



# FOOD SUPPLY IN THE BALANCE

A study to assess the opportunities  
and threats to UK agriculture



Technical work jointly funded with



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## Foreword



*The process of identifying and prioritising threats and opportunities through stakeholder consultation is appropriate given AIC's industry role. It is noticeable that of the resulting list of ten threats, six relate to the threat of increased regulation*

*in some way. There are good economic arguments for intervening in markets that fail, with environmental 'goods and bads' and perhaps some aspects of animal welfare and disease show characteristics that could lead to market failure. Government tends, for political and other reasons, to use regulation, or incentives (eg environmental stewardship) to do this, although there is a body of research that suggests there are more cost effective methods for achieving objectives involving non-market goods.*

*There is an opportunity for the industry to acknowledge that some form of intervention is necessary, but there may be better ways of doing this than relying solely on regulation – better for industry, consumers and taxpayers. A review of methods being used around the world would be a good place to start the process. Improving standards, where exploited, can also have industry benefits.*

### Modelling

*Modelling is difficult and it is not clear that the simple modelling approach effectively captures the commendably restricted ambition of quantifying the effect of selected threats and opportunities on UK agricultural output alone. My overview role does not lead me to offer a judgement on the values produced and therefore my comments should not be used in support of the individual or aggregate results produced. As Andersons recognised at the outset, any modelling exercise is 'wrong' at some level; it is therefore a question of how useful models are. The modelling employed is useful as it has helped to identify important evidence gaps that need to be addressed.*

### Dr Stephen Ramsden

Associate Professor in Management and  
Director of University Farm, School of Biosciences  
University of Nottingham

## Introduction



**At a time when the industry is striving to meet the challenge to 'produce more with less' it is evident that agricultural production is directly impacted by single issue policy decisions.**

In 2013, AIC Board discussions expressed growing disquiet with single issue policy making which appeared to take no account of the cumulative impacts of policy developments. It was felt that these impacts were becoming increasingly detrimental to the UK's

agricultural capacity. This view instigated a journey to understand in more detail the overall opportunities and threats to UK agricultural production. Other studies have addressed specific constraints to production, but we are not aware of any piece of work that is so broad reaching across all sectors. This discussion document brings together two years of investigation and broad industry dialogue. It highlights some of the great opportunities that UK agriculture has along with some serious threats.

I am indebted to Stephen Ramsden of the University of Nottingham for reviewing our work, writing the foreword and his contributions at various points in this document.

We now wish the discussion to continue, for more information to be added to the mix and the industry – both in the UK and across Europe – to rise to the challenge of food supply being in the balance.

**Jon Duffy**  
Chairman, AIC

AIC has documented its analysis and with the help of experts and a simple tool, referred to as *Agmap*, has made a start in providing answers to the key question policy-makers are asking: "What will be the overall effect on UK agriculture if...?"

In some areas, a wealth of information exists to answer the question, but is not being used. Elsewhere, no information exists at all. Our aim was not to estimate values with absolute accuracy but to indicate the likely direction and magnitude of the productivity value gap.

We hope this study will stimulate debate at every level within the UK governments and especially within Europe where so many of the policies affecting our industry are now formed.

