A Changing Climate for Cider

A report by the National Association of Cider Makers (NACM) to its members on the implications of unavoidable climate change for the UK cider industry, developed in conjunction with the UK Climate Impacts Programme (UKCIP)
"Changing Climate for Business" initiative.

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1 Introduction

This report is based on a series of workshops, attended by NACM members, which were designed to understand the risks and opportunities of unavoidable climate change as it affects NACM members and the UK cider industry as whole.

The UK Government set up the UK Climate Impacts Programme[1] (UKCIP) ten years ago to look at the impacts of climate change in the UK and help organisations understand and prepare for these impacts. The work involved the publication of climate change scenarios for the UK, produced by the Met Office Hadley Centre, coordinating stakeholder led research and a range of capacity building activities.

The NACM has joined UKCIP's 'A Changing Climate for Business' (CCFB) Programme aimed at enabling trade associations and professional bodies to progress and share best practice.

The NACM's work was undertaken using UKCIP's resources and methodologies to ensure a rigorous approach. This included the use of UKCIP02 climate change scenarios (Hulme et al. 2002). Full terms of reference can be found in the Appendix.

The scope of the work was limited so that it was as meaningful as possible to the UK cider industry. To this end the scope was limited to:

- Looking out over the next 30 years (approximately the next orcharding cycle)
- The UK cider industry and did not take into account overseas apple supplies or export markets

The objectives of this study were to assess and where possible quantify the risks and opportunities of climate change to NACM members using UKCIP's methodologies. It recognised that there will be other socio-economic changes over the next 30 years, but these are explored in detail in the parallel "Cider Futures" project. Whilst considering all aspects, the study focused on orchards, production, physical assets and market place. Full details and workshop 'write ups' are in the Appendices. The project also enabled a parallel piece of work to take place, the production of an NFU/Forum for the Future "Farming Futures" fact sheet on apple and pear orchard climate change impacts. A copy can be found in the Appendix.

Overall the work highlighted that climate change is likely to impact on the UK cider industry in a number of ways. The four key findings are that climate change could mean:

- A range of new interventions, varieties and techniques will be required to maintain healthy productive orchards, and more thought should be given to siting of orchards to minimise risk from extreme weather events (e.g. Oct '87 storm in the South East);
- Utility costs are likely to rise as requirements for cooling of plant increase and become more widespread against a backdrop of rising electricity and water prices.

[1] www.ukcip.org.uk

- Risks to physical assets will increase, including flood risk and transport to/from risks and companies should seek to address these in good time via business continuity planning;
- There are opportunities for different styles of cider as 'café culture' and warmer weather produce more 'al fresco' usage occasions.

The NACM is now better placed to advise and guide all its members on the risks of climate change, and where appropriate provide background information on potential commercial opportunities.

2 Background to Climate Change Adaptation

There is now a scientific consensus that the climate is changing and that this is as a result of emissions of greenhouse gases. The Inter-governmental Panel on Climate Change, the UN body of leading scientists, concluded in 2007 that it is "very likely that the net effect of human activity since 1750 has been one of warming" (IPCC, 2007). To illustrate, the following gives an overview of some of the implications (mostly taken from headline messages on UKCIP web site scenarios gateway):

- By 2040, average annual temperature for the UK is expected to rise by between 0.5 and 1 °C, depending on region. By 2100, average annual temperature for the UK is expected to rise by between 1 and 5 °C, depending on region and how successful we are at reducing emissions.
- To limit to a 2 °C rise in temperature we need a 60% reduction in global emissions by 2050[2]
- The thermal growing season is expected to continue to lengthen, but soil moisture levels in the summer and autumn are expected to decrease.
- The number of very hot summer days is expected to increase.
- The number of very cold winter days is expected to decrease.
- Heavier winter precipitation is expected to become more frequent.
- Winter storms and mild, wet and windy winter weather are expected to become more frequent (low confidence).
- Global Sea level will continue to rise with extreme sea levels being experienced more frequently.

It is recognised that there are two main actions required from global society, including UK industry, to address this: Mitigation and Adaptation. Mitigation tackles the causes of climate change by reducing greenhouse gas emissions, while adaptation seeks to minimise the adverse effects of climate change as well as exploit any opportunities that may arise.

NACM members are already reducing carbon emissions, through individual companies' work on energy efficiency and renewables.

The levels of climate change for the next 40-50 years indicated above are seen as unavoidable, as they have been pre-set by the previous 100 years. There is a time lag between cause and effect. Over the next few years therefore it is important that we address the business risks and opportunities caused by unavoidable climate change; this is adaptation.

[2] It should be noted that Part 1 of the UK Climate Change Act 2008, enacted on 26 November 2008, gives the Secretary of State a duty to reduce the net UK carbon account for the year 2050 to at least 80% below the level of net UK emissions of targeted greenhouse gases in 1990.

3 Methodology

A small cross-industry group was established, broadly able to represent all business areas; the group was

Bob Cork, Production Manager, Gaymer Cider Company (project leader)
Richard Heathcote, Sustainable Development Manager, Bulmers
Melvyn Dickinson, Marketing Manager, Westons
Liz Copas, independent, orcharding/apple expert
Kay Johnstone, Project Officer (Business), UKCIP

The group held a series of workshops to:

- Familiarise itself with the issues and set scope
- Explore the impacts, risks and benefits
- Prioritise these impacts using a risk assessment
- Where possible identify adaptation options for those risks believed to be highest priority
- Complete a report on the above for members (this document).

4 Findings

4.1 Orcharding

Cider apple trees, a perennial crop, are hugely dependant on weather conditions at all times of the year. Weather patterns in any one year will not only affect the current year's crop but may also have a strong influence in the next year's prospects.

Climate change risks for cider orchards

The unpredictability that climate change brings will inevitably affect the regularity and dependability of the seasonal production of fruit. Atypical weather at critical times during the growing season can cause failure of fruit to set, poor juice quality, low yields and inadequate flower bud production for the following year's crop.

