from Africa and Central Asia. Numerically, inward and outward migration are more or less in balance, but economic stagnation and associated high levels of unemployment have driven the emigration of many of the UK’s most able young people.

- Alex, a bright young man, is already commuting regularly to Brussels to enjoy the weekend club scene. What do you think might finally persuade him to seek employment in Europe and what might keep him in the UK?
- What do you think might be the effect of migration on the countries where young people are leaving to start lives and families in the UK?
‘No Change of Course’ – Cue Card 5

**Location**

In a relatively weak market, London remains an area with high demand for labour; one or two regional centres are also prospering against the national trend. Apart from these few pockets, demand for housing and transport infrastructure is depressed.

- Alex’s parents (his dad is a control systems engineer and his mum an electro-mechanical engineer) live in the East Midlands – not a prosperous area. What do you think might be the impact on them of the stagnant economy and cost/availability of energy?
- Does long-distance commuting increase or decrease in this scenario?
- How might the pattern of peoples’ recreation and holiday patterns change as this scenario develops?

‘No Change of Course’ – Cue Card 6

**Culture and Values**

The UK has pursued a market-oriented, light regulation agenda, but failed to stimulate growth of new business and industry. It remains at arm’s length from its EU neighbours and is somewhat isolated from the US as their interests have turned away from Europe towards the booming economies of the BRIC (Brazil, Russia, India and China) countries.

- In your opinion, does this scenario increase or decrease social inequalities? Why?
- How do you think peoples’ attitudes towards energy consumption have changed in this scenario compared with the current situation? What has happened to ground transport and aviation in this scenario? Would car pooling ever work on a significant scale in the UK? Would an integrated and efficient public transport system be a better solution?
‘No Change of Course’ Scenario – Cue Cards

‘No Change of Course’ – Cue Card 7
Who Wins and Who Loses in this Scenario?

- What kinds of social, economic, environmental and political problems have, in your view, been solved by biofuels in this scenario and which have been exacerbated?
- From your perspective, are there new problems and/or new benefits in this scenario in comparison with our current situation?
- Is everyone equal in this scenario?
- What is life like for a single person, a student, an elderly person, and a poor person in your community currently and what might their lives look like in this future?
- From your perspective, is this scenario good/bad for all nations? What might the global political landscape look like?
- What do you think the government’s role should be in this future? What are people doing about it? Have our responsibilities changed?

‘No Change of Course’ – Cue Card 8
What if...

How would this scenario change if:

- The public and European legislators had been more open to GM?
- The Government had intervened more vigorously to promote research and development into biofuels?
- The UK had done more to limit carbon use and promote carbon efficiency?
- If you were living in this scenario, what kind of issues would you have raised had you been given the chance to discuss your views and concerns before the government took the decisions described in this scenario?
Appendix 2 – Scenario 2

‘Bumping Along the Bottom’ Scenario – Background information

Scenario components

This scenario represents a future situation, 20 - 25 years from now, where there is marked biotechnological progress, but an unfavourable context, as explained below. The scenario is deliberately provocative to generate discussion.

Technology

Biodiesel is being produced from biological wastes and refined into aviation-grade kerosene.

There has been an important breakthrough in engineering a yeast (S. Cerevisiae) to convert human and animal waste into isoprenoids. These can be processed into high-quality aviation fuel at a price below that of conventional oil products. This fuel has a higher energy content so that it is both cheaper and weight-for-weight more efficient. Although it has comparable carbon emissions to those of conventional oil products, its greater efficiency means that less carbon is emitted on any particular flight. The fuel is produced in large population centres where there are reliable supplies of huge volumes of human and animal waste for use as feedstock for fuel. It is distributed through the oil companies’ traditional networks.

Context

Competing Energy Technologies: Biofuels have a niche market.

Improvements in capture of solar energy, through the use of high efficiency, large-scale arrays in desert areas, have created massive supplies of low-cost electricity. This can be used for most transport and heating purposes, either directly or through high-efficiency batteries. Hydrocarbons are still used extensively as chemical feedstocks. Apart from its use in aviation, biofuel from biowaste has a niche market in long-distance freight and off-road transport, such as agriculture, mining and construction. There has been some small-scale adoption of biomass for electricity generation in areas that are too remote for mains electricity connection. The biomass is mainly from renewable planting, particularly willow coppicing.
**Climate and Environment**

**Climate: Neutral**

Climate change continues to be a matter of social and political concern, but the rapid development and adoption of low, or zero, carbon energy technologies has lessened the perceived urgency of the challenge. Global warming is following a low track in the IPCC estimates and is seen as a problem that can be managed by further technological developments, rather than major social or economic changes. As a result, new technologies have largely been grafted onto an existing way of life.

**Environment: Neutral**

Climate change has had some impact on marginal subsistence agriculture, particularly in Africa and parts of Central Asia. As a result there have been localized problems caused by population movement. It has also made some traditional southern European holiday destinations uncomfortably hot during the summer months. However, the emphasis on solar power within the energy mix means that there is limited competition between crops for food and crops, particularly as second- and third-generation biofuels have tended to use waste materials as feedstocks.

**Socio-Economic**

**Economic: Low-growth**

The UK economy has historically grown more slowly than that of other European countries. It was slow to recover from the 2008 economic crisis and growth has averaged 1.5% per annum ever since, whereas growth in Germany has been 2.1% and in Poland 3.5%. As a result, UK living standards have declined relative to the rest of the EU and there are continuing high rates of unemployment, particularly among young people.

**Demographic: Low-growth**

The flat economy has led to a decline in inward migration, because of low demand for labour, while there has been an increase in outward migration, in search of employment. This has predominantly affected the 20-35 year old age-group. As a result the birth-rate has declined, because this age group are having their babies elsewhere in Europe. And, the ratio of working to retired people in the population has changed sharply.
Location: Neutral

The lack of economic growth means that there are few changes in where people live or move to. London continues to have a stronger demand for labour than most of the rest of the UK. Young people are drawn from the provinces to meet this, particularly since other young Europeans are being attracted to more dynamic parts of the EU, where there are more opportunities for skilled workers and professionals.

Culture and Values: Generally pro-market

At least since the 13th century, the English have tended to have a more individualist approach to life than their European neighbours, with occasional brief interruptions. The political culture continues to emphasise market-oriented values and to design social institutions around these.
‘Bumping Along the Bottom’ Scenario – Story

Mrs Palmer goes to work

It is 4am and Ruth Palmer is setting out from her home in Nottingham for her work as a cleaner at East Midlands airport. Ruth’s husband, Warren, is working on a new science park being constructed outside Krakow in Poland. He is an experienced joiner, but in Poland he is employed as a labourer because his skills are not considered to be of a sufficient standard for him to work at his trade. The pay is less than he should earn, but there is no construction work in the UK and he has exhausted his lifetime cap on unemployment benefits. The family need his income.

Their 14-year old daughter is still at school and most days she works an unpaid three-hour shift in a care home under the national community service plan. Their 22 year old son, Josh, has just left the local vocational university. He now lives in a dormitory block in London, where he is doing the year’s unpaid work that is required before he can participate in the lottery for public sector employment opportunities. Just a few private sector jobs go to candidates from the small number of UK universities that are still among the international elite. Josh could have got into one of these, but was reluctant to incur the level of debt involved.

The Palmers’ home is heated and lit by electricity. The house had benefitted from the big drive to upgrade housing insulation that followed the fuel shortages of 2020-2022. The lack of investment in new power stations and the failure of others, run beyond their design life, had led to repeated winter disconnections during which several hundred people had died in the cold. However, they struggled to meet the energy bills because the UK government had refused to participate in the EU Sahara Sunshine solar project. The project had brought cheap and abundant energy to most of mainland Europe, but the European power companies who had promoted the development (with public investment support from their home governments via the EU) saw the unregulated UK market as a way to make higher returns than they were allowed to do in their own countries.

Mrs Palmer walks to the bus along streets lit by electricity, although only one street lamp in three works, following the squeeze on local government in attempts to balance the national budget. Mrs Palmer’s bus is an old design of electric vehicle, bought second hand from Hungary. There are a few biodiesel buses, but these are mostly found in rural areas of Wales and Scotland where the power transmission lines are not adequate for charging the size of batteries needed for buses.

When Mrs Palmer arrives at the airport, she greets her co-workers, many of whom are older than she is. They are employed under the Contribute to the Community
scheme, where employers are exempted from national insurance contributions when employing older workers part-time, if the workers’ only income would otherwise be a state pension. The airport used to be busy with holiday, budget and airfreight traffic. Much of the holiday and budget traffic has gone because many UK residents cannot afford to travel, European immigrants have returned home or moved to more prosperous parts of the continent and European holidaymakers have found East Coast resorts like Skegness to be inaccessible and unattractive compared with those on the Atlantic coasts of France and northern Spain. Business traffic has increased because of the deterioration in UK road and rail infrastructure due to lack of investment. Airfreight is booming too; high value goods are flown in for sorting and onward distribution by air, across Northern Europe, attracted by the region’s cheap land and labour for freight handling work.

As she starts to wipe down the windows of the supervisor’s office, Ruth sniffs the characteristic smell of jet biofuel – funny the way they engineered it to smell like roses when you think how it started out…
‘Bumping Along the Bottom’ Scenario – Script for a short play

Mrs Palmer goes to work

(Ruth Palmer is travelling from her home in Nottingham to her work as a cleaner at East Midlands airport. It is 4am and still dark. At the corner of the street she meets her co-worker, Abeer, and they walk briskly towards the bus stop.)

Ruth: I think we are a couple of minutes late, best walk quickly.

Abeer: No, I think we are OK Ruth. One thing is for sure, the bus won’t be early.

Ruth: If it runs at all. They are so unreliable. The bodywork and seats are OK, they’re cheap to maintain, but the motors and batteries need replacing. They should have been scrapped years ago.

