SESSION II: Pop-Up Talks

Special Presenter: **John G Rees**, NERC
1) **Dennis Konadu**, University of Cambridge
2) **Ian Temperton**, Ian Temperton Consulting
3) **Alexandra Collins**, Imperial College London
4) **Julien Harou**, University of Manchester
Specialist: **Liz Varga**

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wholeSEM

UNIVERSITY OF CAMBRIDGE
Department of Engineering

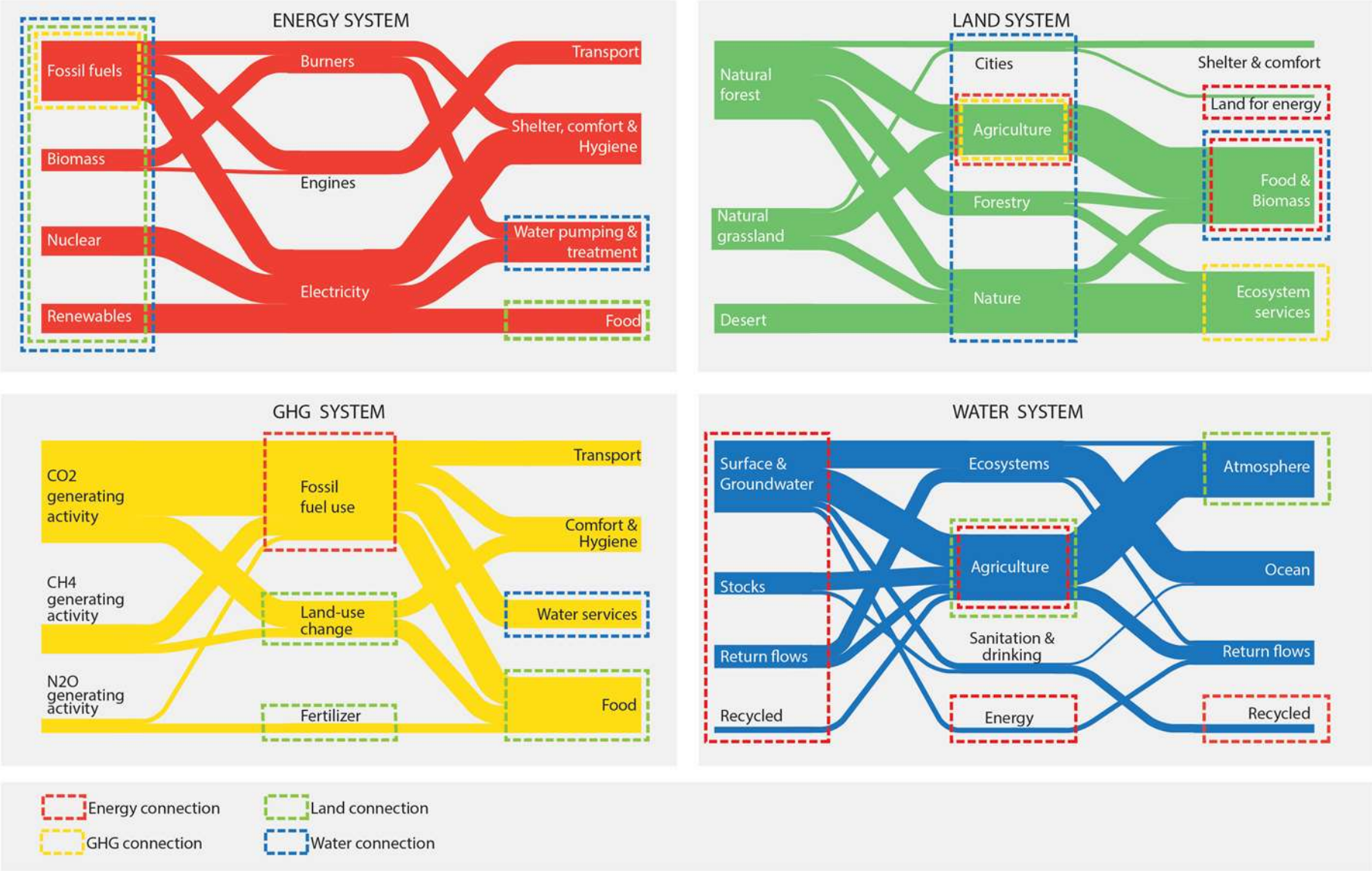
Foreseer - UK

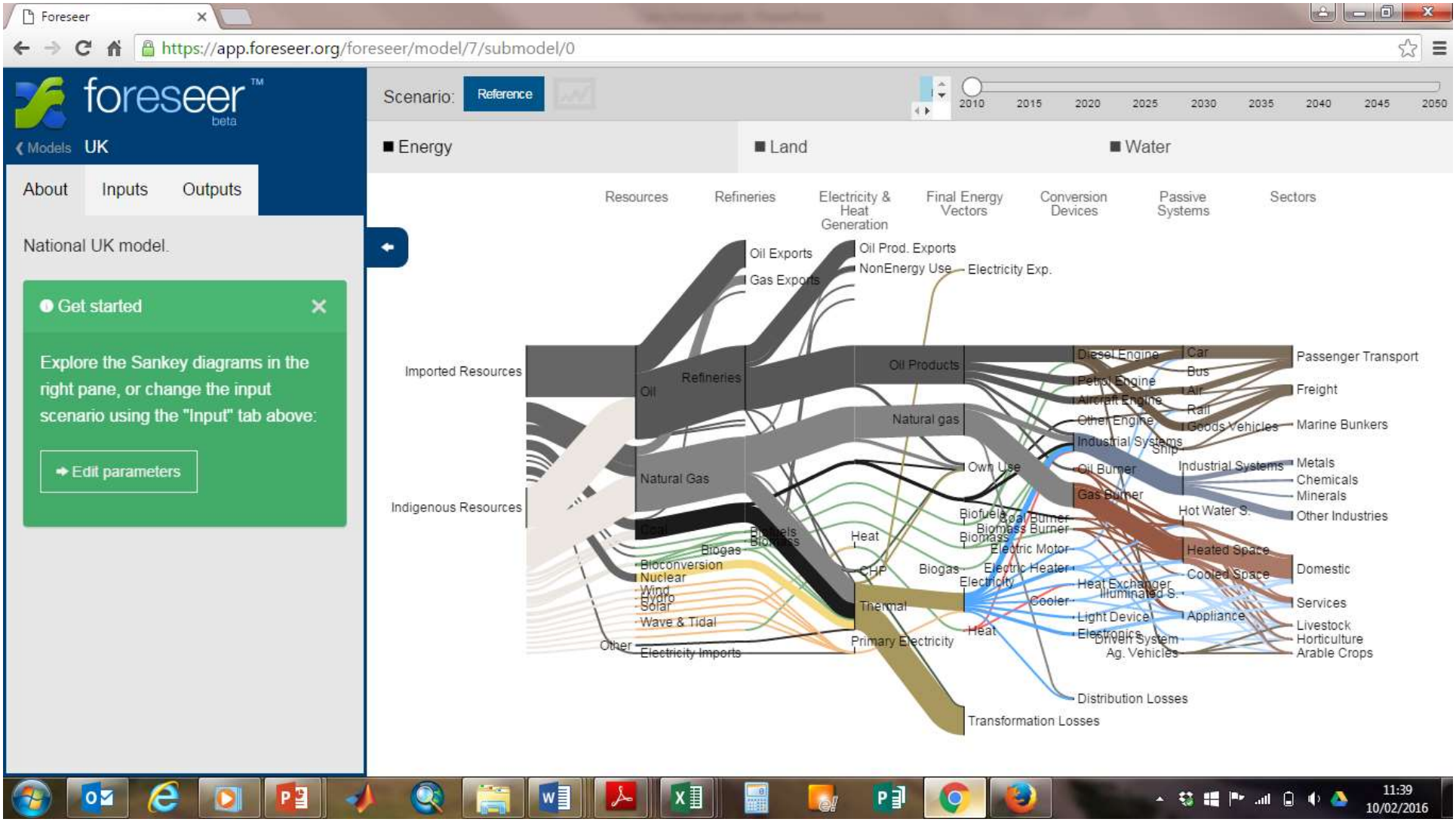
Energy-Land-Water interactions

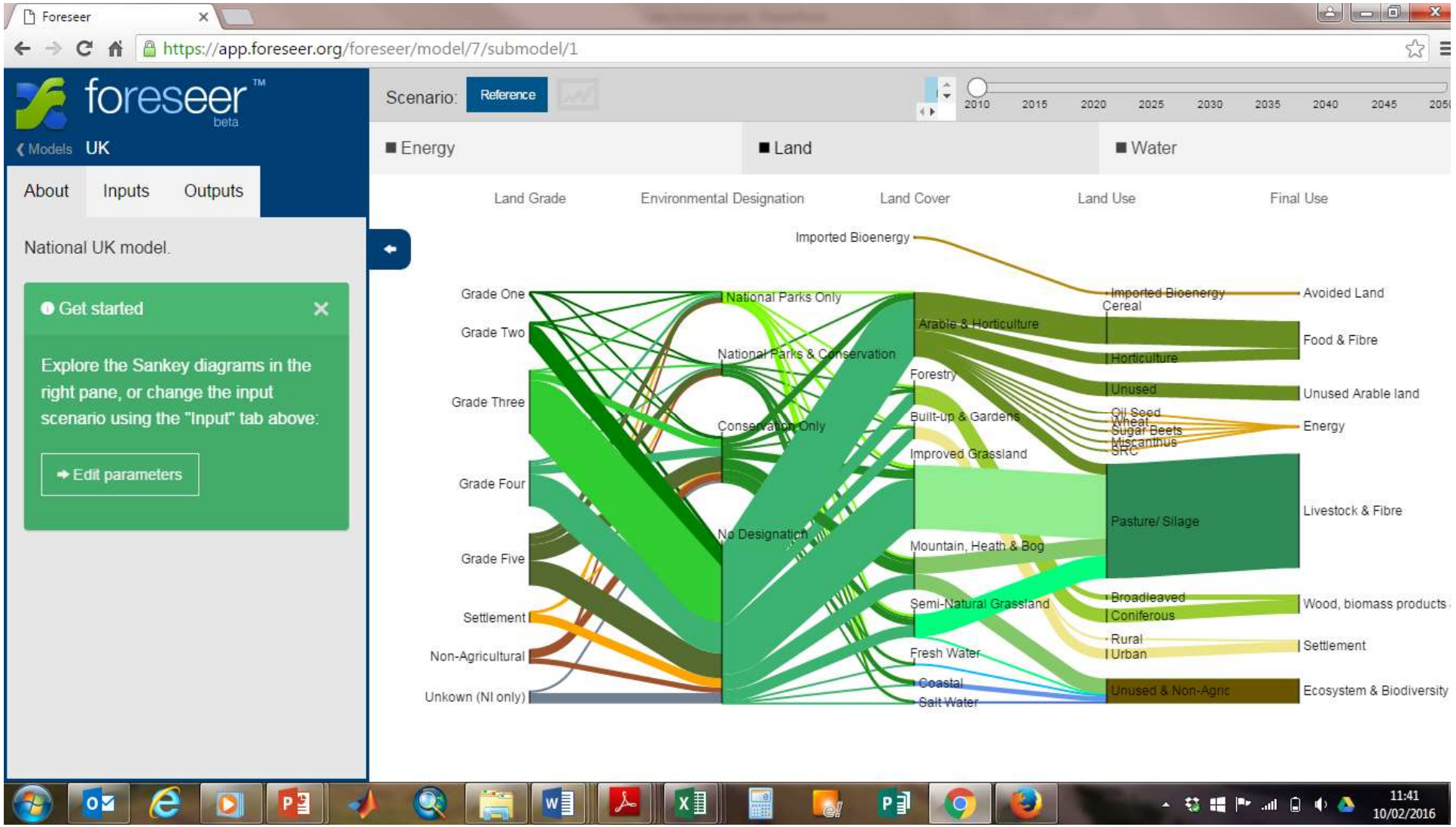
Dennis Konadu, University of Cambridge


foreseer
future resource pathways

System independencies – Energy & Environment




Foreseer
https://app.foreseer.org/foreseer/model/7/submodel/0
foreseer beta
Models UK
About
Inputs
Outputs
National UK model.
Get started
Explore the Sankey diagrams in the right pane, or change the input scenario using the "Input" tab above:
Edit parameters
Scenario:
Reference
2010 2015 2020 2025 2030 2035 2040 2045 2050
Energy
Land
Water
Resources
Refineries
Electricity & Heat Generation
Final Energy Vectors
Conversion Devices
Passive Systems
Sectors
Oil Exports
Gas Exports
Oil Prod. Exports
NonEnergy Use
Electricity Exp.
Imported Resources
Indigenous Resources
Oil
Natural Gas
Refineries
Oil Products
Natural gas
Own Use
Heat
CHP
Thermal
Primary Electricity
Biogas
Bioconversion
Nuclear
Wind
Hydro
Solar
Wave & Tidal
Other
Electricity Imports
Biofuels
Biomass
Electricity
Heat
Distribution Losses
Transformation Losses
Diesel Engine
Petrol Engine
Aircraft Engine
Other Engine
Industrial Systems
Oil Burner
Gas Burner
Biofuels Burner
Biomass Burner
Electric Motor
Electric Heater
Heat Exchanger
Cooler
Light Device
Electronics
Driven System
Ag. Vehicles
Car
Bus
Air
Rail
Goods Vehicles
Ship
Industrial Systems
Hot Water S.
Heated Space
Cooled Space
Illuminated S.
Appliance
Passenger Transport
Freight
Marine Bunkers
Metals