The projected hotter, drier summers threaten periods of drought leading to tree stress, leaf drop, small fruit size and poor juice quality. Associated high temperatures will compound problems of stress. Conversely, the forecast of prolonged winter wet during the dormant season, threatens stress through root losses that can range from moderate and recoverable to lethal.

Apple trees require a set period of winter chilling during dormancy for normal spring growth to proceed. Recent observations confirm that the increasing occurrence of mild winters has already disrupted the spring bud development of some cultivars with a high dormancy requirement, resulting in sporadic, weak blossom and poor fruit set. This shortfall of cold weather is likely to become more pronounced in the future.

Climate change could well increase the likelihood of unexpected farm shifts from arable to orcharding or vice-versa with changes in the economic value of land usage.

There may be a few advantageous opportunities for cider apple growers arising from climate change. It is possible that due to more carbon dioxide available for photosynthesis and growth, there may be a slight increase year on year in tree performance and efficiency leading to greater, more regular crops of fruit. However, this advantage will be limited by the availability of water and nutrients, and could even be offset by losses from tree stress during unseasonable weather.

Some cider apple varieties are blooming one week earlier than they did in the 1970s. Premature flowering may be vulnerable to the occasional spring frost, but earlier spring growth and longer milder autumns will extend the growing season. Prolonged warm autumnal weather greatly benefits late flower bud development. Consequently blossom is stronger, more able to withstand inclement spring weather and more likely to set and hold fruit.

The projected increase in average summer temperatures should lead to earlier and more rapid fruit ripening. It should also increase the juice quality with higher levels of sugar, tannins and enhanced flavour and aroma. Early maturation of some varieties will help to spread the busy mechanical harvesting period and transport of fruit for processing at the factories benefiting both the growers and the cider makers.

Adaptation measures available to growers

There are several measures that growers can and already do use to counteract less than optimum conditions. NACM past and current research work on fertilizer application and pruning techniques offers some answers to maintaining fruit on the trees in adverse summer weather and to improving flower bud development. Biennial fluctuations in cropping patterns are likely as the climate changes, with excessively heavy crops in many orchards followed by generally light crops throughout, with the accompanying disruption at the cider mill. Unfortunately, chemical means of influencing fruit set to achieve the regular annual cropping that is desired by the cider maker are no longer available. However there are some chemical means of manipulating fruit maturation to optimise juice quality and to supply the industry with fruit at the desired timing, but further work needs to be done in all these areas.

To counter problems of stress cider apple growers will need focus harder on the management of their water resources and land drainage. There are plenty of possibilities for collecting and storing excess winter rainwater, or for recycling water from cider mills or from other industrial use. Water piped from settlement ponds through an irrigation system could then be used in time of drought, and applied directly to the trees through the soil. To save water, fertilisers could also be applied through the irrigation network, a system known as ‘fertigation’. It is possible to ameliorate drought stress with foliar applied anti-transpirants that minimise water loss from the leaves. With the use of infra-red aerial imagery, water irrigation or anti-transpirant sprays could be targeted as and when most needed to areas of orchards where trees are showing stress.

Clearly it is even more important to deliberate and choose a site wisely when planning to plant a new orchard. Attention must be paid to establishing stone back-filled, under-soil drainage prior to planting and to the provision of ample drainage ditches. Ground with a high winter water table or impervious subsoil will be unsuitable, although there might be the possibility of planting trees in raised beds, similar to the old practice of 'landing' fields. Other adaptation measures include shade netting of the trees during particularly hot spells and planting on the North facing slopes.

Careful selection of a water tolerant rootstock and cider cultivar will increase the site's long-term prospects. Clearly growers should choose cultivars suited to their local conditions and cultivars with a dormancy requirement should be limited to cooler latitudes where few orchards exist at present.

How the industry is responding

Many of the potential risks attached to climate change have been discussed briefly together with suggestions for adaptation in NFU Farming Futures Fact Sheet: 16, which is available to all growers. Members of the NACM Pomology Committee give individual advice on remedial action. The Pomology Committee has been working on related areas of research for a number of years much of which may be adapted to relieve climate change problems. Growers are kept up to date with the progress of the NACM work through the Growers Update, a bi-annual magazine circulated to all cider apple growers that supply the main cider makers. Research information is also freely available on request in the form of NACM Technical Reports. Additionally, many common problems that arise are discussed during the annual Growers' Orchard Days in orchard locations throughout the counties.

NACM recognises that there is more work needed to counteract climate change problems and is prepared to continue its efforts where necessary. Future initiatives could include:

- A limited 'risk' forecasting service. At present it is neither economic nor possible for growers to insure against catastrophic crop losses. However, should there be a major short-fall of fruit supply from a section of suppliers contracted to any one cider maker, it is normally possible to 'buy in' cider fruit from other non-contract growers.
- Provision of site-specific advice to growers on all climate change issues.
- Research into the dormancy requirements and stress tolerance of commonly used cider cultivars and rootstocks.
- The cider industry may need to strengthen further the partnership between growers and cider makers.
- Promoting the understanding that bittersweet cider apples have no market outside the cider industry, and that a secure market, and possibly a supply contract, needs to be established before investment in planting a long-term crop.

4.2 Production and Logistics

Production and the logistics of delivering product to the consumer will always be governed by two primary drivers. The nature and availability of raw materials and the market forces that prevail. The impacts on both these drivers are considered in the relevant sections of this report, the following chapter considers the adaptations that may be needed within the industry to support these changes. A third driver has also been taken into account for the purpose of this study, that of the need to mitigate the environmental impacts of cider production and associated transport.

