



Foresight & Programming Unit – EMIDA

Overview of foresight studies¹ evaluated in Work Package 4

- DELIVERABLE 4.2 An inventory of foresight methodologies used in relevant foresight studies in the animal health area performed to date
- DELIVERABLE 4.3 An analysis of the outputs of relevant foresight studies in the animal health area performed to date which results in a draft list of future research needs

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¹ Within the framework of this project this includes not only studies which are regarded as and titled foresight studies by the authors themselves, but also studies which address the future of agriculture, animal and human health on a global, continental, regional or sometimes national scale as identified by the members of the EMIDA FPU.

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1. INTRODUCTION.

In the Sixth Framework Programme (FP6) of the European Union (European Parliament and the Council, 2002) and extended in FP7, the possibility exists to set up European Research Area Networks (ERA-NET). For animal health the ERA-NET Emerging and Major Infectious Diseases of Livestock (EMIDA) has been set up. EMIDA contains four work packages. Work package 1 is concerned with the management of the ERA-NET and sustainability of the network of governmental research funders, work package 2 with the inventory and management of resources within the network, work package 3 with the organisation of a joint call, and work package 4 with setting up the common Strategic Research Agenda (SRA). The development of the common SRA requires that it is initially filled with research topics based on the most important priorities in terms of (future) threats to livestock and related human health, and consequently that it is managed in such a way, that it can become a tool to manage research priorities in the long term. Work package 4 therefore can be divided in the following subtasks:

- Setting up a Foresight & Programming Unit (FPU), carrying out a review and analysis of existing foresight studies followed by a process of evaluation and validation;
- Setting up a more permanent organisation for future research programming on a European level and designing the common SRA.

Several formal methods of foresight planning are mentioned in the literature. Scenario planning (Neiner et al., 2004) looks at possible alternative future scenarios, and it allows anticipation of problems and reflection on the consequences. Ma et al. (2006) describe a foresight framework for longer-term planning, using scenario-building to envision plausible alternate futures. Nielsen (1996) used a method called strategic foresight scenarios, which was described as identifying specific forces, testing assumptions for the future and assessing alternative and plausible futures. Likewise, the Delphi technique (Rowe and Wright, 1999) provides a structure to facilitate group communication on a specific task, like the systematic measuring and aiding of forecasting activities and decision-making. It is recognised as being an effective procedure when reliable consensus of opinion needs to be obtained from diverse and dispersed groups. EMIDA's FPU will use the Delphi technique to evaluate and validate the review and analysis of existing foresight studies. The results will form the foundation for setting up the common strategic research agenda. This report gives the inventory of the relevant existing foresights and the review and analysis conducted by the FPU.

2. SUMMARY

Work package 4 of EMIDA should deliver a common strategic research agenda. The method to achieve this consists of a three step procedure of (1) review of existing relevant foresight studies, (2) evaluation and validation of this review using the Delphi technique, and (3) a consensus workshop. The results of the first step are reported here.

From the available literature a number of driving forces, future threats and future research topics were distilled. All the categories show a wide diversity in their output, which is for a part caused by the different methodologies used, and the different and not always very clear cut definitions used in the literature at stake. Nevertheless the overview provides sufficient input as a start for an evaluation and validation (step 2).

3. MATERIALS AND METHODS.

The Foresight & Programming Unit (FPU) consisted of EMIDA-members involved in work package 4. The following countries are represented in the FPU of work package 4:

- The Netherlands (chair of work package and coordinator of FPU)
- Belgium
- Czech Republic
- Spain
- United Kingdom
- Norway

A review and analysis of existing literature related to the subject was used as a starting point for further identification of relevant future research topics regarding emerging infectious animal diseases, their analysis and prioritisation. This is the first step of a three step procedure to deliver a common strategic research agenda. The next two steps will be (a) an evaluation and validation of the foresights review using the Delphi technique, followed by (b) a consensus workshop.

The FPU started with collecting documents (via Google, PubMed, etcetera) in which either foresight studies¹ were published or foresight methodologies were described. The publications used came from a variety of backgrounds. In chapter 4 some characteristics of the studies are given. A total of well over 40 publications were identified. These publications were distributed among the FPU members, who reviewed and analysed these documents according a predetermined format. The template requested identification of drivers, threats, future research topics and the methodology used.

The main items mentioned in the format that were expected to be filled in were:

- **General information**
 - Title
 - Author(s)
 - Key words
- **Content information**
 - Summary
 - List of drivers (driving forces)
 - List of future threats
 - Time scale
- **Methodology**
 - Mapping the future
 - Identifying relevant topics
 - Priority setting
- **Information resources**
- **Conclusion of review**
 - Future research topics
 - Relevancy to WP4 objectives

The results of the reviews were subsequently compiled in order to gain an overview of the most relevant drivers and threats to animal health and subsequently related human health threats, followed by future research topics.

Broadly defined in this context, drivers are influences that provoke threats to develop, while threats are (direct) risks to (animal and human) health as a result of these drivers. However, definitions used by authors of references analysed are not always very clear-cut, and certainly not uniform.

4. GENERAL CHARACTERISTICS OF RELEVANT FORESIGHT STUDIES.

A broad search was done to collect possible foresight studies and consequently a wide variety of publications was found to be analysed. Some of the documents are proper foresight studies, giving overviews of envisaged consequences of events with implications for animal health. Others give a policy perspective on animal health, and give an impression of drivers and threats that have led or may lead to such policies or policy agenda's. There were also documents describing methodologies for foresight studies, some with examples from the field of animal health. A few studies consisted of scenarios for the future for agriculture or the economy as a whole, without specific reference to animal health.

Foresight studies may also differ considerably in terms of methods used. Some have used literature research, whereas many others use expert opinion in one way or the other. Often combinations of methods were used, whereby for example a literature search was followed by a questionnaire or an expert analysis or both.

Table 1 summarises some of the characteristics of the documents used.

Table 1. Characteristics of 44 foresight studies and related literature used in the foresight exercise.

Methods:	Number of times found in literature
Literature reviews	16
(Online) questionnaire	2
Expert opinion/panel	15
Scenario planning/scenario study	9
Animal health risk assessments	2
Working groups/workshops	5
Interviews	2
Gap analysis	1
Analysis on the basis of pre-set criteria	1
Email consultations	1
Assumption based planning	1
Free-listing survey	1
Discussions with policy officers and sector representatives	2
Case studies based on modelling and observed trends	1
Retrospective studies of outbreaks	1
Dialogue	1
Own expertise of authors	2

In four studies no reference was made to the method used.

By far the most popular means of assessing possible future events prove to be literature searches and expert opinions, closely followed by scenario studies. It should be borne in mind that the methods are named and listed according to the way they are addressed and mentioned in the reviews. In fact, expert opinion assessment or literature review can take a number of shapes. The framework of this report does not allow for further detailed description.

5. DRIVING FORCES FOR FUTURE THREATS TO ANIMAL HEALTH.

The driving forces or drivers found in the literature show a wide diversity. They also differ considerably in their scope, their level of detail or abstraction. Climate is mentioned, but poverty as well, and many other issues (see table 2). The drivers as they were found in the reviewed literature are given, and the number of times they were mentioned is indicated in relation to the observed level of relevance for the subject of emerging animal disease. The drivers are classified according to their perceived importance, with the ones being mentioned most often and/or referred to as most relevant at the top of the table, and those mentioned less and/or referred to as less relevant at the bottom.

The term “drivers” has been used in many different ways in the various documents. In some they are mentioned as drivers behind threats to animal health, in others as driving forces behind favourable developments in innovative agricultural sectors. Drivers therefore have a variety of values. In some of the documents no drivers were mentioned, including some documents that the reviewers considered to be highly relevant for the issue of animal health. In most cases these documents refer to assessment methods as part of the foresight studies.

Status: final

Table 2. Driving forces for future threats to animal health (including related human health) and their relevant importance, rated according to 44 literature references from which they were derived (reference numbers between brackets refer to literature list). “Not mentioned” (bottom line) means no drivers were included in the references.

Driving force	Number of times found in reviewed literature, arranged according to relevance for animal health		
	Very relevant	Moderately relevant	Less relevant
Climate change	14 (3, 5, 9, 17, 19, 21, 22, 24, 27, 30, 31, 35, 37, 38)	3 (16, 33, 43)	
Intensification of livestock transports and trade	8 (1, 5, 9, 17, 24, 27, 38, 41)	4 (16, 29, 33, 43)	
Increasing international travel and transport	5 (1, 19, 24, 27, 32)	5 (5, 17, 33, 35, 40)	1 (43)
Economy and trade	5 (1, 24, 27, 31, 38)	4 (16, 29, 33, 43)	
Land use change	4 (3, 18, 19, 43)	2 (33, 35)	
Urbanization	4 (5, 19, 27, 42)	2 (3, 33)	
Wild life, biodiversity	3 (1, 18, 27)	2 (3, 33)	
Policy	2 (22, 31)	2 (3, 28)	2 (16, 29)
Environment	3 (1, 18, 19)	1 (16)	1 (4)
Changing agriculture practices	3 (1, 18, 19)	1 (43)	
Zoonotic challenges to human health	3 (19, 21, 22)		
Increased contact between man and natural host (through ecological, environmental or demographic factors)	3 (5, 18, 19)		
Regulations animal welfare, animal health and environment more strict	3 (2, 41, 42)		
Increasing population	2 (18, 19)	1 (3)	
Failure of public health programs, failure of integration of medical and veterinary health systems	2 (17, 27)	1 (43)	
Level of public anxiety	2 (2, 41)		
Antimicrobial resistance	2 (17, 19)		
Increasing number of immunocompromised people	2 (1, 17)		
Increasing population density	2 (5, 18)		
Antibiotic drug use	2 (18, 27)		
Changing society and attitude towards animals	1 (24)	1 (29)	1 (43)
Health concern for everyone	1 (19)	1 (3)	
Genetic modification and opposition against it	1 (3)	1 (21)	
Vector patterns changes	1 (19)	1 (3)	
(Bio)terrorism	1 (32)	1 (3)	
Structure of the livestock sectors	1 (27)	1 (29)	
Agent/host/vector biology, spread of new diseases	1 (27)		1 (4)
Innovation	1 (28)		1 (1)
Globalization		1 (40)	2 (17, 25)
Global market conditions		1 (21)	1 (28)
Human activities	1 (28)		

Status: final

Driving force	Number of times found in reviewed literature, arranged according to relevance for animal health		
	Very relevant	Moderately relevant	Less relevant
Invasive species (intentional and non-intentional)	1 (5)		
Political instability	1 (35)		
Concerns about food microbiological safety	1 (32)		
Competency of indigenous vectors	1 (9)		
Decrease of profit (decrease of animal products price)	1 (42)		
Increase of quality control in production chain control	1 (42)		
Introduction of biotechnological innovations	1 (42)		
Consumer participation and involvement	1 (42)		
Increase of land price	1 (42)		
Animal optimization level	1 (2)		
Rate & cost of technical innovation	1 (2)		
Hypersensitivity of media	1 (2)		
Level of animal optimization (waste of protein)	1 (2)		
Atmospheric composition	1 (33)		
Free-range animal farming	1 (1)		
Factory farming	1 (1)		
Xenotransplantation	1 (1)		
Blood transfusion	1 (1)		
Disturbed ecosystems		2 (27, 40)	
Rural economy and regional development		1 (16)	
Free Trade Agreement		1 (3)	
Gap of Knowledge Sharing		1 (3)	
Complexity of transportation		1 (3)	
Nanotechnology		1 (3)	
Event Tracking		1 (3)	
Rich poor gap		1 (3)	
Patent in developed countries		1 (3)	
Different views on animal keeping		1 (29)	
Science and technology		1 (16)	
Poor population health		1 (43)	
Contamination of food sources or water supplies		1 (43)	
Sustainable development			2 (28, 44)
Flooding			1 (39)
Feed raw materials			1 (28)
Capital / Ownership			1 (28)
Development of competence			1 (28)
Health management			1 (4)
International spread (pathways)			1 (4)
National/regional spread			1 (4)

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<i>Driving force</i>	Number of times found in reviewed literature, arranged according to relevance for animal health		
	Very relevant	Moderately relevant	Less relevant
Ageing			1 (25)
Growing multi-ethnic and multicultural workforce			1 (25)
Growing burden of chronic disease			1 (25)
Unpredictable forces			1 (25)
Not mentioned	1 (4)	1 (6)	1 (5)

6. FUTURE THREATS TO ANIMAL HEALTH.

As was the case with the drivers, the threats as they were found in the literature are very diverse in terms of specificity and scope. Table 3 shows the threats identified and the number of times they were mentioned, subdivided according to the level of relevance.

Table 3. Future threats to animal health (including related human health) and their relevant importance, rated according to 44 literature references from which they were derived (reference numbers between brackets refer to literature list). “Not mentioned” (bottom line) means no threats were included in the references.

Threat	Number of times found in reviewed literature, arranged according to relevance for animal health		
	Very relevant	Moderately relevant	Less relevant
West Nile fever	6 (1, 9, 19, 30, 35, 37)		
Bluetongue	5 (9, 24, 30, 35, 37)		
Rift Valley fever	5 (1, 19, 30, 35, 37)		
Climate change	3 (21, 22, 39)	1 (38)	
African horse sickness	3 (30, 35, 37)		
Avian influenza	3 (1, 19, 24)		
Increase in zoonotic threat	3 (1, 21, 27)		
Dengue	2 (1, 35)		
Japanese encephalitis	2 (19, 35)		
(Visceral) leishmaniosis	2 (1, 30)		
Leptospiroses	2 (19, 30)		
Crimean-Congo haemorrhagic fever	2 (19, 37)		
Hanta-virus	2 (1, 19)		
Lyme disease	2 (1, 19)		
Tuberculosis	2 (1, 19)		
Drug-resistant foodborne bacteria	2 (1, 27)		
Cross-border threats of communicable diseases	2 (22, 27)		
Other (sub)tropical diseases, novel pathogens	2 (24, 27)		
Invasion of exotic organisms that carry disease	1 (27)	1 (40)	
Environmental degradation	1 (41)		1 (44)
Yellow fever	1 (35)		
Meat consumption falls down	1 (21)		
Insufficient disease surveillance and control systems	1 (32)		
Insufficient public health infrastructure	1 (32)		
Insufficient development of new vaccines, diagnostics and therapeutics	1 (32)		
Insufficient research and training	1 (32)		
VEE (Venezuelan equine encephalomyelitis)	1 (37)		
African Swine Fever	1 (37)		
Louping Ill	1 (37)		
Cowdriosis	1 (37)		
Equine babesia	1 (37)		
Fascioliasis	1 (37)		

Threat	Number of times found in reviewed literature, arranged according to relevance for animal health		
	Very relevant	Moderately relevant	Less relevant
Anthrax	1 (37)		
Waste of valuable animal products	1 (41)		
Concerns of the general public due to mass slaughter	1 (41)		
Negative animal welfare impact	1 (41)		
Devastating economic impact on agricultural industries and national economies	1 (41)		
Vector borne diseases	1 (33)		
Bartonellosis	1 (19)		
Plague	1 (19)		
TSE (transmissible spongiform encephalopathies)	1 (1)		
Rabies	1 (1)		
Expansion of the <i>Anaplasmataceae</i> family	1 (17)		
Wildlife reservoirs species	1 (17)		
Trade and market situation		1 (38)	1 (28)
Changing public health challenges		1 (39)	
Secondary effects of environment issues on distribution of pathogens		1 (39)	
Unsustainable development			1 (44)
Access to feed raw materials			1 (28)
Development of competence			1 (28)
Sustainability in added-value activities			1 (28)
Policy			1 (28)
Not mentioned	6 (3, 5, 13, 14, 18, 34)	11 (7, 8, 10, 11, 16, 20, 25, 29, 31, 36, 42)	6 (4, 6, 12, 15, 23, 26)

The diversity of the threats is enormous. Some refer to specific animal diseases, others to developments in environment, society or sectors. The threats are less markedly distinguished in terms of priority. Of the specific diseases, West Nile fever is mentioned most often. Regarding other specific diseases that were mentioned more than once only bluetongue and African horse sickness are just animal diseases, the others are zoonoses. Most diseases and threats were mentioned only once.

7. FUTURE RESEARCH TOPICS.

In many documents that were reviewed research topics were mentioned that should be addressed in the (near) future based on the driving forces and future threats identified. In table 4 a list is presented of these possible future research topics. They are prioritised according to the number of times a topic was referred to in the documents reviewed.

Table 4. Future research topics

Research topic	Number of times found in reviewed literature
Medication (preventive and therapeutic measures; antiviral drug therapy, antiviral misting, specific purpose vaccination or immune enhancement; avoidance of drug resistance)	10
Prevention: vaccination (e.g. genetically derived vaccines); host selection or modification for genetic resistance to disease	8
Disease knowledge, e.g. Rift Valley fever, West Nile fever, visceral leishmaniosis, leptospiroses, bluetongue, African horse sickness, fish diseases (mechanisms of interspecies transmission, host adaptation, pathogenicity, molecular determinants of host specificity, host-pathogen interaction, epidemiology, disease ecology, spatial distribution)	8
New technologies (novel and easy-to-use delivery systems; generic immune enhancement systems, nano delivery of drugs, genomics)	7
Early detection of disease/pathogen, like: <ul style="list-style-type: none"> - remotely read biosensors (nanotechnology) - diagnostics / analysis (including rapid field diagnostics; on-site diagnostics produced through genomics, proteomics and multiple nucleic acid identification devices) - rapid real-time information flow and analysis with links to a global knowledge web - technologically advanced, focused animal production through strategic agricultural planning - rapid and extremely focused animal destruction, strategically applied 	7
Vectors and vectorborne diseases (vector control (including insecticides and repellants safe for the environment), host range, competence)	5
Surveillance system (epidemiological data; animals/vectors/reservoirs)	5
Remote sensing (e.g. environmental measurements), information access, and rapid transmission	5
Climate (e.g. methods to slow down the change, including education activities)	4
Convergence of animal health and public health strategies, interests and priorities; infrastructure AH & PH; multidisciplinary teambuilding	3
Early warning system development (e.g. systematic screening arbovirus)	3
Relationships in complex ecosystems, long range effects on ecosystems; biodiversity	3
Tracking animal movement	2
Wildlife reservoirs (surveillance of wildlife animal reservoirs)	2
Find ways to reduce public anxiety; societal changes	2
New paradigm for animal health: proactive risk management (using risk management rather than disease elimination); sharing of decision-making responsibility & accountability among all stakeholders, optimizing their engagement	2
Environmental impacts/drivers on animal health	2

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	Number of times found in reviewed literature
Research topic	
International collaboration (including data sharing)	2
Data collection (real time, biotic and abiotic), Data mining, Data sharing, Modelling	2
Bio-informatics	2
Immune modulation and enhancement	1
Pathogen containment	1
Find ways to optimize use of animals	1
Capability building	1
Public health infrastructure (allowing the necessary counter-measures)	1
Communication, to obtain broad acceptance via understanding	1
International travel	1
Emergency preparedness and response	1
Risk analysis	1
Setting of baseline data	1
Fundamental immunology	1
The impacts of introduced species on disease	1
Consumer perception of animal production (animal welfare, niche products, regional / local demand & supply)	1
Economic influence on animal production systems	1
Future demographic change and influence on rural development, animal husbandry systems and pathogen introduction / spread	1

8. DISCUSSION.

Working through existing foresight studies provides a long list of driving forces, threats and future research topics. Various authors clearly have various definitions of both drivers and threats. In some instances, items are called drivers in one reference and threats in the other. Climate change is one such example. The overview however seems to supply enough material to use as a start for a more in-depth foresight exercise, aiming at the priorities EMIDA needs to set up a common strategic Research Agenda.