Chemicals
Minerals
Other Industries
Domestic
Services
Livestock
Horticulture
Arable Crops
11:39
10/02/2016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foreseer beta
Models UK
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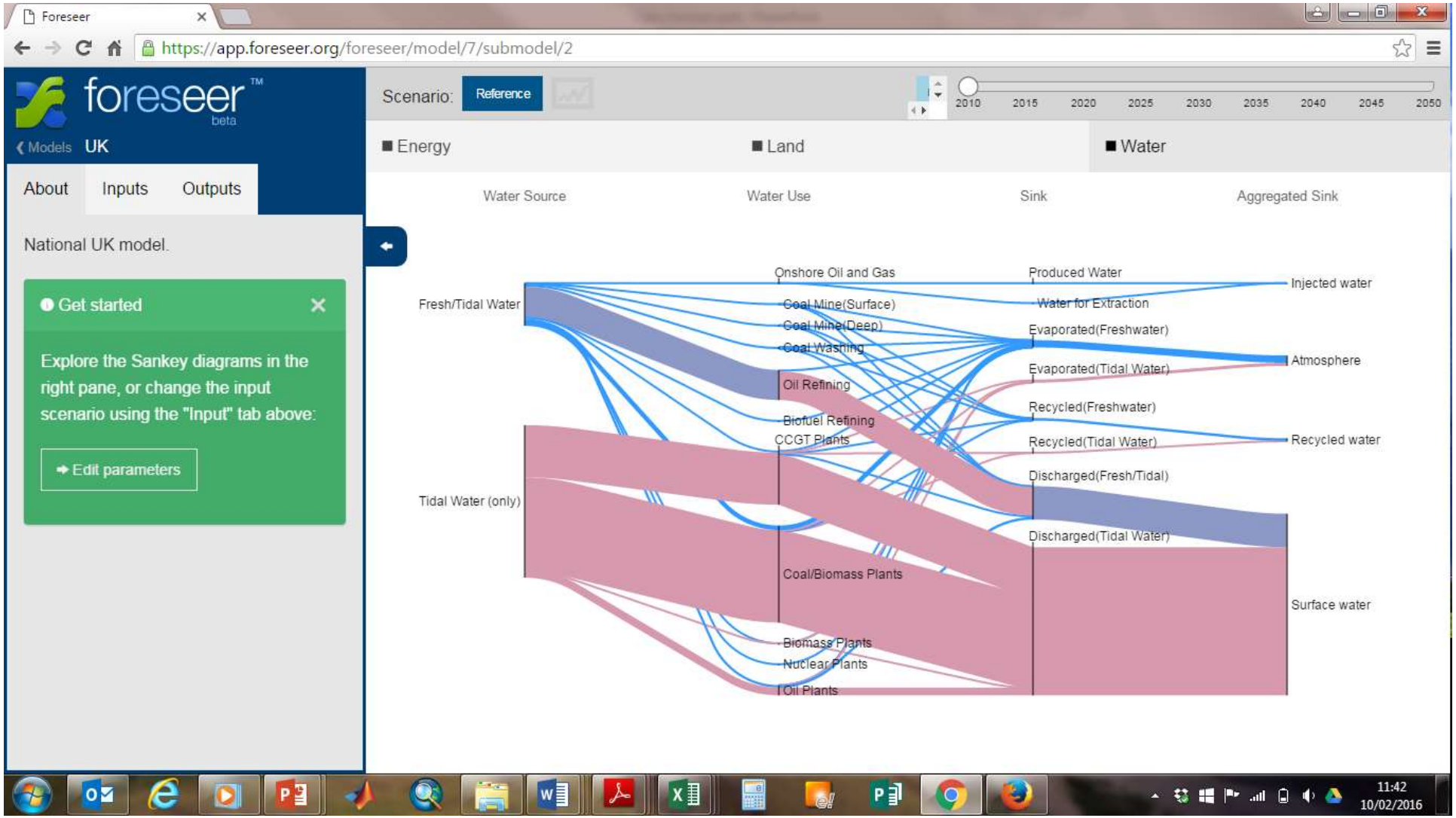
Edit parameters
Scenario:
Reference
2010
2015
2020
2025
2030
2035
2040
2045
Energy
Land
Water
Land Grade
Environmental Designation
Land Cover
Land Use
Final Use
Imported Bioenergy
Grade One
Grade Two
Grade Three
Grade Four
Grade Five
Settlement
Non-Agricultural
Unkown (NI only)
National Parks Only
National Parks & Conservation
Conservation Only
No Designation
Arable & Horticulture
Forestry
Built-up & Gardens
Improved Grassland
Mountain, Heath & Bog
Semi-Natural Grassland
Fresh Water
Coastal
Salt Water
Imported Bioenergy
Cereal
Horticulture
Unused
Oil Seed
Wheat
Sugar Beets
Miscanthus
SRC
Pasture/ Silage
Broadleaved
Coniferous
Rural
Urban
Unused & Non-Agric
Avoided Land
Food & Fibre
Unused Arable land
Energy
Livestock & Fibre
Wood, biomass products
Settlement
Ecosystem & Biodiversity
11:41
10/02/2016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foreseer beta
Models UK
About
Inputs
Outputs
National UK model.
Get started
Explore the Sankey diagrams in the right pane, or change the input scenario using the "Input" tab above:
Edit parameters
Scenario:
Reference
2010 2015 2020 2025 2030 2035 2040 2045 2050
Energy
Land
Water
Water Source
Water Use
Sink
Aggregated Sink
Fresh/Tidal Water
Tidal Water (only)
Onshore Oil and Gas
Coal Mine(Surface)
Coal Mine(Deep)
Coal Washing
Oil Refining
Biofuel Refining
CCGT Plants
Coal/Biomass Plants
Biomass Plants
Nuclear Plants
Oil Plants
Produced Water
Water for Extraction
Evaporated(Freshwater)
Evaporated(Tidal Water)
Recycled(Freshwater)
Recycled(Tidal Water)
Discharged(Fresh/Tidal)
Discharged(Tidal Water)
Injected water
Atmosphere
Recycled water
Surface water
11:42
10/02/2016