Raw Materials – Apples

The cidermakers of the future will be presented with a number of threats to the availability of their basic ingredient – apples for cider making. The varieties that come to the fore in a changing climate will present challenges in maintaining the flavour profiles and character of existing styles and brands. This said, the key here is in the adaptations made in orchard management. There is no evidence to suggest that the basic nature of cider fruit will change significantly. Juice will continue to be blended from Bittersweet, Bittersharp, Sharps and Sweets cider apple varieties. Dessert and Culinary apples with their distinct characters will also remain available.
The art of the cidermaker will need to be employed to create blends that take into account the subtle changes due to the possible shift in varieties. The resultant finished products should be little changed from today's examples. This continual adaptation process has always been a corner stone of the industry.

Single Varietals products will be at greater risk, particularly if based on apple varieties that fare less well due to changes in climate conditions. Some of these products may be lost, whilst others may change in both flavour and character. The nature and the attraction of this type of product is its diversity and that the product will change depending on the vintage. Therefore market tolerance of flavour shift here is much greater. The opportunity to take advantage of new and or changing varieties to bring new versions to market should not be forgotten.

Climate change will bring challenges to the cider producer to innovate and bring new products to market. These new products will be more influenced by the paradigm that is created by the changing market rather than changes in the raw materials available. Cider makers will be expected to adapt the raw materials, production methods and technologies to produce what the customer requires.

Raw Materials – Other ingredients

Sucrose, glucose and fructose syrups used for the chaptalising and sweetening of ciders are probably the ingredient that will be most affected by climate change. Their future availability is more likely to be dictated by the need for bio-fuels than by the impact of climate on the production of the base crop. The future supply of this type of material will not be within the control of the industry. Individual cider making companies will need to work closely with their suppliers to understand the wider market, secure supply and or seek alternative products.

The general supply of additives and ingredients will be impacted by the general rise in fuel costs. Local sourcing will be desirable and this will require cider makers to be inventive in using alternatives which have a lower carbon footprint.

Production Methods

The need to adopt best practice to reduce carbon emissions, control pollution, reduce water usage and minimise environmental impact will be the primary drivers related to climate change. This is 'mitigation' and therefore not the focus of this report. However, production methods will also need to be adapted to minimise the impact of changes to raw materials and ingredients resulting from climate change and there are some interactions between adaptation and mitigation.

Early cropping of fruit may increase the levels of starch present in some varieties at time of harvesting. This is a problem which is well known to cidermakers in present times, it is considerably reduced by ensuring the fruit is harvested when fully ripe. The first level of control must be at the orchard and the scheduling of fruit supply to the mills. A number of starch conversion tools are available to the cidermaker to deal with increased levels, should it become a problem. The down side of introducing an extra step in any production process is the increased use of resources and materials.

Higher ambient temperatures will increase the loading on process cooling systems and therefore generate greater energy usage. Some offset of this increased energy requirement will be gained from heating processes that will require less input. Future design will need to be more inventive to reduce energy consumption. A synergistic approach leveraging both the engineering advantages combined with changes to the actual processes themselves to achieve maximum benefit will be required.

Cleaning of equipment and plant uses considerable quantities of energy, chemicals and water. Member companies of the NACM will have all investigated ways of minimising the consumption related to cleaning whilst maintaining the high levels of hygiene required. Going forward even greater emphasis will need to be given to maximising production in relation to cleaning processes. Constant review will be necessary of the environmental impact of the chemicals used. Further work is also required to investigate the potential to reduce cleaning fluid temperatures and revise processes to minimise water usage, including recovery and treatment to enable reuse.

Rising energy prices will raise questions regarding the methods used to achieve microbiological stability in products. Heat processes including pasteurisation and cold filtration systems are used extensively at present. Chemical methods of stabilisation might also be an option. Companies will need to keep an open mind when evaluating the impacts of these systems. Heat processes need to be compared to the manufacturing footprint and transportation of filtration materials, cartridges etc., while pumping energy is also a consideration. Permitted chemical systems need to be evaluated in the same way considering all aspects of the manufacture and transport.

Microbiology

The overall increased temperatures and damper climate will inevitably have an effect on all areas of microbiology. The rapid growth of organisms in this type of environment might well pose issues for the UK similar to those encountered in warmer regions of the world. Alcoholic beverages by their nature do not support the growth or survival of pathogenic organisms. Cider with its relatively low pH is particularly robust and therefore no food safety issues related to microbiological issues are envisaged.

Potential for the more rapid growth of cider spoilage organisms may increase the risk to product quality from secondary fermentation. This should be taken into account when considering methods for microbiological stabilisation.
Within the parameters of the climatic changes suggested within the UK, major transformation relating to fermentation yeasts or spoilage organisms is unlikely. The presence of wild yeast may increase this will be seen as an advantage to some makers and a hindrance to others.

The production of *mycotoxins* due to the increased susceptibility to moulds on fruit harvested in warmer wetter conditions may create a problem. This issue is well recognised in the fresh pressed apple juice sector. Again, good orchard management and the development of better harvesting techniques will be the key to combating problems in this area.

How the industry is responding

As indicated above, cider-makers are continually exploring techniques for improving the efficiency of their operations and quality of their product. These include the use of starch conversion tools, approaches for improving water and energy efficiency and harvesting techniques that minimise mycotoxins. Much of this activity has external drivers not related to climate change but will become increasingly important as the climate changes. There may be a role for the NACM in sharing information and best practice as well as identifying and tackling gaps in knowledge, such as the likely effects of climate change on microbiology.

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4.3 Marketplace

Cider is a refreshing drink, the consumption of which noticeably increases during warmer, sunnier weather. During recent years the general impression of cider and cider drinkers has been enhanced as being a more premium drink attracting a wider cross-section of male, female and younger (25 to 35 year old) consumers. Cider is increasingly consumed as an accompaniment to food, both in restaurants, bars and at home. Weather patterns have an almost immediate impact on cider sales especially during the summer months.