Abeer: The Hungarians were too smart for that – they just needed a bus company that was short of cash and desperate for second hand buses to take them off their hands. Shame we can’t have some of those new biodiesel buses the Scots have brought in.

Ruth: No chance. The Scottish Government are subsidising the public transport system. No way is our Government going to put their hand in their pocket to support transport, or anything else for that matter. Since the last round of cuts you can hardly see your way down the street. There are so many street lights out – the local council seem to have given up on repairs and putting in new bulbs altogether.

(stopping at the bus stop) Well, no sign of the bus. I see the indicator board is still broken – so no way of knowing when it might turn up.

Abeer: Everything seems to be falling apart. The Government cuts last year have squeezed the council so hard they don’t seem to be able to afford to do anything anymore. The High Street is more or less all boarded up. Kwikshop closed at the weekend you know.

Ruth: No one can afford to shop anymore, at least not for anything but the essentials, that’s what is killing the shops. Although my Warren says, the council hiking the business rates to make up for the Government cuts has pushed most of them over the edge.

Abeer: How is he doing, your Warren. Still building that science park in Germany?

Ruth: Poland. He’s in Poland, just outside Krakow. He’s getting on alright. Hates just being a labourer and not being able to use his skills as a joiner, but they won’t recognise his trade skills there. So the pay is less than he’s worth, but there’s no
construction work here and we need his income. I really miss him Abeer, it’s so expensive to fly home that I haven’t seen him for nearly two months. Thirty odd years we’ve been married and we’ve never been apart for so long.

Abeer: I wouldn’t like that at all. (looking up) Ah! Here’s our bus. And now that Josh is in London it’s just you and Kelly at home, it must feel very empty.

(Abeer and Ruth get on the bus and find a seat together.)

Abeer: How is Josh getting on? He was such a bright boy.

Ruth: He’s living in one of those Olympic dormitory blocks in London, doing the year’s unpaid work he needs so that he can apply for the lottery for public sector jobs. We haven’t been down to see him yet – public transport is just too expensive and unreliable so we don’t travel if we don’t have to. He wants to use his accountancy degree to work in tax collection.

Abeer: Tax collection? No shortage of work there.

Ruth: He thinks a few years in the public sector will give him some skills and experience that will make him more competitive for good jobs in the private sector. Apparently all the big firms recruit from outside the UK, apart from a few candidates from our universities that are still among the international elite. Josh says the good academics and researchers have gone overseas, so most UK universities are poor compared to abroad. (Rummages in her bag). Kelly said she saw Saif last night at the care home.

Abeer: He didn’t say anything to me, but then he is just like any 15-year old, tells his mother nothing. They must have been on the same shift. This national community service plan is really hard on the teenagers. It’s all very well encouraging them to take an active part in society, but working an unpaid three-hour shift, three nights a week, in a care home is too much. Saif barely has time to change from school before he goes out to work.

Ruth: It’s the same for Kelly. She’s exhausted at the end of the week, especially if she has to work a weekend shift. It’s too much for a 14-year old whose also trying to keep up with school work.

Abeer: …I guess it keeps labour costs down for the care home…

(Later at the airport, Ruth and Abeer are joined by co-worker Sam and supervisor Krista.)

Krista: Morning everyone. We are window cleaning in the main departure lounge today. Passenger handling say it will be quiet, a few business travellers first thing on the usual early flights out to London, Edinburgh, Brussels and Amsterdam. After that
not much traffic. No holiday flights and just a couple of long hauls out to Chicago and Beijing in the afternoon, so no one to work around.

**Sam:** Six or seven flights? This place used to be buzzing with sixty or seventy flights a day. Not that I’m complaining – less passengers, less mess, especially from the holidaymakers.

**Krista:** Only business and airfreight Sam, that’s all that keeps us in jobs. Not many people can afford to fly for pleasure anymore.

**Ruth:** …and climate change has killed the Mediterranean holiday trade anyway.

**Sam:** We’re just one big warehouse. Flying stuff in, unpacking, sorting, repacking and flying stuff out.

**Krista:** There are lots of places in the UK that would like to be where we are. Cheap labour and cheap land, it’s not glamorous, but it makes us competitive and it keeps us busy. And busy is what I want to see, let’s get to work.

(A few minutes later on the way to the departure lounge. Sam stops in front of a meal dispenser.)

**Sam:** OK. Let’s check out what the restaurant’s a la carte menu is for today. (Checks the machine.) Yuk… Grey unappetising goo with yellow sauce or grey unappetising goo with red sauce…

**Abeer:** Oh come on Sam, it’s not so bad. They’re improving the processing all the time. Grey goo is long gone. Some of these plant protein meals are not bad. A bit bland maybe, and the meat is never quite like I remember meat being, but not bad.

**Ruth:** Meat. Now there’s a distant memory. Our energy bills are astronomical, but meat prices run them a close second.

**Sam:** Eat meat or pay the energy bills; an interesting choice. Now, imagine if the Government had thought about that when they refused to sign up to the Sahara Sunshine solar project. We might have had cheap meat and cheap energy, like the rest of Europe. They all agreed that their Governments would encourage private investment in the project with tax breaks and now Europe has practically free energy. Meanwhile, we can barely meet our energy needs and barely pay for the energy we use.

**Ruth:** That’s the private power companies for you, unwilling to invest without a big Government subsidy as a sweetener, but happy to share any spare energy from Europe with us, at a cost.
Sam: The government never had the right policy. You’d have thought they would have woken up when so many people froze to death in their own homes during the winter fuel shortages in 2020-2022.

Abeer: They did wake up. They did a lot in the few years after those poor people froze because they couldn’t heat their homes.

Sam: They did a lot of talking..

Ruth: …and they put money into the insulation programme. We had triple glazing and thermal wall cladding on a government grant.

Sam: But they insisted that their big drive to insulate homes, rising energy costs and private investment in energy would solve the problem. It didn’t. We’re where we are now because we didn’t act soon enough and misjudged what was needed.

Abeer: Here comes Krista. If we want to keep on paying our energy bills we better get to work. Choose a meal Sam and let’s get going.

Ruth: (sniffs and pulls a sour face) It’s a shame they didn’t think to engineer a better smell into these meals.

Abeer: Engineer? How do you mean Ruth?

Ruth: Well what do you smell as soon as we step off the bus outside the terminal?

Abeer: Jet fuel, it’s everywhere, you can smell it in here now.

Ruth: Yes, jet fuel, but what does it smell of? What does it smell like?

Abeer: Smell like? Oh I see, it smells like flowers, roses maybe.

Ruth: Yup. Roses. That’s not natural. They engineered jet biofuel to smell sweet, to smell of roses. Isn’t that interesting…

Sam: Yes! Isn’t it, especially when you think where it’s come from…
‘Bumping Along the Bottom’ Scenario – Character Cards

‘Bumping Along the Bottom’ – Character Card

**Ruth Palmer**

**Character:** Middle aged female. Ruth works part time as a cleaner at East Midlands airport. She has 14-year old daughter at school and 22 year old son who has just left the local university.

**Position:** Government cut backs and lack of investment in infrastructure are making life more and more difficult for Ruth. She has seen a lot of changes during her life and is increasingly anxious about the future. The UK’s flat economy means the standard of living is slipping back, in relation to much of Europe.

**Fact:** Energy and transport costs are rising.

**Question:** How will the UK maintain its economy when energy costs are so high and what will be the effect on jobs and the future of her children?

‘Bumping Along the Bottom’ – Character Card

**Abeer Patel**

**Character:** Middle aged female. Abeer works with Ruth as a part time cleaner at East Midlands airport. Her parents, and those of her husband, were immigrants from Bangladesh.

**Position:** Abeer’s neighbour has family in South Morocco and in Chad. She says that the Sahara Sunshine Project has not brought any money into the local economies around the Sahara. It has also put many African farmers out of business because cheap electricity has killed the demand for the biomass crops they were growing.

**Fact:** The energy market is global and has global impacts through its effects on the environment, trade, investment and food supplies.

**Question:** How do changes in our energy use affect less developed parts of the world? Should those effects be considered when making our decisions?
‘Bumping Along the Bottom’ – Character Card

**Krista Gorski**

**Character:** Young female. Krista is half German, half Polish. She has a long-term English partner. She is building services manager at East Midlands airport.

**Position:** Like many young Europeans she is mobile, it is only her English partner who ties her to England. She is concerned about climate change and some of the unintended consequences of technology, but she believes that it will be technological solutions that solve current and future problems – not social changes. She is bemused that the UK Government does not intervene to try to correct the obviously poor economic performance.

**Fact:** The UK has become largely economically uncompetitive because of the high cost of imported energy.

**Question:** How could the UK change its energy mix in order to reduce dependence on expensive imported electricity?
‘Bumping Along the Bottom’ – Cue Card 1

The Climate

Rapid development and adoption of low or zero carbon technologies has cut global CO2 emissions. Global warming is occurring as forecast in climate models predict low to medium rates of warming. Together, this has made it seem less urgent that Governments address climate change issues and they now believe this can be managed by technical solutions, rather than major social and economic changes.

Electricity from solar power plants in the Sahara is powering much of Europe, but the UK has largely missed out on this opportunity.

- The UK is a windy island. What do you think has happened in this scenario, to other alternative energy sources, like wind and wave power that we have in abundance, and why?

‘Bumping Along the Bottom’ – Cue Card 2

The Environment

Development of second and third generation bioenergy crops has been slow. They generally use waste products as feedstocks, so there is no competition with food crops for agricultural land, but there are some problems with transportation, storage and processing of large quantities of waste materials.

- Desert-based solar power stations bring relatively little benefit to the host nations. How do you think the production of biofuels could be more beneficial to them? What infrastructure and regulations would have to be in place to ensure justice and equality for developing countries?
The majority of European countries have bounced back strongly from the 2012-14 ‘Euro crisis’, while the UK economy is under-performing by comparison. Weak economic growth, high costs of living and lack of government investment in education and critical infrastructure (based on a market driven, private investment model) has contributed to stagnation.