No-regrets energy system pathways?

Resource		Core MARKAL	Higher Renewable	Higher CCS	Higher Nuclear
Land					
BAU Yield	*BAU crop composition*				
	50/50 Crop composition				
High Yield improvement	*BAU crop composition*				
	50/50 Crop composition				
Water					
	PAU				
	High Coastal				
	High Inland				
	Integrated CCS				

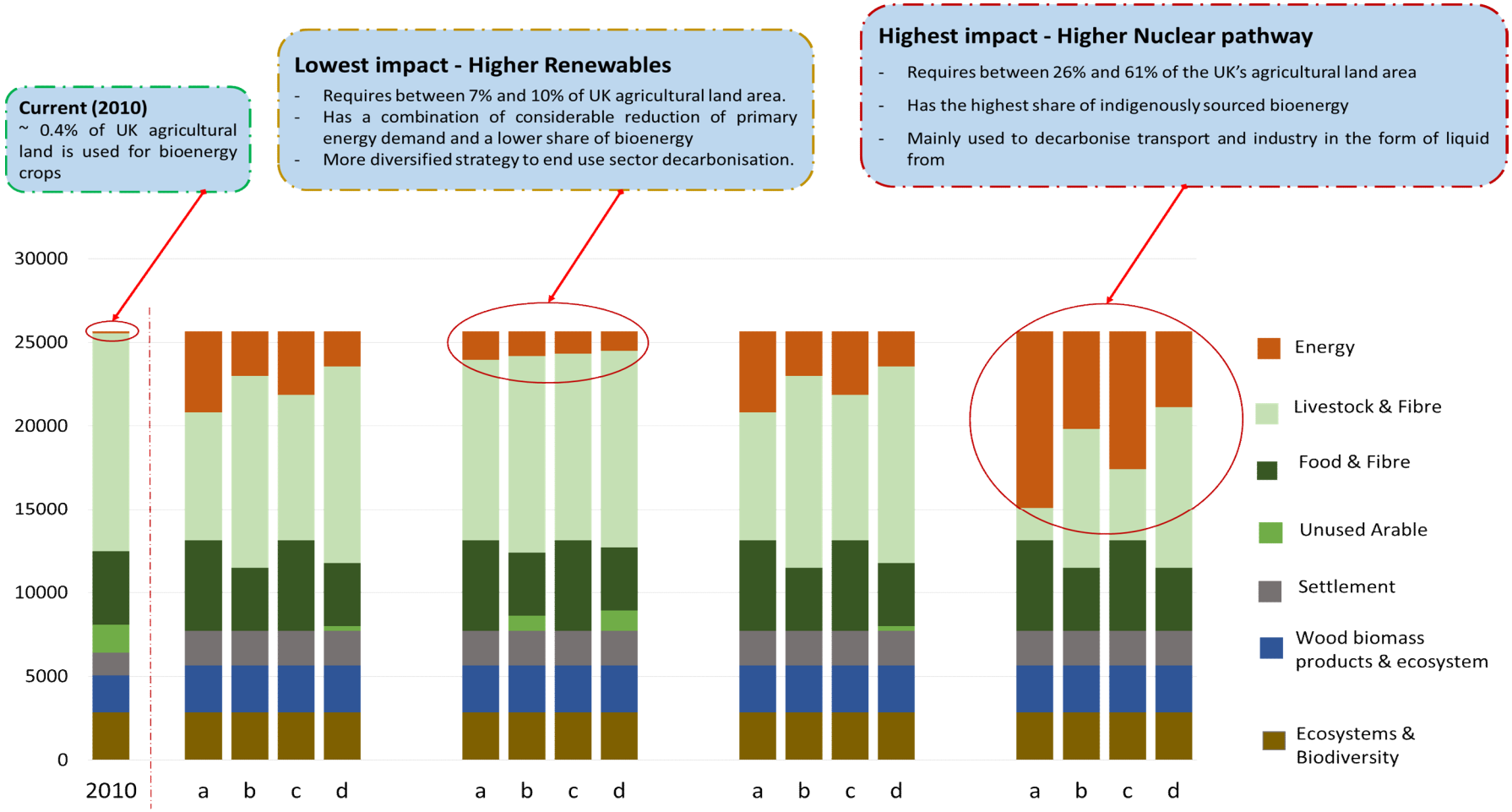
Key: Impact designations

Land		Water	
Low	*Maximum land for energy crops equal or less than currently unused arable land*	Low	*Lower than or up to current actual abstractions level*
Medium	*Up to 10% of UK land area*	Medium	*Up to 100% increase in 2010 abstraction for thermal generation*
High	*Above 10% UK land area*	High	*Above 100% increase in 2010 abstractions for thermal generation*