Climate change risks for Markets

The change in climate patterns is projected to be gradual which provides plenty of time for cider producers to adapt their products, packaging and sales techniques to

accommodate the risks anticipated to be encountered. Due to the projected increase in ambient temperature the consumption of cider is also likely to increase placing demands on the supply of raw materials, production, warehousing and distribution. Provided the supply chain can be managed, the impact of the projected climate change will, in general, have a positive impact on the overall sales of cider.

Warmer, more reliable summer weather will encourage tourism within the UK and visitors, in turn, are more likely to drink cider, as being a traditional English beverage. The combination of the increase in tourism and warmer weather will encourage more of a café culture, where there is a greater demand for lighter, fruitier ciders of lower alcoholic strength.

Climate change could mean that the profile and style of ciders would have to change to those that are lighter and based more on a culinary/desert apple rather than bitter sweet. For some suppliers this would be a distinct advantage whilst for others they will need to make significant changes to meet the new consumer tastes. The introduction of different types of cider apple, more suited to the changing climate, will mean that there will be a change in styles and tastes of cider, all of which will need to be marketed in a positive manner.

Adaptation measures available to the marketplace

There are numerous measures that cider producers can and have already started to implement in order to be able to capitalise on the projected climate change.

The impacts of climate change on product marketing will take place against a backdrop of a greater awareness of sustainability in general and the impact companies have on the environment when producing products. Packaging materials and in particular waste packaging materials will need to be more environmentally “friendly” with a much greater emphasis on recyclable materials and packaging from sustainable sources.

Often recycled materials can have a “substandard” appearance which detracts from goals of the overall packaging and presentation of the goods. Consumer education is needed to emphasise the benefits of being more environmentally aware.

It is likely that climate change will necessitate the need for different types of packaging. Non glass packaging that is suitable for a wide range of outdoor venues is an obvious example. Other examples are the use of materials that withstand rapid chilling and packaging that withholds or supports the use of ice/rapid cooling substances.

As ambient temperatures rise there is likely to be an increased demand for cider to be served at lower temperatures. This will necessitate the need to produce ciders that are capable of retaining their flavour at these colder serving temperatures.

An increase in the café culture would bring a new “style” to the consumption of ciders. Smaller serving sizes at lower strength abv and capable of being dispensed chilled will be more in demand. Cider producers will need to recognise and respond to these changes in consumer demand.

How the industry is responding

For the marketing of cider the anticipated climate change is likely to bring more advantages and opportunities than risks. Already there is a greater awareness of the need for lower alcohol strength ciders and cider that retains its taste when chilled. The main challenge will be for smaller producers to recognise these changes and be able to adapt accordingly.

4.4 Other (inc. physical assets, finance etc)

This section of the report considers some of the non-specific areas which could be affected by climate change, which are just as essential to cider making as any other business. The section considers the risks to cidermaking's physical assets (cider mills, farms, production and supply/delivery logistics, etc.), and the necessary evils of running a successfully risk managed business - finance and insurance.

Physical security

The insurance industry's responses to recent flooding have been well documented in the media, and this may seem the most obvious impact, however it is not the only one (rails buckling in summer heat come to mind!).

Each physical site will have a number of different aspects which might be affected and it is important to understand both direct and indirect climate impacts on these. Direct impacts include a greater risk of damage to stock and physical assets from flooding, subsidence or excessive summer temperatures and difficult working conditions. These in turn could lead to unexpected expenditure, production downtime, lost revenue, staff comfort or health and safety concerns. The level of risk will vary from site to site, therefore it is important to understand:

- The surrounding geography and geology, including aspect, slope, proximity to water courses, drainage and the ability of the land to soak up run-off.
- The age, design, fabric and quality of buildings.
- The relationships with suppliers, contractors and customers and their likely attitude towards potential disruption.
- Any specific vulnerabilities relating to the workforce (e.g. old, young or unwell people can be especially vulnerable to difficult working conditions).

Only by taking into account the specific local conditions for each site, be it cider mill, farm, depot, can these types of risks be properly assessed.

To prepare for these impacts there are a number of adaptation options which can be considered:

- Ensure drainage ditches are maintained, remembering that they may not be your ditches or even that close to the site;
- Consider building diversionary water courses – this is now common practice on new housing/industrial developments, but not when extending an existing site;

- Consider climate factors when undertaking any new build or landscaping work, what are the height, location and aspect factors that could help reduce the impact, e.g. use of trees to provide shading as well as wind breaks to reduce heating/cooling (e.g. of tank farms);
- For direct flood risk consider re-siting essential 'back office' functions e.g. IT infrastructure on higher floors or even just "upstairs";
- Consider investment in contingency e.g. portable pumps.

Given the various market factors, fuel prices are likely to rise significantly over the period of this study. Another risk is interruption of supply of utilities due to the impact of extreme weather events outside the site. To provide security against this consideration could be given to the following. Some of these will also contribute to a reduction in utilities costs.

- Rain water harvesting (and storage) for all 'grey' water uses;
- Some of the financial risks of supply interruption can be offset by negotiating contract terms;
- Recognise critical vulnerabilities and invest in 'coping' capacity, e.g. standby generators, portable pumps;
- More strategically look to invest (this is a long term issue) into renewable technologies embedded on site e.g. solar thermal, wind, ground source heat etc.

Transport arrangements might also be affected – if tarmac melting, flooding or storms were to become a regular problem then there would be severe disruption to transport arrangements. This will apply to both inbound supplies and outbound deliveries. For an industry where the large companies distribute nationally and internationally this may be real issue, but smaller companies can also be affected. How dependent on efficient distribution has each company's market become? There are not many adaptation options for transport but consideration could be given to:

- Diversify modes of transport making use of rail and water (canals or short sea shipping)
- Use of tactical inventory (a return to more localised depots and the end of the Regional Distribution Centre are real possibilities).
- Build 'slack' into logistical arrangements i.e moving away from 'just in time' systems.
- Increase flexibility of supply chains by developing a diverse range of suppliers, routes and delivery arrangements where feasible.