- Do you think the scenario would be very different if the UK had had a more positive attitude to science and technology? What might the pitfalls be of a more open and positive attitude?
- In your opinion, should bioenergy development and use be driven solely by market forces or by regulation and taxation? What do you think are the dangers of Government intervention to create a market?
- In your opinion, does this scenario raise energy security issues? What are they?

Climate change is driving some migration from Africa and Central Asia. Numerically, inward and outward migration is more or less in balance, but economic stagnation and associated high levels of unemployment have driven the emigration of many of the UK’s most able young people.

- What do you think might be the effect of migration on the countries where young people are leaving to start lives and families in the UK?
- In this scenario, transport energy needs are met in different ways depending on local circumstances/needs. From your perspective, what are the benefits and barriers to producing bioenergy locally?
The UK has pursued a market-oriented, light regulation agenda, but failed to stimulate growth of new business and industry. It remains at arm’s length from its EU neighbours and is somewhat isolated from the US as their interests have turned away from Europe towards the booming economies of the BRIC (Brazil, Russia, India and China) countries.

• How do you think peoples’ attitudes to energy consumption have changed in this scenario, if compared with the current situation?

In a relatively weak market, London remains an area with high demand for labour. One or two regional centres are also prospering against the national trend. Apart from these few pockets, demand for housing and transport infrastructure is depressed.

Anna, a young lawyer, commutes daily to work in London. In your opinion, what do you think has been the impact of Government’s cut backs in transport on the lives of people like Anna?

• Anna’s parents (her dad is a control systems engineer and her mum an electro-mechanical engineer) are planning to move soon. What kind of housing and which locations do you think might be attractive in a stagnant economy? And how do you think the pattern of peoples’ recreation and holiday patterns might change as this scenario develops?
‘Bumping Along the Bottom’ – Cue Card 7
Who Wins and Who Loses in this Scenario?

• What kinds of social, economic, environmental and political problems have, in your view, been solved by bioenergy in this scenario and which have been exacerbated?
• In your perspective, are there new problems and/or new benefits in this scenario in comparison with our current situation?
• Is everyone equal in this scenario?
• What is life like for a single person, a student, an elderly person, and a poor person in your community currently and what might their lives look like in this future?
• In your perspective, is this scenario good/bad for all nations? What might the global political landscape look like?
• What do you think the Government’s role should be in this future? What are people doing about it? Have our responsibilities changed?

‘Bumping Along the Bottom’ – Cue Card 8
What if...

How would this scenario change if:
• the UK Government had engaged with the EU in the Sahara Sunshine project?
• the UK Government had intervened more vigorously to promote Research and Development into biofuels?
• the UK had done more to limit carbon use and promote carbon efficiency?
• If you were living in this scenario, what kind of issues would you have raised had you been given the chance to discuss your views and concerns before the government took the decisions described in this scenario?
‘How Green is my Valley?’ Scenario – Background information

This scenario represents a future situation, 20 - 25 years from now, where biofuel technologies make modest progress in an otherwise apparently favourable environment. It particularly stresses political and social changes that lead in a communitarian direction, dominated by communitarian values, which favour village-scale communities, depending largely on their own local resources, with very limited travel and trading between them. This provides participants with an opportunity to explore what this might mean for everyday living. The ‘Deep Green’ approach to our energy future that is described here has relatively few contemporary advocates, but it allows a facilitator to ask exactly how far participants might be willing to go in adopting the values and lifestyle presented here. Remember that the scenarios are not predictions, but tools to generate debate, and are deliberately provocative to generate discussion.

Scenario components

Technology

Oil is being extracted from plants (perhaps including algae) and the resulting waste is then used to produce butanol and biodiesel to be used in the transport sector. Timber biomass is being used for local electricity generation.

A strain of E.coli has been engineered to very efficiently produce butanol from plant waste. Using this fibrous residue left after extracting the oil, results in a particularly efficient low-carbon process that can operate on a regional scale. The butanol can be used in existing petrol engines and blended with diesel at high levels.

There are developments in the use of other forms of biomass, particularly the use of tree species, genetically engineered for faster growth and suitability for coppicing, to provide timber for wood-based electricity generation. Timber biomass is carbon-neutral and can be used in microgeneration units so that emissions from transporting biomass are minimised. However, supplies are relatively restricted because of land-use competition. Agricultural policy has been to increase domestic food crop production in order to reduce food imports, which still depend on hydrocarbon-based fuels and produce significant carbon emissions.
Context

Competing Energy Technologies: Biofuels and local renewable energy sources dominate the market because energy demand is closely regulated to suppress competition between energy sources and to minimise overall energy usage.

New regulations have massively reduced energy demand. Conventional hydrocarbon fuel technologies survive in niche applications like aviation and shipping, but an emphasis on local self-sufficiency and distributed or remote-access services has left little space for them in the energy mix. Large-scale renewable energy supplies have not become established because of the carbon cost of their initial construction and of the transportation of rare minerals involved in their manufacture.

Climate and Environment

Climate: Neutral to favourable

Increasing concerns about climate change, prompted by extreme weather events in the UK, have led to growing caution about any process that emits carbon - even if this is broadly neutral. Governments are trying to move to a negative emission position, where carbon is being locked up faster than it is being emitted. Although both butanol and biodiesel can be produced on a regional scale, which reduces emissions in the fuel production to end-user supply chain, their carbon outputs are only about one-third lower than those of oil-based fuels, so they still contribute to greenhouse gas emissions.

Environment: Neutral

Climate change has had some impact on marginal subsistence agriculture, particularly in Africa and parts of Central Asia. This has resulted in some local problems caused by population movement. Aggressive energy demand management has limited competition between food crops and biomass, particularly as second- and third-generation biofuels have tended to use waste materials as feedstock. However, the depression of demand for exported biomass crops has hit farm incomes in developing countries and aggravated problems of poverty and under-investment.
Socio-Economic

Economic: Low to medium-growth

The UK economy made weak growth since recovering from the 2008 economic crisis and has been left badly exposed to a further shock in 2018. (This might be the result of conflicting economic policies in the US and China or a major default in a lightly regulated financial system like that in India. The precise cause does not matter since there are a number of plausible possibilities.) Memories of 2008 mean confidence in market economies is low and a greater degree of central planning has had, in the short-term at least, an impact by promoting growth and rebalancing the economy away from dependence on the UK financial sector.

Demographic: Low-growth

The flat economy and discouragement of personal mobility has led to a general decline in all forms of migration, whether within the UK or internationally. The birth-rate has declined, partly due to the effect of economic uncertainty and partly the effect of negative attitudes to reproduction as a personal choice - because of its consequences for carbon emissions. As a consequence, the ratio of working to retired people in the population has changed sharply.

Location: Neutral to favourable

The flat economy and discouragement of personal mobility mean that there are few changes in where people live or move to.

Culture and Values: Collectivist or communitarian

The English have tended to have a more individualist and pro-market approach to life than their European neighbours. However, they have been badly shocked by the 2018 financial crisis and a succession of extreme weather events. The latter caused many deaths among vulnerable groups who were unable to meet the costs of adequate heating or cooling in their homes. As a result, there has been a reaction in favour of more collectivist and communitarian policies, much as happened in the 1940s in response to the economic troubles of the 1930s and the challenges of the Second World War. These include the introduction of personal carbon credit quotas as proposed by a number of academics, politicians and environmental groups from about 2005 onwards.
‘How Green is my Valley?’ scenario – Story

Mr Patel and the Village Hub

Anwar Patel unlocks the Village Hub on a bright May morning. His work plan for the day starts with his weekly trip to the regional distribution centre in the community van. He will use the trip to restock the shelves of the shop area in the Hub and collect supplementary food orders, mail and parcels for the villagers. The van has seating for four passengers so villagers with carbon credits, which allow them to travel for socially authorised purposes, can share the van.

This week Anwar will need to refuel the van from the regional biofuel depot. He checks the schedule on his tablet. Cindy and Kate, the online credit controllers living at Red Knoll, have ordered Thai green curry using some of the bonus credits earned from a successful year at their bank. Alex, from Irongates, who remotely manages a biorefinery, has ordered Henderson’s Relish. Anwar will pick up parcels from various online retailers. These are delivered weekly through a pooled supply chain that replaced Royal Mail when it was wound up in 2016. It is a system that minimises the carbon credit costs of local distribution.

He has three passengers today. Mrs Palmer is heading for the medical centre to follow up a tele-consultation at the Hub. The local robotic equipment has taken a range of blood and tissue samples, but the doctors want to perform a high-resolution scan on her suspected cancer and have authorised an issue of carbon credits to make her journey possible. The twins, Bethan and Trevor, whose parents run the GM willow plantation, are leaving for a flight to Ethiopia. They are using the one-off carbon allocation granted to 18-year olds who volunteer for a year’s service in one of the developing countries that have been impoverished by the falling demand for their exports because of the carbon costs of transport.

Bethan and Trevor will probably be glad to get away. Relationships in the village have been rather strained since the biomass stocks ran low at the end of yet another severe winter and, during February the generator had to be switched off for parts of each day to conserve stocks. There was a lot of ill-feeling, especially when the Carbon Allocation Agency inspectors were called in by an anonymous person to fine some villagers who had opened up their old chimneys and burned unauthorized biomass to keep warm.

It was all a long way from the days when Anwar’s grandfather had bought the village shop and post office on the edge of Sherwood Forest. Back then the Patels had been treated with great suspicion, but now they were valued as key members of the community. They had survived difficult times; firstly, the economic collapse of 2018 and then a succession of extreme weather events.
These difficult times had shifted social and political values in favour of strong government policies, and regulation that created employment in environmentally-friendly industries and developed a system of personal and community carbon credits. The latter addressed the looming energy gap by reducing demand, rather than increasing supply or shifting to renewable sources to sustain the same level of energy use. This strategy had freed capital for investment in other sectors. It had increased national self-sufficiency in both energy and foodstuffs because farmers could only change land use when issued with the right permits, and these were regulated to prioritise domestic food production wherever land was suitable.