Literature searches seem to be important as a means to get a grip on future developments. Yet, by nature literature often describes the past, rather than the future. Nevertheless, trends and developments, from which possible future scenarios can be deduced, can very well be derived from literature. Most of the formal foresight planning tools described in literature propose several possible future scenarios, none of which may entirely reflect the truth, but altogether enable an analysis of possible consequences and testing assumptions.

In tables 2 and 3, the relevance of the references is divided in three levels: very relevant, moderately relevant and less relevant. It should be borne in mind that this subdivision is made on the basis of the opinion of the referee who rated the literature, not on a formal set of criteria. Again, the main issue here is that this overview provides enough information to use as basic input for the Delphi study to be carried out, with the intention to question and validate this input. Furthermore the Delphi study should elicit additional expert opinions and should preferably lead to consensus. The division in three levels without formal criteria may seem artificial. Yet, on the basis of the expertise of the respective reviewers the FPU presumes it has been able to identify the most important trends.

In some cases, the authors of the literature studies have used phrases or words that are not very explicit. Some examples in table 2 are: “human activities”, “increasing population”, “level of public anxiety”, etc. Within the Delphi-method it will be possible to discuss the meaning of these phrases more in depth and to either accept and rank, or discard them.

The list of future research topics (table 4) reflects the opinion of the authors of the literature reviewed. Together with the expected results of the Delphi study these research topics can be considered as future research needs, although in general a detailed and extensive comparison with existing / ongoing research is lacking. This implies that a thorough analysis of existing research and knowledge on the one hand and envisaged needs of research and knowledge on the other will be necessary. The result of this 'gap' analysis should create a thorough foundation on which a common Strategic Research Agenda (SRA) can be based. This common SRA will provide guidance for strengthening the EU overall knowledge on emerging and major infectious diseases of livestock, and will allow for the prevention of duplication of research efforts. In fact the common SRA will provide the opportunity for development of a more focused approach regarding future research commissioning on local, regional and trans-national level.

A clear problem faced by any exercise of this nature is that one can never be complete. Also, the selection of literature references is by definition biased. On the other hand, the group that has carried out the collection of the references, and that has carried out the assessments, is considered competent in the field of animal health, and therefore it is assumed that the selection offers a fair representation. Nevertheless, some bias must be taken into account, which will hopefully be corrected by the formal foresight exercise (based on the Delphi technique) as a next step to identify the important topics to address in the (near) future. In

Status: final

fact, it will not be possible to draw up a “closed” list of topics. There will always be new developments, and in fact an exercise such as this should be repeated every few years.

Tables 2 and 3 show a very long list of drivers and threats, of which several have only been mentioned once. The descriptions are derived from the literature analysed by the reviewer.

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ANNEX 1. LITERATURE SURVEYED

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Status: final

ANNEX 2. MEMBERS OF FPU

The following representatives of EMIDA partners who have been involved in the Foresight & Programming Unit of work package 4 in this foresight studies review, are:

Name member	EMIDA partner	Memberstate
Xavier van Huffel	FASFC	Belgium
Sabine Cardoen	FASFC	Belgium
Dominique Vandekerchove	FPS-CR	Belgium
Hein Imberechts	CODA-CERVA	Belgium
Milan Podsedníček	MZE	Czech Republic
Ed van Klink (coordinator FPU)	LNV	Netherlands
Wim Ooms (leader wp4)	VWA	Netherlands
Oystein Ronning	RCN	Norway
Rolf Giskeødegård	RCN	Norway
Joan Calvera	INIA	Spain
Ana Belén Aguilar Palacios	INIA	Spain
Scott Sellers	Defra	United Kingdom

ANNEX 3. REVIEWS

1.

General information	
Title	Report of the WHO/FAO/OIE joint consultation on emerging zoonotic diseases
Year of publication	2004
URL (web-link)	Http://whqlibdoc.who.int/hq/2004/WHO_CDS_CPE_ZFK_2004.9.pdf
Author(s)	Anon.
Authors' affiliation	WHO/FAO/OIE
Country	Switzerland
Language of publication	English
Commissioned by	WHO/FAO/OIE in association with the Health Council of the Netherlands
Key words	Emerging diseases, risk factors,
Content information	
Summary	
Objectives	
List of drivers (driving forces)	<p>For Europe (an overview was made for all of the WHO regions):</p> <p>Socioeconomic:</p> <ul style="list-style-type: none"> - human behaviour (e.g. Travel, eating habits, outdoor life) - increasing number of immunocompromised people (e.g. Elderly) - increasing movement of people and animals/products <p>Ecological:</p> <ul style="list-style-type: none"> - wildlife and game farming - free-range animal farming - factory farming <p>Medical technology:</p> <ul style="list-style-type: none"> - xenotransplantation - blood transfusion <p>Agricultural practices:</p> <ul style="list-style-type: none"> - trade <ul style="list-style-type: none"> - Potential shift of factory farming from western to eastern Europe <p>Global warming:</p> <ul style="list-style-type: none"> - providing an enabling environment for vectors of disease <p>Other general risk factors:</p> <ul style="list-style-type: none"> - differences in the quality of public health and veterinary public health infrastructure, and Lack of coordination at the regional level - insufficient investment in public health-related scientific research - complacency (professionals, politicians) <p>Risk factors for avian influenza:</p> <p>Primary risk factors</p> <ul style="list-style-type: none"> - mixed farming - insufficient biosecurity on farms, leading to indirect contact with wildlife <p>Amplifying risk factors</p> <ul style="list-style-type: none"> - flock density (many intensive contacts) - animal-to-human transmission <ul style="list-style-type: none"> - human-to-human contacts (including containment strategy)

Status: final

List of future threats	<p>Zoonotic agents for which emergence will have a major impact on public health:</p> <ul style="list-style-type: none"> - avian influenza virus - drug-resistant and more virulent strains of foodborne bacteria. <p>Zoonoses and zoonotic agents with current and potentially increasing impact:</p> <ul style="list-style-type: none"> - transmissible spongiform encephalopathies (tses) - Hanta virus1 - rabies (eastern Europe): EBL/classic - orthopox virus1 - tick-borne encephalitis - hepatitis E (porcine) - Lyme disease1 - Rickettsia spp. - tuberculosis (bovine/avian) - tularaemia - Brucella melitensis - marine brucellosis <ul style="list-style-type: none"> - Echinococcus multilocularis - Echinococcus granulosus - Leishmania spp. - Taenia solium - trichinellosis - Baylisascaris ascaris1 (larval migrans) - toxoplasmosis - cryptosporidiosis/giardiasis <p>Zoonoses and zoonotic agents from outside the WHO European Region:</p> <ul style="list-style-type: none"> - Rift Valley fever - dengue virus - West Nile virus - alpha viruses - tses - pandemic influenza - SARS coronavirus - monkeypox - paratuberculosis - Borna virus - pathogens transmitted via blood and blood products - pathogens from marine environments (Vibrio spp., influenza A/B, Calici virus, Brucella Spp., nematodes) <ul style="list-style-type: none"> - Burkholderia pseudomallei (potentially)
Time scale of the outlook	
Methodology	
Method used for mapping the future	Literature, own expertise of presenters and participants
Method used for identifying relevant topics	Id.
Method used for priority setting	Id.
Information resources	
Expert opinion	Workshops. Plenary presentations
Literature	See report
Internet	
Output / Outcome	
Conclusion of review:	
List of future research topics	
Relevancy to WP4 objectives	High

Status: final

2.

General information	
Title	IWADA Animal health foresight project
Year of publication	2005
URL (web-link)	Http://www.usaha.org/committees/aem/presentations2005/caroltuszynski_animalhealthforesight Project.ppt
Author(s)	Anonymous
Authors' affiliation	Not mentioned
Country	Canada, United States, Australia, New Zealand
Language of publication	English
Commissioned by	Canada, United States, Australia, New Zealand
Key words	Alternatives to mass animal destruction (MAD) – drivers for change – public anxiety – optimized use of animals – proactive risk management – stakeholder involvement – animal and public health convergence – emerging opportunities & threats
Content information	
Summary	An interdisciplinary expert panel developed four plausible scenarios based on a list of drivers. The two drivers considered as the most important (and least predictable) were public anxiety and animal optimization level. The two scenarios where animal optimization was low (mass animal destruction or MAD) were considered as failure scenarios. The scenario where animal optimization was high and public anxiety was low was considered as the optimum scenario. Actions should be undertaken to reduce public anxiety and increase animal optimization. Critical change elements in this respect are science and technology R&D, education, engagement, information management and communication. This also involves a new paradigm for animal health, where risk management is proactive rather than reactive (MAD), where all stakeholders are involved in decision-making and responsibility, and where animal and human health strategies, interests and priorities converge.
Objectives	Utilize a foresight approach to stimulate the creation of a new paradigm from which alternatives to large-scale depopulation could be conceived.
List of drivers (driving forces)	<ul style="list-style-type: none"> - Rate & cost of technical innovation - Public anxiety - Hypersensitivity of media, always on world - Animal welfare advocacy - Industry advocacy - Environmental impacts - Level of animal optimization (waste of protein) - Regulatory agency capacity - Terrorist threat potential - Trade & production economics - Public health - Marginalization of veterinary decision-makers
List of future threats	Evolution toward a situation where <ul style="list-style-type: none"> - Public anxiety is high and animal optimization is low ("failure scenario") - Public anxiety is low and animal optimization is low ("failure scenario") - Public anxiety is high and animal optimization is high (least threatening of the three)
Time scale of the outlook	5 – 25 years
Methodology	
Method used for mapping the future	Expert working groups considering multiple, plausible future scenarios, based on the current situation, in 4 meetings over a 4 month-period : 1 scoping meeting, 2 stakeholder meetings, 1 synthesis meeting
Method used for identifying relevant topics	Expert panels, discussion a series of questions to build possible scenarios
Method used for priority setting	Expert panels discussing the plausible scenarios
Information resources	
Expert opinion	Agri-industry Academia Animal welfare IT technologies Policy makers Research community Industry associations Veterinary community
Literature	
Internet	
Output / Outcome	Four scenarios based on the two main drivers (public anxiety and animal optimization), of which two are failure scenarios and one is the optimum scenario.
Conclusion of review:	

Status: final

List of future research topics	<ol style="list-style-type: none">1. Find ways to<ol style="list-style-type: none">1.1. Reduce public anxiety1.2. Optimize use of animals2. A new paradigm for animal health :<ol style="list-style-type: none">2.1. Proactive risk management2.2. Sharing of decision-making responsibility & accountability among all stakeholders, optimizing their engagement2.3. A convergence of animal health and public health strategies, interests and priorities
Relevancy to WP4 objectives	Points 1.2. And 2.1.

Status: final

3.

General information	
Title	An APEC-Wide Foresight Project Converging Technologies to Combat Emerging Infectious Diseases – Phase 1 (Draft)
Year of publication	2007
URL (web-link)	Http://www.apecforesight.org/apec_wide/EID/docs/EID_scenario_workshopsummaryreport_draft.pdf
Author(s)	APEC CTF (APEC Center for Technology Foresight)
Authors' affiliation	APEC (Asia-Pacific Economic Cooperation)
Country	Thailand
Language of publication	English
Commissioned by	APEC (Asia-Pacific Economic Cooperation)
Key words	
Content information	
Summary	<p>The APEC-Wide Foresight Project “Roadmapping Converging Technologies to Combat Emerging Infectious Diseases” aims to enhance the region’s capacity in using converging technologies to contribute to the prevention and management of emerging infectious diseases that could become widespread in the APEC region.</p> <p>The Scenario Planning is part of the first stage of this project, together with a preforesight study and an online questionnaire. The project will identify a group of converging technologies by using bibliometric analysis and scenario planning.</p> <p>In the second stage, invited experts in various technological areas throughout APEC will to jointly build roadmaps of these technologies. Since technologies usually take time to develop, this participatory process will stimulate immediate action needed to be taken today, and guide future collaboration in the region towards the next decade, in the perpetual combat against diseases.</p> <p>The final output, the technology roadmaps, will provide specific recommendations for governments of member economies, the academia and the industry to cooperate and respond to the region’s urgent need in not only short term, but medium to longer term.</p>
Objectives	<p>Objectives of the preforesight study:</p> <ul style="list-style-type: none"> • To share the result of bibliometric analysis to experts in APEC economies. • To confirm the results of bibliometric analysis. • To learn more about on going research projects related to EID from APEC economies. <p>Objectives of the online questionnaire:</p> <ul style="list-style-type: none"> • To identify additional potential technologies and additional technology applications. • To comment on the overall process. <p>Objectives of the scenario workshop:</p> <ul style="list-style-type: none"> • To create four scenarios for Emerging Infectious Diseases (EID) in 2017, using the scenario planning technique. • To discuss the opportunities of technology applications in combating EID.
List of drivers (driving forces)	<p>Key drivers for EID (STEEP classification):</p> <ul style="list-style-type: none"> • Social: <ul style="list-style-type: none"> - Health concern for everyone. - Increasing population. - Urbanization. - Gap of Knowledge Sharing. • Technology: <ul style="list-style-type: none"> - Complexity of transportation. - Nanotechnology. - Genetic modification. - Event Tracking. • Economics: <ul style="list-style-type: none"> - Free Trade Agreement. - Sufficient economy. - Rich poor gap. • Environment: <ul style="list-style-type: none"> - Climate change. - Vector patterns changes. - Land use change. • Politics: <ul style="list-style-type: none"> - Wild life: changes of wild life consumption but pet trades will increase. - Terrorism. - Patent in developed countries, incubate for developing countries. - Wrong policy.
List of future threats	1Not applicable

Status: final

Time scale of the outlook	10-20 years.
Methodology	
Method used for mapping the future	See below
Method used for identifying relevant topics	<p>Preforesight study:</p> <ul style="list-style-type: none"> • Bibliometric analysis study run by NISTEC Japan. • Bibliometric analysis study run by NECTEC and the Center. • Literature reviews on UK Foresight on Infectious Diseases. <p>Online questionnaire: 21 respondents from 6 economies.</p> <p>Scenario planning:</p> <p>Participants were divided into 4 groups. Each group had approximately 10 members (6-7 experts from different background, 2 facilitators and 1 note taker). Every group were asked to identified the key drivers and trends that relate to emerging infectious diseases using a classification called STEEP (social, technological, economic, environmental and political). The groups also classified uncertainties, which can be obtained either from wildcard event or trends that the participants were not certain in its likelihood and/or impact.</p> <p>The first day of the workshop ended with lists of drivers, trends and uncertainties. Uncertainties and the lists of drivers were subsequently used as inputs (scenario logics) for the four groups to create their scenarios.</p> <p>The groups spent the second day to develop scenario, including presenting their scenario to other groups. Based on the scenarios derived in each group, participants identified potential technology applications that will prevent or reduce impact of crisis in each scenario.</p>
Method used for priority setting	Not applicable
Information resources	
Expert opinion	Yes, experts in various technological areas throughout APEC.
Literature	
Internet	Http://www.apecforesight.org (APEC Center for Technology Foresight) Http://www.who.int/kms/en/ (Knowledge Management and Sharing - KMS)
Output / Outcome	<ul style="list-style-type: none"> • "Malaria in Miami 2017". • "20,000 people now confirmed dead from mistery disease": flavivirus. • October 2017: "Archaea virus". • "Emerging Rainforest Syndrome (RFS)".
Conclusion of review:	
List of future research topics	<p>Technology applications that will potentially reduce impacts of EID: three <u>research domains</u>:</p> <p>1) Ubiquitous</p> <ul style="list-style-type: none"> • Field tests networked • Data collection (real time) • Data mining • Mobile phone tracking • Data sharing • Modelling • Bioinformatics • Network info system countries sign up for info sharing <p>2) Treatment</p> <ul style="list-style-type: none"> • Drug design • Delivery vaccine • Vaccine development • Personalised medicine advance in pharmaceuticals • Nano delivery of drugs • Molecular medicine, Cell-based vaccine development advance in genetic engineering of virus and antiviral material • Conventional Drug Discovery <p>3) Diagnostic kits</p> <ul style="list-style-type: none"> • Micro/Nano array molecular • Implantable diagnostics • Simple thermographical scanner • Genotyping characterization • Advance in micro-fluidic device • Advance in genetic sequencing • Advance in lab on a chip
Relevancy to WP4 objectives	Yes, but it is not focused on animal health threats, and the stress is put on technologies relevant to reduce the impact of emerging diseases.

Status: final

4.

General information	
Title	A qualitative assessment tool for the potential of infectious disease emergence and spread
Year of publication	2007 (Preventive Veterinary Medicine 81 (2007) 80-91)
URL (web-link)	
Author(s)	V.E. Bridges, J. Akkina, J. Grannis, C. Johnson, R. Johnson, C. Tuszynski
Authors' affiliation	US Department of Agriculture, Centers for Epidemiology and Animal Health, Center for Emerging Issues
Country	USA
Language of publication	English
Commissioned by	USDA
Key words	Factors for disease emergence; Qualitative risk assessment; Emerging disease; Risk factor
Content information	
Summary	<p>A risk assessment tool has been build to enable to predict disease emergence and to be built by an industry. They focused on and used information of the food fish portion of the U.S. aquaculture industry. Driving forces were identified , as were risk factors within these areas of driving forces.</p> <p>The risk factors were categorised. The categories were the 6 different driving forces, and three disease emergence elements. Next to this the risk factors were scaled from high, medium, low risk to no defined risk.</p> <p>It was concluded that this initial work on a risk assessment tool for animal disease emergence could also be used for industries and government apart from aquaculture. Although adjustments in the risk factors should be made of course. As it is a rather new method the validity still has to be proven by starting to use the tool.</p> <p>While further refinement and evaluation is needed, this qualitative risk assessment method shows promise of being a helpful tool for government and industry to monitor potential for disease emergence and to target mitigation efforts in an efficient and effective manner, thus decreasing risk of disease emergence.</p> <p>Definition of emerging infectious disease used: Emergiong infectious diseases are thos diseases that have newly appeared in a population or have previously existed but are evolving or increasing in incidence or geographic range.</p>
Objectives	To develop a method utilizing information on risk factors which could assess disease emergence potential for an industry. Therefore the focus was to assess an industry's likelihood of disease emergence rather than assessing the likelihood of emergence of a particular disease.
List of drivers (driving forces)	<p>Driving forces:</p> <p>Agent/host/vector biology, ecology/environment/climate, economics/industry, health management, social/cultural, politics/regulations</p> <p>Disease emergence elements:</p> <p>Disease evolution elements, International spread (pathways), national/regional spread</p>
List of future threats	No future threats identified (it was not the goal of the study)
Time scale of the outlook	Not applicable
Methodology	
Method used for mapping the future	Not applicable
Method used for identifying relevant topics	Published literature, expert opinions, utilisation of standard epidemiological principles
Method used for priority setting	Expert opinion; concerning the risk factors and the level of risk it was first based on data availability, when there was a lack of data expert opinion led the way
Information resources	
Expert opinion	Yes, but not provided
Literature	
Internet	-
Output / Outcome	Apart from the fact that this was not a foresight study it provides a list of driving forces which can be matched with results from other studies and see whether it supports other ideas on areas to be addressed in the future when trying to map the future animal health situation.
Conclusion of review:	
List of future research topics	As this study was not aimed at identifying future research topics it is not possible to provide a list.
Relevancy to WP4 objectives	Not very relevant. Nevertheless the study identifies relevant driving forces (based on existing literature by the way) which can be helpful in our task to look for future research topics.