Commercial Insurance

Anecdotal reference was made to insurance above, and risk of increased commercial premiums is a very real one. There were 27,000 commercial claims made after summer '07 floods (ABI, November 2007), and a proportion of these businesses will never recover. The Association of British Insurers has published a climate change manifesto (ABI, June 2007), which sets out the industry position in some detail.

In order to reduce exposure to increased premiums there is a number of options which might be considered:

- Joining forces as an industry to spread risk and collectively negotiate reduced premiums. This could be industry based e.g. NACM, BBPA, or also through the larger trade federations on a geographic basis e.g. the Food & Drink Federation;
- Consider business critical back-office infrastructure – can it be sited in a less risky part of the site, on higher floors?;

- Undertake flood prevention work to negotiate reduced premiums – the insurance companies will increasingly take note of flood barriers, temperature resilient buildings, etc.;
- Reduce the threat by working closely with insurers; what do they see as the critical issues for your site? - and then see how they can be addressed;
- Use the insurance companies as advisers for new sites – remember they will have teams of people assessing climate change risk as full time roles.

Finances

Beyond insurance, there are two main aspects to the potential financial impacts of climate change: cost of capital and interest rates and the actual cost of equipment. Both of these are perhaps more affected by a number of factors beyond climate change, but the net effect is the same – increased costs.

As the Indo-Chinese economies grow, demand for capital goods is increasing with global price increases for steel, aluminium etc. leading to increased costs. These macro-financial pressures and climate change impacts, may lead to changes in markets with currently unforeseen demands for goods and materials leading to increased costs.

Again, there are a number of ways industry members could work together to minimise these:

- As the NACM, we could carefully monitor capex cost drivers via the various economic indicators, but we will need to decide which are most relevant to UK cider growth and expansion, and also look for new drivers – when will the need to cool increase demand for cooling plants?
- Secure a proportion of the financing of long term core or base fixed cost . In the short term this is likely to be more expensive but will make the longer term predictable, available, less 'noisy' and so cheaper in the long run;
- Could the NACM set up negotiated special loan facility for smaller members/affiliated members?

This area is not clear, and it is recommended that we study this in more detail (probably via a third party) as trends emerge over the next few years.

5 Conclusions and Next Steps

In conclusion, the study and this report show that there is a number of critical areas for UK cider which will be affected by climate change. Whilst the exact rate and exact implications of the projected climate parameters cannot be known, as an industry we are now aware of the direction and in this report have explored risk, opportunities and adaptations we can consider.

Some of the implications of climate change are site specific while others are industry wide. Therefore, it is up to individual companies to decide what type of action to take for themselves, and the NACM Executive Committee might consider over the next few years what interventions might be made for the industry as a whole. This could include, for example, forecasting, advice, strengthening networks, research, information sharing or awareness raising activities.

In terms of next steps, the NACM intends to release this report later in 2008 and might promote it using appropriate media. It is recommended that each company should consider these findings carefully.

It is also recommended that the NACM should continue to work closely with UKCIP over the next few years as new climate change scenarios (projections of future climate) become available. These new projections (UKCIP08 is imminent) will have features which will enable probabilities of particular climate parameters to be projected. This will lead to more knowledge over the timing of critical 'weather' changes. This will in turn enable consideration to be given now to new directions for orchard development and also emerging new styles and usage occasions for cider.

6 Appendices

Full list of impacts, risk and opportunities by BACLIAT heading.
Prioritisation matrices and rationale.
Full list of workshops notes on adaptation options.
ABI report
Terms of reference
Farming futures factsheet

References

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UKCIP Scenarios Gateway web pages:
http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=156&Itemid=287

Appendix 1: Terms of Reference

Vision, objectives, scope and deliverables

- The vision is to provide information that will contribute to the adaptive capacity of the UK cider industry.
- The study aims to identify the significant impacts that climate change is likely to have on the UK cider industry up until the 2030s and explore a range of options for adaptation.
- The scope of the study includes orchards, production and markets but not raw material production. This matches the scope that has been set for parallel activity on carbon foot-printing.
- It is recognised that some impacts will be very location or business specific therefore this study will aim to take an industry perspective.
- The future time period of the 2030s has been chosen to reflect the timescale required for orchards to reach maturity.
- The output will be a report aimed primarily at cider producers in the UK of all sizes and types but also at cider apple growers.
- The assumptions for all of the analyses are: that there will be a UK cider industry in the 2030s and that production will be based within the UK.

Stakeholders, roles and responsibilities

- The project team comprises:
    - Bob Cork, Gaymer Cider Company
    - Richard Heathcote, Bulmers
    - Melvyn Dickinson, Westons
    - Liz Copas, Independent Consultant (orcharding)
    - Kay Johnstone, UKCIP
- It is recognised that smaller cider producers are not represented in this group, therefore care will be taken to include consideration for this group of stakeholders at each stage of the process.
- UKCIP will coordinate the process and provide details of the current climate change scenarios for the UK.
- The four cider industry representatives will provide all of the background information on the cider industry, carry out the analyses and write the final report.
- It is not the role of NACM to influence the competitive relations between companies and the responses to climate change are likely to be different depending on location, business model, processes etc. Therefore the emphasis will be on representing a range of alternative adaptation options rather than telling members which to implement.

Resource, financial and quality plans

- NACM will fund the time of the four cider industry project team to work on this study.
- UKCIP is funded by DEFRA, therefore support is free on the understanding that where not commercially sensitive the learning and findings can be fed back into publicly available tools and resources.
- The project team has been chosen because of the wide range of expertise they bring covering knowledge of orcharding, production processes, cider markets, business management and climate change impacts and adaptation.
- The report will be reviewed by NACM committee to make sure it is industry relevant and by UKCIP to ensure scientific rigour.