Konadu et al. (2015) GEC

Land for bioenergy

Some pathways could cause land use stress



Comparison of current and projected impact of bioenergy cropping on land UK distributions by 2050 under different scenarios of crop yield and composition: (a) BAU Composition & BAU Yield; (b) BAU Composition & Increase Yield; (c) BAU Composition & Increase Yield (d) 50-50 Composition & Increase Yield

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Observations on investment decision making under uncertainty in clean energy

Ian Temperton

Corporate investment decision making remains unsophisticated

- Boards, executive and investment committees do not make investments under uncertainty and certainly don't have aleatoric risk…
  - … despite always living in uncertain times
- Most investment decisions rely on
  - IRR analysis…
  - …with a hurdle rate…
  - …which is arbitrarily set above WACC…
  - … and which is always exceeded in all investment assessments
- Sensitivity analysis is as good a measure of uncertainty as you get …
  - … but in case that turns out to be useful we always have the red dotted box

Theories of uncertainty are probably more useful in explaining corporate behaviour than informing it

Agency theory	• Short term incentives / long term investments • Information asymmetries • Herding
Behavioural impacts	• Anchoring (always use a red box) • Confirmation bias • Excessive discounting • Loss aversion
Real options	• Delay (and more analysis) not rejection • Entry and exit costs • Short term focus • (BTW people don't generally buy options)

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Department
for Environment
Food & Rural Affairs

Incorporating Uncertainty into Evidence Syntheses

Experiences Gained from the UK Department for Environment, Food and Rural Affairs

Presented by: Dr Alexandra Collins
Date: 10th February 2016

Imperial College London

Uncertainty in Policy Making

Risk

Success rate

"Uncertainty is an uncomfortable position. But certainty is an absurd one."

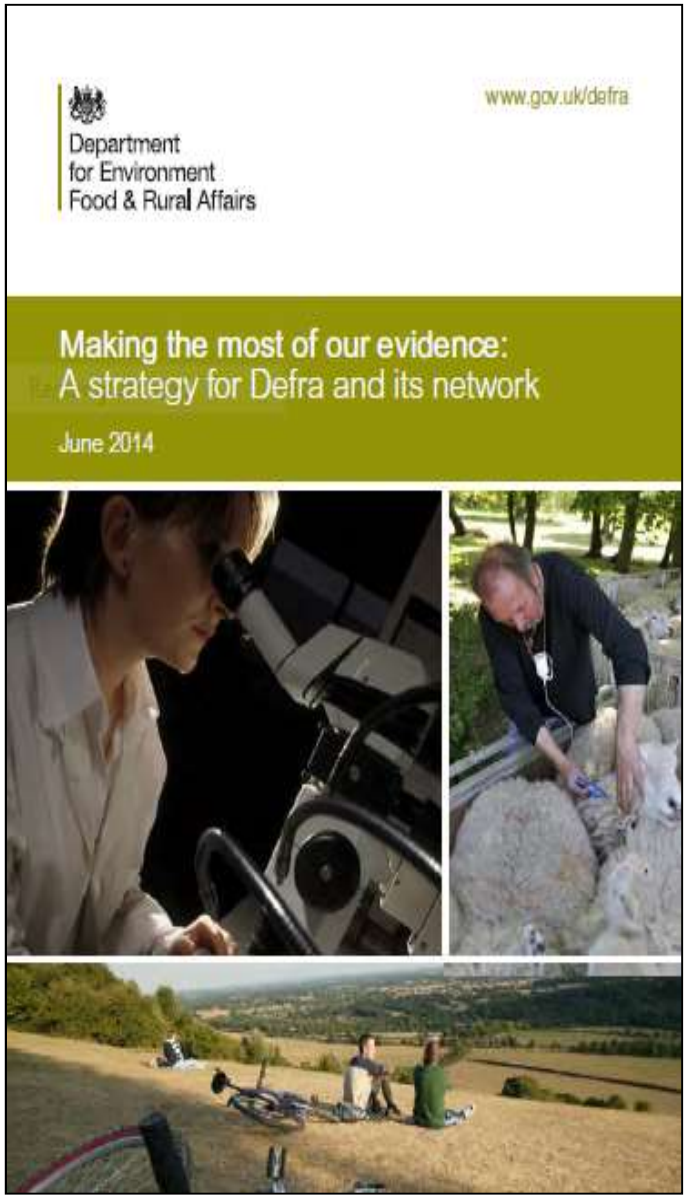
— VOLTAIRE

Implications

Influencing factors

Problem Statement

- Evidence syntheses of increasing importance
- Evidence Investment Strategy
- CSA requirement for Evidence Statements
- How to review evidence to reduce uncertainty?
- How to measure uncertainty?
- How to communicate uncertainty?



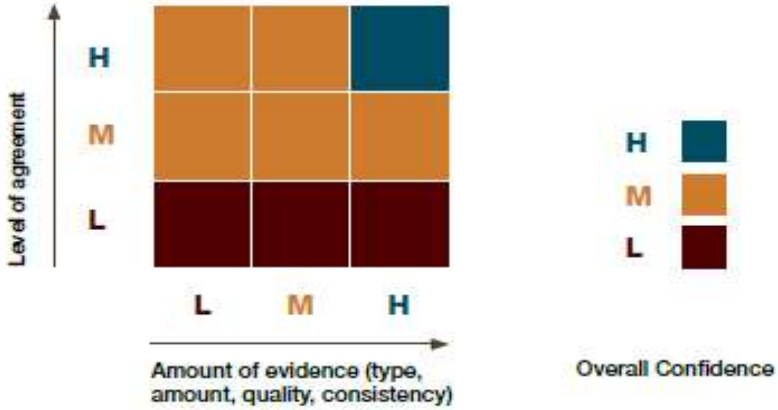
Methods Reviewed

Table 1. Likelihood Scale	
Term*	**Likelihood of the Outcome**
Virtually certain	99-100% probability
Very likely	90-100% probability
Likely	66-100% probability
About as likely as not	33 to 66% probability
Unlikely	0-33% probability
Very unlikely	0-10% probability
Exceptionally unlikely	0-1% probability

* Additional terms that were used in limited circumstances in the AR4 (*extremely likely* – 95-100% probability, *more likely than not* – >50-100% probability, and *extremely unlikely* – 0-5% probability) may also be used in the AR5 when appropriate.