Status: final

5.

general information	
Title	The spread of invasive species and infectious disease as drivers of ecosystem change
Year of publication	2008
URL (web-link)	
Author(s)	T.A. Crowl ¹ , Th.O. Crist, R.R. Parmenter, G. Belocsky, A.E. Lugo
Authors' affiliation	*Utah State University, Logan, Utah
Country	United States of America
Language of publication	English
Commissioned by	National Science Foundation and others
Key words	Biodiversity; Invasive species; pathogens; ecosystem services; vector; host
content information	
Summary	Invasive species, disease vectors, and pathogens affect biodiversity, ecosystem function and services, and human health. Climate change, land use, and transport vectors interact in complex ways to determine the spread of native and non-native invasive species, pathogens and their effects on ecosystem dynamics. Early detection and in-depth understanding of invasive species and infectious diseases will require an integrated network of research platforms and information exchange to identify hotspots of invasion or disease emergence. Partnerships with state and federal agencies that monitor the spread and impacts of invasive species and pathogens will be critical in developing a national data and research network that can facilitate a full understanding of the resulting effects on ecosystems and society. Citizen science can also play a role; individuals can report new invasions, record phenological changes associated with invasions or disease outbreaks. The ecological and societal impacts of invasive species and pathogens differ across gradients of climate and land use, and in the presence of global climate change may exacerbate both their propagation and impacts. Understanding the interaction of invasive species, disease vectors, and pathogens with other drivers of ecosystem change is critical to human health and economic well-being.
Objectives	To frame questions and hypotheses for linking regional and continental-scale processes that govern the spread and impact of invasive species and disease; To highlight the need for a continental-scale network of sites for monitoring and predicting the spread and impact of invasive species and disease.
List of drivers (driving forces)	Driving forces for disease emergence: <ul style="list-style-type: none"> - Invasive species (plant and animal) <ul style="list-style-type: none"> o Human transport o Land-use change o Climate change o Globalisation / increased connectedness o Commerce in food and non-food plants and animals o Shipping containers and ballast water o Intentional introduction by fish stocking, horticulture and pet trade o Human population density (urbanisation) o Plant/animal population density (native richness) o - host diversity - hydrologic dynamics - climatic variability / climate change - demographic changes
List of future threats	Not mentioned; not part of objective
Time scale of the outlook	Not applicable
Methodology	
Method used for mapping the future	Literature review and hypothesis development
Method used for identifying relevant topics	Hypothesis development
Method used for priority setting	Not applicable
Information resources	
expert opinion	-
literature	Article's list of references

Status: final

internet	-
Output / Outcome	Not applicable as it was not a foresight study; but (1) apart from the identification of some driving forces regarding the complex interaction in ecosystems relevant to disease emergence, (2) suggestions are made what kind of research is necessary to be able to assess the impact of and predict invasive species and disease. This could of value for EMIDA WP4.
Conclusion of review:	
List of future research topics	<ul style="list-style-type: none"> - create networks of study sites in geographical terms for monitoring data on host, vector and pathogen populations and their environment, including spatial distribution, demography and behaviors to better address issues in invasion and disease ecology; and better enable these networks to predict and forecast emerging threats. - remotely sensed data and embedded sensor networks can provide the detailed environmental measurements that are needed for more predictive climate- or habitat-based niche models of potential species distributions across ecosystems, regions and geographical ranges. - Data on biotic an abiotic environmental conditions are needed - We need to understand species interactions and the consequences to local ecosystems to be able to assess (and prevent/reduce) the impacts of introduced species on disease
Relevancy to WP4 objectives	Although focused on the US situation and on ecosystems change and its drivers, the article provides information on the complexity of ecosystems and its disturbances/changes which can have impact on disease emergence in plants, animals and humans. Therefore the topics addressed and the literature review provided is relevant to EMIDA WP4.

Status: final

6.

General information	
Title	Fish to 2020; supply and demand in changing global markets
Year of publication	2003
URL (web-link)	Http://www.ifpri.org/pubs/books/fish2020/oc44.pdf
Author(s)	Delgado, C.L., Wada, N., Rosegrant, M.W., Meijer, S., and Ahmed, M.
Authors' affiliation	International Food Policy Research Institute, Washington, D.C. Worldfish Center, Penang, Malaysia
Country	USA and Malaysia.
Language of publication	EN
Commissioned by	
Key words	1. Fish trade. 2. Fish trade—Developing countries. 3. Fisheries—Economic aspects 4. Fisheries—Environmental aspects
Content information	
Summary	
Objectives	
List of drivers (driving forces)	
List of future threats	
Time scale of the outlook	2020
Methodology	
Method used for mapping the future	Scenarios. Baseline scenario is the most probable. The others are deviations from this.
Method used for identifying relevant topics	
Method used for priority setting	
Information resources	
Expert opinion	
Literature	
Internet	
Output / Outcome	Based on the most likely set of assumptions—the baseline scenario—global food fish production will increase slightly faster than global population through 2020.
Conclusion of review:	
List of future research topics	
Relevancy to WP4 objectives	Do not address EMIDA objectives

Status: final

7.

General information	
Title	Vaccines: innovation and human health
Year of publication	2006
URL (web-link)	Http://www.easac.eu/document.asp?Id=41&pageno=1&detail=1&parent=31
Author(s)	EASAC
Authors' affiliation	
Country	United Kingdom
Language of publication	English
Commissioned by	
Key words	Vaccines, human health, infectious disease, vaccine development
Content information	
Summary	The document of EA-SAC – European Academies Science Advisory Council. Vaccines are a crucial part of the armoury for dealing with infectious diseases. The report focuses on the importance of vaccines: reviewing the latest scientific developments and their implications for public health. Recommendations include a call for an increasing role for the European Commission in public health; clarifying priorities for the European Centre for Disease Control; introducing incentives to manufacture vaccines; strengthening public sector R&D and regulatory authority research capacity; and promoting vaccine use.
Objectives	
List of drivers (driving forces)	
List of future threats	
Time scale of the outlook	
Methodology	
Method used for mapping the future	
Method used for identifying relevant topics	
Method used for priority setting	
Information resources	
Expert opinion	
Literature	
Internet	
Output / Outcome	
Conclusion of review:	
List of future research topics	
Relevancy to WP4 objectives	The document is oriented to the human health but general principles are the same for the veterinary vaccines development, too.

Status: final

8.

General information	
Title	Migration and infections diseases (EASAC)
Year of publication	2007
URL (web-link)	Http://www.easac.eu/document.asp?id=79&pageno=1&detail=1&parent=31
Author(s)	EASAC
Authors' affiliation	
Country	
Language of publication	English
Commissioned by	
Key words	Infection disease in human population, migration, spreading of infections
Content information	
Summary	The document of EA-SAC – European Academies Science Advisory Council. The healthcare screening and treatment processes for migrants entering the EU need to be better evaluated and coordinated across Member States to prevent the potential spread of infectious diseases such as TB and HIV. The European Academies Science Advisory Council (EASAC) has urged in a statement. The priorities for research and policy development require improved collection of epidemiological data, increased sharing and implementation of good practice in screening systems, and establishment of mechanisms for access to healthcare.
Objectives	
List of drivers (driving forces)	
List of future threats	
Time scale of the outlook	Not real foresight
Methodology	
Method used for mapping the future	
Method used for identifying relevant topics	
Method used for priority setting	
Information resources	
Expert opinion	
Literature	
Internet	
Output / Outcome	
Conclusion of review:	
List of future research topics	
Relevancy to WP4 objectives	The document is oriented to the human health but some principles can be also useful for animal health care.

Status: final

9.

General information	
Title	Aanzet tot een risk analysis m.b.t. Introductie van bluetongue virus en West Nile virus in Nederland (approach to a risk analysis on introduction of Bluetongue virus and West Nile virus in The Netherlands)
Year of publication	2003
URL (web-link)	
Author(s)	A. Elbers, P.A. van Rijn and E.M. A. Van Rooij
Authors' affiliation	Central Veterinary institute, Lelystad, The Netherlands
Country	The Netherlands
Language of publication	Dutch
Commissioned by	Ministry of Agriculture, Nature and Food Quality
Key words	Arbovirusses, Bluetongue, West Nile virus, risk analysis
Content information	
Summary	<p>On the basis of literature a risk analysis (hazard analysis, risk assessment and risk management advice) has been done for the possible occurrence of Bluetongue and West Nile virus in The Netherlands. It was deemed likely that, because of the changes in climate, the advance of both diseases in the direction of north western Europe was likely. For bluetongue it was expected that the BTV competent vectors would spread in the north westerly direction. Intensified livestock traffic could have the sameneffect, through transport of the vector or of the virus.</p> <p>West Nile virus is present in northern Europe in wild birds. In the south eastern region of France several clinical cases have been seen. The infected vector must therefore be present in that region. It is not known whether it is possible that the virus is transmitted under the circumstances in north western Europe.</p>
Objectives	To present the risks of outbreaks of Bluetongue and West Nile disease in The Netherlands
List of drivers (driving forces)	Climate change, intensification of livestock transports, competency of indigenous <i>Culicoides</i> species
List of future threats	Bluetongue, West Nile virus
Time scale of the outlook	The next few decades ahead
Methodology	
Method used for mapping the future	Literature review
Method used for identifying relevant topics	Literature review
Method used for priority setting	N/a
Information resources	
Expert opinion	
Literature	See report : 37 references, including Promed references
Internet	Promed
Output / Outcome	
Conclusion of review:	
List of future research topics	<p>It was recommended that the <i>Culicoides</i> species present in the north western region should be analysed in terms of presence, as well as competency.</p> <p>It is recommended that surveillance for the virus should be extended from suspected clinical cases to midges. It is also necessary to get a beter insight in the species of midges in the region and their competency for WNV. It is also necessary to know more about the birds that are capable of transmitting the disease.</p>
Relevancy to WP4 objectives	High: relevant diseases for the whole of Europe

Status: final

10.

General information	
Title	A new Animal Health Strategy for the European Union (2007-2013) where "Prevention is better than cure"
Year of publication	2007
URL (web link)	Http://ec.europa.eu/food/animal/diseases/strategy/animal_health_strategy_en.pdf
Author(s)	
Authors' affiliation	European Commission European Parliament
Country	
Language of publication	English
Commissioned by	European Commission
Key words	Priorities EU legislation Surveillance Preparedness Research
Content information	
Summary	<ul style="list-style-type: none"> ▶ Prioritisation of EU intervention. Threats should be analysed according to the cost-benefit and cost-effectiveness of the intervention needed to reduce them; targets and performance indicators are needed to estimate the risk of new threats. ▶ The EU animal health framework. A single regulatory framework should be established, in line with international standards 'i.e. OIE/Codex); looking for participation of governments, animal owners, industry and eventually the insurance sector; EU should promote international recommendations/standards to third parties for import and export; EU should become a member of OIE. European companies should be able to compete in the international market. ▶ Prevention, surveillance and preparedness. Making available guidelines to improve biosecurity on herds (for animal owners and industry); electronic identification and tracing of animals (especially ruminants); improved border biosecurity: better document check (declaration of freedom of disease), technical assistance; improvement of rapid detection, spread of information and measures to prevent spreading of disease. ▶ Science, Innovation and Research. The CRL and NRL should collaborate more efficiently with ECDC and EFSA; research action plans should be developed together with the industry and others involved, also at the international level.
Objectives	<p>The strategy provides direction for the development of animal health policy, based on extensive stakeholder consultation and a firm commitment to high standards of animal health. It will facilitate the establishment of priorities that are consistent with agreed strategic goals and the revision of, and agreement on, acceptable and appropriate standards.</p> <p>There are 4 strategic goals:</p> <ul style="list-style-type: none"> To ensure a high level of public health and food safety by minimising the incidence of biological² and chemical risks to humans. To promote animal health by preventing/reducing the incidence of animal diseases, and in this way to support farming and the rural economy. To improve economic growth/cohesion/competitiveness assuring free circulation of goods and proportionate animal movements. To promote farming practices and animal welfare⁴ which prevent animal health related threats and minimise environmental impacts in support of the EU Sustainable Development Strategy.
List of drivers (driving forces)	See strategic goals.
List of future threats	Not mentioned
Time scale of the outlook	Six year action plan: 2007-2013.
Methodology	
Method used for mapping the future	Methodology not mentioned.
Method used for identifying relevant topics	Methodology not mentioned.
Method used for priority setting	Not mentioned.
Information resources	
Expert opinion	Not mentioned
Literature	Reference to EU legislation, OIE, Codex, SPS
Internet	Not mentioned
Output / Outcome	See summary.
Conclusion of review:	<p>Very general document, stating the EU Commission's view (vision, goals, [broad] action plan) on EU animal health. It describes the general objectives of the role the EU Commission should play to protect the animal health in the EU.</p> <p>Since there are no detailed proposals for initiatives (except for the general animal health legislation), the document is policy-driven.</p>
List of future research topics	Not mentioned.

Status: final

Relevancy to WP4 objectives

General information.

Status: final

11.

General information	
Title	Scenario study on agriculture and the rural world (SCENAR 2020)
Year of publication	
URL (web-link)	Http://ec.europa.eu/agriculture/agrista/2006/scenar2020/final_report/scenar2020final.pdf
Author(s)	EC
Authors' affiliation	
Country	
Language of publication	English
Commissioned by	
Key words	European agriculture, trends and perspectives, agricultural policy, commodities, SWOT analysis
Content information	
Summary	The document of European commission – directorate for general agriculture and rural development. Identification of the future trends and driving forces that will be the framework for the European agricultural and rural economy on the horizon of 2020. Partly interesting for research organization in the field of animal health.
Objectives	To identify major future trends, driving factors and perspectives for European agriculture
List of drivers (driving forces)	
List of future threats	
Time scale of the outlook	2020
Methodology	
Method used for mapping the future	Establishing the basic data set
Method used for identifying relevant topics	Analysis of trends from 1990 to 2005 reviewed by experts groups
Method used for priority setting	SWOT analysis
Information resources	
Expert opinion	
Literature	
Internet	
Output / Outcome	
Conclusion of review:	
List of future research topics	
Relevancy to WP4 objectives	Trends and perspectives in European agriculture. Used methodology for information.

Status: final

12.

General information	
Title	European Technology Platform for Global Animal Health Vision 2015
Year of publication	2005
URL (web-link)	Http://www.ifahsec.org/europe/euplatform/Brochure_fin.pdf
Author(s)	European Technology Platform for Global Animal Health (ETPGAH)
Authors' affiliation	
Country	
Language of publication	English
Commissioned by	International Federation for Animal Health – Europe (IFAH-Europe)
Key words	
Content information	
Summary	The European Technology Platform for Global Animal Health (ETPGAH) was launched in December 2004 with the encouragement and guidance of the European Commission in order to bring together companies, research institutions, the financial world and regulatory authorities to define a common research agenda. It depends on the International Federation for Animal Health – Europe (IFAH-Europe), the federation representing manufacturers of veterinary medicines, vaccines and other animal health products in Europe. The Technology Platform will provide a mechanism for focusing research that delivers new tools for the control of major animal diseases: vaccines, pharmaceuticals and diagnostic tests.
Objectives	The document is a generic overview on the state-of-the-art in vaccines, pharmaceuticals and diagnostic tests useful in the control for animal diseases.
List of drivers (driving forces)	Not applicable
List of future threats	Not applicable
Time scale of the outlook	10 years
Methodology	
Method used for mapping the future	Not applicable
Method used for identifying relevant topics	Not applicable
Method used for priority setting	Not applicable
Information resources	
Expert opinion	
Literature	
Internet	Http://www.ifah.be/Europe/euplatform/Platform.htm (European Technology Platform for Global Animal Health) Http://www.europa.eu.int/comm/research/biosociety/index_en.htm (Biosociety and the Knowledge-Based Bio-Economy, European Commission) Http://www.cordis.lu/technology-platforms (European Technology Platforms, CORDIS)
Output / Outcome	
Conclusion of review:	
List of future research topics	Just an overview: focus on the need to improve vaccines, diagnostics and pharmaceuticals.
Relevancy to WP4 objectives	This document deals with an overall vision about the development of vaccines, pharmaceuticals and diagnostics tests, but it has limited practical application.

Status: final

13.

General information	
Title	Prioritization of Animal Diseases
Year of publication	2006
URL (web-link)	
Author(s)	
Authors' affiliation	
Country	Belgium
Language of publication	English
Commissioned by	European Technology Platform for Animal Health (EU TP GAH)
Key words	
Content information	
Summary	Stakeholders Meeting about prioritization of animal diseases, the first step of the Strategic Research Agenda (SRA).
Objectives	<p><u>Objectives of the platform:</u></p> <ul style="list-style-type: none"> To protect Europe from the incursion of epidemic animal diseases and zoonoses. To deal rapidly and effectively with outbreaks in Europe should they occur. To assist in speed of access to market, facilitation of world trade and the alleviation of poverty by reducing the impact of these diseases in developing countries. To reduce worldwide levels of disease and thereby indirectly protect Europe from disease spread by people trade. <p><u>Objectives of the prioritization model:</u></p> <ul style="list-style-type: none"> To develop a risk-based, consistent system to evaluate Global Animal Health Priorities (endemic, exotic, emerging) and the risk they pose for the European Union. To determine baseline criteria important for a disease prioritization model (likelihood of disease occurrence, epidemiology, economical impact, availability of products, likelihood of program success, etc.). To validate model with major stakeholders of the EU TP GAH. To propose the Animal Health Priority rating model and preliminary list of identified Global Animal Health Priorities to de EU Commission as part of the Industry led Strategic Research Agenda developed by the current Technology Platform of Global Animal Health.
List of drivers (driving forces)	
List of future threats	
Time scale of the outlook	
Methodology	
Method used for mapping the future	
Method used for identifying relevant topics	
Method used for priority setting	Methodology for prioritization animal diseases is described in the Strategic Research Agenda.
Information resources	
Expert opinion	
Literature	
Internet	
Output / Outcome	
Conclusion of review:	
List of future research topics	
Relevancy to WP4 objectives	Animal health priority scoring criteria. This document complements and supports the contents of the document entitled: "European Technology Platform for Global Animal Health Strategic Research Agenda".