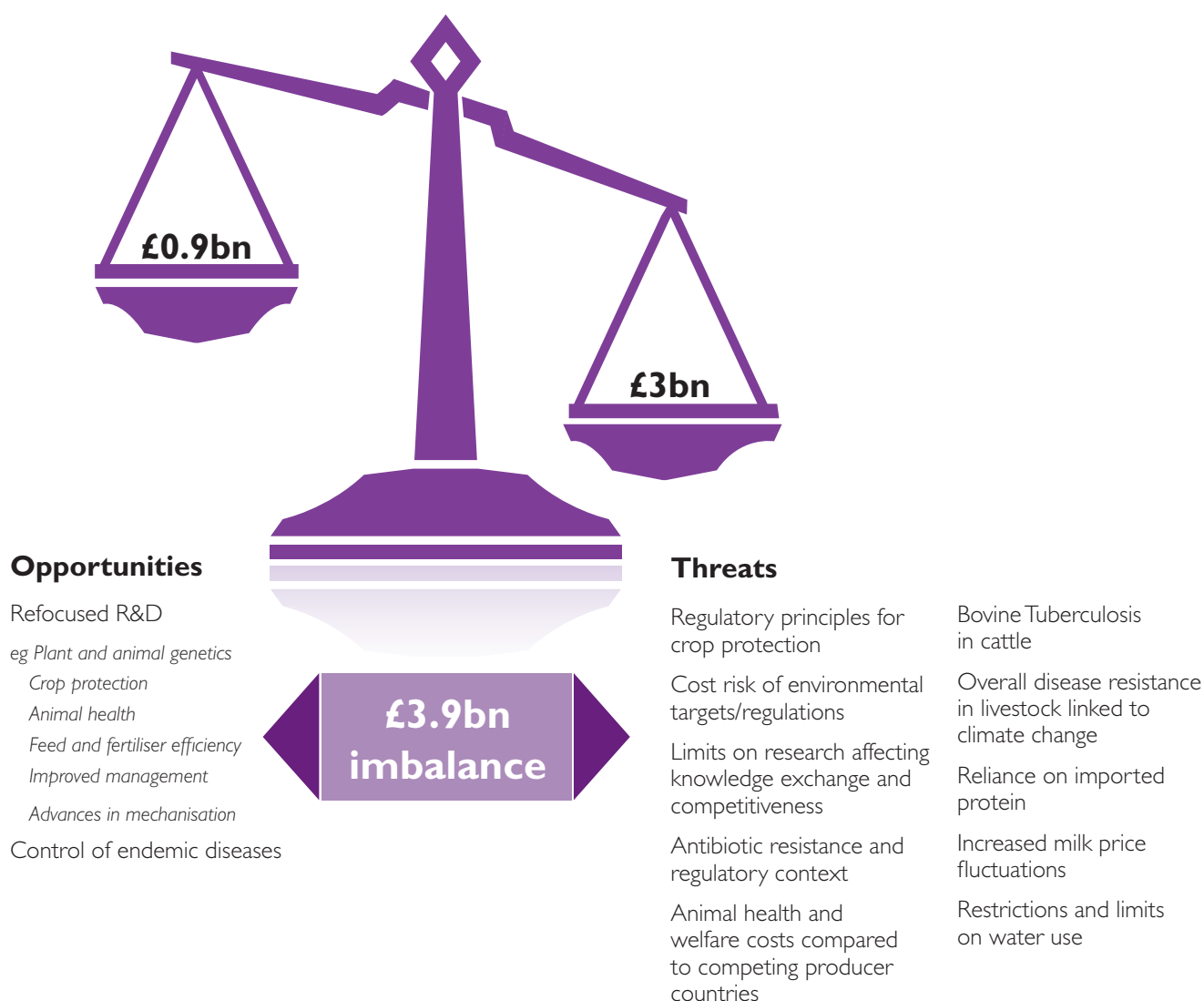
## Striking a sustainable balance

**British agriculture has great potential to play a vital part in feeding and fuelling an ever growing population in a sustainable way. There is potential to increase output and efficiency across every sector and every discipline while protecting the environment.**

AIC has begun a journey to explore the overall opportunities and threats to UK agricultural production. Our primary aim was to develop an evidence base to describe the gap between the combined threats and opportunities and suggest solutions to avoid an ever widening gap.

While the term 'sustainable intensification' has begun to steer minds towards solutions, translating the concept into a suitable policy environment is more challenging particularly without a robust evidence base to inform decisions.

**Our studies conclude that re-balancing the scales and closing the widening gap has – at a very conservative estimate – an opportunity value of £3.9bn. This is a financial opportunity that will not only benefit the industry but also the wider public purse.**