The investments in biorefineries and local biomass generation only sustained about half the previous level of energy output. People had got used to not travelling, working remotely from each other and living in heavily insulated homes that needed little heating most of the time. However, many complained about the monotony of their diet, the lack of human contact with any group beyond a very small circle in their locality and the rather puritan policing of everyday life that went with this existence.

So why hadn’t they voted for change? Citizens who did not have a positive personal carbon credit balance were excluded from voting because their carbon overdraft indicated that they were not seriously accepting the responsibilities of citizenship. Mass action to force change was hard to organise because mobility was so limited. People’s main connections were through ultra-high-speed broadband, which facilitated grumbling blogs, but completely failed to threaten the Government’s hold on the country and its ability to push through its policies. Apparently the next challenge would be to reduce the UK population by licencing births.
Mr Patel and the Village Hub

(Anwar Patel is unlocking the Village Hub. It is early morning in May. Anwar is preparing to leave for the local resource distribution centre in the community van. He is expecting several villagers to join him on the journey).

Anwar (muttering to himself as he consults his smart tablet): OK. Trevor and Bethan are off to the airport so I’ll drop them first at the rail station. Mrs Palmer has to be at the polyclinic for 9:30am, so I can drop her next and I’ll be on the right side of town for the distribution depot. By the time I’ve topped up the van with biodiesel I…

Mrs Palmer (interrupting Anwar’s list): Good morning Mr Patel, you seem a bit put out. I hope you aren’t waiting for me? I thought I was in good time.

Anwar (smiling): Oh good morning Mrs Palmer. No, no I am not cross, just concentrating.. and (laughing) probably talking to myself, that is if my wife is to be believed. You’re not late, a little early if anything. You caught me thinking about our route and checking my list. Making one trip a week to collect most of the village’s needs is a great way to save on carbon credits, but it does mean there is always a long and complicated list of errands, people to transport and things to collect.

Mrs Palmer (grumpily): Carbon credits. (Snorts.) What a good idea they seemed when the Government introduced them. Now we are stuck with them because only people with a positive carbon credit balance can vote and the majority of those are dyed in the wool, knit your own yogurt, environmentalists. The majority of us would prefer a less draconian system, but now we can’t vote out the government... and they are in the environmentalists’ pockets.

Anwar: I think that’s a little harsh Mrs Palmer. After all it’s in everyone’s interest to control carbon use and limit carbon dioxide emissions.

Mrs Palmer: Of course. But there has to be a better way to manage these things. Life is so controlled. Do you know that I only just got the carbon credits to travel to this appointment? The doctor at the polyclinic who managed my tele-consultation was convinced I need detailed tests, but some bean counter in the administration office said I had to wait until my amber medi-report moved to red, before they could authorise travel. I don’t know what the doctor said or did, but somehow he got me the credits. You can’t wait around with suspected cancer.

Anwar: Cancer. Oh. Mrs Palmer I am so sorry to hear that…
Mrs Palmer: Well thank you Mr Patel. It was a nasty shock when I first heard, but of course we are of an age when cancer was the big killer. Nowadays almost no one dies of cancer, so now I am over the shock I am not too worried – it’s not even certain I have it. Still it will be better to know for sure, one way or the other, and to get treatment if that’s what I need. (Indignant) Wait for a red medi-report indeed! Anyway, don’t let me stop you preparing – I wouldn’t want anyone to miss out on their mail or a parcel delivery because I distracted you.

Anwar: I’m just about finished. I’ve just set an alarm to remind me to collect these last items from the compound at the luxury depot. Lemongrass and Thai green curry for Cindy and Kate at Red Knoll. They must have done well at the bank again this year – spending their bonuses on life’s little luxuries. And Alex, from Irongates, has ordered Henderson’s Relish. Did you know he manages a biorefinery in Scotland from his home office. He tells me it’s all done remotely, he says he never sees anyone who works for him except on a tele-conference screen.

Trevor: Hi Mr Patel. Hope we are not late.

Anwar: Oh hello Trevor, where is Bethan? Aren’t you both travelling today?

Trevor: Sure, but Bethan’s dragging everything in her rucksack, including the kitchen sink, so she’s travelling a bit slower than me. Here she comes, like a snail with its home on its back. In this case literally its home on its back.

Bethan (crossly): You could have waited Trevor. Hello Mr Patel.

Anwar: Hello Bethan. Do you two know Mrs Palmer? She’s travelling into town with us today. Mrs Palmer this is Bethan and her twin brother Trevor. Their parents run the GM willow biomass plantation on the edge of the village.

Mrs Palmer: Pleased to meet you.

Anwar: Shall we get going. Let me stack those rucksacks in the back of the van for you. Mrs Palmer, you take the front passenger seat next to me.

(A little later on the journey into town).

Mrs Palmer: Where are you two off to then? From the look of those bags you’ll be gone some time.

Bethan: We’re flying out to Ethiopia this evening. Mr Patel is dropping us at Sherwood Parkway for us to catch the intercity to Thames Gateway airport.

Mrs Palmer: Ethiopia, how wonderful. You must be terribly excited.
Bethan: Yes, very excited… and a bit anxious too. Neither of us has travelled much. Well, I suppose no one travels much anymore do they?

Mrs Palmer: No, no… Far too expensive for most people. So how can you afford the carbon credits?

Trevor: Its part of the Government’s Carbon Aid scheme. Any 18-year old can volunteer to work for a year in a developing country and get the carbon credits they need to make the journey. It’s meant to support countries whose economies have been badly hit by the effects of carbon credits on their industry and exports.

Bethan: …It’s probably a once in a life time opportunity. No way are we going to be able to afford a journey like it ever again.

Trevor: It’s back to robot travel avatars and ultrafast broadband links when we get home.

Mrs Palmer: Maybe not. You travel to see your relatives in Bangladesh don’t you Mr Patel?

Anwar: Yes I do, but I can only apply for a carbon credit allocation every 5 years and I am sure that it is much more difficult to get an allocation if you cannot prove a family connection in the place you want to travel to. And I think it will get harder in the future. There is talk of extending the period between allocation slots to 10 years.

Mrs Palmer: Five years is a long time, but ten years is just ridiculous. We have to do something about this Government and its policies. They control our whole lives.

Anwar: That’s not really true is it? It’s mainly travel that’s restricted and ultrafast broadband helps to keep us all in touch.

Mrs Palmer: A teleconference is no substitute for meeting face-to-face. And it isn’t just travel that is controlled. The carbon credit cost, controls the food we can afford to eat, the type of homes we can afford to live in, how often we can afford to buy new clothes or change our furniture.

Bethan: I think Mrs Palmer is right, Mr Patel. The carbon credits are an almost invisible influence on much of our lives. And not just the way we live, but the sort of people we are…

Trevor: We’re looking forward to getting out of the village for a year. It’s like living in a goldfish bowl, everyone watching everyone else. It’s all too insular to be healthy.

Anwar: Do you mean the unpleasantness about the power cuts?
**Bethan:** The weather was so cold this winter that the stores of willow biomass ran low in January. Dad had to ration them to keep the generator running, but that meant power cuts in February and March when people still needed a lot of power.

**Mrs Palmer:** I think most people in the village knew that wasn’t your Dad’s fault.

**Anwar:** It didn’t stop the usual culprits making nasty remarks and blaming him for the cuts. But that wasn’t much more than the usual low level grumbling. It was the anonymous tip-offs to the Carbon Authorisation Agency that really stirred people up.

**Mrs Palmer:** That did a huge amount of damage to the village.

**Trevor:** Whoever it was that started reporting people for opening up their old chimneys and hauling out their old oil heaters to burn unlicensed biomass really poisoned the place.

**Bethan:** It was like a witchhunt, or the old communists of the 20th century. Everyone denouncing one another, and a lot of real nastiness.

**Mrs Palmer:** Some of those flyposters that went up around the village were outrageous… dreadful things to say… But I’m sure a lot of it was just frustration coming to the surface. People feel powerless to change things that just aren’t working.

**Bethan:** Well, me and Trevor are just grateful that this trip gets us out of the place for a while. Maybe things will have changed for the better when we get back.

**Anwar:** Certainly, things are not good at the moment, but it has made people look again at buying a biodiesel storage unit so that we have back-up fuel for the biomass-fired generator. It would also makes us less reliant on the old water wheel generator, which froze solid just when we needed it most.

**Trevor:** That’s a big project and a lot of carbon credits.

**Anwar:** If we go ahead with putting a community freezer in the Hub, so that villagers don’t use individual freezers just lockers in the main freezer, then the carbon credits we save would contribute to the biodiesel unit. We just have to be sure to buy a big enough one to cover the carbon credits we’d need to bring biofuel by tanker from the processing plant on the edge of the National Forest in Staffordshire.

**Bethan:** Here’s the Parkway, can you let us out just over there Mr Patel. Well you’ve got a year to get that new biodiesel unit in place before we get back. Good luck.
‘How Green is my valley?’ – Character Card

**Anwar Patel**

**Character:** Male. Anwar’s parents were immigrants from Bangladesh. Anwar is a respected member of the village community where he has a central role as manager of the village hub. He meets many of the villagers and hears their views when they come into the hub.

**Position:** Anwar recognises that life is not perfect. However, he believes that climate change (and associated severe weather events) and the need to manage energy demand and use, are so significant that everyone should be willing to accept some curtailment of their personal freedoms and choices.

**Fact:** Climate change has resulted in extreme weather events (flash summer floods and prolonged extremely cold winters) that have killed hundreds.

**Question:** If we do not restrict carbon use by price, how can we manage CO₂ emissions and resulting climate change with its uncertain long term impacts?