Status: final

14.

General information	
Title	European Technology Platform for Global Animal Health Strategic Research Agenda
Year of publication	2006
Url (web-link)	http://www.ifahsec.org/europe/euplatform/sra_may06.pdf
Author(s)	European Technology Platform for Global Animal Health (ETPGAH)
Authors' affiliation	
Country	
Language of publication	English
Commissioned by	International Federation for Animal Health – Europe (IFAH-Europe)
Key words	
Content information	
Summary	<p>The European Technology Platform for Global Animal Health (ETPGAH) was launched in december 2004 with the encouragement and guidance of the European Commission in order to bring together companies, research institutions, the financial world and regulatory authorities to define a common research agenda.</p> <p>It depends on the international federation for animal health – Europe (IFAH-Europe), the federation representing manufacturers of veterinary medicines, vaccines and other animal health products in Europe.</p> <p>Three working groups of experts were established in order to develop the strategic research agenda (SRA). The work of these groups provided the basis for the recommendations in this SRA.</p>
Objectives	<p><u>Objectives of the platform:</u> "to facilitate and accelerate the development and distribution of the most effective tools for controlling animal Diseases of major importance to Europe and the rest of the world, thereby improving human and animal health, food safety and quality, animal welfare, and market access, contributing to achieving the millennium development goals."</p> <p><u>Objectives of the agenda:</u> to recommend research in its broadest sense thus it encompasses reviews of available information, analysis of markets and attitudes, and the development of useful tools as well as the more traditional areas of veterinary science.</p> <p><u>Key interacting themes:</u></p> <ul style="list-style-type: none"> • To prioritise animal diseases. • To conduct a number of gap analyses. • To ensure high quality relevant fundamental research. • To identify the enabling factors to improve the rate of technology transfer. • To consider regulatory issues. • To maintain a global perspective.
List of drivers (driving forces)	Since the document is a proposal, the drivers would be considered during the study.
List of future threats	Id.
Time scale of the outlook	10 years.
Methodology	
Method used for mapping the future	<p><u>Gap analysis:</u></p> <p>The main objectives were to identify the gaps in key areas and then to consider how the gaps could be filled by the development of the SRA.</p> <p>issues are considered under 5 headings:</p> <ul style="list-style-type: none"> • Gaps: disease knowledge. • Gaps: product availability regarding vaccines, diagnostic tests and pharmaceuticals. • Gaps: sourcing of products. • Gaps: technology usage. • Gaps: research activity. <p>The gap analysis should identify where technological advances will assist the development of diagnostics, pharmaceuticals and vaccines.</p>
Method used for identifying relevant topics	See above (gap analysis)

Status: final

Method used for priority setting	<p>Prioritisation of animal diseases/infections: initially a range of major animal diseases, both for EU member states and for other countries with a special emphasis on developing countries, were listed according to their impact on animal and/or human health.</p> <p>A number of different groups of criteria were employed. An initial method used three main criteria based on the economic, zoonotic and developing country impact of the diseases. A second system used 7 criteria each of which was scored between 0 and 5. In this case the criteria were: societal relevance, food safety, direct economic effect (on the animals), trade consequences, risk of EU introduction or prevalence in the EU, zoonotic properties and importance to developing countries. The diseases were listed and the top 30 considered further.</p> <p>The 30 diseases or infections were classified into 3 groups:</p> <ul style="list-style-type: none"> • Major diseases. • Diseases for surveillance. • Neglected zoonosis.
Information resources	
Expert opinion	<p>Three expert working groups:</p> <ul style="list-style-type: none"> • Basic research and mapping. • Technology exchange and transfer. • Horizontal issues.
Literature	
Internet	http://www.ifah.be/europe/euplatform/platform.htm (European Technology Platform for Global Animal Health)
Output / outcome	
Conclusion of review:	
List of future research topics	<p>Fundamental research:</p> <ul style="list-style-type: none"> • Host-pathogen interactions. • Fundamental immunology. • Epidemiology. • Genomics. • Integrated biology (bio-informatics).
Relevancy to wp4 objectives	SRA and WP4 have very similar (somehow overlapping) objectives and, therefore, this document establishes a good guideline to start work in the development of a strategic trans-national animal health research agenda.

Status: final

15.

General information	
Title	Sustainable Farm Animal Breeding and Reproduction. A vision for 2025.
Year of publication	2006
URL (web-link)	Http://www.fabretp.org/images/vision.fabretp.def1.pdf
Author(s)	Working group
Authors' affiliation	
Country	
Language of publication	English
Commissioned by	
Key words	Animal breeding; Europe; Sustainability; Technology
Content information	
Summary	The document of Working group „Sustainable Farm Animal Breeding and Reproduction Technology Platform“ (FABRE-TP). The document is a vision of how, in synergy with other economic and social players in Europe animal breeding and reproduction sector can contribute to animal agriculture and aquaculture in a prosperous and distinctive Europe. Interesting vision for breeders but also for research workers in this area.
Objectives	
List of drivers (driving forces)	
List of future threats	
Time scale of the outlook	2025
Methodology	
Method used for mapping the future	
Method used for identifying relevant topics	
Method used for priority setting	
Information resources	
Expert opinion	
Literature	
Internet	
Output / Outcome	
Conclusion of review:	
List of future research topics	
Relevancy to WP4 objectives	Not exactly. It is namely for breeders.

Status: final

16.

General information	
Title	Foresighting food, rural and agri-futures
Year of publication	2007
URL (web-link)	Http://ec.europa.eu/research/agriculture/scar/pdf/foresighting_food_rural_and_agri_futures.pdf
Author(s)	Foresight expert group of SCAR
Authors' affiliation	
Country	Belgium, DG Research European Commission
Language of publication	English
Commissioned by	DG Research
Key words	Foresight; agriculture; disruptive scenario; climate; energy; food; health; satellite imaging; Internet technologies; knowledge transfer;
Content information	

Status: final

Summary	<p>Based on the 8 major driving forces identified during the EURAGRI members' conference in 2005 the SCAR Foresight expert group gathered and analysed foresight information on these drivers. The foresight exercise that followed focused on 4 different disruptive scenarios, climate shock, energy crisis, food crisis and cooperation with nature (see methodology).</p> <p>Main findings: The European Union is now facing a major disruption period in terms of international competitiveness, climate change, energy supply food security and societal problems of health and unemployment Disruption means fast change, resulting in both positive and negative impacts and Thus the main challenge facing agro-food actors is the speed of adaptation and proactive responses to secure a European lead in this area. Systemic approaches show that decentralised systems adapt themselves faster to change than centralized ones. But decentralised adaptation relies on the availability of a high performance information system allowing the decision makers, each operating at his level, to use in real time the best upgraded data necessary to implement their rationality. Technology now offers the operational tools to put upgraded data at the disposal of the farmers and decision makers of the food chain and to allow an exchange of experience between actors. Satellite imaging and Internet diffusion technologies allows for building an early warning, free access information system on climate change and its long-term consequences for ecosystems. The Internet is emerging as a powerful tool for the linkage of researchers and endusers of research results and has the potential to facilitate a more proactive engagement of rural communities, farmers and citizens in the design and implementation of ongoing research and knowledge exchange activity. In order to facilitate these interactions, Europe strategies at the European and national levels need to cater for the extension of broadband access at affordable prices to rural communities, farmers, citizens and other stakeholder. European agricultural research is currently not delivering the type of knowledge that is needed by end-users in rural communities as they embark on the transition to the rural knowledge-based biosociety.</p> <p>Recommendations:</p> <ul style="list-style-type: none"> ▪ More coordinated EU, national and regional policy responses to a range of challenges that affect the world rural agri-economy and facilitate the shift to a knowledge-based biosociety are needed ▪ There is a need for a new strategic framework for that planning and delivery of research. The framework needs to cater for 5 challenges that lay ahead, sustainability challenge, security challenge, knowledge challenge, competitiveness challenge and a policy and institutional challenge ▪ The complex, dynamic inter-connection of challenges, facing European agriculture research from a forward-looking, 20- year perspective requires strategic European policy responses right now. This will entail re-designing the institutional framework for research and putting in place a two-track approach for agri-futures research: <ul style="list-style-type: none"> ▪ A transition research agenda to address the more immediate sustainability and safety/security concerns and the radical transformation arising from the reform of the Common Agricultural Policy (CAP), combined with ▪ A more long-term high-tech research agenda to ensure that appropriate high-tech research investments are put in place so that Europe's agri-food industries and rural economies retain their competitive position in global markets ▪ A regionally-focused, demand-driven approach to research and innovation needs to be developed ▪ The competitiveness challenge and demographic decline facing rural communities, combined with reduced global financial support to agriculture, may lead the EU to adopt, under emergency pressure, a temporary protectionist strategy. Long-term, strategic and institutional capacities in knowledge transfer, public early warning on ecosystems evolution and decentralised systems of agricultural research and approaches are of even more central importance in the transition from a subsidies-driven to a knowledge-driven biosociety. ▪ Continued, active engagement in foresight is critical for enhancing the strategic and institutional capacities of Europe's agricultural policy-making and research and knowledge transfer organisations
Objectives	To formulate possible scenarios for European agriculture in a 20-year perspective allowing for the identification of evidence required (for more robust policy approaches) and innovation needs in the medium to long-term. The main objective was to set priorities for the medium to long-term
List of drivers (driving forces)	Economy and trade, science and technology, rural economy and regional development, societal and demographic changes, climate change, non-food and energy, environment, health
List of future threats	Threats listed are not addressing animal health or infectious diseases; therefore not mentioned here
Time scale of the outlook	2015-2020
Methodology	

Status: final

Method used for mapping the future	Scenario study; disruptive scenarios
Method used for identifying relevant topics	Literature study; Expert opinions
Method used for priority setting	Expert opinions
Information resources	
Expert opinion	Yes, not provided
Literature	See the report pp 72-97
Internet	See the report
Output / Outcome	The agriculture addressed in this foresight exercise was arable farming, and unfortunately animal health was not taken into account.
Conclusion of review:	
List of future research topics	<p>Focussing on generic topics which could also be important regarding animal health:</p> <ul style="list-style-type: none"> ▪ Improving the transparency and security of the food supply chain; ▪ Consumer confidence in food safety and food production has to be re-established; ▪ Agriculture has to overcome the notion of being a latecomer in implementing and accepting new technologies; ▪ The adaptation to climate change has in particular to be factored in as part of ongoing technological development in agriculture, including plant breeding, livestock feeding technologies, irrigation management, application of ICT, etc.; ▪ Adequate observation instruments to monitor and act on the effects of global warming; ▪ The effect on secondary factors of agricultural production (e.g. Soil, weeds, pests and <u>diseases</u>); the interaction with the surrounding natural ecosystems; ▪ Tackling the challenges in maintaining biodiversity at various spatial scales; ▪ There is a need for more foresights in the area of 'food' and to a lesser extent for 'rural areas' (which I doubt, Wim Ooms), and in both an emphasis on a highly systemic perspective.
Relevancy to WP4 objectives	The relevancy is medium, because infectious diseases are not addresses. Nevertheless, the disruptive scenarios and its driving forces provide clues for experts from animal health disciplines to identify future threats considering emerging infectious diseases. Furthermore, because there is a lot of common ground that can be recognised there are some generic recommendations that can (and should) be taken into account like the continuation of foresight effort to facilitate and prepare EU policymaking and research regarding animal health, and support knowledgetransfer.

Status: final

17.

General information	
Title	drivers for the emergence and re-emergence of vector-borne protozoal and bacterial diseases
Year of publication	2005
Url (web-link)	harrus drivers emergence vectorborne.pdf(1mb)
Author(s)	harrus, s. And baneth, g.
Authors' affiliation	school of veterinary medicine, the hebrew university of jerusalem (israel)
Country	israel
Language of publication	english
Commissioned by	
Key words	emergence, re-emergence, spread, vector-borne, protozoa, bacteria
Content information	
Summary	in recent years, vector-borne parasitic and bacterial diseases have emerged or re-emerged in many geographical regions causing global health and economic problems that involve humans, livestock, companion animals and wild life. The ecology and epidemiology of vector-borne diseases are affected by the interrelations between three major factors comprising the pathogen, the host (human, animal or vector) and the environment. Important drivers for the emergence and spread of vector-borne parasites include habitat changes, alterations in water storage and irrigation habits, atmospheric and climate changes, immunosuppression by HIV, pollution, development of insecticide and drug resistance, globalization and the significant increase in international trade, tourism and travel. War and civil unrest, and governmental or global management failure are also major contributors to the spread of infectious diseases. The improvement of epidemic understanding and planning together with the development of new diagnostic molecular techniques in the last few decades have allowed researchers to better diagnose and trace pathogens, their origin and routes of infection, and to develop preventive public health and intervention programs. Health care workers, physicians, veterinarians and biosecurity officers should play a key role in future prevention of vector-borne diseases. A coordinated global approach for the prevention of vector-borne diseases should be implemented by international organizations and governmental agencies in collaboration with research institutions.
Objectives	<ul style="list-style-type: none"> To evaluate the different causes responsible for the emergence and re-emergence of vector-borne protozoal and bacterial diseases. To describe how major drivers affect the patterns or their local and global distributions.
List of drivers (driving forces)	<ul style="list-style-type: none"> Habitat change, deforestation and urbanization. Atmospheric and climate changes. Pollution. Development of insecticide and drug-resistance. Globalization and increased trade, travel and human movement. Effect of HIV and use of immunosuppressive drugs. War and civil unrest. Movement of vectors by wind and migrating birds. Global and governmental management failure.
List of future threats	<p>future and current threats:</p> <ul style="list-style-type: none"> Expansion of the <i>anaplasmataceae</i> family. Wildlife reservoirs species. Recent detection of cutaneous leishmaniasis in red kangaroos (Australia's norther territory). Kennel dogs infected with <i>leishmania infantum</i> without known vectors or autochthonous human cases (eastern usa).
Time scale of the outlook	not applicable.
Methodology	
Method used for mapping the future	not applicable.
Method used for identifying relevant topics	bibliographic review.
Method used for priority setting	vector-borne diseases included in the unpd/world bank/who special program for research and training in tropical diseases (tdr) – who, 2002: prioritisation of tropical diseases in accordance with dalys (disability adjusted life years - the number of healthy years of life lost due to premature death and disability-).
Information resources	
Expert opinion	not applicable.
Literature	the literature cited in the article is available at the link : harrus drivers emergence vectorborne.pdf(1mb)
Internet	the study does not identify valuable websites.
Output / outcome	not applicable.
Conclusion of review:	

Status: final

List of future research topics	<ul style="list-style-type: none">• Further research for elucidation and basic understanding of transmission mechanisms, epidemiology and environmental drivers responsible for the emergence of vector-borne diseases: molecular biology (discovery of new vector-borne pathogenic diseases), wildlife cycles of infection.• Development of new chemotherapeutics, vaccines, insecticides, repellants and biological products.• Multi-drug therapies or rotational therapy against parasites in order to prevent the development of drug-resistance.• Insecticides and repellants safe for the environment.• Biological pest control.
Relevancy to wp4 objectives	<ul style="list-style-type: none">• Development of multi-national eradication and control programs.• Sustainability studies and risk evaluations to forecast future outbreaks and appreciate the effect of global changes upon the environment and the transmission of diseases: patz <i>et al.</i>, 2004; ezzati <i>et al.</i>, 2005. (see <i>references.</i>)

Status: final

18.

General information	
Title	Global trends in emerging infectious diseases
Year of publication	2008 Nature vol 451; 21 Februari 2008 ; doi:10.1038/nature06536
URL (web-link)	Http://www.nature.com/nature/journal/v451/n7181/full/nature06536.html
Author(s)	K.E. Jones ¹ , N.G. Patel ² , M.A. Levy ³ , A. Storeygard ³ , D.Balk ³ , J.L. Gittleman ⁴ , P. Daszak ²
Authors' affiliation	1: Insitute of Zoology, Zoological Society of London 2: Consortium for Conservation Medicine, Wildlife Trust, New York 3: Center for International Earth Science Information Network, Earth Institute, Columbia University, New York 4: Odum School of Ecology, University of Georgia, Athens (Georgia, USA)
Country	UK, USA
Language of publication	English
Commissioned by	Supported by: NSF, NIH, Eppley Foundation, The New York Community Trust, V. Kann Rasmusen Foundation and a Columbia University Earth Institute fellowship.
Key words	Emerging infectious disease, zoonosis, predictive model, driving factors, wildlife, vector-borne, hotspots
Content information	
Summary	<p>The emergence of infectious diseases is thought to be driven largely by socio-economic, environmental and ecological factors, but no comparative study has analysed these linkages. To understand global temporal and spatial patterns of eids this study analysed 335 EID 'events' between 1940 and 2004 and demonstrates non-random global patterns. EID's are dominated by zoonoses (60.3% of eids); the majority (71.8%) originate in wildlife and are increasing significant over time.</p> <p>The former mentioned driving factors are confirmed. The study provides a basis for identifying regions where new eids are most likely to emerge. Furthermore it reveals a substantial risk of wildlife zoonotic and vector-borne eids originating at lower altitudes where reporting efoort is low.</p> <p>The study concludes that global resources to counter disease emergence are poorly allocated, with the majority of the scientific and surveillance effort focused on countries from where the next important EID is least likely to originate.</p> <p>The findings highlight the critical needs for health monitoring and identification of new, potentially zoonotic pathogens in wildlife populations, as a forecast measure for eids.</p> <p>Definition om EID event: the first temporal emergency of a pathogen in a human population which was related to the increase in distribution, increase in incidence or increase in virulence or other factor which led to that pathogen being classed as an emerging disease.</p> <p>The EID events are grouped as: Zoonotic pathogens from wildlife, zoonotic pathogens from non-wildlife, drug-resistant pathogens, vector-borne pathogens</p>
Objectives	To analyse a database of EID events to compare and identify driving factors which influence trends in zoonotic emerging infectious diseases.
List of drivers (driving forces)	<p>Socio-economic drivers :</p> <ul style="list-style-type: none"> Human population density Human population growth Agriculture practices Antibiotic drug use Land use change <p>Ecological and environmental drivers/conditions: Biodiversity (wildlife host richness) Variables like latitude, rainfall</p>
List of future threats	Not provided
Time scale of the outlook	Not applicable
Methodology	
Method used for mapping the future	Retrospective study on emerging infectious disease events between 1940 - 2004
Method used for identifying relevant topics	Literature study to identify driving factors and validation thereof by above mentioned retrospective study; although relevant topics are not addressed as such. They are to be identified within the important driving factors provided.
Method used for priority setting	Not applicable
Information resources	
Expert opinion	No
Literature	
Internet	

Status: final

Output / Outcome	<p>The analysis provide a basis for developing a predictive model for the regions where new eids are most likely to originate (emerging disease 'hotspots').</p> <p>The study is not a foresight study that provides a map of how the future world will look like, but provide the means (a model) to map the world by pinpointing the spots on the globe where disease emergence can be expected. This approach may be valuable for deciding where to allocate global resources to pre-empt, or combat, the first stage of disease emergence.</p> <p>The focus is on zoonoses, which excludes animal diseases per se.</p>
Conclusion of review:	
List of future research topics	Not provided; but by using the model topics can be identified
Relevancy to WP4 objectives	Very relevant, although the focus is on zoonoses

Status: final

19.