## A growing concern

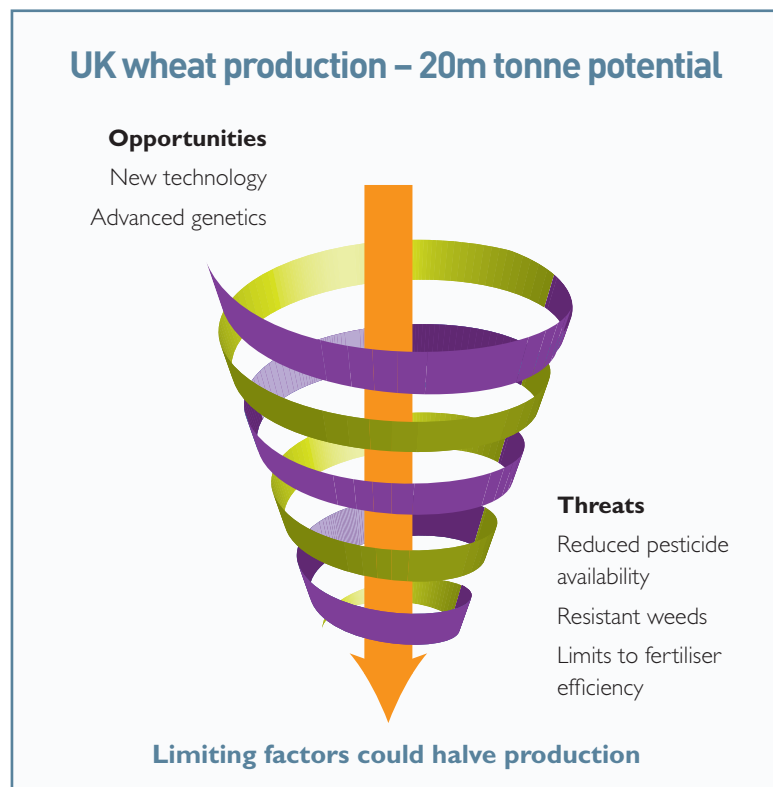
### The Economist's view

Building on the 'gaps' identified under the modelling approach, there is a need for systematic reviews and, where feasible, meta-analyses of the type being conducted more widely in Universities and Research Centres in the UK and internationally. There is a wealth of information available which is not being used as well as it could be.

From a modelling perspective, UK agriculture does need up to date economic models, with sufficiently rich representation of both agriculture and the agricultural supply chain, that would allow us to provide more detailed answers to the sorts of questions raised in this report. We can also do a lot through the use of standard economic concepts, such as thinking in terms of trade-offs and using relatively straightforward, but effective, analyses of existing data. A striking example is provided by the Cambridge Institute for Sustainability Leadership, where under one set of assumptions, the authors identify a potential total additional demand for land of 7 million hectares if the UK is to meet aspirations relating to food, space, energy and natural capital protection. Understanding the potential scale of the impact of policy interventions, at an early stage, is essential; economic analysis would do this and would help to embed a culture of 'joined up' thinking spanning different policy objectives.

**Dr Stephen Ramsden**

Recognising the many factors that challenge agriculture's ability to adapt to threats and maximise opportunities – as illustrated for wheat production (below), AIC's Board sought a study to assess likely cumulative effects. Initial desk research confirmed concerns that single issue policy making could seriously threaten potential crop output.



While researchers pointed to a potential 20m tonne wheat crop if opportunities from new technology were implemented; the cumulative effect of both maintaining current approaches to policy development while failing to maximise new technological opportunities, could in future as much as halve that level.

In effect, it led to a hypothesis that the sum of the whole was greater than that of the parts, when considering the challenges and prospects for agriculture over the next 10–15 years.

### 2014 – taking a wider view

The early studies gave sufficient cause for concern that AIC guided by its Strategy Group, which focuses on longer-term, broader issues, set out to explore the key opportunities and threats for UK agriculture. Financial assistance was provided by the Agriculture and Horticulture Development Board (AHDB) to explore the situation further. Agribusiness consultants The Andersons Centre was commissioned to provide technical expertise to develop a methodology.

The objective was to identify opportunities and threats, then assess the cumulative impacts upon the productivity, rather than profitability, of UK agriculture. Productivity is key to the industry's effectiveness and the nation's food security and would give a broader and more informed picture than concentrating solely on profitability.





### Identifying the key issues

Over 40 partners (see back page) joined with AIC's core team to identify the main opportunities and threats.

Two workshops, involving 70 delegates drawn from industry, academia and research, were brought together to develop scenarios likely to significantly impact agriculture up to 2030. One focused on crops, including horticulture and roots; a second addressed livestock: dairy, beef, sheep, pig and poultry.