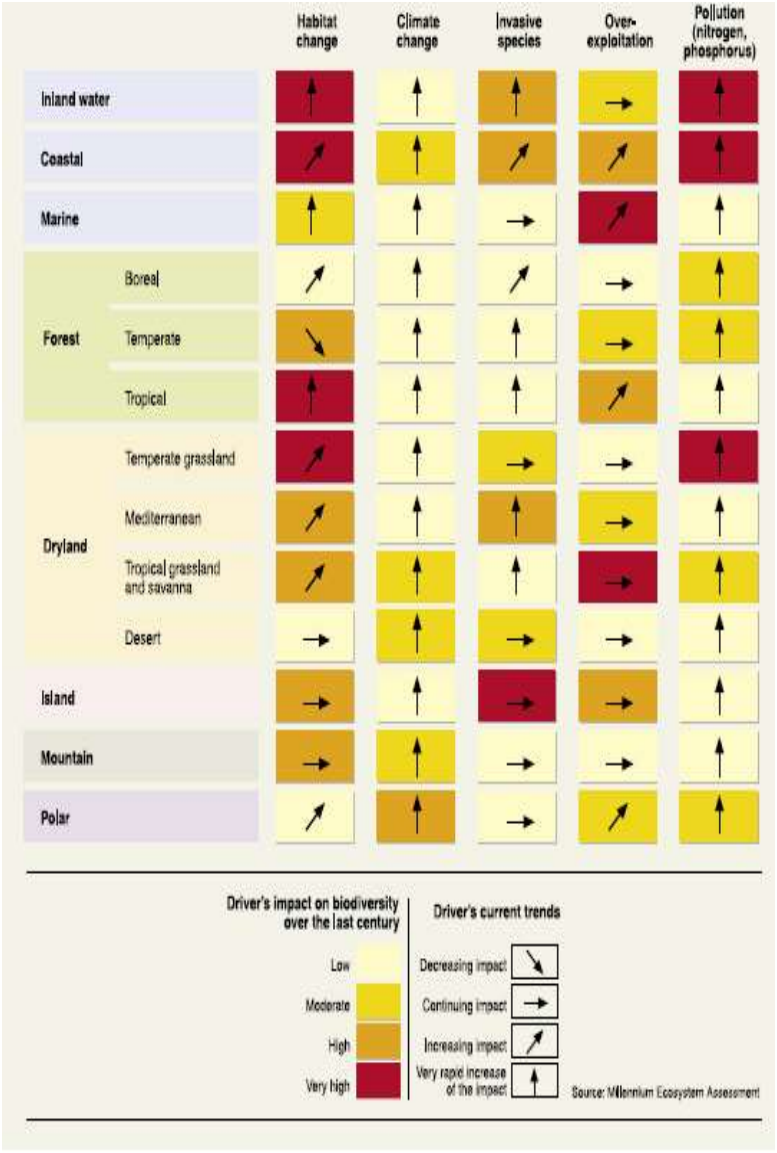
IPCC reports

The Report Card has simplified the assessments to provide an overall confidence level of high (H), medium (M) or low (L). Low confidence results are still based on evidence and still reflect expert judgment.

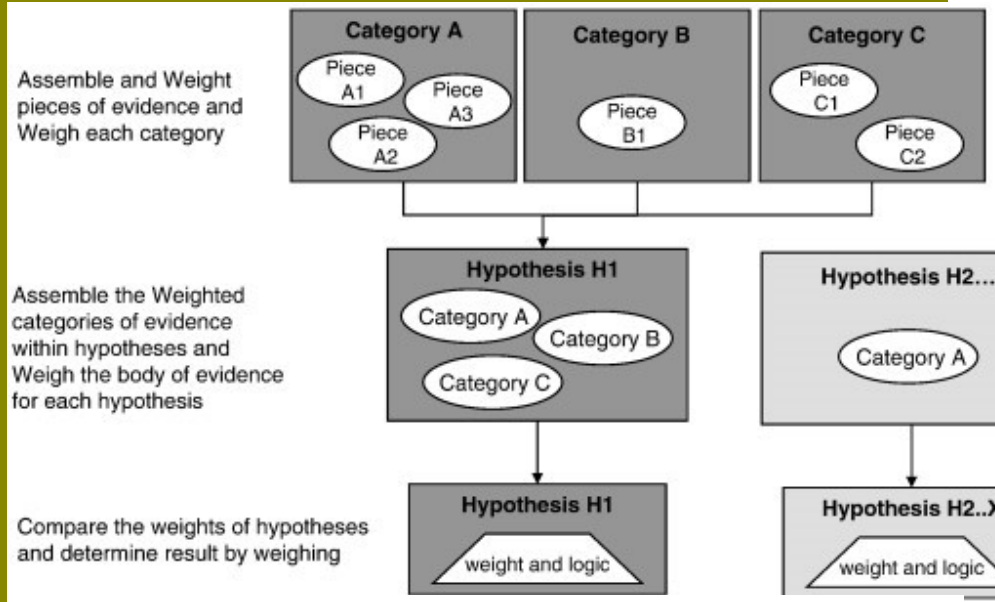


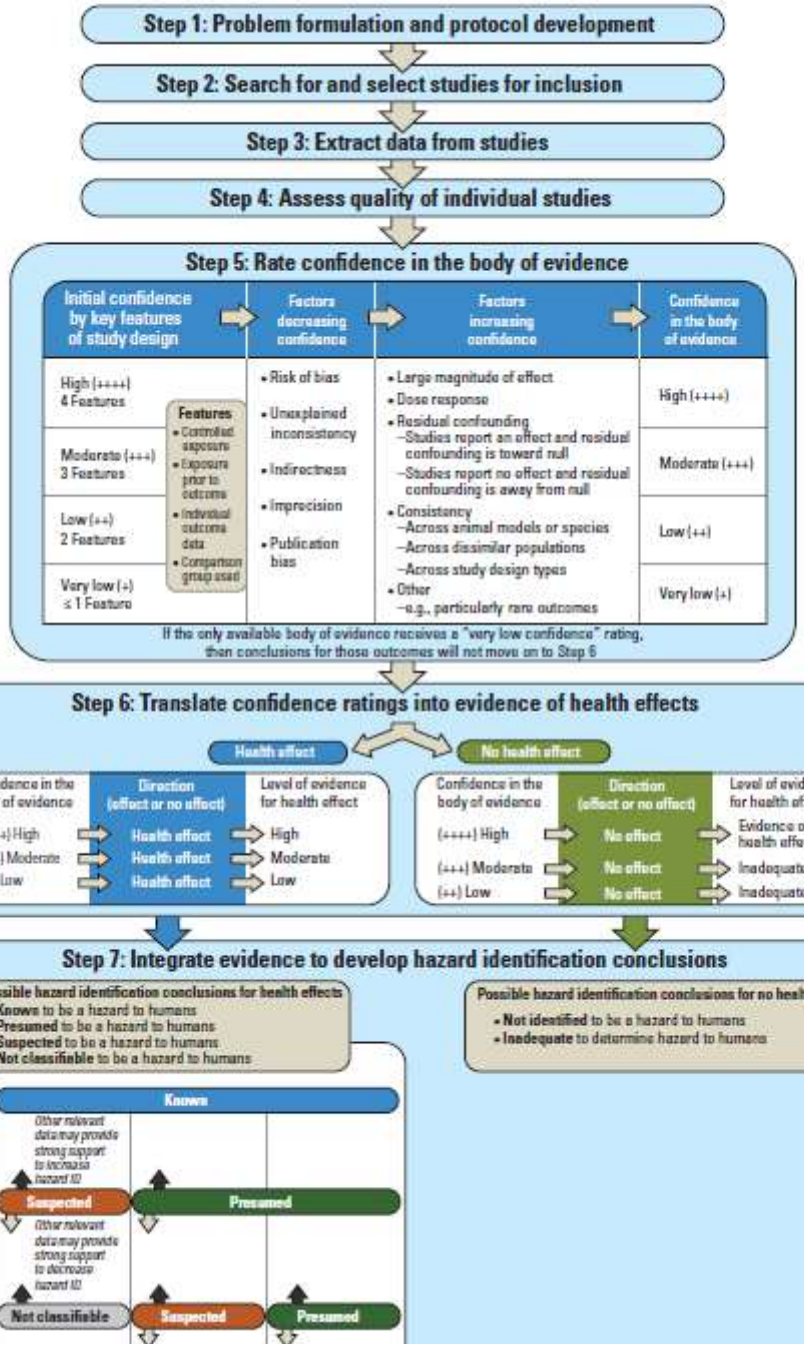
LWEC report cards

MA Ecosystem Assessments



Methods Reviewed





EVIDENCE STATEMENTS

All evidence statements adhere to the following format:
Title, main evidence statement followed by information from supporting studies.
Studies: **First author, date of publication** ([quality rating of study] country study took place, sample size of study, intervention duration/length of follow-up) [*intervention details*]. Main (relevant) study findings.

POPULATION LEVEL CHANGE

EVIDENCE STATEMENT 1. POPULATION LEVEL CHANGE IN MASS MEDIA INTERVENTIONS TO INCREASE WALKING

There was inconsistent evidence from 2 studies on the effectiveness of mass media interventions (which included paid advertisements [TV, radio, cable, newspapers], billboards/posters, public relations, educational activities and community participation), delivered in the community in increasing population levels of walking for leisure or travel in adults up to one year post intervention. One BA study (Wimbush 1998 [+]) showed no effect on walking (the reporting of data in this study was poor) and one CS study (Wray 2005 [+]) showed a small, but positive effect on walking.

Wimbush 1998 (BA [+] UK n=3476, 12 months) [*40 second TV advert supported by a telephone helpline*]. No change in number of days spent walking for at least 30 minutes: mean of 4.26 days in 1995 and 4.13 days in 1996, no significance statistics given.