General information	
Title	Emerging zoonoses and pathogens of public health concern. Scientific and technical review 23 (2)
Year of publication	2004
URL (web-link)	
Author(s)	Edited by L.J. King
Authors' affiliation	University of Michigan
Country	USA
Language of publication	English
Commissioned by	OIE
Key words	Emerging zoonoses, factors influencing emergence
Content information	
Summary	The book, to which a number of authors contributed, gives an overview of a number of pathogens and influences that are associated with their emergence.
Objectives	To give an overview of the possible causes of emergence of new pathogens in animals and humans
List of drivers (driving forces)	Ecological, environmental or demographic factors that place people in increased contact with the natural host for a previously unfamiliar zoonotic agent or that promote the spread of the pathogen Changes in human exposure: new agricultural practices, urbanisation, or globalisation, as well as climate change Antimicrobial resistance Burgeoning human population, the increased frequency and speed of local and international travel, the increase in human-assisted movement of animals and animal products, changing agricultural practices that favour the transfer of pathogens between wild and domestic animals, and a range of environmental changes that alter the distribution of wild hosts and vectors and thus facilitate the transmission of infectious agents Human demographics, economic development and land use, international travel and commerce, and microbial adaptation
List of future threats	AI, Rift Valley fever, West Nile fever, Japanese encephalitis and Crimean-Congo haemorrhagic fever, bartonellosis, leptospirosis, Lyme borreliosis and plague TB Hanta virus
Time scale of the outlook	Not mentioned
Methodology	
Method used for mapping the future	Nvt
Method used for identifying relevant topics	Own expertise of authors
Method used for priority setting	Own expertise of authors
Information resources	
Expert opinion	
Literature	
Internet	
Output / Outcome	
Conclusion of review:	
List of future research topics	
Relevancy to WP4 objectives	High

Status: final

20.

General information	
Title	Using foresight methods to anticipate future threats: the case of disease management
Year of publication	2006
URL (web-link)	Http://www.ncbi.nlm.nih.gov/pubmed/17077701?Ordinalpos=18&itool=entrezsystem2.pentrez.Pubmed.Pubmed_resultspanel.Pubmed_rvdocsum
Author(s)	Ma S., Seid M.
Authors' affiliation	<ul style="list-style-type: none"> Ma: Mphil, doctoral fellow, Pandee RAND Graduate school, USA Seid; phd, behavioural/social scientist, RAND Corporation, USA
Country	USA
Language of publication	English
Commissioned by	
Key words	Scenario planning - assumption-based planning (ABP) foresight – strategic planning – health care
Content information	
Summary	The article describes a method of scenario planning linked to a method of assumption-based planning, to help health care managers in long-term planning (study specific to disease management).
Objectives	To present a systematic approach to long-term planning using foresight methods and taking disease management (human health care) as example
List of drivers (driving forces)	No application (human health care) Rising health care costs, aging and increasingly diverse population, growing prevalence of chronic disease, problems with health care quality, advances in health care technology, etc.
List of future threats	No application (human health care)
Time scale of the outlook	Long-term (2020)
Methodology	
Method used for mapping the future	<p>Link of 2 methods:</p> <p>Scenario planning (identification of factors (driving forces, drivers, definition: physical or virtual force expected to be a significant cause of change, or contributor to change) that may affect the environment → scenarios of alternate plausible future, 8 extreme scenarios))</p> <p>+</p> <p>Assumption-based planning (ABP, identify vulnerable, load-bearing assumptions; when an assumption becomes vulnerable, then significant change might be needed; signposts (changes in direction of certain factors) are events or thresholds that indicate important change in the validity of vulnerability of an assumption)</p> <p>=</p> <p>Link: determine which assumptions would be likely to fail in each of the 8 futures and suggest strategies for countering such threats; monitoring signposts may allow anticipation of futures</p>
Method used for identifying relevant topics	<p>Method to identify drivers (significant causes of or contributors to changes) and scenarios:</p> <p>On line free-listing (free lists to identify items in a cultural domain and to calculate each item's relative salience) survey with experts (were asked to list the 5 issues they think will be the most important in the next 5 – 15 years and rank in order of importance) + information about experts (demography, etc) + extensive literature review → 63 experts → data sorted by 3 researchers (differences resolved by consensus) → 12 drivers → group in 3 categories of actual drivers (consumer empowerment, concentration of purchasing power, technology implementation) → plotted in 3-D cube with 2 possibilities of end (high or low) for each dimension → 8 extreme scenarios of alternate health care futures that could emerge+ infinite number of more likely scenarios that could emerge</p> <p>Method to identify assumptions:</p> <p>Interview of a responsible of a firm (specialised in disease management, industry specific assumptions), by adopting journalists' questions techniques (by asking "Why...?") To discover the implicit logic behind, to push to explain or reveal some hidden assumptions → identification of a set (4) of vulnerable and load-bearing assumptions (example: treatments will be too expensive and will not be developed for chronic diseases) → link to scenarios</p>
Method used for priority setting	<p>Link assumptions to scenarios of future:</p> <p>Examine each assumption within each scenario and determine which assumptions would likely to fail (r to hold) in each of the 8 alternate futures (fail, hold, may fail, may hold) → table (8 scenarios, 4 assumptions) → analysis of the table: which assumptions fail or may fail in which alternate future (anticipating alternate future) + which factors threaten each of the assumptions (assess potential threats to key assumptions)</p>
Information resources	
Expert opinion	Authors

Status: final

Literature	<ul style="list-style-type: none"> • Thomson et al., 2005: Improving the science and policy relationship with the help of foresight: a European Perspective • Kuwahara, 2006: The potential and implications of DELPHI approach (URL: see in article pdf) • Dewar et al., 2002: Assumption-based planning: a tool for reducing avoidable surprises • Ryan et al., 2003: Techniques to identify themes
Internet	
Output / Outcome	No application (human health care)
Conclusion of review:	
List of future research topics	No application
Relevancy to WP4 objectives	<ul style="list-style-type: none"> • Specific threats and specific futures are impossible to predict; the analysis bounds some possibilities • Limitation: do not include some wild card situations (ex bird flu pandemic, wide-scale bioterrorist attack) which would change the whole planning • Specific to health care (human) • Abstract • Does not give recommendations for research topics • --> ??

Status: final

21.

General information	
Title	Developing an Animal Health Science Agenda for the National Animal Health Strategy (NAHS) Application of Strategic Foresight to the Development of Vision, Goals, Objectives and Actions
Year of publication	2008 (first version in February 15, 2008)
URL (web link)	Http://www.healthyanimals.ca/english/wg-gt/g_futscience/ws-at/march2008/AHS-Backgrounder.pdf
Author(s)	Bruce mcNab, Craig Stephen, Andrew Potter, Pierre Falaradeau, Mark Williamson, Harpreet Kochhar, Jean Pierre Vaillancourt, and others
Authors' affiliation	Ontario Ministry of Agriculture and Rural Affairs British Columbia Centre for Coastal Health (CCH) and the University of Calgary Veterinary Infectious Disease Organisation (VIDO)/Intervac Saskatoon Centre de développement du porc du Québec inc. CRTI Centre for Security Science (CSS) Defence Research Development Canada (DRDC) Canadian Food Inspection Agency (CFIA) University of Montreal Universities, animal health industry, sector of agriculture and food, external consultants.
Country	Canada
Language of publication	English
Commissioned by	Canadian Food Inspection Agency (CFIA)
Key words	Scenarios based study Canada Government and industry 20 years foresight
Content information	
Summary	The Strategic Foresight process was initiated with active participation from the animal health science community and focussed on animal health science needs twenty years into the future, in 2026. The aim was for an Agenda for animal health science that would allow partners to plan proactively, thus enabling effective preparation for a range of potential futures. The process resulted in the development of five scenarios of the future circa 2026 that highlight key uncertainties facing strategic decision makers. Based on this, a Working Group on Future Animal Health Science was established in summer 2007 to contribute to the implementation of the National Animal Health Strategy (NAHS). The WG employed the five scenarios to develop a proposed strategic direction for Animal Health Science, including a Vision and Goals. The completion of an Animal Health Science Agenda, including Objectives and step-wise Action Plans over the next years will involve networks of participants from regional science communities in Canada.
Objectives	In order to best protect Canadians from preventable animal-related health risks, the NAHS aims to consolidate and coordinate the activities of governments, industries and animal health communities, each of which is currently responsible for various facets of animal health in Canada. The NAHS proposes the following objectives: To protect Canadians from preventable animal-related health risks; To strengthen domestic and international confidence in the integrity of Canada's animal health, environment protection and food safety inspection systems; To minimize the economic and social consequences of animal diseases; To sustain animal health, by maintaining viable animal populations and genetic diversity; To help prevent exposure of animals to disease, toxic substances and other health hazards; To continue to improve the quality of life for animals; To protect ecosystem health through prudent animal health practices; To develop an integrated governance system to mitigate identifiable risks.

Status: final

List of drivers (driving forces)	<p>Global phenomena such as international trade and travel and climate change are emphasising the interrelated nature of animals, humans and the environment. It has been estimated that 75 per cent of diseases that have appeared in human populations in the last 20 years have originated in animals. As diseases are able to move freely among borders, the management of animal diseases has become a topic of international concern.</p> <p>The World Organization for Animal Health (OIE) has encouraged the international community to strengthen its ability to manage new emerging risks to animal health exemplified by diseases such as bovine spongiform encephalopathy (BSE) and avian influenza.</p> <p>In addition, Canada's recent experiences with disease outbreaks have highlighted the need for all animal health stakeholders to align their objectives and approaches.</p> <p>OR (<i>drivers used to develop the future scenarios</i>):</p> <ol style="list-style-type: none"> 1. Global market conditions create an opportunity for Canadian food producers. 2. A growing portion of the North American population becomes vegetarian; others are eating far less meat. 3. Increased zoonotic challenges to human health. 4. Climate change and environmental degradation 5. Steady growth in genomic knowledge and lessening public opposition to genomic manipulation.
List of future threats	<p>Climate change</p> <p>Meat consumption falls down</p> <p>Zoonotic threat</p>
Time scale of the outlook	The Agenda is expected to be completed by the end of 2008, with implementation beginning in 2009.
Methodology	
Method used for mapping the future	<p>Basis = 5 future scenarios concerning Canada's role in animal production.</p> <p>A multidisciplinary working group, consisting of the government, CFIA, universities, animal industry and consultants used these scenarios to develop a strategic direction for animal science englobing 5 activities: research, surveillance, diagnostics, risk analysis, and emergency preparedness and response. Suggestions for the organisation (need for networking, certainly among multidisciplinary, highly specialised teams), people from different organisation, technology (e.g. New methods and technologies for surveillance and monitoring, for tracing) and for the process (science based management) were made.</p> <p>The outcome will be discussed in regional working groups, in order to obtain the most support from all actors involved.</p> <p>Finally, an agenda will be put forward that should be put into practice from 2009 on.</p>
Method used for identifying relevant topics	Not clear; probably task force discussing the 5 scenarios.
Method used for priority setting	No priorities set.
Information resources	
Expert opinion	<p>Government</p> <p>Food Inspection Agency</p> <p>Universities</p> <p>Animal industry</p>
Literature	General information
Internet	General information
Output / Outcome	
Conclusion of review:	<p>The action plan focuses on research, surveillance, diagnostic testing, risk analysis, and emergency preparedness and response.</p> <p>The main objectives in the agenda are the identification of public health impacts of animal-health interface (zoonoses), the increased ability to measure environmental impacts in relation to animal health, the development of early-warning and emergency prevention systems, the establishment of a systems-based approach to animal health science which connects health related concerns with socially and environmentally sustainable practices, the implementation of new technologies that allow for rapid sample collection and diagnosis, and for real-time surveillance.</p> <p>The study is rather broad in its approach and therefore does not mention specific diseases or infections that will mean a threat to Canada's animal production, but nevertheless details the need for the optimal organisation of the animal health structure and the education of partners involved. From a broad social-economic perspective, it highlights the need for multidisciplinary team building, high education of professionals, use of innovative scientific tools for especially infection monitoring and tracing of animal products, and for alert systems for animal infections.</p>
List of future research topics	Not mentioned. The agenda is in favour of the development of new monitoring technologies and methods and of the development of tracing back systems.
Relevancy to WP4 objectives	The approach, which starts with the scenario's, is interesting, and the study describes the general needs for the animal health partners, the need for innovative technologies and alert systems.

Status: final

22.

General information	
Title	Combating the threat of zoonotic infections
Year of publication	2008
URL (web-link)	Http://www.leopoldina-halle.de/cms/fileadmin/user_upload/leopoldina_downloads/EASAC_Zoonoses.pdf
Author(s)	Volker ter Meulen et al. (in collaboration with an expert panel from Germany, Belgium, Slovak Republic, UK, Switzerland, Slovenia, Czech Republic, Hungary, France, Greece, Norway and Poland – 16 persons in total, see attachment 1)
Authors' affiliation	German Academy of Sciences, Leopoldina
Country	UK (EU)
Language of publication	English
Commissioned by	The European Academies Science Advisory Council (EASAC)
Key words	Zoonoses – epidemiology – surveillance – risk monitoring – international co-operation – research – education - innovation
Content information	
Summary	The expert panel recommends action both on the EU and national level. Key areas are (1) epidemiology, standardised surveillance and risk monitoring on a set of priority pathogens ; (2) international co-operation, taking into account climate change, human migration and transport ; (3) research and education, with as the most significant deficits at the moment basic science (host-pathogen interaction, interspecies transmission, antimicrobial resistance), vector-borne zoonoses and wildlife reservoirs, and socio-economic impact of zoonotic infections ; and (4) innovation, including diagnostics, vaccines and chemotherapy.
Objectives	To identify the current and future needs for infrastructure, skills, investment in fundamental science, and support for the development of novel healthcare products and services, with specific reference to zoonoses.
List of drivers (driving forces)	Zoonoses account for <ul style="list-style-type: none"> - Many of the recently emerging infectious diseases with high potential for public health and socio-economic impact - And for the continuing, major burden associated with food-borne infection. It is essential for policy-makers <ul style="list-style-type: none"> - To enhance the sharing of information - To co-ordinate control measures - To build critical mass in research and development capabilities
List of future threats	Cross-border threats of communicable diseases Climate change
Time scale of the outlook	None mentioned
Methodology	
Method used for mapping the future	Expert panel in working group, reviewed and approved by EASAC Council, working by the following steps : <ul style="list-style-type: none"> - Evolution since 2004 ? - Current situation in the Member States ? - What further resources and action are needed at the EU level ? - What are the issues for EU public health arising from animal and human mobility ?
Method used for identifying relevant topics	Expert panel – working group EU priorities for policy and research on zoonoses (Annex 2 of the report, Directive 2003/99/EC)
Method used for priority setting	Expert panel – working group
Information resources	
Expert opinion	X
Literature	X (see attachment 2)
Internet	X
Output / Outcome	Peer reviewed EASAC report with recommendations
Conclusion of review:	

Status: final

List of future research topics	<p>Basic research in infectious diseases :</p> <ul style="list-style-type: none"> - Mechanisms of interspecies transmission - Host adaptation - Pathogenicity - Molecular determinants of host specificity <p>Types of zoonoses :</p> <ul style="list-style-type: none"> - Vector-borne (surveillance based on arthropod vector populations) - Wildlife reservoirs (surveillance of wildlife animal reservoirs) <p>Vector ecology :</p> <ul style="list-style-type: none"> - Host range - Vector populations and competence (pathogen movement into new vectors) - Impact of climate and environmental change on vector distribution <p>Detection tools :</p> <ul style="list-style-type: none"> - Development of rapid, sensitive, simple and cheap diagnostic tests, using new technologies (e.g. Micro-array) - Identification of pathogen characteristics, like drug resistance - Host response : signals, biomarkers, immunosignatures =<= early detection <p>Predictive and real-time epidemiological modelling and simulation</p> <p>Engineering/study of animal host genome :</p> <ul style="list-style-type: none"> - Increased resistance - Increased susceptibility (sentinel animals) <p>Genetic engineering of vectors (cf. Transgenic malaria resistant mosquitoes)</p> <p>Vaccines :</p> <ul style="list-style-type: none"> - Basic and applied immunology - Identify mechanisms to provide appropriate incentives for the industry (relatively weak return) <p>Chemotherapy :</p> <ul style="list-style-type: none"> - Novel anti-infective agents for bacteria, virus and parasites - Build collaboration with the private sector <p>Infrastructure :</p> <ul style="list-style-type: none"> - Biological containment facilities (L3 and L4 ; maximise use by sharing) - Harmonisation and standardisation in the facilities and procedures - Human resources : continuing education and training programmes in microbiology and infection control
Relevancy to WP4 objectives	<p>Nearly all of the above.</p> <p>Specific priority zoonoses ("list A" in appendix 2 of the report), to be included in monitoring :</p> <ul style="list-style-type: none"> - Brucellosis - Campylobacteriosis - Echinococcosis - Listeriosis - Salmonellosis - Trichinellosis - Tuberculosis (<i>Mycobacterium bovis</i>) - Verotoxigenic <i>Escherichia coli</i> <p>Zoonotic agents to be monitored according to the epidemiological situation ("list B") :</p> <ul style="list-style-type: none"> - Viral zoonoses : calicivirus, hepatitis E virus, influenza virus, rabies, viruses transmitted by arthropods - Bacterial zoonoses : borreliosis, botulism, leptospirosis, psittacosis, tuberculosis other than in list A, vibriosis, yersiniosis - Parasitic zoonoses : anisakiasis, cryptosporidiosis, cysticercosis, toxoplasmosis - Other zoonotic agents

Status: final

23.

General information	
Title	Act on early warnings
Year of publication	2007
URL (web-link)	Http://baywood.com
Author(s)	Myers N., Rabe A, Silberman K.
Authors' affiliation	?
Country	USA
Language of publication	English
Commissioned by	
Key words	Early warning - preventive action
Content information	
Summary	<p>Describes procedures how and when to take preventive action (acting with foresight) to protect human health or environment even in the presence of scientific uncertainty i.e.:</p> <ul style="list-style-type: none"> - Assume that biologically active chemicals are harmful - Act when science is uncertain - Defining the "credible evidence of harm" threshold for protective action - Create and strengthen health and environmental programs by: <ul style="list-style-type: none"> → expanding health monitoring programs → establishing early warning committees → expanding environmental and fish and wildlife monitoring programs → redirecting public health research agenda to study complex biological systems and relationships - Monitor novel technologies - Consider clusters of health problems to be early warnings
Objectives	To inform and to warn how and when can be acted on early warnings
List of drivers (driving forces)	/
List of future threats	/
Time scale of the outlook	Not of application
Methodology	
Method used for mapping the future	Not of application
Method used for identifying relevant topics	Not of application
Method used for priority setting	Not of application
Information resources	
Expert opinion	/
Literature	/
Internet	/
Output / Outcome	
Conclusion of review:	
List of future research topics	<ul style="list-style-type: none"> - Study complex biological systems and relationships - Study long range effects on biological systems
Relevancy to WP4 objectives	Minor

Status: final

24.