‘How Green is my valley?’ – Character Card

**Ruth Palmer**

**Character:** Middle aged female. Head teacher of the local primary school.

**Position:** Ruth is comfortable with technology and recognises its many benefits. She was originally in favour of carbon credits and other Government actions to manage carbon use and reduce carbon emissions. She now has serious misgivings about the new political and social order that has resulted – in particular the disenfranchisement of many people, notably most of the parents of the children at her school.

**Fact:** Government policy has concentrated on making carbon (energy) very expensive, in order to drive down demand and encourage carbon (energy) saving.

**Question:** What will be the long term social effects of restricting personal freedom and choice, especially restricting travel and thus creating small communities whose main interaction with the ‘outside world’ is via ultrafast broadband links?
‘How Green is my valley?’ – Character Card
Bethan Morley

**Character:** Young female. Bethan is Trevor’s twin. She has recently left school. She plans to study biological sciences at University when she returns from a one year trip to Ethiopia where she will work on an aid project.

**Position:** Technology is so much part of Bethan’s life that it is largely transparent, she hardly notices or thinks about it, it is just ‘there’ to be used. Researching her trip to Ethiopia has made her more aware of social inequalities and she is disturbed that the UK’s (and Europe’s) decisions on managing energy use, climate change etc, seem to have had serious damaging effects on less developed countries.

**Fact:** The UK’s decision to concentrate on locally produced biomass for energy production, and the high carbon cost of transporting materials, has contributed to the destruction of the market for biomass imported from developing countries.

**Question:** The UK, along with the rest of the world, has to try to manage climate change and energy use. How can that be done in a way that is globally fair?

‘How Green is my valley?’ – Character Card
Trevor Morley

**Character:** Young male. Trevor is Bethan’s twin. He has recently left school. He plans to study environmental economics at University when he returns from a one year trip to Ethiopia where he will work on an aid project.

**Position:** Technology is so much part of Trevor’s life, that day–to–day he hardly notices or thinks about it. However, he is fascinated by the potential that science and technology offers and is concerned that relatively little has been used to manage energy use, climate change etc. The Government seems to favour social and economic change to address these issues.

**Fact:** The UK’s decision to concentrate on locally produced biomass for energy production has starved other types of biofuels of investment for research and development.

**Question:** How radical should we be in our solutions to energy use? Should our long term plan for bioenergy production be based on ‘low tech’ (e.g. burning copiced wood), or ‘high tech’ solutions (e.g. biofuel-producing algae grown in closed glass with high-tech equipment to keep the algae in optimal conditions)?
‘How Green is my valley?’ Scenario – Character Cards

‘How Green is my valley?’ – Character Card
African farmer

**Character:** Middle aged female. Well educated and articulate. A woman who prospered briefly when there was a boom in demand for biomass crops, but whose business collapsed when the Europeans introduced carbon credits that made it uneconomic to export African produced biomass. She now supplements her living by making and selling ethnic jewellery through an aid charity.

**Position:** Her experience of technology has largely been second hand. Her business boomed for a few years when biomass crops were in global demand. She is grateful for the mobile phones that transformed communication and trade in Africa and the trickle down of medical developments that are slowly improving health care. She sees carbon credits as yet another way to disadvantage those who already have little.

**Fact:** International trade and decision-making takes little account of those without wealth, resources or political power.

**Question:** Is it possible, or desirable, to enforce social responsibility on international governments and companies, so that as economic conditions change, developing economies are protected from disastrous shocks?
‘How Green is my Valley?’ – Cue Card 1
The Climate

Because of a marked increase in extreme weather events the UK public accept that the Government has to strictly regulate CO₂ emissions and use of fossil fuels. Many governments have introduced regulations that ensure they capture more CO₂ than they generate. Major social and economic changes are seen as the only way to address climate change.

- Biofuels reduce carbon emissions by about one third compared to fossil fuels. However, there are questions around how much energy is needed to make them and the carbon costs of transporting them etc. Do you think there is a case for researching and developing biofuels’ use? What do you think the alternatives could be?

- Carbon capture technologies require large amounts of money investment. Do you think that the cost and environmental impact of carbon capture technologies would be preferable to the major social changes needed to 1) reduce CO₂ emissions and 2) reduce the concentration of CO₂ in the atmosphere?

‘How Green is my Valley?’ – Cue Card 2
The Environment

The use of second and third generation bioenergy crops has largely eliminated competition between bioenergy and food crops. There has not been significant resistance from the public or EU legislators over the use of GM in non-food crops. The sharp suppression of demand for energy, using taxation, carbon credits and cost, has depressed demand for biomass crops and hit farm incomes in some developing countries.

- The sudden loss of markets for biomass crops has put many developing country farmers out of business. What do you think might happen to the environment in developing countries if the farmers go out of business?
‘How Green is my Valley?’ – Cue Card 3

The Economy

The majority of European countries bounced back strongly from the 2012-14 ‘Euro crisis’ and the effects of the US-BRIC trade war in 2018. The UK economy was much less robust. The loss of confidence in market economics set the mood for more centralised control and regulation in the UK and a more resilient and independent position on energy and trade.

- Personal carbon credits are central to this scenario. Can you imagine a set of circumstances that would make introduction of personal carbon credits acceptable? What are those circumstances?
- Should bioenergy development and use be driven solely by market forces or by regulation and taxation? What are the dangers of Government intervention in, or to create, a market? Was there widespread resistance to personal carbon credits? How do you think carbon use could be regulated in a fair and equitable manner?

‘How Green is my Valley?’ – Cue Card 4

Demography

The regulation of carbon emissions, across most of the planet, has discouraged travel and restricted migration (within the UK and more widely). Globally, birth rates are falling, both because of economic uncertainty and the consequences for carbon use. Consequently, the ratio of working to retired people has changed sharply.

- What might be the effect of restricted migration?
- In your opinion, what societal issues are raised by a sharply ageing population in a society where energy use is strictly controlled?
The UK public had voted in a government with a regulatory, interventionist agenda to manage the perceived crisis of climate change. Anxiety over extreme weather events and the spiralling costs of energy have resulted in a move away from a free-market economic model.

- How do you think peoples’ attitudes to energy consumption have changed in this scenario compared with the current situation?
- People moved around freely, networked via social media and consumed relatively cheap imported goods from China. In your view, how will the UK society adapt to a more frugal existence, where personal freedom to travel and consume, is restricted by rising global costs and carbon taxes?

A relatively flat economy and discouragement of personal mobility means demand for labour is low and there is little non-essential movement e.g. commuting, trading up of homes. Housing demand and transport infrastructure is depressed.

- What, in your opinion, might be the social effects of restricted travel opportunities? Could these effects be mitigated and how?
- Almost certainly some communities will be better placed than others to limit and/or supply their energy needs from local sources. How do you think such energy inequality could be managed?
- In this scenario, energy needs are (barely) met from a mixed energy economy, including a local biomass generation plant. What are the benefits and barriers to producing bioenergy locally? How would this have to be managed to be acceptable?
‘How Green is my Valley?’ Scenario – Cue Cards

‘How Green is my Valley?’ – Cue Card 7
Who Wins and Who Loses in this Scenario?

- What kinds of social, economic, environmental and political problems have, in your view, been solved by biofuels in this scenario and which have been exacerbated?
- In your perspective, are there new problems and/or new benefits in this scenario, in comparison with our current situation?
- Is everyone equal in this scenario?
- What is life like for a single person, a student, an elderly person, and a poor person in your community currently and what might their lives look like in this future?
- In your perspective, is this scenario good/bad for all nations? What might the global political landscape look like?
- What do you think the Government’s role should be in this future? What are people doing about it? Have our responsibilities changed?

‘How Green is my Valley?’ – Cue Card 8
What if...

How would this scenario change if:
- The Government had intervened more vigorously to promote research and development (R&D) into biofuels?
- The UK had done more, earlier, to limit carbon use and promote carbon efficiency?
Appendix 4 – Scenario 4

‘Riding Along on the Crest of a Wave…?’ Scenario – Background information

This scenario represents a future hypothetical situation, 20-25 years from now, where biofuel technologies make rapid modest progress in a favourable environment. The scenario imagines successful innovation and marketing strategies have brought biofuels into widespread use. It explores what this might mean for everyday living and whether there may be other strategies that could bring about the same result. The scenario imagines a radical laissez-faire approach that has relatively few contemporary advocates, but it allows a facilitator to ask exactly how far participants would be willing to go in adopting the values and lifestyle presented here. Remember that these scenarios are not predictions but tools to generate debate and are deliberatively provocative to generate discussion.

Scenario components

Technology

Using synthetic biology techniques, algae have been engineered to produce high concentrations of oil. Production can take place anywhere there is a suitable supply of nitrogen-rich liquid waste. Other improvements in microbial technology, for extracting oils and converting residues into animal feed, have resulted in a ready supply of oil that can be processed in conventional refineries to produce the full range of current liquid fuels.

One of the major constraints on algal biofuel production is the requirement for a concentrated source of CO₂ as an input. It has been suggested that algal biofuel plants could be located adjacent to major CO₂ emitters (coal-fired power plants or certain types of chemical plant) but this limits the range of locations and, hence, the achievable volume of production. It also assumes the continued operation of these plants, despite the pressure on these industries to develop low-carbon emission technologies. The concentration of CO₂ in air is not sufficient to support levels of algal growth that would be high enough to produce oil at a marketable cost. If CO₂ could be concentrated within the algae production system, then production plants could be established anywhere there was a sufficient supply of nitrogen-rich liquid waste; whether from human sewage, animal waste or agricultural run-off. In theory, the result could be a virtuous system that both removed atmospheric CO₂ and cleaned up waste water before its return to the environment. The residues could potentially substitute for cattle cake and molasses in animal feed: the resulting diet seems to reduce methane emissions from cattle, which is a further environmental benefit.
**Context**

**Competing Energy Technologies: Biofuels dominate the market**

Traditional oil companies have made major investments in the development of algae-based processes that produce liquid biofuels that are more or less identical to those they are familiar with. The rapid and early success of this investment has meant that alternative, electric-based, technologies are stillborn. Neither consumers, nor engine manufacturers, nor governments are willing to make the additional changes necessary to move to electric-based modes of transport. Liquid biofuels flow through existing supply chains to existing uses in power generation and transport. Battery, fuel-cell and hydrogen technologies are all displaced. Electricity continues to expand as the main power source for fast rail transport, because of the technical advantages it offers over diesel locomotive power. However, the electricity is generated from biodiesel, which displaces first oil, then coal and finally natural gas as fuel for power generation. The price is towards the upper end of the range for oil, so there remain incentives to improve efficiency of energy use, through building insulation, rooftop solar panels and improvements in engine and generation technology, but there is little demand for other forms of generation. Most wind farms are rapidly dismantled for scrap.