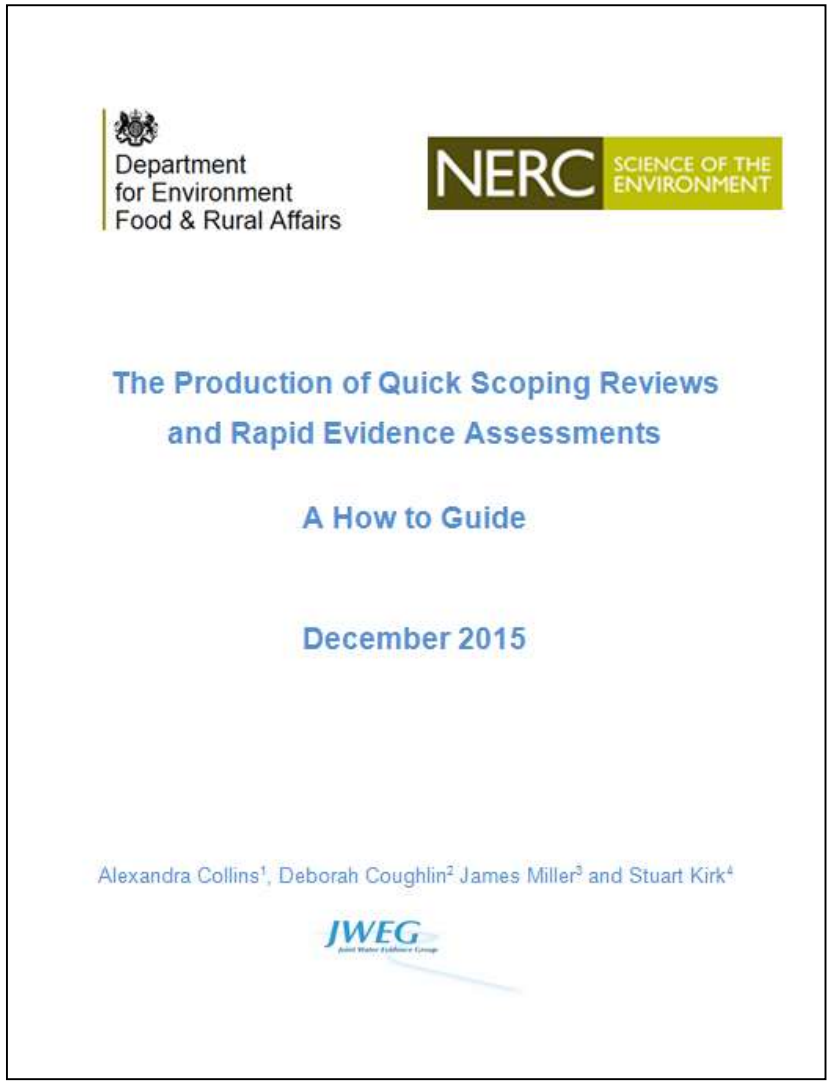
Combining Quality Assessments

Category	Study Type
A	Quantitative experimental *e.g. Before-after experiments, randomised control trials, non-randomised control trials*
B	Quantitative observational *e.g. before-after observations, case-controls, cohort studies, correlations*
C	Qualitative studies *e.g. interviews, expert elicitation*
D	Economic studies *e.g. cost-benefit/effectiveness/consequence studies*
E	Reviews *e.g. literature reviews, systematic reviews, reviews of randomised control trial*

++	All or most of the methodological criteria appropriate for the study type have been fulfilled (*low risk of bias*)
+	Some of the methodological criteria appropriate for the study type have been fulfilled and those criteria that have not been fulfilled or not adequately described are thought unlikely to alter the conclusions (*risk of bias*)
–	Few or no methodological criteria have been fulfilled. The conclusions of the study are thought likely or very likely to alter (*high risk of bias*).

High	Evidence from many studies classed as + and/or 1 or more studies classed as ++
Medium	Evidence from one or more studies that have been classed as at least +
Low	Evidence from a small number of studies or studies classed as –
Contested	Evidence that differs in its conclusions (present the class for each study/evidence)

Where To Find Out More


Department for Environment Food & Rural Affairs

NERC SCIENCE OF THE ENVIRONMENT

The Production of Quick Scoping Reviews and Rapid Evidence Assessments

A How to Guide

December 2015

Alexandra Collins[1], Deborah Coughlin[2] James Miller[3] and Stuart Kirk[4]

JWEG

- Confidence statements
  - https://connect.innovateuk.org/web/jweg
  - Defra intranet
  - Environment Agency
  - Natural England
- Weight of evidence approach
  - Paper with CSA in progress

Thank You

- Alexandra.Collins@imperial.ac.uk
- www.imperial.ac.uk/people/alexandracollins

@AlexMaryCollins

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MANCHESTER 1824

The University of Manchester

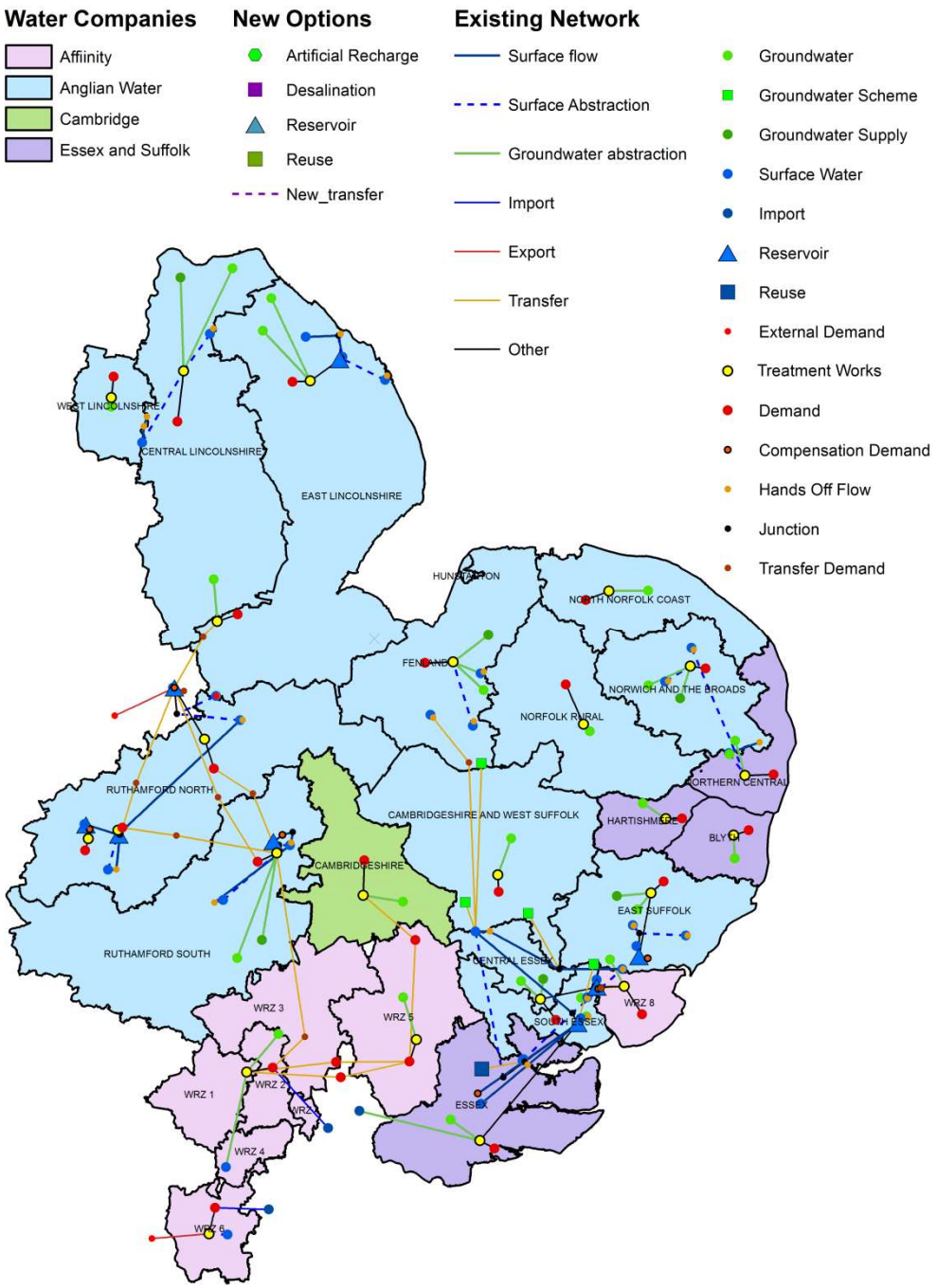
Planning water regional water resources investments in East Anglia

