Environmental interactions and constraints: The FORESEER tool

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WholeSEM/DECC stakeholder Workshop

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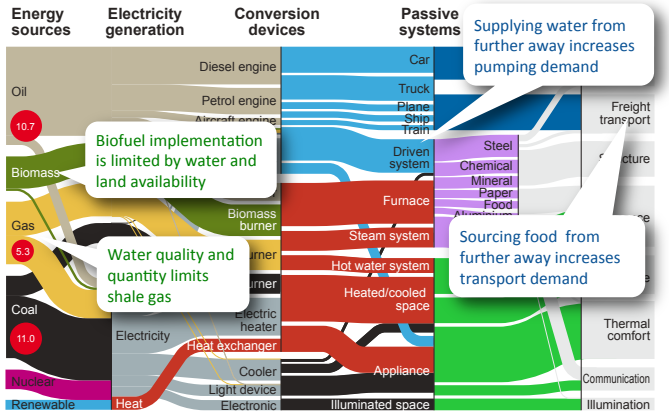
Objectives of Foreseer

- Assess the **connections** and **trade-offs** between water, energy and land (food, ecosystems) over time and under user defined scenarios
- Present **visually** clear, **physically based** predictions of future resource requirements and stress, under user defined scenarios
- Evaluate and illustrate **uncertainty** in future forecasts through sensitivity studies

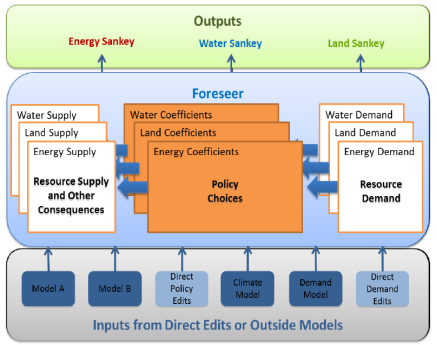
Starting Point: Global energy use

How will resource stresses affect future energy supply?

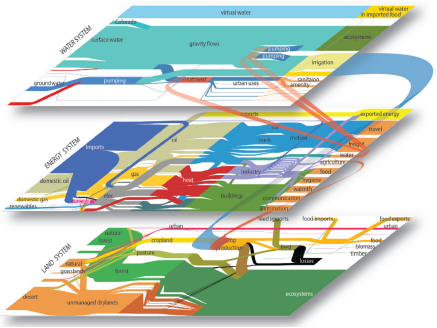
How will resource stresses affect future energy demand?



Foreseer Tool: energy-land-water integration



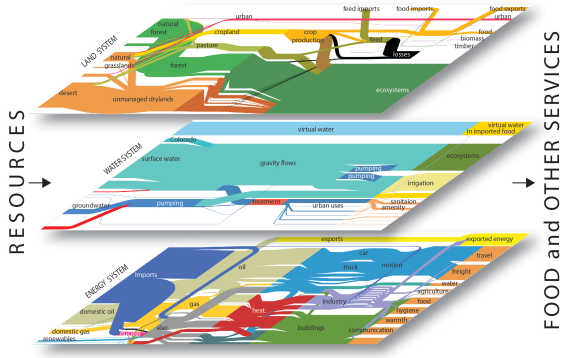
Conceptual Model of Foreseer tool



Linkages between water, energy and land Sankey diagrams of the Foreseer tool

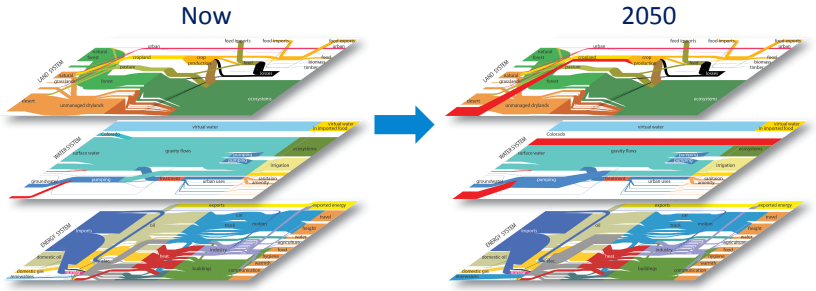
Our Process

1st Step: data collection, analysis & visualisation of current resource flows and connections in a region.