From an extensive list, developed from preceding interviews, the Expert Groups ranked key opportunities and threats to agree a manageable number of scenarios to study in more depth.

### Analysis

Final selection of the scenarios to study was dependent on there being adequate peer-reviewed data or well-established expert opinion. This process highlighted that for some areas of concern there is little, if any, credible data. A more comprehensive study could be undertaken if investment was made in data generation and collation.

### The 'Agmap' tool

Chosen scenarios were built into an interactive spreadsheet (The Agmap Tool) by The Andersons Centre and AIC, drawing on data supplied by the many project partners, who also helped to verify data and resulting calculations.

The analysis is based on assessments of the likelihood of an event occurring coupled with the impact such an event would have on productivity. It is seen as an initial step to help inform future risk assessment models or to identify the gaps in knowledge. To date, such analysis, for agricultural scenarios falls short of what might be needed to test future implications or to determine cumulative impacts.

It is recommended that the preliminary calculations contained in this tool should be taken forward and refined in a partnership between industry and government to achieve improved determination of cumulative implications of policy changes.

### Results from chosen scenarios

The impact of ten key threats and two opportunities on the productivity of individual sectors were initially evaluated in isolation between now and 2030. Where peer reviewed published material was not available, best estimate assumptions were made on the potential impact. Source data were noted. Each threat on output per hectare of land or head of animal was built into the model with a risk variable. This means that as the likelihood of a scenario changes the risk variable changes automatically.

Users of Agmap would be able to see the full impact of a threat and then, from a range of risk factors create most likely and worst case versions of a scenario.

As the impact of a threat can be partial the model includes a 'rate of impact occurrence'. Each threat and opportunity is modelled on the current performance of UK agriculture, however uncertainty rises as changes are born out between now and 2030.

The populated model was then validated by the Expert Groups giving rising to a single figure for the threats and a single figure for opportunities covering the entire industry.

## The Economist's view

The report rightly emphasises the Total Factor Productivity work of Colin Thirtle and colleagues and notes the relatively poor productivity performance of the UK (not just in Agriculture) and the relative decline, potentially locked in for ten years from 2012, in R&D spending relating to increasing productive use of UK agricultural resources. Returns to agricultural research have historically been high: in a 2001 review of OECD countries, Evenson reports a median internal rate of return to agricultural research of 40% across 146 studies. Two important components driving these returns are the nature of the research itself and the extent to which it is adopted by farmers. As an example, consistently high levels of adoption of higher yielding crops, particularly 'Green Revolution' genetics, in South East Asia have made major contributions to economic growth in the developing world. Basic and applied research are needed as well as appropriate knowledge exchange where new technology is being introduced.

It is commonly acknowledged that increased agricultural production has come at some environmental cost. Substituting research away from environmental concerns is not a credible option – instead, an increase in funding levels of basic and near-farm applied research should be a UK and EU priority.

Sustainable intensification is one way of framing the problem of how to achieve both productivity and environmental objectives. An accessible interpretation of the concept is provided in a 2014 'RISE' report which sets out the argument for improving both environmental productivity and traditional measures of productivity such as yield per hectare; indeed improving environmental outcomes, particularly in relation to soil, will help to improve yields.

There is a need for a better framework for the allocation of public funding of public R&D and KE. The need to demonstrate value for money requires prioritisation of projects and recognition that some are better than others. This approach would apply to both productivity-based and environmentally-based research. At the same time there is a need to determine the extent to which agricultural productivity has been traded off for valuable productivity gains elsewhere.

**Dr Stephen Ramsden**

Evenson, R.E. (2001). *Economic impacts of agricultural research and extension*. In: Bruce L. Gardner and Gordon C. Rausser, Editors, *Handbook of Agricultural Economics*. Volume 1, Part A, Pages 573-628.

The aim of the analysis was not an attempt to estimate values with absolute accuracy but to indicate likely direction and magnitude along with the productivity value gap that lies between threats and opportunities.

## Likely interaction between threats and opportunities

There is considerable risk in assessing interactions due to difficulties in predicting industry response and timing of events. There are also data compatibility issues.

However, it is considered important to assess likely combined influences of key factors for each farming sector which are highly likely to weaken industry's resilience.