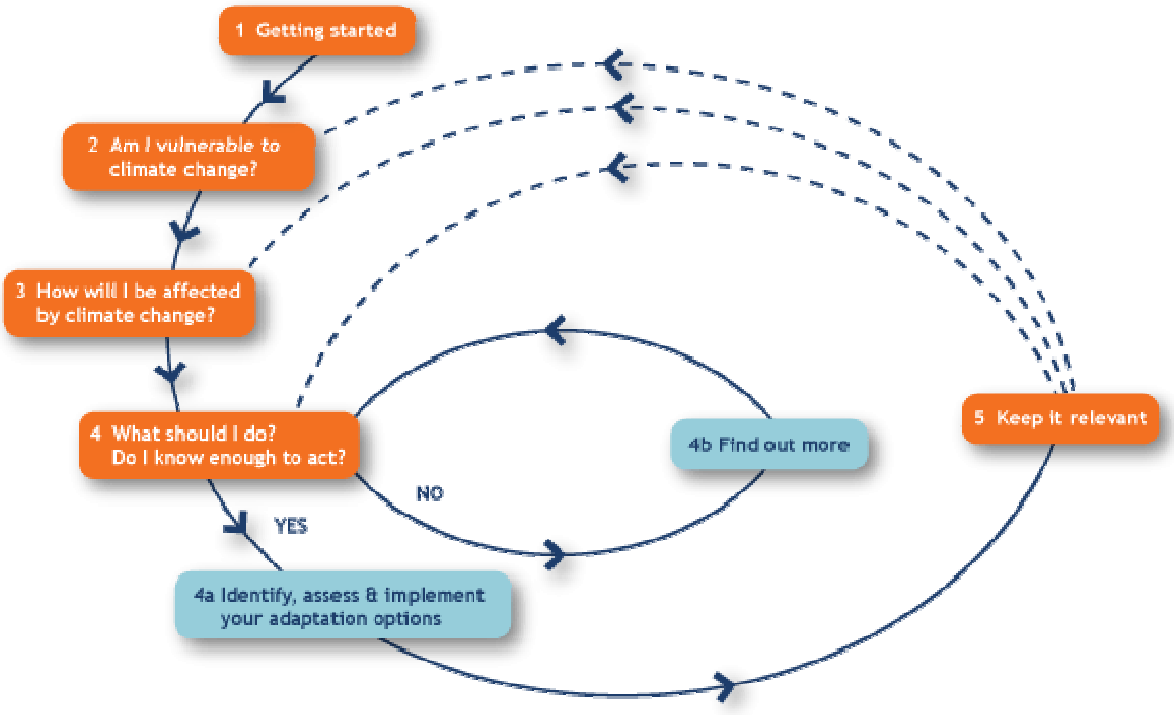
Work breakdown structure and schedule

- Four meetings will be held throughout 2007 and early 2008 to scope the likely impacts of climate change, assess the risk to the industry and identify a range of adaptation measures in priority areas.
- The draft report will be launched at the NACM AGM and the final version soon thereafter.

Appendix 2: Methodology and Process

The study was guided by the structure of UKCIP's Adaptation Wizard (see figure A.1 below), which is based on the Risk, Uncertainty and Decision Making Framework. This includes a process of first understanding the issue, setting the scope and objectives, consideration of current vulnerability to weather and climate and future climate impacts and identifying a range of adaptation options. All of these questions are revisited throughout the process and monitoring and review of these findings is an ongoing activity.

Figure A.1: The Adaptation Wizard



For more information on the Adaptation Wizard see:
http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=147&Itemid=297

For more information on the Risk Uncertainty and Decision-Making Framework see:
http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=62&Itemid=184

The NACM study was structured as follows:

Meeting one on 30 November 2007

- Kay Johnstone gave an overview of UKCIP and climate change impacts and adaptation.
- Dave Marshall introduced the Farming Future factsheets and explained the HOCE project as context to this study.
- A discussion was started on scope, assumptions and objectives
- An exercise was started in scoping the impacts of climate change using UKCIP's Business Areas Climate Impacts Assessment Tool (BACLIAT). This is a brainstorming aid for scoping the impacts of climate change on either a company or a sector, encouraging users to think of both threats and opportunities under six generic business areas: markets, process, logistics, premises, people, finance.
- The 'process' business area was amended slightly to break it down into raw materials (orchards), cider production and packaging.

For more information on BACLIAT see:
http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=82&Itemid=195