**Climate and Environment**

**Climate: Neutral**

Climate change continues to be a matter of social and political concern. In the UK, reducing demand by managing energy prices, and substituting biofuels for coal and gas-fired power generation, has lessened the perceived urgency of the challenge of climate change. The country is projecting a slow decline in carbon emissions, although these will remain above the levels that some climate scientists regard as optimal because biofuels are low-carbon, rather than zero carbon. However, the enthusiastic response of the US and China to liquid biofuels has taken some of the pressure off other countries. In the US the vested interests of the coal mining industry have restricted the full potential of biofuels to displace hydrocarbons. Global warming is following a low to median track in the IPCC estimates and is seen as a problem that can be managed by further technological developments, rather than major social or economic changes. For example, bioengineering the atmosphere by continuing to develop algae strains that are particularly efficient at fixing carbon.

**Environment: Neutral to Adverse**

Climate change has had some impact on marginal subsistence agriculture, particularly in Africa and parts of Central Asia. This has resulted in local problems caused by...
population movement. It has also made some traditional southern European holiday destinations uncomfortably hot during the summer months.

The most important change has been the collapse in demand for biomass crops and for hydrocarbons, which has had a devastating effect on incomes in many developing countries. Although these are suitable sites for algal biofuel production, the closed production systems are highly automated and require very little labour. Famine and food riots have occurred in some areas because people lack the income to buy food, rather than because of absolute food shortages. Ecosystem management in these areas has become problematic because unused agricultural land does not necessarily become an environmental asset unless it is returned to nature in a planned way, rather than just being abandoned.

**Socio-Economic**

**Economic: High-growth**

The UK economy has bounced back from the 2008 economic crisis. Spare capacity in its manufacturing sector and the flexibility of its labour market allowed it to grow rapidly. As an early adopter of the new algal biofuel technology, with few sunk costs because of its dependency on imported energy, the UK has enjoyed sustained growth, whereas less flexible European competitors have lagged. UK living standards have rapidly recovered the ground lost after 2008. The availability of low-cost energy and transport networks has brought peripheral regions securely into the UK national economy. Policy concerns are mainly about inflation and over-heating brought about by full employment.

**Demographic: High-growth**

The buoyant UK economy has sucked in labour from all over Europe and beyond, mainly among the 20-35 year old age group. The economic problems in developing countries have led to additional illegal migration, predominantly among the same group. However, the rate of job creation has been such that there has been little concern about the implications of this: the economy can absorb everybody who wants to work and still have local labour shortages. The ratio of working age to retirement age people in the UK population has improved, but migration has aggravated the problems elsewhere in Europe. Many of the migrants are establishing families in the UK and showing signs of becoming permanent residents.

**Location: Neutral**

London continues to have a stronger demand for labour than most of the rest of the UK. However, cheap energy and low transport costs have helped disperse growth and
prosperity so that there are only small pockets of social exclusion, mainly in areas where there is a long-established culture of disengagement from employment and a lack of education and skills to participate in the labour market. In principle, young people can get good jobs in any region. There is considerable pressure on the housing market from people wanting to establish their own households and this has serious implications for urban sprawl and long-distance commuting.

Culture and Values: Generally pro-market

At least since the 13th century, the English have tended to have a more individualist approach to life than their European neighbours, with occasional brief interruptions. The political culture continues to emphasise market-oriented values and to design social institutions around these. The successful reconstruction of the economy since 2008 is held by many to be a vindication of this tradition.
‘Riding Along on the Crest of a Wave…?’ Scenario – Story

The Rewards of Initiative

Guy Morley shuffled the cushions on his sun lounger and adjusted the gold chain on his bronzed torso. He looked up at the cruise ship’s funnel, which dispersed a virtually invisible stream of smoke into the hot African air. He was old enough to remember when ships burned the crudest of bunker oil. Now they had all converted to bio-bunker grade, bought at a fraction of the cost of fossil oil, and smoke-blackened stacks had become the stuff of poems and historical novels.

Guy’s attention wandered to his wife Joy, who was spraying one of the new nanotech tanning compounds over her shoulders and thighs. There had been some early cancer scares, but recent formulations had proved entirely safe and had pretty much replaced traditional sunscreens.

He reflected on the part that technology had played in his life. He had studied bioscience at a relatively unfashionable university and gone on to work as an investment consultant for a group of venture capitalists who were looking to invest in small biotech companies. However, Guy had not lost his interest in practical science and spent a lot of evenings playing around with synthetic biology kits that he ordered on the internet. ‘Garage biology’ it was called in those days, although he actually had a garden shed rather than a garage. Around 2010, a lot of people were throwing money into development of algal biofuels, but most of this was going through large corporations and public bodies into big research universities so that everything was regulated and gold-plated. Guy and his friends just chucked things together to see what happened.

Guy got lucky. He assembled an alga that could concentrate carbon dioxide from the air and so grow faster. He had immediately seen the potential. A college friend, who had trained as a patent agent, took care of the legalities and Guy used his own connections to line up some sharp-eyed venture capitalists.

He had run the company for ten years or so while his team improved the algal strain, developed closed production systems to minimise the risk of contaminating either the environment or the strain, and consolidated the patents. Eventually he had sold out to a major oil company and settled down to enjoy the abundant wealth and leisure that a combination of skill and luck had delivered.

His teenage daughter Bethan, weaved through the bodies around the liner’s pool and pushed up the sleeves on her cheesecloth shirt to show him the bruises that she had got when she and her twin brother, Trevor, had gone ashore with the excursion yesterday. West Africa was having a pretty bad time at the moment. The collapse in
the fossil oil market had led to a major crisis in urban employment – they had sailed past the rusting hulks of abandoned oil rigs for most of the previous day. Farmers who had switched, around 2015, to growing biomass crops for fuel had seen their market disappear and the rapid growth of unemployment meant that they could not move back into food crops because there was no market for these either.

The ports were now full of desperate beggars and the shore excursions were accompanied by security guards who chaperoned the passengers around historic sites and carefully screened shopping malls. However, it did not take much to lose track of the tour – Bethan had lingered to look at some jewellery and it was fortunate that Trevor had stayed with her. The guards had come quickly enough once the fracas had started and Bethan began screaming, but Trevor was nursing a few bruises and some cuts on his knuckles where he had discouraged a few beggars. A good reason to avoid the excursions, thought Guy.

Back home, life was better ordered. Cheap, low-carbon fuels had led to rapid economic growth, which had been facilitated by low personal and company taxation. There had been some problems, of course. The demand for larger and more spectacular houses, given the real decline in heating bills, had built up pressures for urban sprawl and long-distance commuting, although these were tempered by the extension of mobile working from homes and local office hubs. Guy’s cleaner, Mrs Palmer, is always complaining about how much time she spends waiting on street corners for buses that are always dirty and overcrowded. With fuel efficiency no longer a particular concern there was currently a revival of the 1950’s fashion for large cars with chromed fins and bumpers, which had created some conflict with regulators overly concerned about pedestrian safety. Supermarkets were constantly replenished with exotic foods and flowers brought in by air from all corners of the planet.

Of course, there were a few malcontents who complained about the social divisions that were accentuated by this abundance, but looking at the Africans fighting for scraps, Guy concluded that even poor people in England had a standard of living way in excess of their basic needs – providing they were willing to work for it. Some climate scientists were beginning to warn about the consequences of consuming so much CO₂ but they were obviously the sort of people who could never see anything positive in economic growth and personal affluence…
‘Riding Along on the Crest of a Wave…?’ Scenario – Script for a short play

The Rewards of Initiative

(Guy Morley, his second wife Joy and Guy’s teenage twins, Bethan and Trevor, are cruising off the West African coast on board the SS Gaia. It is mid-morning. Guy and Joy are sitting on pool side loungers on the sun deck. Joy is searching her bag for sunscreen. Guy is arranging the cushions on his lounger.)

**Guy (lying down and looking up):** Look at that Joy, isn’t it just great to be part of it?

**Joy (following Guy’s gaze and then looking at him):** Look at what love. I can’t see anything but the ship’s funnel.

**Guy:** That’s what I mean! Nothing to see. Nothing coming out the funnel, at least, nothing much. Don’t you remember the days when ships looked like they were burning old tyres in their boilers. That’s what we’ve done for the world, ships’ funnels without smoke, cars without pollutants and limitless cheap oil.

**Joy (rummaging in bag again):** Not we, you. That’s what you’ve done. All those evenings and weekends, fiddling with those chemicals you bought off the internet. No wonder Kate left you. All those hours shut in the shed doing your shed biology…

**Guy:** (sighing)... not shed, it was garage biology, wherever you did it that’s what we called it back then, garage biology. Just interested part-timers tinkering with algae to see if we could beat the big boys by producing biofuels cheaply enough to replace fossil fuel. I got lucky, or perhaps I am just brilliant…

**Joy (laughing):** .. you got lucky… (pulls sunscreen from her bag)

**Guy:** Either way... that first super-producing strain in 2012 got the ball rolling and over the years the start-up company steadily improved the oil yield and quality until it got to the point that I could sell out to the oil companies.