Early indications from expert opinion on the results point to the very real threat posed by reduced public Research and Development funding levels. Preliminary analysis suggests that across all sectors studied, with the possible exception of intensive poultry production, any real term reduction in public R&D funding for the agriculture and food sector would increase the scale of impact of existing issues by as much as 60% with regard to the move from a risk to hazard approach for crop protection inputs. The scenarios studied also highlight an increased cost risk in terms of the industry being able to react to meet new environmental targets.

The table below shows the impact of the main scenarios mapped under the expert opinion process. Figures reflect both financial impacts and effects as a percentage reduction of current production value. These figures attempt to show not only potential costs or losses which might be associated with mapped threats, but also lost opportunity costs if positive action highlighted under the opportunity scenarios is not realised.

Often, opportunities and threats are different sides of the same coin. Actual outcomes will depend on the policy background which should not simply restrict but seek to provide sufficient flexibility for industry to respond to combinations of challenges as they arise.

## Indicative annual aggregate impact to UK agriculture

Sector	Total value of production lost (£m)	Decrease in production value (%)
<b>Crops</b>		
Arable	1,281	30
Horticultural & Potatoes	629	25
<b>Livestock</b>		
Dairy	708	18
Grazing Livestock	286	7.8
Intensive Livestock	148	4.2
<b>Total</b>	<b>3,052</b>	<b>16</b>





### Redirection and increase in R&D funding – a real opportunity

The analysis recognised the over-riding importance of R&D funding and its influence across every opportunity and threat considered. However, the inability to estimate an accurate relationship between R&D funding and agricultural production levels is acknowledged. This failure hampers the agricultural sector's ability to attract funding as well as expertise and entrepreneurship. It also weakens public perception in terms of the industry's reliance on, and willingness to embrace, R&D and new technology more generally.

Conversely, the analysis gives a clear warning of the challenges of delivering evidence-based legislation as policy makers are pushed more and more towards single issue pressures influenced by public opinion.

### Total Factor Productivity

AIC's project has studied productivity. As such it aligns Defra's recognition that Total Factor Productivity (TFP) has a major impact on farm income over the medium to long term. Additionally the Government's Agri-Tech Strategy drew early attention to TFP in agriculture as a demonstration of the decline in UK agriculture's competitiveness. Defra figures indicate no real change in TFP for the past 10 years, largely due to little or no increase in outputs.

This study investigates this further and considers how funding changes impact on the level of TFP with particular emphasis on the elasticity of TFP to R&D funding and output.

The study finds that a 1% real term increase in public R&D expenditure can double the TFP elasticity, underlining the need for a sustainable approach to maintaining public R&D funding of the sector beyond the current Agri-tech timetable.

### Annual impact of redirection and 2% increase in public R&D on production

Sector	Gain in production (m t) / (m l)	Total benefit in production value (£m)	Gain in value of production (%)	Benefit to self-sufficiency (%)
<b>Crops</b>				
Arable	161	22	0.5	0.5
Horticulture & potatoes	45	13	0.5	
<b>Livestock</b>				
Dairy	70	20	0.5	0.5
Grazing livestock	6.6	19	1.0	0.9
Intensive livestock	16	18	1.5	1.2
<b>Total gain in production</b>		<b>92</b>	<b>0.5</b>	

There are a wide range in estimates of the relationship between TFP and R&D dependent on the choice of model, lag structure etc.

## An evolving dialogue

### Benefits of a joined up approach

*It is encouraging that UK Government and the European Commission already go some way to considering the impact of other related regulations and policies in agriculture before creating additional requirements.*

***For example, the additive effect of the Nitrates Directive (also supporting the Water Framework Directive objectives) and Climate Change policies are all taken into account when calculating the UK's ability to deliver environmental targets for ammonia, implemented through the National Emissions Ceilings Directive.***

*However, the current regulatory premise is solely focused on the environmental objectives rather than fully exploring how regulation could drive sustainable intensification to achieve increased Nitrogen Use Efficiency.*

*AIC's early evidence suggests that wider issues need to be factored in, not just regulatory influences. Key threats, such as disease risk and economics, must be taken into account; along with opportunities that research may offer.*

*Fully evaluating any likely scenario will be a major step forward in how policies are devised.*

#### Whilst outside the remit of this work ...

it is worth noting the concerns of some scientists and academics in agricultural R&D over the increasing lack of impartiality in such processes as the peer review process. Maintaining robust, informed but independent peer review is crucial to continuing R&D input into UK agriculture and the food sector; as well as ensuring policy making is based on reliable evidence.