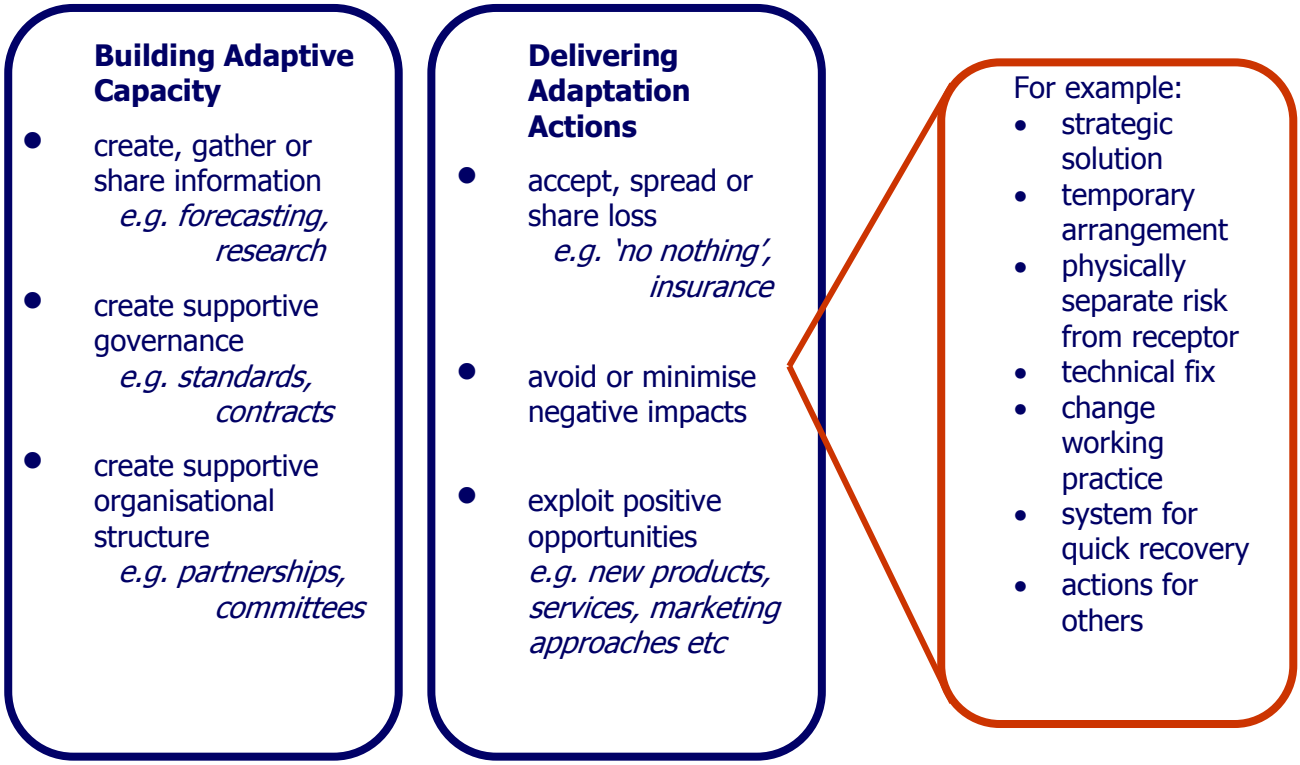
Meeting two on 6 March 2008

- The BACLIAT exercise started previously was completed. The results of this are shown in appendix 3 below.
- The list of impacts that resulted from the BACLIAT exercise required some consolidation in order to remove duplicates and those that were more features of vulnerability (for example 'orchards have long planning horizons) rather than impacts and to clarify the description of each.
- A risk assessment was carried out on the threats identified in the BACLIAT exercise. A scale of 1-5 for likelihood and magnitude was used. The likelihood and magnitude were estimated using a mixture of expert opinion and deliberation within the group. The results of this are shown in appendix 3 below.

Meeting three on 23 May 2008

- A risk assessment was carried out for the opportunities identified in the BACLIAT exercise. Again a scale of 1-5 for likelihood and magnitude was used. As part of this there was some consolidation, revisiting, removal of duplicates etc. The results of this are shown in appendix 3 below.
- The scope, objectives and context were reviewed in discussion, including the significance of the parallel work on futures being led by Forum for the Future.
- A brainstorming session began the process of identifying a range of adaptation options for key threats. The group was encouraged to think of a wide range of adaptation options include those aimed at building adaptive capacity as well as adaptation actions that could be taken. The framework in figure A.2 was used to encourage lateral thinking.
- Interim work between meetings three and four was carried out by the project team to complete the identification of a range of adaptation options for priority threats, drawing on the specific expertise of the group.

Figure A.2 Different types of adaptation options



Meeting four on 23 July 2008

- The group discussed the range of adaptation options that had been identified since the last meeting adding to and amending these as appropriate.
- The report structure, style and target audience was agreed.
- There was some discussion on next steps including marketing, dissemination and further analysis,

such as the use of the forthcoming UKCIP08 scenarios.

Appendix 3 Climate Risks

The potential threats and opportunities to the UK cider industry presented by climate change are listed in tables A.1- A.8 below for each business area. Figures A2 and A3 then show risk assessment matrices for threats and opportunities respectively. The numbers match up with the impacts in tables A.1-1.8 and the priority risks are contained within the blue sections in the top right hand corners.

Table A.1 Impacts on markets

Threats		**Opportunities**	
1	Too hot and humid for cider consumption	1	Increased consumption of cider due to rising temperatures
2	Bitter sweet ciders could be less preferable in hot weather	2	Increased tourism due to more reliable summer weather and more inbound tourism
3	Increased outbound tourism in winter reducing the market	3	Different styles of ciders because of different varieties
4	Increased/ different packaging requirements in hotter weather	4	Product diversification (café culture, lower abv, still vs sparkling etc)
5	Marketing threat of increased consumption i.e. reputation issues	5	Outdoor drinking of mulled cider during mild winters
6	Wet, windy winter weather could result in "SAD" winters and reduced cider demand	6	Increasing popularity of east coast style ciders
		7	Localism of spread of cider apples
		8	Producers in dappled shade areas feature

Table A.2 Impacts on process: raw materials (orchards)

Threats		**Opportunities**	
7	Potential stress (Long drought or long wet)	9	Longer growing season and increased sugar but countered by decreased yield plus pressing costs and complexity
8	Different and / or more pests and predators	10	Growing different varieties allowing growers to be more dynamic and responsive to the market, increasing return on investment and spreading the risk
9	Unexpected farm shifts (e.g. Blue Tongue)	11	Growing in new or more places, e.g. increasing temperatures will benefit the further north where there are longer days:
11	Less regular and predictable crops		
12	Threat to winter dormancy in milder winters leading to bud problems and disturbance to patterns of tree growth		
13	Increased threat of fireblight infection resulting from a combination of hot days and storms, especially for pears.		
14	Catastrophic crop loss by single extreme weather event		
15	Orchard crop manipulation and timing of cropping becomes more complex (location specific)		