Our Process

2nd Step: Modelling and analysis of future scenarios

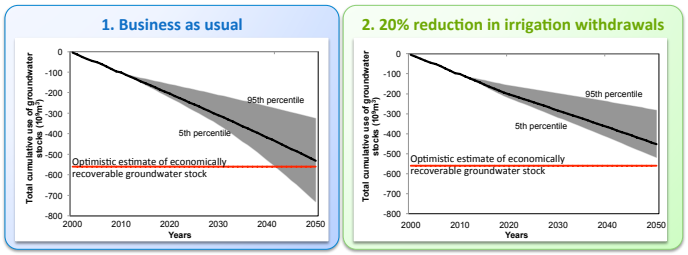


Visualise deterministic results through a web-based tool using ***dynamic*** Sankey diagrams to show the ***connections*** & ***trade-offs*** between the services provided by water, energy and land under different user defined scenario

Our Process

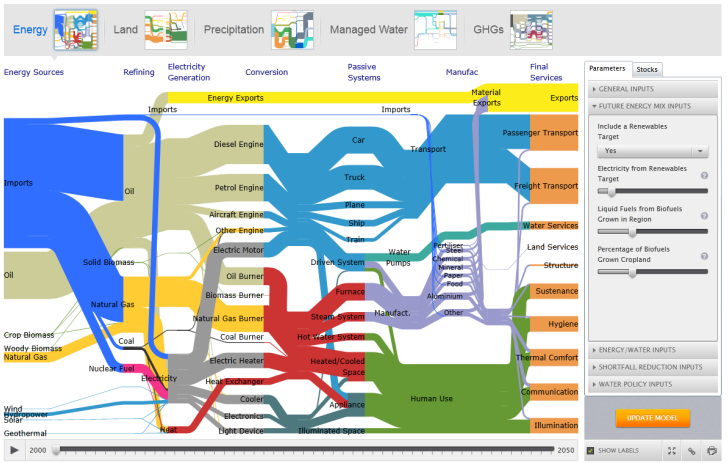
3rd Step: Aggregating metrics of stress and treating uncertainty

Climate/Env change	e.g. uncertainties about future precipitation patterns
Technological change	e.g. uncertainties about development and uptake of technology
Socio-economic change	e.g. uncertainties about future dietary habits



Cumulative change in groundwater stocks modelled with uncertainty of future rainfall

Foreseer in action (www.foreseer.org)



Foreseer

- **Visual, User friendly and provides a whole system analysis**

  Visual comparison to explore trade-offs between the resources under specific user-defined scenarios and different policies

- **Simplicity & Complexity**

  The tool can be as simple or as complex as required (depends on objectives of study & available local/regional or global data)

- **Exploring strategic decisions**

  Can be used to inform long-term national/commercial strategic decisions of impact of resource stress

- **Can be adapted to different scales**

  Country Level (UK, Uganda), Regional Level (California), Basin Level (Sichuan/ Pearl River Basin)

Energy and water study in China

An energy and a water for energy study has been undertaken and visualised in the Foreseer tool. This includes:

- A dynamic national energy Sankey diagram under three IEA scenarios
- A dynamic water for energy Sankey diagram showing the flow of water from source to sink through the various energy processes that utilises water under extraction, preparation and power generation
  - The user has the option to change the technologies utilised in water for energy to investigate the effect they have on overall water use in the energy sector
- Analysis of the energy sector's total water demand as a % of the total industrial water use allowed under the '3 red lines' policies

Future energy scenarios in China

Scenarios based on IEA future energy scenarios and enriched with supplemental sources.

1) **Current policies scenario**: based on the perpetuation, without change, of the government policies and measures that had been enacted by mid-2012.

2) **New policies scenario (IEA's central scenario):** takes into account broad policy commitments and plans that have already been implemented to address energy related challenges as well as those that have been announced, even where the specific measures to implement these commitments have yet to be introduced.

3) **450 Scenario:** based on an energy pathway that is consistent with a 50% chance of meeting the goal of limiting the increase in average global temperature to 2C.

"3 red lines" water policies

- **National Cap**
  - Cap national water demand at 635 bcm (billion m^3) by 2015, 670 bcm by 2020 and 700 bcm by 2030.
- **Efficiency**
  - Reduce water usage per 10,000 RMB of IVA (IVA is the contribution of industry to the overall GDP) from current 130 m^3 to 65 m^3 & 40 m^3 in 2020 and 2030 respectively.
  - Improve water irrigation efficiency to above 53% by 2015, 55% by 2020 & 60% by 2030.
- **Quality**
  - 60% of water systems (rivers & lakes) to meet national water quality standards by 2015, this increases to 80% and 95% by 2020 and 2030 respectively.

Each province has their own set target.

China - 2010 Energy Sankey Diagram

- To be shown at the Workshop (we have been asked not to circulate this slide)

China - 2010 Water Sankey Diagram

- To be shown at the Workshop (we have been asked not to circulate this slide)

Main messages – China "3 red lines" water policy

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The Foreseer tool in WholeSEM

- Implementing a UK energy-land-water resource analysis in the Foreseer Tool
  - characterising current UK land use and water resources including land services
  - characterising the links between energy and land productivity, water and energy
  - estimating the UK's 'avoided land use' through imports of biomass from other countries
  - 'stress-testing' current and future UK energy pathways under increased demand, climate change and potential energy mix diversification
- Iterative development of coupled economic and resource scenarios