Julien Harou, Evgenii Matrosov,

2/10/16, Imperial College London Risk & Uncertainty Workshopp

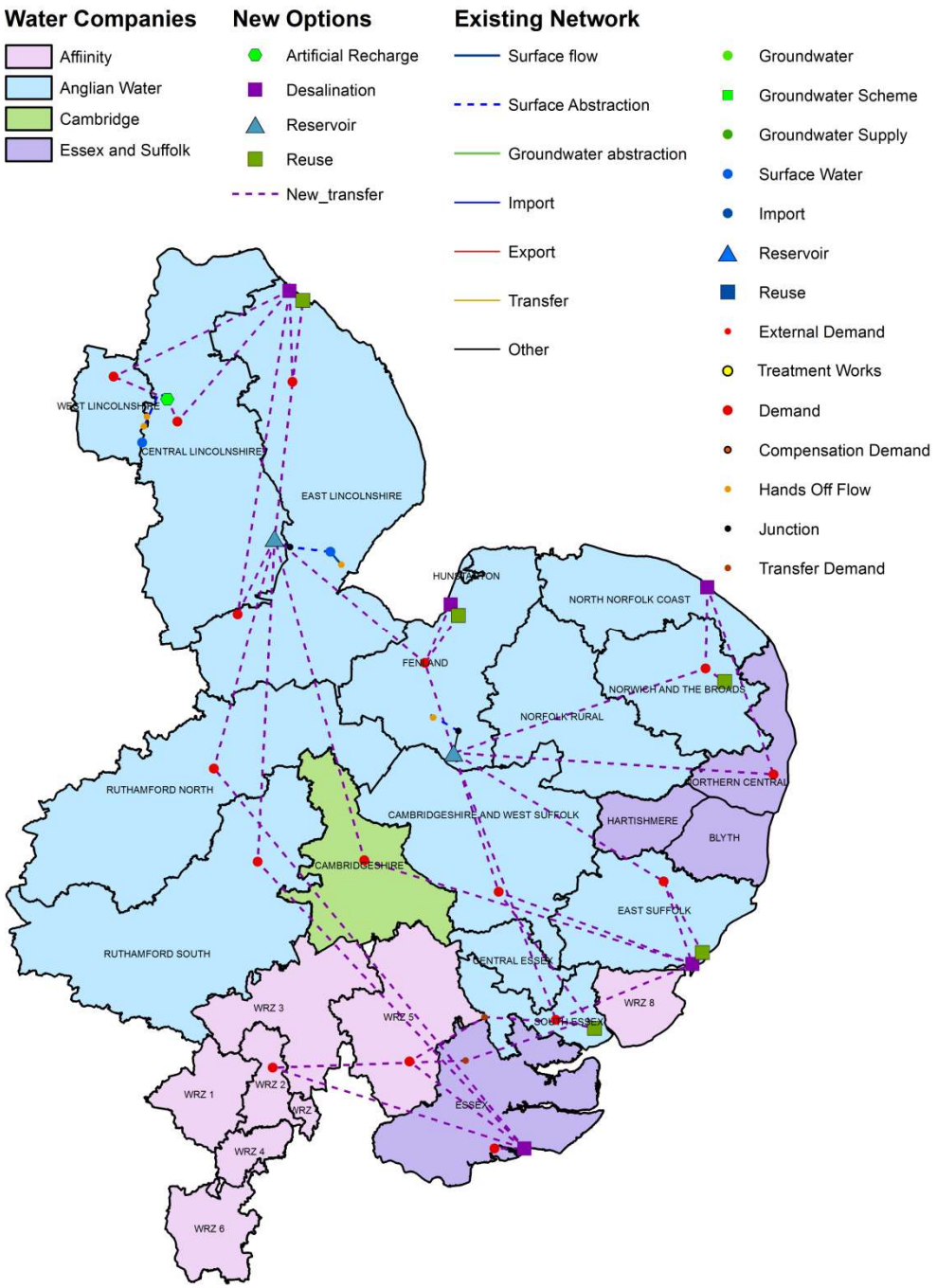
Project scope

- Multi-company strategic water resource planning project for East Anglia
- Focus on the challenge of growth, sustainability reductions and climate change
- Consider future supply options including: reservoirs, strategic transfers, aquifer storage and recovery, water reuse, desalination



1st Phase: Build WREA regional system simulation model (IRAS-2010)

- Models surface water system
- Groundwater and demand aggregated into RZ level
- Simulates 60 years in 8 seconds with a weekly time-step



Proposed options modelled in WREA simulator

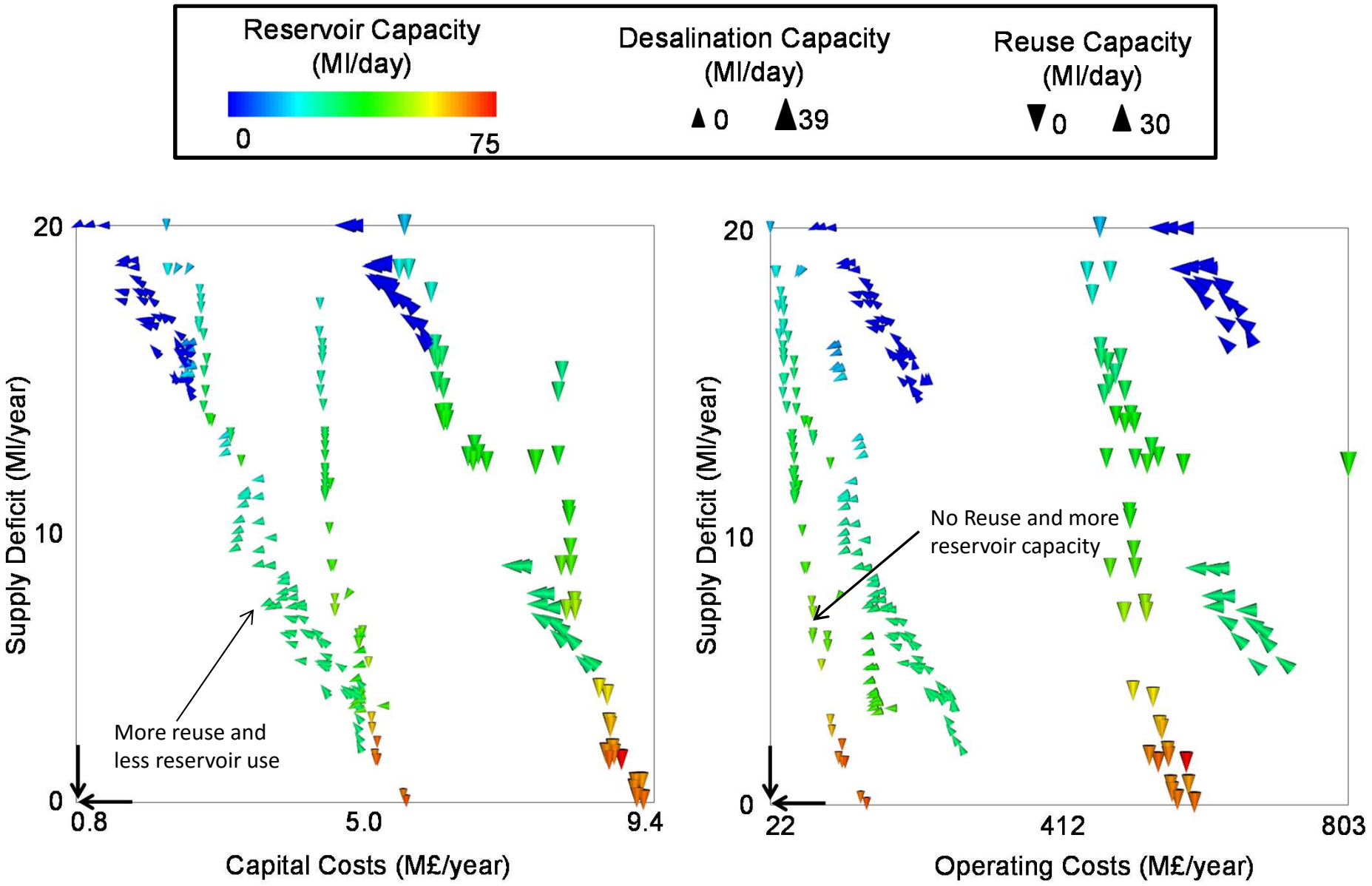
- 5 desalination options
- 5 reuse options
- 2 reservoir options
- 1 artificial recharge scheme
- 2 transfers from existing reservoir
- 38 unique supply to demand transfer links