Table A.3 Impacts on process: cider production

Threats		Opportunities	
16	Reduced CO_2 availability	12	Reduced evaporation costs (but increased cooling costs
17	More extraction problems (e.g. if sugar is harder to process or starch issues)		
18	Increased use of utilities (cooling – thermal efficiency/ balance; water use; water availability)		
19	Challenge in maintaining the taste profile in the face of apples grown in the new climate		
20	Similar issues for syrups		
21	Pathogens could adapt to the new conditions leading to implications for plant, packaging and consumption		
22	Difficulties in maintaining temperature control in material storage		
23	Impact on microbiology and biochemistry		

Table A.4 Impacts on process: Packaging

Threats		Opportunities	
24	Packaging implications arising from the requirement for cooler products	13	Different consumer packs for different usage occasions (i.e. café culture, outdoors / over ice, multi packs, self cooling packs, branded ice etc)
25	A change in CO_2 carbonation trends	14	Bottle conditioned CO_2 fermentation

Table A.5 Impacts on logistics

Threats		Opportunities	
26	Threat to security of energy supply and waste collection, especially in rural locations.	15	Geography of production and distribution changes leading to cost savings at medium and small scale cider-making.
27	Threat to security of deliveries to site, especially with 'just in time' systems and especially in rural locations.		

Table A.6 Finance

Threats	
28	Increased commercial insurance premiums
29	Investment more difficult to obtain or more expensive
30	Increasing costs of water, energy and costs of action on orchard pests and diseases.
31	Change in fiscal structures as a response to the changing climate could affect the cider industry like any other
32	Loss of income from competitive pressure that comes from "ciders" that do not conform to the UK standard and are therefore able to adapt to climate change pressures by reformulation

Table A.7 Impacts on people

Threats	
33	Difficult working conditions inside and outside
34	Travel disruption caused by extreme weather events

Table A.8 Impacts on premises

Threats	
35	Physical security flood, subsidence etc
36	Environmental concerns relating to increased odour in hot weather

Figure A.3 Risk matrix: threats

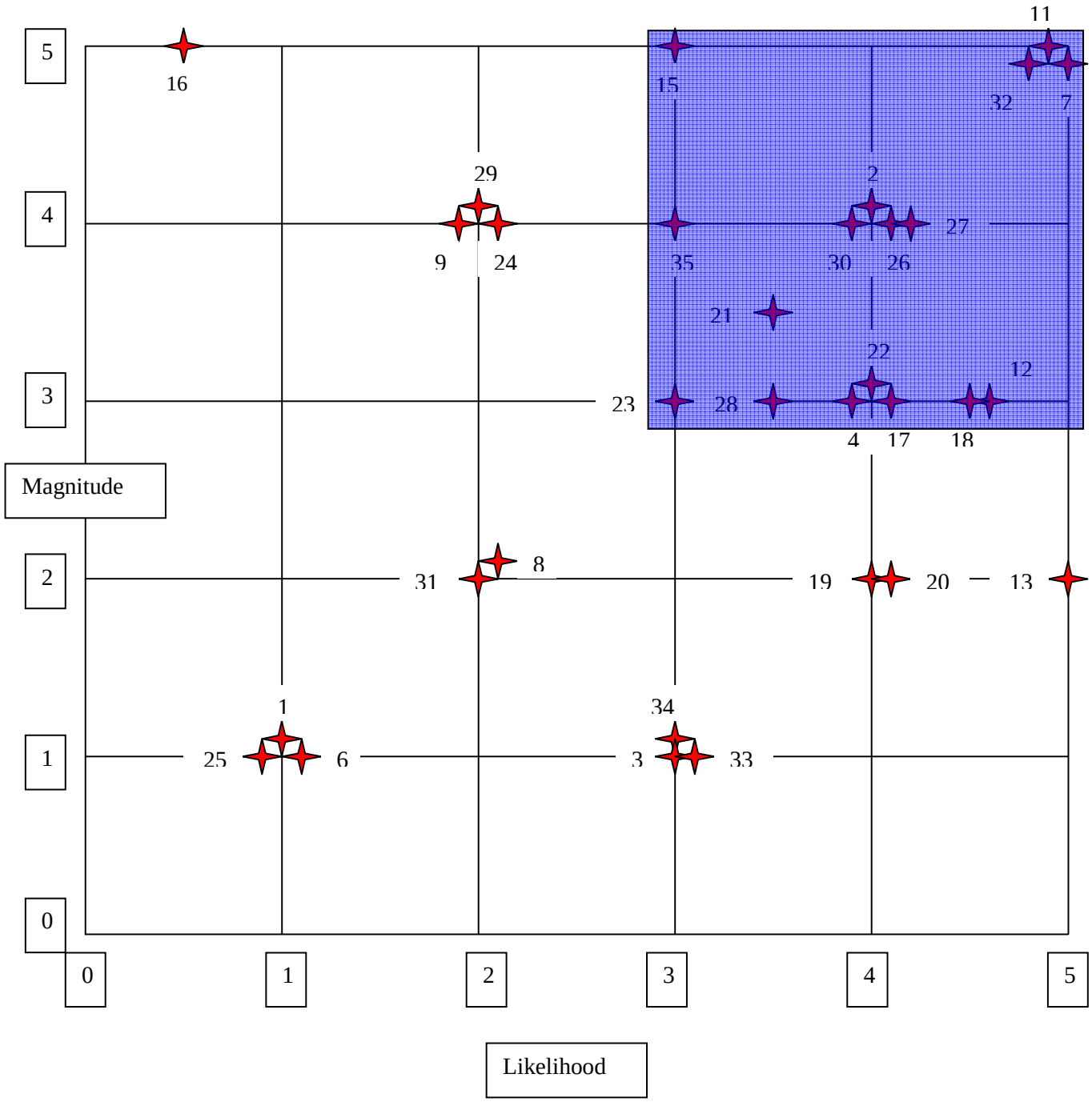


Figure A.4 Risk Matrix: Opportunities