General information	
Title	Nationale Agenda Diergezondheid (National Agenda Animal Health)
Year of publication	2007
URL (web-link) ¹	
Author(s)	Policy officers, Ministry of Agriculture, Nature and Food Quality
Authors' affiliation	Ministry of Agriculture, Nature and Food Quality, The Netherlands
Country	The Netherlands
Language of publication	Dutch
Commissioned by	Ministry of Agriculture, Nature and Food Quality
Key words	Animal health policy
Content information	
Summary	The document shows the background and policy plans of the Ministry in the field of animal health. It covers a wide range of topics related to animal health and animal keeping. The scope of the document is broader than previously. Not only livestock, but also companion animals and wild animals are subject of the policy plans. At the same time, contrary to what had been the custom over the last years, not only the notifiable diseases are given attention, but also the other animal health problems. The policy is placed in the perspective of a changing society: the attitude of people versus animals is changing, which has consequences for the way in which Government can deal with animal health crises. While in previous years stamping out through culling of healthy animals took place, the method of choice will in future be, whenever possible, vaccination.
Objectives	To present the ministerial policy on animal health in The Netherlands
List of drivers (driving forces)	Climate change, intensification of livestock transports, changing society and attitude towards animals, intensification of traffic of people over the globe, intensification of trade.
List of future threats	Avian influenza, bluetongue, other (sub)tropical diseases.
Time scale of the outlook	2007 – 2013
Methodology	
Method used for mapping the future	Discussion between policy officers and with sector representatives
Method used for identifying relevant topics	Discussion between policy officers and with sector representatives
Method used for priority setting	N/a
Information resources	
Expert opinion	
Literature	
Internet	
Output / Outcome	
Conclusion of review:	
List of future research topics	Changes in society, in international travel as well as climate change may pose threats to which the animal health authorities must prepare themselves.
Relevancy to WP4 objectives	High: discussion on policy approaches predominantly.

Status: final

25.

General information	
Title	Using scenario planning in public health: anticipating alternative futures
Year of publication	2004
URL (web-link)	/
Author(s)	Neiner J.A., Howze E.H., Greaney M.L.
Authors' affiliation	CHES (?)
Country	USA
Language of publication	English
Commissioned by	
Key words	Scenario planning – public health planning – chronic disease – prevention - control
Content information	
Summary	Scenario planning is applied to public health to illustrate 4 steps. Key risk factors are: unhealthy diet and physical inactivity. <ul style="list-style-type: none"> - Step 1: agreeing on a strand and clear sense of purpose - Step 2: understand driving forces (predictable and unpredictable) or key patterns and trends - Step 3: scenario plots - Step 4: plot strategy, rehearse and converse
Objectives	Describes a method for anticipating alternative futures
List of drivers (driving forces)	Predetermined forces: ageing, growing multi-ethnic and multicultural workforce, globalization, growing burden of chronic disease. Unpredictable forces
List of future threats	/
Time scale of the outlook	Not of application
Methodology	
Method used for mapping the future	Scenario analysis → scenario plot matrix
Method used for identifying relevant topics	Not of application
Method used for priority setting	Not of application
Information resources	
Expert opinion	Interdisciplinary public health experts
Literature	Yes
Internet	On scenario planning: www.wou.edu/education/healthpe/brazaj/mfbib.html ; www.gbn.org ; www.wired.com/wired/scenarios/build.html On brainstorming and creative thinking processes: www.synecticscam.com/home.cgi On visioning the future with your team: www.buzzblick.com/search.htm On brainstorming with groups: www.tmn.com/openspace/index.html
Output / Outcome	
Conclusion of review:	
List of future research topics	Not of application
Relevancy to WP4 objectives	Stepwise description of scenario planning

Status: final

26.

General information	
Title	Preparing for change: strategic foresight scenarios
Year of publication	1996
URL (web-link)	
Author(s)	Nielsen G.A.
Authors' affiliation	Manager of health information services and managed care at Allen Hospital (place of the study)
Country	USA
Language of publication	English
Commissioned by	Own institute (Allen hospital)
Key words	Strategic foresight scenario – driving forces – factors – strategic planning
Content information	
Summary	A good scenario can stimulate foresight; it can show how relevant driving forces may affect not only the industry but also the individual health system. It identifies specific forces affecting healthcare delivery systems, tests assumptions for the future, assesses alternative and plausible futures and can form a springboard for future planning
Objectives	A strategic foresight scenario study was performed in a US hospital to prepare for imminent future changes and strategic planning
List of drivers (driving forces)	No application (health care – hospital)
List of future threats	No application (health care – hospital)
Time scale of the outlook	1995 → 2005
Methodology	
Method used for mapping the future	A small group of persons (6) considered factors that would affect healthcare delivery in 2005 and created, wrote a scenario (in the form of a story line) → presented to a greater group (33 persons) of senior managers → opening for discussions → output: questions about the future and answers + appreciation of scenarios (possible, probable, not, etc.)
Method used for identifying relevant topics	Expert opinion
Method used for priority setting	No priority setting
Information resources	
Expert opinion	For future information about strategic foresight techniques, contact Richard Ireland (Snowmass Institute, tel 303/771-5501)
Literature	No "If you have been through a similar exercise, please submit it to <i>Radiology Management</i> for possible publication
Internet	/
Output / Outcome	Questions about future and responses
Conclusion of review:	
List of future research topics	No No predict the future but model and inspire an open-mindedness and active approach to the future ("learning tool, not a crystal ball" → edictions, only guesses)
Relevancy to WP4 objectives	Too qualitative (only expert opinions of 6 persons)

Status: final

27.

general information	
Title	Foresight – Detection and identification of Infectious Diseases
Year of publication	2006
URL (web-link)	http://www.foresight.gov.uk/OurWork/CompletedProjects/Infectious/Key%20Information/Project%20Outputs%20.asp
Author(s)	OFFICE OF SCIENCE AND TECHNOLOGY, UK
Authors' affiliation	UK Government report
Country	UK
Language of publication	English
Commissioned by	Office of Science and Technology - DTI
Key words	Emerging infectious diseases; future threats; diagnostic technologies; identification and detection
content information	
Summary	<p>The report provides an output to an extensive Foresight study focussed on the future threats posed by infectious diseases and the potential development of diagnostic technologies to meet the threat. It is noted that the report is a cross sectional study across human, animal and plant pathogens, allowing for synergies to be drawn across the differing disciplines. With regard to animal health there are many specific reports that are directly relevant and the overall structure of the report works toward 4 cross cutting themes (termed challenges) for consideration in the development of future detection systems, in short; data-mining, genomics, hand-held diagnostics, fast throughput screening. Initial scoping activity working toward these themes included extensive analysis of future threats and reviews of current and future developments in science but was also backed up by putting these potential developments onto a societal context. It is note-worthy that in the analysis of future threats 4 out of 8 of the key themes identified and studied were directly relevant to EMIDA activities (i.e. animal health) – novel pathogens, pathogens acquiring resistance, zoonoses and trans-boundary animal diseases.</p> <p>To note that this study is focused on detection and identification of infectious diseases and does not take a holistic view of disease control.</p> <p>Also the report sets out to examine 3 different countries/continent from a developed, emerging and developing perspective (UK, China, Africa), that may be used to draw parallels on a global perspective.</p>
Objectives	<p>The aim of the project was to provide a long-term vision for the detection of infectious diseases, taking account of the evolving risk of diseases, changing user requirements for detection and cutting edge science. In so doing, the objectives were to:</p> <ul style="list-style-type: none"> - Take a broad perspective across species/specialism boundaries to include plants, animals and humans - To consider these issues on an international basis as well as national - Provide reviews of state of the art and future science - Undertake an analysis of future threats - Undertake an analysis of the societal context in the use of detection technologies - Provide an evaluation of potential detection technologies (the 4 user challenges) - Provide an action plan for moving forward. To note that this action plan includes extensive contribution from national and international organisations.
List of drivers (driving forces)	<p>Drivers identified with respect to animal diseases include:</p> <ul style="list-style-type: none"> - The movement of animals and animal commodities - The intensification of animal agriculture - Better integration of medical and veterinary health systems - Climate change - Development programmes (new dams, urban and agricultural development encroaching on wildlife habitats) <p>Across the animal, plant, human field common place drivers included:</p> <p>Increasing travel, migration and trade</p> <p>Exotics, i.e. the spread of new diseases from wild species</p> <p>Drug use leading to drug resistant organisms</p> <p>To note that specific reports were undertaken to examine important areas as potential drivers:</p> <ul style="list-style-type: none"> - Climate change - Animal and human disease in china (to represent Asia and potential zoonoses emergent in the region), also note that 9 separate drivers were identified to the region.

Status: final

	- The effect of infectious diseases in ecosystems.
List of future threats	Novel pathogens Pathogens acquiring resistance Zoonoses HIV/AIDS Epidemic plant diseases Acute respiratory infections Sexually transmitted diseases Trans-boundary animal diseases.
Time scale of the outlook	10-25 years
Methodology	
Method used for mapping the future	A variety of scoping studies, consultation activities and expert workshops were undertaken throughout the lifetime of the project in support of the flow of work toward the production of the report. Briefly an initial scoping workshop was held to discuss potential threats and drivers and future scientific developments. From the output to this 3 strands of activity were set up to examine specifically; future risks, future science and the analysis of future non-technological (i.e. societal) contexts. The outputs from these areas were drawn together to define 4 cross cutting user challenges or themes which represented potential activities to help mitigate against future threats (listed in the summary above). To note that the project was overseen by a high-level stakeholder group with representatives from many organisations and government departments including: WHO, FAO, OIE, Gates Foundation, World Bank. Also an expert advisory group regularly met to discuss progress with representatives from a number of government departments and academic institutes.
Method used for identifying relevant topics	Scoping workshops and expert opinion were the main methodologies, although many specific scientific reports and literature reviews were also commissioned to feed into the process.
Method used for priority setting	As above, although the aim was to identify future challenges and potential technologies/scientific advances that may help to mitigate against those threats. Given the wide remit of the work the prioritisation worked toward thematic areas rather than toward specific diseases. Although it is worth mentioning that in many cases disease specific scientific reports were undertaken and examples of specific disease scenarios are detailed.
Information resources	
expert opinion	Over 300 experts from 30 countries, covering a wide range of disciplines. These are listed in annex a of the executive summary
literature	Literature lists are provided as appropriate with each scientific review.
internet	-
Output / Outcome	-
Conclusion of review:	
List of future research topics	A wealth of future activities and commitments are stated by various organisations in the project output as activities going forward. However the future themes are best represented by the four user challenges stated above: data-mining genomics hand-held diagnostics fast throughput screening
Relevancy to WP4 objectives	The output is extremely relevant to WP4 objectives, but must be taken in context that it is focussing on disease detection, across multiple species barriers and on a wide geographic context (global). However many of the issues on a macro (global) level will still be pertinent on a continental scale.

Status: final

28.

General information	
Title	Aquaculture 2020. Transcending the Barriers – as long as... A Foresight Analysis
Year of publication	2005
URL (web-link)	Http://www.forskningsradet.no/servlet/Satellite?Cid=1088005976008&pageid=1088005976008&pagename=havbruk%2fpage%2fhovedsideeng&site=havbruk
Author(s)	The report is made up of three parts: Part 1: Analysis and recommendations, written by Finn Ørstavik. Part 2: Process and experiences, written by Erik Øverland. In the Appendixes are the materials produced in the gatherings along with the start-up document and a list of all those who took part in one or more of the gatherings.
Authors' affiliation	Erik Øverland: The Research Council of Norway. Finn Ørstavik, NIFU STEP
Country	Norway
Language of publication	English
Commissioned by	The Research Council of Norway
Key words	
Content information	
Summary	In the autumn of 2003 the Research Council invited the aquaculture industry, the research Communities and the public authorities to take part in a broadly focused future-oriented dialogue, a foresight analysis about Norwegian aquaculture, Aquaculture 2020. The initiative was received with considerable interest on the part of institutions and individuals. A total of 70 persons took part in four gatherings where some 150 mini-scenarios and five more complex scenarios were developed and one arrived at strategic recommendations and initiatives directed towards research, the public authorities, and trade and industry. The Mini-scenarios and the scenarios in Aquaculture 2020 represent a set of different and hopefully interesting perspectives on the potential condition of Norwegian aquaculture in 2020. The scenarios also attempt to explain that which has taken place along the way. The report is made up of three parts: Part 1: Analysis and recommendations, written by Finn Ørstavik. Part 2: Process and experiences, written by Erik Øverland. In the Appendixes are the materials produced in the gatherings along with the start-up document and a list of all those who took part in one or more of the gatherings.
Objectives	
List of drivers (driving forces)	<p>Factors</p> <ul style="list-style-type: none"> Market Feed raw materials Innovation Capital / Ownership Development of competence (research and education) Sustainable Development (environmental and food product safety) Policy <p>Actors</p> <ul style="list-style-type: none"> Companies Research, educational and competence communities Industry Organisations Investors Public Authorities Advocates Consumers/ Customers

Status: final

List of future threats	<p>The market situation – Because access to the export markets will be decisive to the industry's opportunities for development and because this access has been characterised by unpredictability and uncertainty for many years.</p> <p>Access to feed raw materials – Because access to adequate feed at reasonable prices can come to be a serious bottleneck in relation to further growth and because administration of marine resources is a large and global challenge.</p> <p>Development of competence – Because expertise is unevenly distributed in the industry, because the will to invest in research-based innovation has been and remains extremely changeable and because the distribution of responsibility and conditions for action within the knowledge infrastructure have been unclear, creating both uncertainty and conflicts.</p> <p>Sustainability in added-value activities – Because sustainability and environmental considerations have an increased significance, because climate changes can occur with great repercussions for the industry and because it is not a given that fish farming implies a sustainable allocation of limited resources, such as in terms of energy and protein consumption.</p> <p>Policy – Because the regulation of the industry has been vital to its development, because the regulatory system has undergone intense modification and has not found its final form, because market access internationally is closely connected with how the industry is administrated by the authorities in Norway, because the political system itself is in the process of being modified and can be heavily influenced should Norway become a member of the EU and because an active government is seen as entirely decisive to large parts of the aquaculture industry, while an industry-neutral government is seen as a necessary condition for healthy economic growth in leading economic and finance policy communities.</p>
Time scale of the outlook	2005 – 2020
Methodology	
Method used for mapping the future	Scenario methodology
Method used for identifying relevant topics	Dialogue-based techniques
Method used for priority setting	Dialogue-based techniques
Information resources	
Expert opinion	
Literature	
Internet	
Output / Outcome	
Conclusion of review:	
List of future research topics	The Foresight report became an important document in working out the plans for the Great Program AQUACULTURE – An industry in growth (HAVBRUK). The Aquaculture – program has Fish health as a special research area. The fish health area prioritise fish diseases, vaccination, diagnostic, epidemiology etc, both basic and applied projects.
Relevancy to WP4 objectives	

Status: final

29.

General information	
Title	Verkenning Nationale Agenda Diergezondheid; Analyse van meningen en ideeën van stakeholders met betrekking tot het toekomstige diergezondheidsbeleid (in Dutch: exploration national Agenda Animal Health: analysis of opinions and ideas of stakeholders in relation to the future animal health policy)
Year of publication	2007
URL (web-link)	
Author(s)	Van der Peet and Leenstra
Authors' affiliation	Animal Sciences Group, Wageningen University
Country	The Netherlands
Language of publication	Dutch
Commissioned by	Ministry of Agriculture, Nature and Food Quality
Key words	Animal health policy
Content information	
Summary	The document gives the result of a stakeholder consultation that was carried out in the framework of the new National Animal Health Agenda of The Netherlands. The analysis of the effort shows, that differentiation in policy between various groups of livestock keepers is acceptable, as is vaccination. Government should make more use of networks and information that is present in the sectors. Policy should be geared much more towards prevention. There is going doubt about the effectivity of the "veterinary fortress". Discussion about the structure of the sector need to take place. International extension of the existing monitoring system is necessary, by linking up with existing databases. International approaches are needed in animal health policy. Attention needs to be given to animals in nature.
Objectives	To explore the opinios and ideas of stakeholders regarding the ministerial policy on animal health in The Netherlands
List of drivers (driving forces)	Changing society and attitude towards animals, structure of the livestock sectors, different views on animal keeping, game animals, intensification of trade.
List of future threats	
Time scale of the outlook	2007 – 2013
Methodology	
Method used for mapping the future	E-mail consultation of a large number of stakeholders, combined with interviews and some workshops
Method used for identifying relevant topics	Same
Method used for priority setting	N/a
Information resources	
Expert opinion	
Literature	
Internet	
Output / Outcome	
Conclusion of review:	
List of future research topics	Changes in society, in international travel, preventive medicine, monitoring.
Relevancy to WP4 objectives	Medium: discussion relation between stakeholders and policy predominantly.

Status: final

30.