This is intentionally a discussion document, not a report. As such we propose questions to enable the debate to move forward. These include:

- Should the key principles behind the methodology for impact assessments be reviewed – ie by open consultation?

*Impact assessments are now a key tool in policy development but there is a widespread concern about their fitness for purpose. At both UK and EU level there needs to be informed debate to improve their accuracy and role in sound policy development.*

- How is greater transparency in producing impact assessments achieved?

*We believe part of the debate must include a review of the transparency of methodology to provide greater clarity on the impact factors considered.*

- What information, such as that generated by an Agmap tool, is needed to make the analysis as robust as possible?

*Any impact assessment must withstand scrutiny across the range of impacts. The development of tools to improve the availability and accuracy of data can only improve robustness.*

- How are gaps in evidence made clear? Where confidence levels in data are low, should this be stated to avoid future policy being made on weak evidence?

*While confidence ratings are normally part of much of the statistical work undertaken by government, it would appear that this is not transferred through, to impact assessments.*





- How can resources be directed to improve the evidence behind Government-commissioned impact assessments?

*This is one of the main challenges facing the Agri-tech Informatics Centre which sits as an independent determiner of data quality. This linkage should be part of further exploration by the Centre in conjunction with Government and industry.*

- How does Government and industry work together?

*A partnership approach to delivering a sound and credible impact assessment must be the cornerstone of effective policy development.*

### **Wider discussion**

AIC has begun discussions with its European industry partners who indicate a particular interest in using such a modelling approach to help inform and strengthen regulatory impact assessments at EU level.

Moving forward, we believe it is important that the approach taken in the AIC study is replicated and tested across several Member States ahead of more detailed discussion with the EU Commission on how this new approach can help deliver a similar robust assessment within policy development.

## Future policy areas



**1** Evidence gaps prevent comprehensive, evidence-based impact assessments being undertaken as part of future policy creation. This is placing agricultural production, its future resilience and the industry's ability to respond to challenges in the balance.

**2** An evolution is needed in the way regulatory impact assessments are both developed and subsequently used to inform policy development.

**3** Productivity drives growth, Research & Development and Knowledge Exchange. Public R&D investment will generate a financial return. Whilst the money delivered under the Agri-tech programme has been crucial, there is an equally important requirement for this funding to be maintained beyond the original five year time frame if the benefits and returns on investment are to be realised.

**4** With a conservative cost assessment of £3bn per year, the threats to UK agricultural productivity are stark. This figure however could well be dwarfed by the listed opportunity cost in this study of £900m. The study has only scratched the surface of the potential opportunities that could benefit the industry.

**5** Driven by an enhanced impact assessment process, policy development must shift from being 'problem-led' to becoming 'outcome-led'.

6

The study supports previous calls for better linkages between industry, policy makers and academia/ research to deliver a more effective evidence base for farmers and advisers. The Defra Sustainable Intensification Platform offers an example of how this can be delivered in practice.

7

Building on this, a partnership approach is needed to evaluate and take forward the preliminary calculations within this study in order to achieve an improved determination of the cumulative impacts of policy change.

8

A greater emphasis is needed on UK investment in business solutions to equip industry and allow it to build resilience and maximise opportunities in a liberalised global trading arena whilst developing and maximising innovative methods to address environmental legislative challenges.

9

Greater coordination in the use and development of data (eg through the Agri-tech Informatics Centre), to both monitor and fill gaps in understanding as a central component of an improved impact assessment.

10

Better 'response data' is needed on the effect of intervention in the market, whether regulatory or by other mechanisms. What are the benefits and costs of regulation relative to alternative methods? How does society value these goods and what willingness is there to pay for them?



AIC wishes to acknowledge the in-kind expert input to this study from the research and academic communities as well as industry, including AIC Member companies.

Many organisations offered advice, references and cross checking which generated the material to produce this policy-facing report.



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