Planning analysis

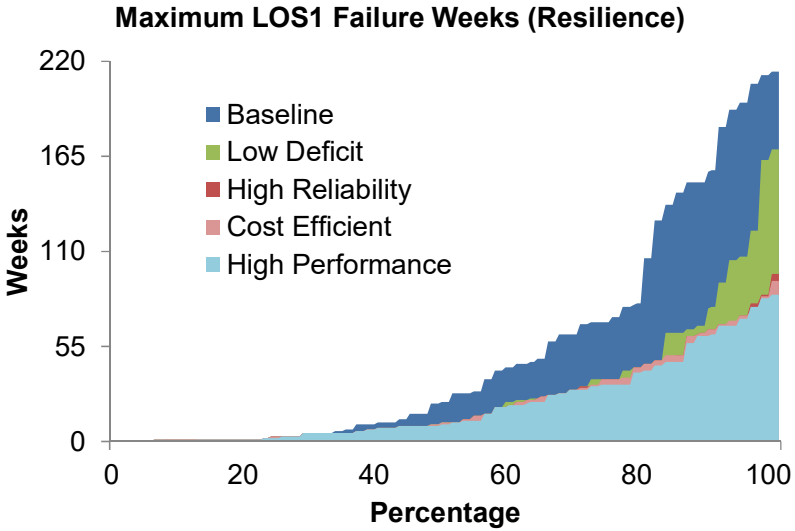
- Multi-criteria search under multiple scenarios
  - Incorporates multiple performance criteria
  - Finds designs that are robust given future uncertainty
- Robust decision making
  - Characterise vulnerabilities of selected plans

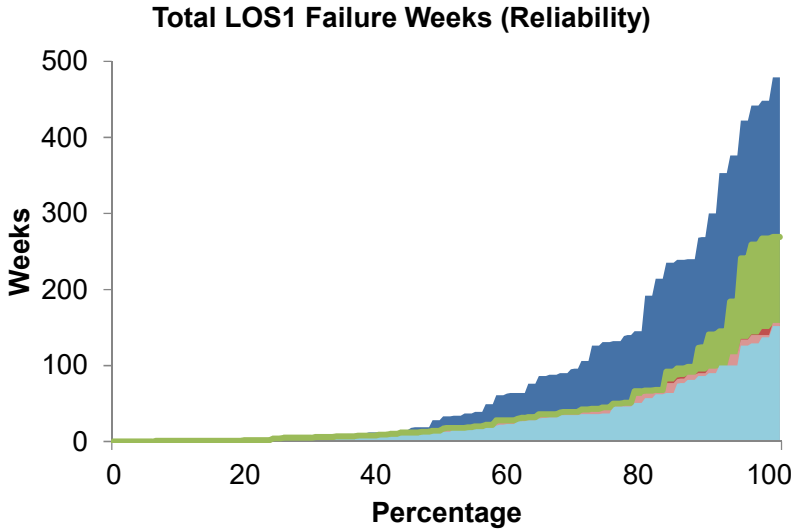
WREA model performance metrics

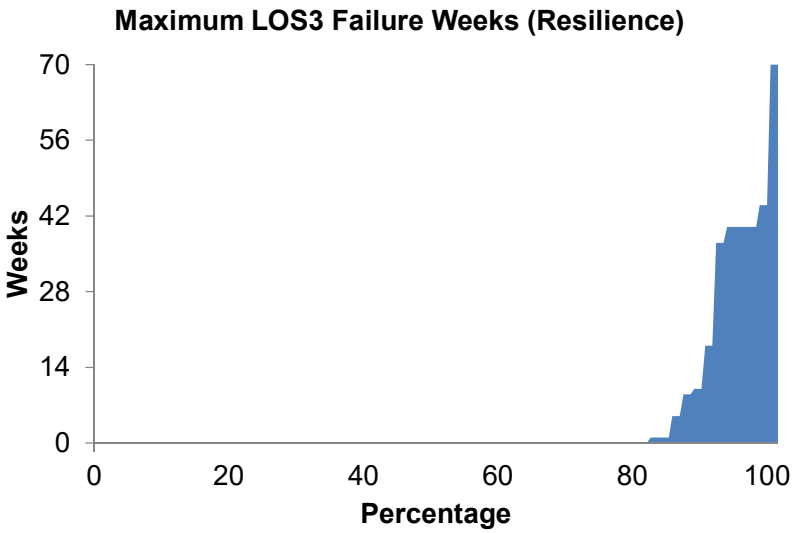
Performance Metric	Description
Operating costs	total operating costs of simulations
Capital costs	Annual capital costs of portfolios
Supply deficit	total supply deficit summed over all RZ's
Total weeks with level of service 1 (LOS1) failures	number of weeks of LOS1 failure summed over all reservoirs
Maximum duration of LOS1 failures	longest consecutive number of weeks of LOS1 failure summed over all reservoirs. Maximum duration metrics demonstrate system resilience.
Total weeks with levels of service 3 (LOS3) failures	number of weeks of LOS3 failure summed over all reservoirs
Maximum duration of LOS3 failures	longest consecutive number of weeks of LOS3 failure summed over all reservoirs

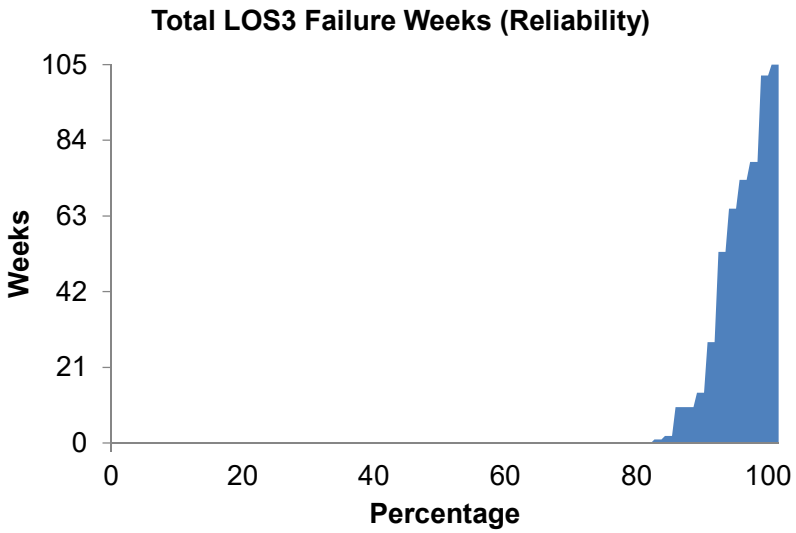

Reservoir Capacity (Ml/day)
0
75
Desalination Capacity (Ml/day)
0
39
Reuse Capacity (Ml/day)
0
30
Supply Deficit (Ml/year)
20
10
0
0.8
5.0
9.4
Capital Costs (M£/year)
More reuse and less reservoir use
Supply Deficit (Ml/year)
20
10
0
22
412
803
Operating Costs (M£/year)
No Reuse and more reservoir capacity

Relative performance of selected portfolios









Vulnerabilities of the ‘Cost Efficient’ portfolios

Scenario/Dimension	1	2
Demand increase	≥5%	≥0%
Reduction in winter hydrology	17%	>42%
Reduction in summer hydrology	45%	>49%

Scenario	Failure Density	Coverage
1	92%	69%
2	60%	28%
Total	79%	97%

SESSION II: Q & A

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