General information	
Title	Rapport sur l'évaluation du risque d'apparition et de développement de maladies animales compte tenu d'un éventuel réchauffement climatique
Year of publication	2005
URL (web-link)	Http://www.afssa.fr/Documents/SANT-Ra-Rechauffementclimatique.pdf
Author(s)	<ol style="list-style-type: none"> 1. François Rodhain 2. Emmanuel Albina 3. Geneviève André-Fontaine 4. Maxime Armengard 5. Gilles Dreyfuss 6. Barbara Dufour 7. Gérard Duvallet 8. François Moutou 9. Stéphan Zientara 10. Anne-Marie Hattenberger 11. Françoise Gauchard
Authors' affiliation	<ol style="list-style-type: none"> 1. Institut Pasteur 2. CIRAD, dépt. EMVT, Programme santé animale 3. Ecole nationale vétérinaire de Nantes 4. En retraite, correspondant de l'Académie de Médecine 5. Faculté de pharmacie de Limoges 6. Ecole nationale vétérinaire d'Alfort 7. Centre d'écologie fonctionnelle et évolutive (UMR 5175), Université de Montpellier 8. AFSSA Lerpaz – Site de Maisons Alfort 9. AFSSA Lerpaz – Site de Maisons Alfort 10. Agence française de sécurité sanitaire des aliments (AFSSA) 11. Agence française de sécurité sanitaire des aliments (AFSSA)
Country	France
Language of publication	French
Commissioned by	French Ministry of Agriculture, Food, Fisheries and Rural Matters, Directorate General of Food
Key words	Climate change – vectors – intermediate hosts – domesticated animal diseases – zoonoses
Content information	
Summary	An expert panel has studied a list of diseases that may be influenced by the climate change. This included vector-borne diseases (insects and ticks), risks caused by molluscs (parasites) and diseases originating from wildlife (mammals and birds). The study resulted in a list of recommendations on disease priorities, disease surveillance, research, and information management.
Objectives	<ul style="list-style-type: none"> - Evaluation of the risks of animal disease emergence, spread, or increase, as a result of the climate change - Identification of the animal diseases, especially vector-borne, that may be influenced by the climate change - Draft of a hierarchical list of these diseases
List of drivers (driving forces)	Climate change (temperature, rainfall, extreme weather conditions) Human behaviour Ecology Disease / vector cycle Host physiology
List of future threats	<p>Zoonoses :</p> <ul style="list-style-type: none"> - Rift Valley fever - West Nile fever - Visceral leishmaniosis - Leptospiroses <p>Other animal diseases :</p> <ul style="list-style-type: none"> - Bluetongue - African horse sickness
Time scale of the outlook	20-30 years
Methodology	
Method used for mapping the future	<ol style="list-style-type: none"> 1. Consultation of 2 climate experts 2. Listing of relevant diseases 3. Selection of diseases influenced by climate changes 4. Individual examination of selected diseases (ways of transmission ; interactions with environment ; possible spread and emergence) and establishment of a hierarchy 5. Study of the sanitary consequences for animals and humans 6. Study of the economic consequences in view of possible control methods 7. Study of the capacity for detection and control

Status: final

Method used for identifying relevant topics	Criteria : - Probability estimation of increase in incidence - Sanitary and economic consequences - Comparison of the different disease risks
Method used for priority setting	Criteria : - Public health - Animal health and economic consequences - Probability of occurrence Method : qualitative system (no risk, negligible risk, low risk, moderate risk, high risk)
Information resources	
Expert opinion	X
Literature	X (see attachment)
Internet	X
Output / Outcome	AFSSA report
Conclusion of review:	
List of future research topics	Climate change : research resulting in - Environmental actions (control of vector cycle and breeding grounds) - Technological / administrative actions (vaccines, medication, surveillance system, diagnostic tools, screening, "education" of the people involved) - "individual" actions (everyday habits, house climate, prophylaxy when travelling or when transporting animals, ...) Diseases : - Rift Valley fever - West Nile fever - Visceral leishmaniosis - Leptospiroses - Bluetongue - African horse sickness Epidemiological surveillance : research resulting in useful information on / for - Animals / vectors / reservoirs - Early warning system
Relevancy to WP4 objectives	Priority research on Specific diseases : - Rift Valley fever - West Nile fever - Visceral leishmaniosis - Leptospiroses - Bluetongue - African horse sickness In general : - Vaccines - Medication - Diagnostic tools - Surveillance / early warning system - Disease / vector cycle

Status: final

31.

General information	
Title	RELU (Rural Economy and Land Use) animal and plant disease workshop
Year of publication	Produced 2008 (not published)
URL (web-link)	RELU website - http://www.relu.ac.uk/
Author(s)	RELU is a research council organised programme with Defra support
Authors' affiliation	RCUK
Country	UK
Language of publication	English
Commissioned by	RELU
Key words	Not listed
Content information	
Summary	The workshop was set up to examine disease control practise (including research) across differing agricultural sectors. The outputs focus more on governance issues and recommends a more holistic approach to development of disease control policy, including changing agricultural practises and how they may affect risk to different diseases.
Objectives	To bring together research workers and stakeholders in a cross disciplinary workshop to discuss plant and animal disease control. Considering how research may meet disease control policy needs in the future.
List of drivers (driving forces)	Changing farming practise in response to a variety of factors: governance of disease control policy, adaptation to climate change.
List of future threats	Disease threats not specifically listed.
Time scale of the outlook	Not given.
Methodology	
Method used for mapping the future	Workshop to discuss cross disciplinary working, not specifically mapping future scenarios
Method used for identifying relevant topics	Not given
Method used for priority setting	Not given
Information resources	
Expert opinion	Government, industry, independent organisations and research workers.
Literature	Not given
Internet	Http://www.relu.ac.uk/
Output / Outcome	The workshop report focuses on governance and responsibility sharing for disease control comparing and contrasting the plant and animal disease situations. With reference to animal health there is recognition of a step change toward sharing responsibility with industry, comment raised regarding exotic and endemic disease threats. Exotic threats being transient, where as endemic diseases may change farming practises as systems adapt. Also recognised that disease control polices need to be updated to remain effective, in light of changing farming practises. Future threats and risks concerning specific diseases are not addressed.
Conclusion of review:	
List of future research topics	N/A
Relevancy to WP4 objectives	In consideration of future research the workshop highlights the need to have cross sector awareness of what drives risks of disease introduction. Some factors are more direct (climate change and distribution of vectors), others are less so, e.g. Adapting agricultural practise in response to CC, trade etc... Causing habitat variation that creates opportunity for new pathogens.

Status: final

32.

General information	
Title	Infectious diseases – importance of co-ordinated activity in Europe
Year of publication	2005
URL (web-link)	Http://www.vMRI.hu/Nagyb/Infectious.pdf
Author(s)	Fiona Steiger et al. (in consultation with an expert panel from Germany, Austria, Hungary, Italy, France and UK – 18 persons in total, see attachment 1)
Authors' affiliation	The European Academies Science Advisory Council (EASAC)
Country	UK (EU)
Language of publication	English
Commissioned by	The European Academies Science Advisory Council (EASAC)
Key words	Human and animal infectious diseases – long-term strategy – surveillance – control – transdisciplinary co-ordination – research – training
Content information	
Summary	This report describes key issues facing Europe in terms of the opportunities for improved disease surveillance and public health infrastructure, the basic research agenda, support for the pharmaceutical and vaccine industry sectors, the needs of developing countries and newer EU Member States, scientific responsibility and public engagement.
Objectives	Prioritise future work to attempt to address and resolve this broad front of scientific and policy issues for infectious diseases. This report is intended as an introduction to identify some of the cross-cutting priorities in the public and private sectors.
List of drivers (driving forces)	<ul style="list-style-type: none"> - Increasing problems in infectious disease (SARS, TB, AIDS, influenza, West Nile fever, ...) - Increasing concerns about food microbiological safety - Increasing international travel and transport - Bioterrorism (animal and human diseases)
List of future threats	<ul style="list-style-type: none"> - Insufficient disease surveillance and control systems - Insufficient public health infrastructure - Insufficient development of new vaccines, diagnostics and therapeutics - Insufficient research and training
Time scale of the outlook	None mentioned
Methodology	
Method used for mapping the future	Expert opinion – working group
Method used for identifying relevant topics	Expert opinion – working group
Method used for priority setting	Expert opinion – working group
Information resources	
Expert opinion	X
Literature	X (see attachment 2)
Internet	X
Output / Outcome	Introductory EASAC report, offering independent advice at the European level
Conclusion of review:	
List of future research topics	<ul style="list-style-type: none"> - Disease surveillance and control systems (rapid reaction to health threats) - Public health infrastructure (allowing the necessary counter-measures) - Development of vaccines, diagnostics and therapeutics (as well as fundamental understanding of e.g. Genetic flexibility, and new techniques) - Research and training, to be able to provide the capability to support the previous topics, co-ordinating the human and veterinary science agendas
Relevancy to WP4 objectives	<ul style="list-style-type: none"> - Disease surveillance, early warning systems, control systems, and co-ordination of / collaboration between laboratories and institutions - Development of (new types of) vaccines, early and specific diagnostics, and therapeutics, e.g. For : <ul style="list-style-type: none"> o Avian influenza o EHEC o <i>Campylobacter jejuni</i> o <i>Salmonella</i> o Animal diseases in developing countries (including zoonoses) o Antibiotic resistance - Research and training, e.g. <ul style="list-style-type: none"> o Epidemiology & quantitative modelling o Infectious disease research in general (was under-supported by FP6) o Animal-related research in general (recent support for veterinary research was rather limited according to an analysis of the US National Academy of Sciences, while it has potential to significantly impact many fields, including animal health, human medicine, food safety and bioterrorism).

Status: final

33.

General information	
Title	Global change and human vulnerability to vector-borne diseases
Year of publication	2004
URL (web link)	Http://cmr.asm.org/cgi/content/full/17/1/136
Author(s)	Sutherst RW
Authors' affiliation	CSIRO
Country	Australia
Language of publication	English
Commissioned by	
Key words	Host-pathogen-environment interaction Impact and adaptation
Content information	
Summary	<ul style="list-style-type: none"> ▶ An extensive list of drivers are discussed, all related to vector-borne infections ▶ The possible impact of these drivers is estimated, taking into account the sensitivity of the population to the vectors or the pathogen. In addition, the vulnerability of a population (human, animal) is discussed, which includes the adaptive, protective measures of that population.
Objectives	The manuscript aims at developing a holistic approach to the assessment of vulnerability of societies to vector-borne infections. The risk of potential changes in vector-borne infections is assessed and possible adaptation mechanisms are reviewed.
List of drivers (driving forces)	Atmospheric composition, climate change, urbanization, land use, land cover and biodiversity, pollution with hormone disrupting chemicals, trade and travel.
List of future threats	Vector-borne infections
Time scale of the outlook	Years to come
Methodology	
Method used for mapping the future	Reference is made to IPCC (Intergovernmental Panel on Climate Change).
Method used for identifying relevant topics	Review of literature on vector-borne infections
Method used for priority setting	No priorities set: all vector-borne infections are included
Information resources	
Expert opinion	No
Literature	Extensive (review article: 358 references)
Internet	
Output / Outcome	See summary.
Conclusion of review:	The drivers are well defined, as well as their impact on humans and animals. Interesting are the possible adaptation mechanisms, but the review is restricted to vector-borne infections.
List of future research topics	Setting of baseline data, study of the interaction between host and pathogen, especially in a changing environment, study of protective measures (and drugs, vaccines) especially for the developing world.
Relevancy to WP4 objectives	Well described drivers for vector-borne infections.

Status: final

34.

General information	
Title	Risk factors for human disease emergence
Year of publication	2001
URL (web-link)	None
Author(s)	Taylor, Latham and Woolhouse
Authors' affiliation	Centre for tropical veterinary medicine, University of Edinburgh,
Country	Scotland, UK.
Language of publication	EN
Commissioned by	
Key words	Emerging diseases, zoonoses, epidemiology, public health, risk factors.
Content information	
Summary	
Objectives	
List of drivers (driving forces)	
List of future threats	
Time scale of the outlook	
Methodology	
Method used for mapping the future	
Method used for identifying relevant topics	A database of pathogens infectious to human was compiled from texts of human infectious diseases. The following information was collected: <ul style="list-style-type: none"> - Genus and species name of pathogen. - Taxonomic division (virus, bacteria, fungus, protozoa, helminths) - Transmission routes (direct, indirect, vector) - Zoonotic - Emerging species
Method used for priority setting	Analyses were performed comparing emerging and non-emerging species by taxonomic division, transmission route and zoonotic status and combinations of these. Results were expressed as relative risks.
Information resources	
Expert opinion	
Literature	
Internet	
Output / Outcome	Zoonotic species are twice as likely to be associated with emerging diseases than non-zoonotic. Zoonotic viruses and protozoa are very likely to emerge while helminths are unlikely to do so.
Conclusion of review:	
List of future research topics	
Relevancy to WP4 objectives	Highly relevant

Status: final

35.

General information	
Title	Influence des changements climatiques globaux sur la progression des arboviroses
Year of publication	2006
URL (web-link)	Http://www.facmv.ulg.ac.be/amv/articles/2006_150_1_04.pdf
Author(s)	J.-F. Toussaint, P. Kerkhofs, K. De Clercq
Authors' affiliation	Veterinary and Agrochemical Research Centre (CODA-CERVA-VAR)
Country	Belgium
Language of publication	French
Commissioned by	Not applicable
Key words	Climate change – arbovirus – travel – transport – urbanisation – land use
Content information	
Summary	The progression of several arbovirus and climate change may be linked, but human activity (travel, transport of goods and animals, urbanisation and land use) also has a strong influence. A further spread of arbovirus distribution may be expected.
Objectives	To describe the factors influencing the spread of arbovirus.
List of drivers (driving forces)	Global climate change (temperature, rainfall, wind, extreme climatic phenomena) ; Human activities (travel, transport of goods and animals, urbanisation, land use); Political instability (wars) causing displacement of people and livestock, and disruption of normal disease management (vaccination programs, vector control etc)
List of future threats	Further spread of arbovirus and their vectors : Bluetongue Yellow fever Dengue African horse sickness Rift Valley fever West Nile fever Japanese encephalitis Arbovirus finding new vectors Vectors finding new breeding grounds resulting from climate change or human activity
Time scale of the outlook	Several decennia
Methodology	
Method used for mapping the future	Literature study
Method used for identifying relevant topics	Literature study
Method used for priority setting	Literature study
Information resources	
Expert opinion	X
Literature	X (see attachment)
Internet	
Output / Outcome	Peer reviewed publication
Conclusion of review:	
List of future research topics	- Methods to slow down climate change - Systematic screening for arbovirus and early warning system - Vector control - Vaccination
Relevancy to WP4 objectives	Priority research : - Systematic screening for arbovirus and early warning system - Information on vectors => vector control - Vaccination

Status: final

36.

General information	
Title	The use of scenario analysis in local public health departments: alternative futures for strategic planning
Year of publication	1993
URL (web-link)	
Author(s)	Venable JM, Qing Li MBA, Peter M, Duncan WJ.
Authors' affiliation	Instructor in the school of business, doctoral student University ..., Profesors University ...
Country	USA
Language of publication	English
Commissioned by	
Key words	Scenario analysis – strategic planning – methodology -
Content information	
Summary	This article is a review of scenario analysis methodology as strategic planning technique, with an example (application to health service). Driving forces were identified using published sources, focus groups, questionnaires and personal interviews. The most important of these issues were selected by scorisation of probability of occurrence x impact on public health. The most important forces formed the basis for developing scenario logics (story line) → set of plausible scenarios that aided in strategic planning
Objectives	Explain methodology of scenario analysis
List of drivers (driving forces)	No application (human health care)
List of future threats	No application (human health care)
Time scale of the outlook	5 (most common) – 15 years. Guidelines for length: (1) the forecast extend the time over which large changes in the environment can be expected to occur, (2) to extend the scenario out as far as the organization is prepared to commit resources
Methodology	
Method used for mapping the future	Quantitative forecasting techniques versus scenario analysis (qualitative):
Method used for identifying relevant topics	Scenarios best suited for long-range forecasts involving highly complex situations with many key unquantifiable factors, highly uncertain situations, situation with few or no reliable data for quantitative models; ok for public health management; a better approach is to postulate a set of plausible futures instead of trying to predict the future itself
Method used for priority setting	Multiple scenarios (2 or 3 issues max, with key variable(s), assumptions) better than 1 issue scenario (dangerous) General methodology: <ol style="list-style-type: none"> 1. Identify the strategic decision context 2. Identify key driving forces of the environment (trends, driving forces, risk factors, for example risk factors of emergence of animal diseases e.g. Globalisation): scanning, monitoring, assessment of environmental forces that are key to the scenario via idea generation, Delphi panels, literature review, nominal group techniques, expert interviews. Combination and synthesis of these influencing factors into issues (e.g. 16 issues) 3. Identify and analyse significant issues to reduce their number to a manageable number: evaluation of each issue along two dimensions: probability of occurrence and magnitude of impact on health development (five points numeric scales) → 4 quadrants: high impact quadrant designated for strategic issues and further used to develop scenarios → generation of two issue sets (for two scenarios) 4. Develop scenario logics (story line) and elaborate the scenarios 5. Scenario as common thread for strategic planning
Information resources	
Expert opinion	/
Literature	<ul style="list-style-type: none"> • Linneman et al., 1985: Using scenarios in strategic decision making • Etc. (see ref article)
Internet	/
Output / Outcome	
Conclusion of review:	
List of future research topics	No application
Relevancy to WP4 objectives	Ok method

Status: final

37.

General information	
Title	Assessing and managing the impacts of climate change on the environmental risks of agricultural pathogens and contaminants.
Year of publication	2007 (note this is not yet published, the final report for the project will join up the study reviewed here on animal health with work from other agencies) I have attached a copy of the animal health report, to be treated as unpublished.
URL (web-link)	Http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&projectid=14408&fromsearch=Y&Publisher=1&searchtext=SD0&sortstring=Projectcode&sortorder=Asc&Paging=10#Description
Author(s)	VLA (Veterinary Laboratories Agency)
Authors' affiliation	VLA
Country	UK
Language of publication	English
Commissioned by	Defra
Key words	N/A
Content information	
Summary	This report considers how climate change may influence animal health within the UK. A literature review has been undertaken of previous studies on this subject (note: the reference list may be worth investigating), risk factors that may be influenced by climate change were identified and used to construct a qualitative risk assessment. The RA was applied to a range of pathogens and conclusions drawn regarding future risks. I would question whether this approach has been driven more by what is known about particular threats rather than a genuine priority order? Not convinced that our efforts should be concentrated toward liver fluke.
Objectives	The work is part of a larger study to develop a framework to study the overall impact of climate change on agricultural pathogens and contaminants. The literature review is a useful source of information, but the study is limited in that the output is qualitative making it difficult to ascribe a robust priority to those pathogens that may or may not be the top threats.
List of drivers (driving forces)	Climate change and effects on: Movement of pathogen, the pathogen directly, host, vector, direct contact (transmission), environmental persistence.
List of future threats	Diseases identified for further investigation, include: AHS, BTV, WNF, RVF, VEE, ASF, Louping Ill, CCHF, cowdriosis, equine babesia, Fascioliasis (liver fluke), anthrax. Of which climate change is considered to have the strongest impact on liverfluke.
Time scale of the outlook	N/A
Methodology	
Method used for mapping the future	Literature review, followed by a qualitative risk assessment
Method used for identifying relevant topics	Feedback from questionnaire/RA
Method used for priority setting	Feedback from questionnaire/RA
Information resources	
Expert opinion	From published literature and feedback to RA
Literature	Literature list provided as references in the attached document.
Internet	N/A
Output / Outcome	
Conclusion of review:	
List of future research topics	Not presented as such
Relevancy to WP4 objectives	The drivers identified and the literature review may be more informative than the conclusions.