**Joy (sprays sunscreen onto her palm and studies it):** I know science and technology is important and it’s what is paying for our cruises and the kids’ education and everything else we have... But I’m still not sure about some of it, human enhancement, mind-improving drugs that sort of thing... I guess your biofuel is one piece of science that is a real success story, but some of the other stuff I’m not so sure… (she wipes sunscreen on her arm).

**Guy (propped up and watching Joy):** Is that one of the new range from Safesun?
Joy (still rubbing in sunscreen): Yes it is.

Guy (lies back on his lounger): Well that’s new technology.

Joy (looking at the spray can): I know, nanotechnology, it penetrates into the skin better and gives better protection. Stops me burning and it stops me going old and wrinkly. And that’s not just the ads, I think it really works better.

Guy: Clinically proven to be better...

Joy: …and clinically proven to be safe. I wouldn’t touch it at first, not after those cancer scare stories went around. But now most people seem to be happy to use it rather than the old lotions. You should use some, you’re going a bit pink.

Guy: I’ll put some on in a minute. At least I’m not going orange!

Joy: Orange?…

Guy: I was talking about new technology. It reminded me of that story about the orange senators. It was a few years after I discovered the super-producing strain, so I’d already given up working as an investment consultant for that group of venture capitalists who were putting money into small biotech companies. How I hated that job, I should have been in a lab, working at the bench. But having all those wealthy contacts certainly paid off when we wanted to launch the start-up company.

…Anyway, a couple of garage biologists in the States got us all a bad name by giving half the US Congress bright orange skin…

Joy (startled): They did what…

Guy (laughing): Turned them orange! You must have seen the story. They altered a harmless virus so that it accelerated melanin production and then slipped it into the drinks of a couple of interns working at the US Congress. Within a week it had infected half of Congress. Going bright orange, even for just a few days, had the legislators hopping mad. That’s when they cracked down on research, tightened up regulation and introduced strict controls on access to synthetic biology components. It shut down the garage biology movement practically overnight.

Joy (recalling an old memory): Oh yes! I remember the pictures of the (makes quote marks with her fingers) ‘orange senator’ with the scary headlines… It was frightening.

Guy (dismissively): It was safe. It was just a prank…
Joy (forcefully): It was stupid and it frightened people. It could easily have been something much worse, much much worse.

Guy (defiant, but not wanting a row): Well it wasn’t and it made no odds to me anyway. I had already engineered and patented the super-producer strain and the start-up company was up and running. The ‘orange senator’ was all over the news for weeks, when it should have been our announcement that we were about to run the first pilot scale production of algal biofuel...

Joy (puts her hand on Guy’s arm to get his attention): Here comes Bethan, don’t go on about what happened yesterday, she is still a bit shaken up.

Bethan (cheerfully): Hi Joy. Morning Dad, you should put some sunscreen on, you’re going pink.

Guy (muttering): Not you as well…

Joy (laughing): …at least it’s not orange.

Bethan (quizzically): What?

Joy: Never mind… How are you this morning?

Bethan: Absolutely fine. (Pulls up a shirt sleeve). A couple of bruises where I got banged into stuff in the pushing and shoving that went on in the market yesterday. No big deal.

Guy (crossly): You should have been more careful. It could have been a lot worse…

Bethan (bridling): Well it wasn’t...

Joy: Stop it the pair of you, it’s all over with.

Bethan: Well it wasn’t worse. It was partly my fault anyway because Trevor and I stopped to look at some jewellery and lost the tour group.

Guy (crossly): The security guys should have been more careful.

Bethan: Dad, they can’t watch everyone, every moment, in a group that size. They came fast enough when everyone started yelling, after Trevor hit that beggar. He was a bit over the top, my brave twin brother, but I suppose he was as frightened as I was when the crowd pushed in around us like that, all wanting us to buy something or demanding money…

It was a bit scary, they looked so desperate. And up close you can see just how poor they are. They are so thin and the state of their clothes is just disgusting.
Guy: That’s our fault. Years of living on handouts from well-meaning charities and international aid has taught them to expect something for nothing. Most of these people used to be farmers, but they would sooner idle away the days hustling tourists for easy pickings than work the land.

Bethan (indignant): Dad! That’s not fair! They don’t beg because they are lazy. They have no markets for their crops so farming doesn’t pay. A lot have had their land taken to cover their debts. The ship’s doctor was telling me that in 2015 this was a prosperous place. All those derelict oil platforms and offshore windfarms we have passed along the coast used to provide a lot of jobs. When the world suddenly wanted bioenergy, many of the farmers went into growing biomass crops. The economy boomed. Then biofuel came along and the fossil oil and wind energy markets collapsed, farmers lost their markets and their farms and many people lost their jobs. (hesitating) At least, that’s what the doctor said.

Guy: Biofuel is a good thing, it’s cheap, it’s clean, it’s secure and it is limitless.

Bethan: Is it a good thing Dad? It’s good for us! It’s good for the UK! We are all getting bigger houses and bigger cars, it costs us less to travel and to eat, but we are concreting over more and more countryside, everywhere is getting more congested and we still haven’t got on top of controlling CO₂ emissions.

Guy (dismissively): We’ll deal with CO₂ the way we dealt with energy needs, using science and technology, not by living in mud huts. You are too idealistic, the world will never be perfect. There will always be few people who complain – even when things are good.

Bethan: But things aren’t good for everyone. When Mrs Palmer came in to clean for us the other week, she was telling me that she can’t afford to run a car because of the local car use tax and the congestion charge. But the bus company won’t invest in new buses since the Government has relaxed its drive for fuel efficiency and the old buses are so unreliable that she often waits more than hour for one to turn up.

Guy: Bethan, you’re young and you’re an idealist…

Joy (softly): You were an idealist once. That’s why you set out to develop algal biofuel, to make the world a better place…
‘Riding Along on the Crest of a Wave…?’ – Character Card

Joy Morley

**Character:** Female. Ex-occupational health nurse and lecturer at the local medical school. She no longer needs to work because of the wealth of her second husband – Guy. She enjoys the luxury lifestyle. She is intensely proud of all Guy has achieved and will not hear him criticised, but is uneasy that, although he is retired, she sees less and less of the open-hearted idealist and more of the ruthless business man.

**Position:** Joy is comfortable with technology and recognises its many benefits. She has misgivings about some new technologies and their potential impact on human health. She does not see any issues with biofuels, but still worries about the children’s future.

**Fact:** Algal biofuels have dramatically reduced the cost of travel and maintaining a home. The Western economy has boomed, unemployment fallen and planned Government environmental legislation melted away as fuel prices have dropped.

**Question:** What will the future look like for Bethan and her twin brother Trevor? Are there unforeseen consequences of using algal biofuels?
‘Riding Along on the Crest of a Wave…?’ – Character Card

**Bethan Morley**

**Character:** Female. Privileged and uncomfortable with it. She is slightly embarrassed by her family’s wealth and their conspicuous consumption. At the same time she enjoys all the good things that wealth can buy. She is in some ways the typical rebellious teenager, but a ‘thinker’ and aware that she is compromised by her privileged position. Often crosses her father.

**Position:** Technology is so much part of Bethan’s life that, she hardly notices or thinks about it, it is just ‘there’ to be used. Since leaving public school to go to the local Sixth Form Academy she has been exposed to some of the social inequalities in the UK. A couple of cruises and some long haul holidays have also raised her awareness of international inequalities. Her generation are deeply concerned about the environment.

**Fact:** Cheap, readily available biofuel has undermined efforts to reduce pollution and to develop alternative, clean, energy sources.

**Question:** Are biofuels necessary, would it not be better to develop other alternative energy sources and new distribution systems?

‘Riding Along on the Crest of a Wave…?’ – Character Card

**African jeweller**

**Character:** Female. Well educated and articulate. A business woman who has been used to prosperity when she owned and ran a small successful boutique in better times. Now making a living by selling ethnic jewellery she sources from local outworkers. She is resigned to the changes in the economy that have devastated the area.

**Position:** Her experience of technology has largely been second hand. Her business boomed for a few years when biomass crops were in global demand and collapsed when algal biofuels began to out-compete them in the energy market. She is grateful for the mobile phones that transformed communication and trade in Africa and also the trickle down of medical developments that are slowly improving health care.

**Fact:** International companies pumped oil from vast reserves under the sea, then built windfarms, taking advantage of cheap labour and lax regulation, then bought up farmland at low prices to grow biomass crops. It all ended when it became possible to produce algal biofuels, cheaply, in the US and Europe.

**Question:** Is it possible, or desirable, to enforce social responsibility on international companies, so that as economic conditions change, developing economies are protected from disastrous shocks?
‘Riding Along on the Crest of a Wave…?’ Scenario – Character Cards

African beggar

**Character:** Female. An engineer who was trained to work on the off-shore windfarms along the coast. Articulate and educated. She is deeply frustrated that she is unable to find work, to use her education, and is struggling to support her extended family.

**Position:** She is comfortable around technology and recognises and welcomes its many benefits. She is very angry that the global economic systems, which briefly brought prosperity and significant development, have shifted to plunge her nation into poverty again.

**Fact:** Algal biofuel is so cheap and easy to produce that almost all energy is now produced this way.

**Question:** Is it safe or economically sensible for the global energy economy to be dependent on one or two main sources of energy?

Cruise ship doctor

**Character:** Female. African. Articulate and well-educated. The African economic boom funded her medical training.

**Position:** She recognises the great benefit of technology in medical advances such as stem cell therapy and GM vaccines and drugs. She is grateful that she personally has not been affected by the collapse of the African boom, but she is distressed to see the disillusion and despair of the local people and the seeming indifference of the tourists.