Status: final

38.

general information	
Title	A new agenda for biosecurity
Year of publication	2005
URL (web-link)	http://randd.defra.gov.uk/Document.aspx?Document=SD0301_3036_FRP.doc
Author(s)	Jeff Waage, Rob Fraser, John Mumford, David Cook and Andy Wilby
Authors' affiliation	Imperial College, London.
Country	UK
Language of publication	English
Commissioned by	Defra
Key words	Non-native species, ecology, economics, horizon scanning, prevention.
content information	
Summary	The study aims to take a holistic view of potential threats posed by the introduction of non-native species into the UK. Various types of invasive organism are considered, both in the context of the organism itself but more importantly the consequences of its introduction (and prevention and control), including economics, environmental and sociological aspects. The study considers a number of cases and develops general tools/models to assess the potential future impact of non-native species and their management.
Objectives	The study aims to develop a general model (economic and ecological) to assess the current and future impact of non-native species introduction into the UK. In the longer term the work aims to provide a platform for assessing the risks posed by non-native species so the benefits and costs of action can be effectively judged.
List of drivers (driving forces)	Growing risk of introduction of non-native species, largely from the deliberate importation of organisms, but also influenced by the amount of trade generally.
List of future threats	Climate change, Trade and markets, Social questions (i.e. is it acceptable for a non-native species to remain)
Time scale of the outlook	20 years
Methodology	
Method used for mapping the future	Changing parameters of the economic/ecological model in line with future predicted trends and comparing with the model run on current parameters. In effect individual case studies.
Method used for identifying relevant topics	Relevant species were selected to provide a broad taxonomic coverage. Not stated but is evident that species were selected where there is data available regarding their incursion into geographical regions (UK).
Method used for priority setting	n/a
Information resources	
expert opinion	
literature	P167 – p174 of document. Web link provided above.
internet	
Output / Outcome	The output of the study is a generalised ecological-economic model to allow a quantitative comparison of risk and impact across differing non-native species, it is noted that the authors caveat, the model would require much further testing and refinement before it could be used in an operational capacity.
Conclusion of review:	
List of future research topics	Not provided
Relevancy to WP4 objectives	The report provides a generalised model for comparison of risks posed from different sectors, rather than specifying what the future threats will be it describes future drivers and aims to provide a facility to assess the risk and impact from a particular organism of interest.

Status: final

39.

General information	
Title	Prioritising the dimensions of uncertainty
Year of publication	2007
URL (web-link)	Http://www.erff.org.uk/publications/reports/20071212-horizon-scanning-report.aspx
Author(s)	Waverley consultants for ERFF
Authors' affiliation	ERFF (Environmental Research Funders Forum)
Country	UK
Language of publication	English
Commissioned by	ERFF
Key words	
Content information	
Summary	A cross sectional study that has drawn up a prioritised list of factors that are perceived to have an impact on the environment in the future. The factors will form the basis of an action plan to guide future research agendas. Note action plan not yet published.
Objectives	Identify and prioritise factors that should influence the strategic direction of environmental research. Future work to develop an action plan based on these priorities.
List of drivers (driving forces)	The report lists subjects/issues for consideration that may drive future research, the list is broad in its scope as it addresses environmental issues per se. Some of the issues may be described as driving forces of future threats, others identified as specific threats. The priority issues are listed below.
List of future threats	<p>Priority issues: Flooding, cities and the environment, housing and planning, transport and mobility, food production, costs and benefits of renewable energy, sustainability of the water supply, changing behaviours.</p> <p>In relation to animal health, from the 29 issues identified, subjects include: reducing uncertainty around climate change (metrics of which would include animal disease distribution patterns), changing public health challenges (early warning systems and understanding changing distributions of pathogens), food production, farming economics.</p> <p>Many of the environment issues, may have secondary effects that would influence distribution and types of livestock in the UK that may in turn affect distribution of pathogens.</p>
Time scale of the outlook	20 years
Methodology	
Method used for mapping the future	Workshops and interviews held (108 participants) to identify 29 issues (dimensions of uncertainty) that may impact on UK environmental interests over the 20 years.
Method used for identifying relevant topics	As above.
Method used for priority setting	Participants ranked 29 issues by order of relevance. Software used to determine ranking by analysis of relevance and deviation of voting.
Information resources	
Expert opinion	Experts used from government, industry, non-government organisations and researchers.
Literature	N/A
Internet	N/A
Output / Outcome	
Conclusion of review:	
List of future research topics	Priority order as identified under 'list of future threats'. The report states that an action plan will be drawn up (early 2008) to take forward the output of the report in regard to the top issues identified, not yet published on the ERFF website.
Relevancy to WP4 objectives	Some of the issues relate to animal health indirectly, of those listed the key issue is how climate change may affect the distribution of pathogens (reducing uncertainty around climate change). The output of the report does not provide further detail in this regard.

Status: final

40.

General information	
Title	Biologische globalisering (biological globalisation)
Year of publication	2005
URL (web-link)	
Author(s)	Drs. Wouter J. Van der Weijden, Dr. Rob Leewis, Dr. Pieter Bol
Authors' affiliation	CLM Onderzoek en Advies, Milieu- en natuurplanbureau, Technische Universiteit Delft
Country	Netherlands
Language of publication	Dutch
Commissioned by	Ministry of Agriculture, Nature and Food Quality
Key words	Invasive species
Content information	
Summary	Describes the causes and consequences of biological globalisation in terms of invasion of (harmful) species.
Objectives	
List of drivers (driving forces)	<input type="checkbox"/> Globalisation; <input type="checkbox"/> Economic growth <input type="checkbox"/> Mondial traffic and transport <input type="checkbox"/> Technological developments in traffic and transport <input type="checkbox"/> Disturbed ecosystems <input type="checkbox"/> Political developments: pressure to demolish trade barriers
List of future threats	Invasion of organisms that carry disease
Time scale of the outlook	
Methodology	
Method used for mapping the future	Literature, expertise
Method used for identifying relevant topics	Literature, expertise
Method used for priority setting	
Information resources	
Expert opinion	
Literature	
Internet	
Output / Outcome	
Conclusion of review:	
List of future research topics	
Relevancy to WP4 objectives	Medium

Status: final

41.

General information	
Title	Aspects of future animal health: the Animal Health Foresight Project
Year of publication	2006
URL (web-link)	Http://www.ncbi.nlm.nih.gov/pubmed/17220499?Ordinalpos=1&itol=entrezsystem2.pentrez .Pubmed.Pubmed_resultspanel.Pubmed_rvdocsum
Author(s)	N. G. Willis
Authors' affiliation	President of the Norm Willis Group Inc. Honorary President of the OIE Managing Partner, Research and Life Sciences, of the Professional Development Institute
Country	Canada
Language of publication	English
Commissioned by	Canadian Food Inspection Agency and US Department of Agriculture
Key words	Future role of veterinarians – alternatives to stamping out – disease control – drivers for change– foresight technology
Content information	
Summary	An interdisciplinary working group of experts was composed to consider possible alternatives for stamping out in disease control, in response to drivers for change. The WG consisted of 43 participants from various stakeholder groups. It met four times, and used challenge questions and scenario development as foresight tools. As a result, 10 conclusions were formulated : (1) an approach should be found that lessens public anxiety as well as enhances optimization of the use of the animals, (2) risk management rather than freedom from disease, (3) improve involvement of the different stakeholders, (4) enhance the animal health – public health relationship, (5) enhance research (cf below for specific subjects), (6) necessity for more effective communications (7) necessity for more effective information management, (8) where possible, cooperate / partner up with multinational corporations, (9) foresight technology is a valuable tool for long-term planning (10) focus on the maximum utility of animal protein to meet the needs of society. Moreover, a plea to provide the necessary subjects in veterinary schooling to allow an adequate response to the changing needs in disease control was added.
Objectives	To explore alternatives to large-scale depopulation of domestic livestock as a mechanism for disease control. In this respect, the specific goals were to <ul style="list-style-type: none"> - Allow animals to reach the original purpose for which they were bred and raised - Humanely achieve the highest possible value from the animals or their products.
List of drivers (driving forces)	<ul style="list-style-type: none"> - Agri-industry economics - The environment - Public opinion (public anxiety) - Animal welfare - Trade and exports - Avoid waste of high-quality animal protein (animal optimization)
List of future threats	<ul style="list-style-type: none"> - Waste of valuable animal products - Distasteful visual images of mass animal destruction, leading to important concerns of the general public - Negative environmental impact - Negative animal welfare impact - Devastating economic impact on agricultural industries and national economies
Time scale of the outlook	5 to 25 years
Methodology	
Method used for mapping the future	<ul style="list-style-type: none"> - Challenge questions - Scenario development
Method used for identifying relevant topics	An interdisciplinary working group of experts consisting of 43 participants from various stakeholder groups. It met four times.
Method used for priority setting	An interdisciplinary working group of experts consisting of 43 participants from various stakeholder groups. It met four times.
Information resources	
Expert opinion	Agricultural industry Academia Animal-welfare agencies The information technology field (IT) The regulatory policy-making arena The research community Industry associations The veterinary community
Literature	
Internet	
Output / Outcome	Publication in the JVME 33(4) 2006

Status: final

Conclusion of review:	
List of future research topics	<ol style="list-style-type: none">1. Remote sensing, information access, and rapid transmission2. Rapid field diagnostics3. Immune modulation and enhancement4. Pathogen containment5. Tracking animal movement
Relevancy to WP4 objectives	Points 1-4.

Status: final

42.

General information	
Title	Towards a healthy animal production in 2015
Year of publication	1997; NRLO report 97/30
URL (web-link)	-
Author(s)	J.G. de Wilt (editor)
Authors' affiliation	National Council for Agricultural Research (now: innovationnetwork)
Country	The Netherlands
Language of publication	Dutch
Commissioned by	Ministry of Agriculture, Nature and Food Quality
Key words	Animal health, animal welfare, environment, ecology, consumer, society, technological innovations, diagnostics, disease eradication, production chain control, disease control, law and regulations, R&D
Content information	
Summary	<p>The individual essays differ in their approach and abstraction level. Nevertheless all writers primarily focus on the Dutch livestock industry. Within the European context, of course. It is foreseen that there will be a flow of urban people escaping the big city and living in the countryside. Their expectations will influence animal husbandry. More hobby production will develop which include an increased threat of pathogen introduction. On the other hand less but larger farms, with increased sophisticated control technologies will develop. The need to prevent introduction and spread of pathogens requires proper early warning systems, effective (marker)vaccines and diagnostic tools.</p> <p>More chain oriented production with good quality control systems are foreseen which need to address more strict EU and Dutch regulations regarding environmental, animal welfare and health issues (influenced directly and indirectly by consumers, including society accepted ways of disease eradication). Biotechnological innovations will be introduced in several fields.</p> <p>Economy driven developments will show the need for an change from a animal health strategy based on clinical diagnosis and therapy towards a more data and information technology driven care.</p> <p>The types of animal production foreseen are large scale production, special products (niche) farming and organic/nature farming.</p> <p>Animal production will be more technology driven to become more cost-effective to survive import competition. On the other hand it is expected that the increased demand for local / regional products will create a specific selling point.</p> <p>As R&D budgets in veterinary pharmaceuticals are relative minor the necessity to exploit the spin-off from human pharmaceutical research is stressed.</p>
Objectives	To provide a contribution for a new animal health strategy (disease control, disease eradication) and consequently input for innovations in research.
List of drivers (driving forces)	<ul style="list-style-type: none"> - Decrease of profit (decrease of animal products price) - Increase of quality control in production chain control - Subsequent introduction of biotechnological innovations - Consumer participation and involvement - Regulations re animal welfare, animal health and environment will become more strict (protective, preventive) - Increase of land price - De-urbanisation and rural development - More regional / local marketing (supply and demand) - Availability of innovative technologies (vaccines, data-sharing, diagnostic tools)
List of future threats	Not specified
Time scale of the outlook	- 2015
Methodology	
Method used for mapping the future	5 (groups of) persons were invited to map the future as foreseen by them regarding the provided topic 'soundness of the livestock industry in the Netherlands in 2015' and write an essay; expert opinion
Method used for identifying relevant topics	Idem
Method used for priority setting	None
Information resources	
Expert opinion	Veterinary medicine ; Economy ; Agro-economy ; Ecology; Animal Welfare; Technology (vaccines & diagnostics);
Literature	-
Internet	-
Output / Outcome	See summary
Conclusion of review:	

Status: final

List of future research topics	No priority order: <ul style="list-style-type: none">- Consumer perception of animal production (animal welfare, niche products, regional / local demand & supply)- Future demographic change and influence on rural development, animal husbandry systems and pathogen introduction / spread- Economic influence on animal production systems- Exploitation of human pharmaceutical R&D for veterinary use- Development of early warning systems (and screening/ monitoring tools)
Relevancy to WP4 objectives	There is a relevancy on the level of driving forces, although it should be verified whether the Dutch situation represents a local, regional, continental and/or global view/situation.

Status: final

43.

General information	
Title	Hoste Range and Emerging and Reemerging Pathogens
Year of publication	2005
URL (web-link)	http://www.cdc.gov/ncidod/EID/vol11no12/pdfs/05-0997.pdf
Author(s)	Mark E.J. Woolhouse and Sonya Gowtage-Sequeria
Authors' affiliation	Centre for Infectious Diseases (University of Edinburgh)
Country	United Kingdom
Language of publication	English
Commissioned by	
Key words	
Content information	
Summary	An updated literature survey identified 1,407 recognized species of human pathogen, 58% of which are zoonotic. Of the total, 177 are regarded as emerging or reemerging. Zoonotic pathogens are twice as likely to be in this category as are nonzoonotic pathogens. Emerging and reemerging pathogens are not strongly associated with particular types of nonhuman hosts, but they are most likely to have the broadest host ranges. Emerging and reemerging zoonoses are associated with a wide range of drivers, but changes in land use and agriculture and demographic and societal changes are most commonly cited. However, although zoonotic pathogens do represent the most likely source of emerging and reemerging infectious disease, only a small minority have proved capable of causing major epidemics in the human population.
Objectives	<ul style="list-style-type: none"> To review the updated information on biology and epidemiology of recognized human pathogens (viruses -and prions-, bacteria, fungi, protozoa and helminths). To examine in detail the relationship between host range and pathogen emergence or reemergence. To catalog the kind of drivers that have been linked with pathogen emergence or reemergence.
List of drivers (driving forces)	Main categories of drivers associated with emergence and reemergence of human pathogens: <ol style="list-style-type: none"> Changes in land use or agricultural practices. Changes in human demographics and society. Poor population health. Hospitals and medical procedures. Pathogen evolution. Contamination of food sources or water supplies. International travel. Failure of public health programs. International trade. Climate change.
List of future threats	An appendix listing human pathogen species regarded as emerging or reemerging is given. It comprises 77 viruses, 54 bacteria, 22 fungi, 14 protozoa and 10 helminths.
Time scale of the outlook	Not applicable: It focuses on current pathogens affecting humans.
Methodology	
Method used for mapping the future	Not applicable (see above)
Method used for identifying relevant topics	Bibliographic review and statistical analysis.
Method used for priority setting	Number of pathogens described in which a link with a particular driver is known.
Information resources	
Expert opinion	No
Literature	The literature cited in the article is available at the link : http://www.cdc.gov/ncidod/EID/vol11no12/pdfs/05-0997.pdf
Internet	http://www.cdc.gov/ncidod/EID/index.htm (Centers for Disease Control and Prevention) http://www.cdc.gov/ncidod/EID/vol11no12/05-0997_app.htm (Appendix: human pathogens species regarded as emerging or reemerging) http://www.who.int/topics/emerging_diseases/en/ (World Health Organization: emerging diseases) http://www.promedmail.org/pls/otn/f?p=2400:1000 : (promed-mail) http://www.ncbi.nlm.nih.gov/Taxonomy/taxonomyhome.html/ (National Center for Biotechnology Information: taxonomy browser) http://www.oie.int/eng/en_index.htm (World Organisation for Animal Health)
Output / Outcome	
Conclusion of review:	
List of future research topics	Not applicable

Status: final

Relevancy to WP4 objectives

The review focuses on pathogens of humans, and it is only partly relevant to EMIDA WP4 objectives, mainly referring to zoonotic agents.

These are the main conclusions:

- Zoonotic pathogens are disproportionately likely to be associated with emerging and reemerging infectious diseases.
- Pathogens associated with emerging and reemerging diseases share some common features:
 - Emerging and reemerging pathogens are disproportionately viruses (especially RNA viruses).
 - Emerging and reemerging pathogens are not strongly associated with particular nonhuman host types.
- Pathogens are exploiting almost any change in human ecology that provides new opportunities for transmission.
- The possible magnitude of an infectious diseases outbreak is related to the basic reproduction number, R_0 (the average number of secondary infections produced by a single primary infection introduced into a large population of previously unexposed host).

Status: final

44.

General information	
Title	Technology foresight and sustainable development: proceedings of the Budapest workshop 11 december 1998
Year of publication	1999
URL (web-link)	Http://www.oecd.org/dataoecd/58/3/1898327.pdf
Author(s)	Working Group on Innovation and Technology Policy
Authors' affiliation	OECD
Country	N/A
Language of publication	English
Commissioned by	OECD
Key words	Technology, sustainable development, environment, methodology
Content information	
Summary	<p>The document represents the results of a workshop held in Budapest in 1998 on technology foresight in the framework of sustainable development and environment. Some of the contributions deal with methodology, while others give results of foresight studies. In total nine papers were presented. Technology foresight is a tool to match emerging technologies with future needs. "Environmental technology" have limited contribution to enhancing competitiveness while improving environmental performance. Cleaner and resource efficient technologies are needed for environmental performance and economic performance, through cost saving, enhancing competitiveness and productivity growth. Organisational or "soft" innovations are important. Generic technology areas include information and communication technology, biotechnology, nano- and micro-scale technologies, and advanced materials. The application areas range from agriculture, water treatment, waste and hazardous substance treatment and management, vehicle technology, construction, cleaner industrial processes, and energy, to monitoring and counteracting global environmental changes. Agreement on kinds of technologies but extreme uncertainty about the prospects for realisation of such technologies on a significant scale. The extent of use of environmental technologies depends on the socio-economic system that will be in place in the future. The real world is likely to consist of a mixture of conflicting values and socio-economic trends rather than stereo-typical systems that scenarios tend to depict. Socio-economic systems that focus on more growth are likely to fail to implement environmental technologies and lead to an unsustainable future. Systems that favour regional integration and co-prosperity between the regions of the world, while allowing pluralistic values and equitable growth, improve chances to achieve a sustainable future.</p> <p>Methodology: The integration of market orientation is a crucial component of foresight exercises. Identifying future technologies is less important compared to the foresight process of bringing together the research base and the industry to consider together the opportunities and challenges for marketable innovations. The importance of foresight was in the process not in the prediction. The importance of an interactive process was stressed in the foresight exercises of smaller countries. Research base of smaller countries is often too small to design and implement foresight exercises. The results of larger countries' foresight studies were used to identify future technologies, and within the country, the foresight exercise's focuses on generating interactive process involving government, research base, industry and societal groups.</p>
Objectives	To bring together results and experiences from various sources with the tool of foresight studies in order to extract information on the use of this instrument for environmentally sustainable development technologies.
List of drivers (driving forces)	Sustainable development, process rather than result, environment
List of future threats	Environmental degradation, unsustainable development
Time scale of the outlook	N/A
Methodology	
Method used for mapping the future	Various. In many cases process of discussions with government as well as industry participating
Method used for identifying relevant topics	Various
Method used for priority setting	N/A
Information resources	
Expert opinion	Various
Literature	Various
Internet	
Output / Outcome	
Conclusion of review:	
List of future research topics	
Relevancy to WP4 objectives	Low