**Fact:** Climate change is affecting African agriculture. The uncertainty of the rains means cultivation of food crops is increasingly difficult. Unlimited, carbon neutral algal biofuel has dramatically reduced the international focus on responding to climate change.

**Question:** Carbon neutral algal biofuel has brought many benefits, how should those benefits be shared, especially in mitigating the effects of climate change?
Biofuels have almost eliminated global demand for biomass crops and fossil oil. This has devastated many developing countries that were enjoying increased prosperity from these industries. Poverty and malnutrition are becoming serious issues again, as is damage to ecosystems, because of the collapse of agricultural and economic systems.

- What has happened to other energy sources, like wind, wave and solar power, now that there are more or less unlimited cheap supplies of biofuel from algal sources?

Biofuels are low carbon, rather than carbon neutral. Widespread take up has reduced, not eliminated, global CO₂ emissions. Global warming is occurring more slowly than expected and Governments believe it can be managed by technological solutions, rather than major social and economic changes.

- What has happened to other energy sources, like wind, wave and solar power, now that there are more or less unlimited cheap supplies of biofuel from algal sources?
The buoyant UK economy has attracted labour from all over Europe and beyond, mainly among 20-35 year olds. The economic problems in developing countries have led to an increase in illegal immigrants from the same age group. The rate of job creation has meant there is little concern about immigration: the economy can absorb everybody who wants to work and there are still localised shortages.

• What do you think might be the effect of migration on the countries that young people are leaving to start lives and families in the UK?

• Considering this scenario, how might the UK need to adapt, to ensure its own population enjoys the maximum benefits from biofuels?

• In your view, how might migration affect energy use and needs; locally, nationally and internationally?
‘Riding Along on the Crest of a Wave…?’ – Cue Card 5

Location

Low energy and transport costs have helped to spread growth around the UK. Biofuel production is large-scale, highly mechanised and has generated few direct jobs. Economic growth has driven demand for housing, putting pressure on land around major cities and their dormitory towns.

- How do you think this scenario has contributed to Anna’s quality of life, a young lawyer who commutes daily to work in London?
- Anna’s parents (her dad is a control systems engineer and her mum an electromechanical engineer) are planning to move soon. What kind of housing and which locations might be fashionable in a booming economy? How might the pattern of people’s recreation and holiday patterns change as this scenario develops?

‘Riding Along on the Crest of a Wave…?’ – Cue Card 6

Culture and Values

The UK has pursued a market-oriented, light regulation agenda that has helped growth of new business and industry. It remains at arm’s length from its EU neighbours and is somewhat isolated from the US after a serious political spat over US import quotas for biofuels – provoked by lobbying from US fossil fuel interests.

- How do you think people’s attitude to energy consumption has changed in this scenario, in comparison with the current situation?
‘Riding Along on the Crest of a Wave…?’ Scenario – Cue Cards

Who Wins and Who Loses in this Scenario?

- What kinds of social, economic, environmental and political problems have, in your view, been solved by biofuels in this scenario and which have been exacerbated?
- In your perspective, are there new problems and/or new benefits in this scenario in comparison with our current situation?
- Is everyone equal in this scenario?
- What is life like for a single person, a student, an elderly person, and a poor person in your community currently and what might their lives look like in this future?
- In your perspective, is this scenario good/bad for all nations? What might the global political landscape look like?
- What do you think the government’s role should be in this future? What are people doing about it? Have our responsibilities changed?

‘Riding Along on the Crest of a Wave…?’ – Cue Card

What if...

How would this scenario change if:

- The biofuel algae were developed, but weren’t nearly as efficient as in this scenario biofuel cost as much, or more, than other renewable energies?
- Other bioenergy products were price competitive?
Appendix 5 – Picture Cards

1. Potential for wealth creation

2. Impact on climate change

3. Impact on agriculture

4. Impact on biodiversity
Appendix 5 – Picture Cards

Energy security 5

Fuel price 6

Impact on food security 7

Who benefits from the technology 8
Appendix 5 – Picture Cards

- Is the technology sustainable
- Impact on developing countries
- Impact on farmers
- Development of a new industry
Appendix 5 – Picture Cards

Impact on CO$_2$ emissions 17

Impact on UK food production 18

Impact on wildlife 19

Impact on land use 20
Appendix 5 – Picture Cards

Clean fuel

Impact on greenhouse gas emissions

Who owns the technology

Is the technology carbon neutral

(no additional CO₂ emissions from using it)
Appendix 5 – Picture Cards

Waste products 25

Impact on the existing energy supply chain 26

Impact on existing energy suppliers 27

Impact on existing transport systems 28
Appendix 5 – Picture Cards

Impact on Government’s long term energy strategy

Toxicity to humans

Toxicity to the environment

Impact on international competitiveness
Appendix 5 – Picture Cards

Impact on household utility bills

Impact on other renewable energy sources

Impact on international trade

Impact on environmental management
Appendix 5 – Picture Credits

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18 - Digital Vision ©Thinkstock 2012
19 - iStockphoto ©Thinkstock 2012
20 - Valueline ©Thinkstock 2012
21 - Hemera ©Thinkstock 2013
22 - iStockphoto ©Thinkstock 2012
23 - Comstock ©Thinkstock2012
24 - Hemera ©Thinkstock 2012
25 - Digital Vision ©Thinkstock 2012
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**Appendix 6 – Glossary**

**Advanced biofuels** – commonly refers to biofuels made from non-food crops or that make use of the non-food parts of food crops (in contrast with first generation biofuels). Sometimes referred to as Second and Third generation biofuels.

**Algae** – A group of organisms, ranging from single cells to large seaweeds with many cells. Many algae use sunlight for energy, like plants.

**Algae fuel or algal biofuel** – algae can either be used as fuel themselves or as mini-factories to produce other fuels.

**BBSRC** – Biotechnology and Biological Sciences Research Council

**Biodiesel** – A diesel-equivalent fuel that is derived from plant oil or animal fats, instead of being derived from fossil fuels. It can be blended with diesel to use as a transport fuel.

**Biodiversity** – The variety of all life on Earth, including all species of animals and plants, and the natural systems that support them.

**Bioenergy** – Energy including heat, electricity and liquid fuels, derived from renewable, biological sources such as plant material and food waste.

**Bioethanol** – Biofuel consisting of alcohol produced by fermentation of plant material. It is the principal fuel used as a petrol substitute for road transport vehicles.

**Biofuel** – A renewable fuel produced from biological material such as recently dead plants, animals or their waste.

**Biomass** – Any biological material that, in this context, can be used either directly as a fuel, converted to a fuel or used in industrial or fibre production.

**Biorefinery** – a facility that produces a range of products such as biofuels, chemicals, heat and power, etc., from biological material

**Carbon dioxide (Co2)** – A gas produced by the burning of fuels (as well as when animals breathe). Used by plants to make sugar. Increasing amounts of carbon dioxide in the atmosphere are linked to global warming.

**Carbon neutral** – Applies to a process which occurs without any change in the total amount of carbon dioxide present in the atmosphere i.e. as much carbon dioxide is removed from the atmosphere as is emitted during the process.

**Cellulose** – Major structural material from which plant cells are made.

**Crops** – A plant grown to be harvested for agricultural use.
**Energy security** – is about ensuring people have access to the energy they need, at prices they can afford, today and in the future.

**Enzyme** – A substance that speeds up a chemical reaction in living things.

**Ethanol** – A type of alcohol produced both from crude oil and via biological processes, e.g. by fermenting sugars with yeast (as for making beer).

**Ethanol fermentation** – process in which sugars such as glucose are converted by cells (such as yeast cells) into ethanol and carbon dioxide (as metabolic waste products).

**Feedstock** – Crops or products that can be converted to another form of fuel, chemical, or energy product.

**Fermentation** – An anaerobic (without oxygen) process in which, typically, sugars are converted into alcohol.

**First generation biofuels** – commonly refers to biofuels that are made from the food parts of food crops, such as sugar cane, palm oil and corn.

**Food security** – is about having access to affordable, safe and nutritious food, today and in the future.

In the context of bioenergy it relates to the debate about how land is used, for growing food crops and/or for growing bioenergy feedstocks.

**Fossil fuels** – non-renewable fuels, such as coal, oil and gas, formed over millions of years from plant and animal remains. They offer high energy density, but making use of that energy involves burning the fuel, which releases carbon dioxide to the atmosphere.

**Fuel** – A substance that can undergo a chemical change to release energy, usually as heat, in a controlled way.

**Genetic modification (GM)** – a technology where the genetic material of a cell is altered, often with the aim of making it capable of performing functions it would not otherwise perform, such as producing oil.

**Global warming** – rise in the average temperature of Earth’s atmosphere and oceans since the late 19th century and its projected continuation.

**Greenhouse gas (GHG)** – gas, such as carbon dioxide, that traps heat in the atmosphere.

**Hydrocarbon** – Chemicals that are made only from hydrogen and carbon. Fuels contain large amounts of this type of chemical.
Hydrocarbon fuels – see fossil fuels.

Lignocellulose – The fibrous and inedible parts of plant cells are composed of lignocellulose. It provides the cells with structure and strength. Can be broken down to lignin, hemicellulose and cellulose to be used to make bioenergy, or used directly as a feedstock.

Microbe – A very small living thing that can only be seen with a microscope. Some are harmful and some are useful e.g. yeast is used in bread making but Salmonella can give you food poisoning.

Photosynthesis – process used by plants and other organisms (e.g. algae and some bacteria) to convert the light captured from the sun into energy that can be used to perform the organism’s activities.

Renewable energy – a type of energy derived from a source that can be replenished.

Sustainability – the balancing of environmental, social and economic factors in order to meet the need of present generations without compromising the needs of the future.

Waste product or residue – what is left over or remains from another process. Examples from agriculture include straw from wheat, barley, etc., but forestry and municipal (i.e. relating to a town or district) activities also produce waste.

Sugar – carbohydrate that is a source of energy in respiring cells. Glucose belongs to this food group.