The Foreseer tool

The Foreseer Tool, which was developed as part of the Foreseer project in Cambridge, is a tool for visualising the influence of future demand scenarios on requirements for energy, water and land resources. The basis of the tool is a set of linked physical models for energy, water and land plus the technologies that transform these resources into final services – e.g. housing, food, transport and goods.

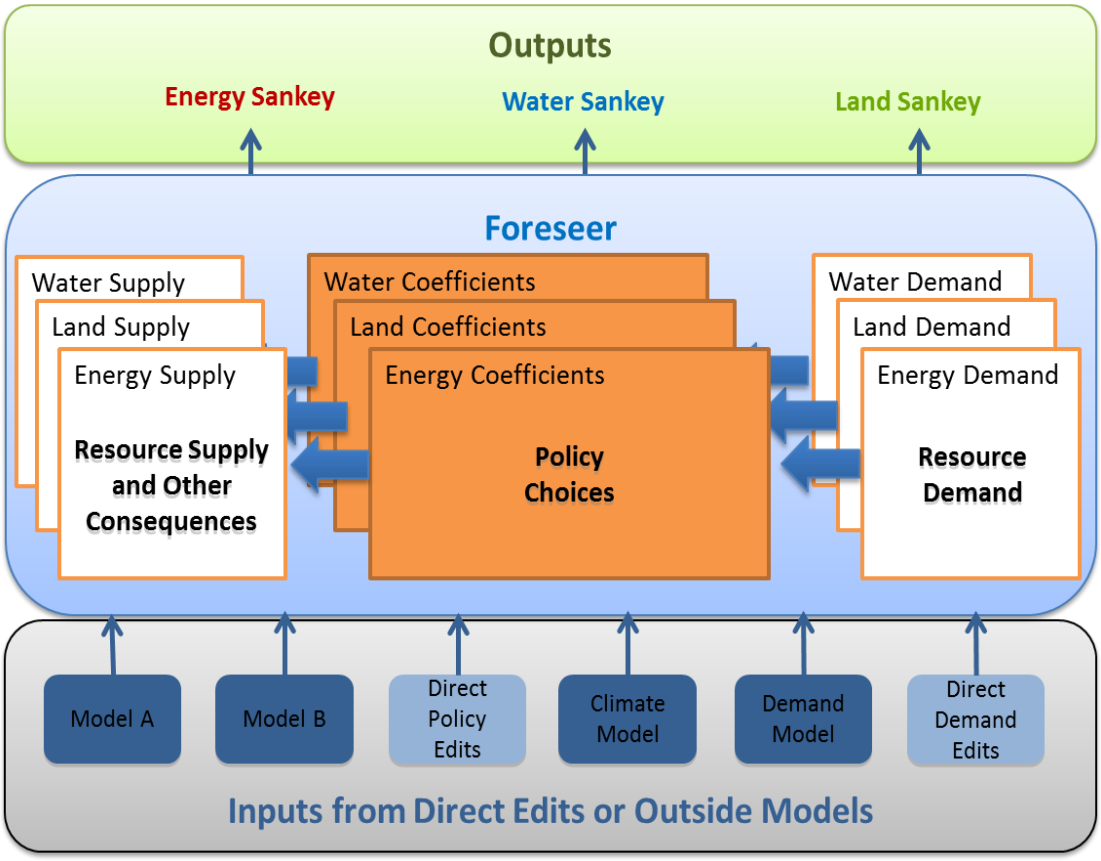

Figure 1: Conceptual model of the Foreseer Tool

The tool shows resource shortages and other indicators of stress (e.g., ecosystem services) as a result of user inputs. Foreseer has a modular structure, with the potential to incorporate specialised analyses or models to calculate future demand, climate change, technological change, or other effects of relevance to the user (Figure 1). The inputs to the Foreseer Tool include forecasts of demand for final services and technology scenarios to predict how technology performance and selection (e.g. between electric or petrol cars) may evolve over time. The tool also allows for sensitivity analysis to predict the value of technology

innovations. Figure 2 presents a typical Graphical User Interface (GUI) of the online version of the Foreseer Tool.

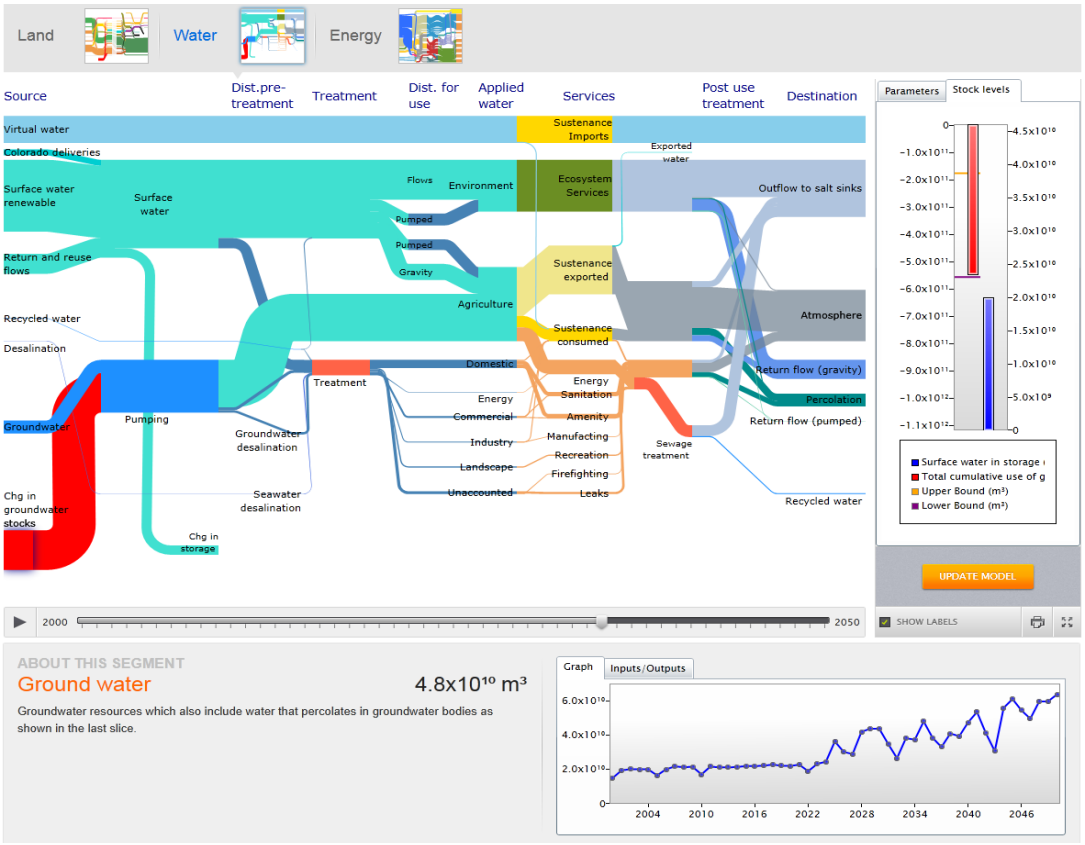

Figure 2: A typical GUI of the online version Foreseer Tool

The Foreseer Tool visualises linked energy, water and land resource futures by outputting a set of Sankey diagrams for energy, water and land, showing the flow from basic resource (e.g. coal, surface water, and forested land) through transformations (e.g. fuel refining and desalination) to final services (e.g. sustenance, hygiene and transportation). A sample output Sankey of the Foreseer Tool is shown in Figure 3, illustrating the linkages between water, energy and land resources.

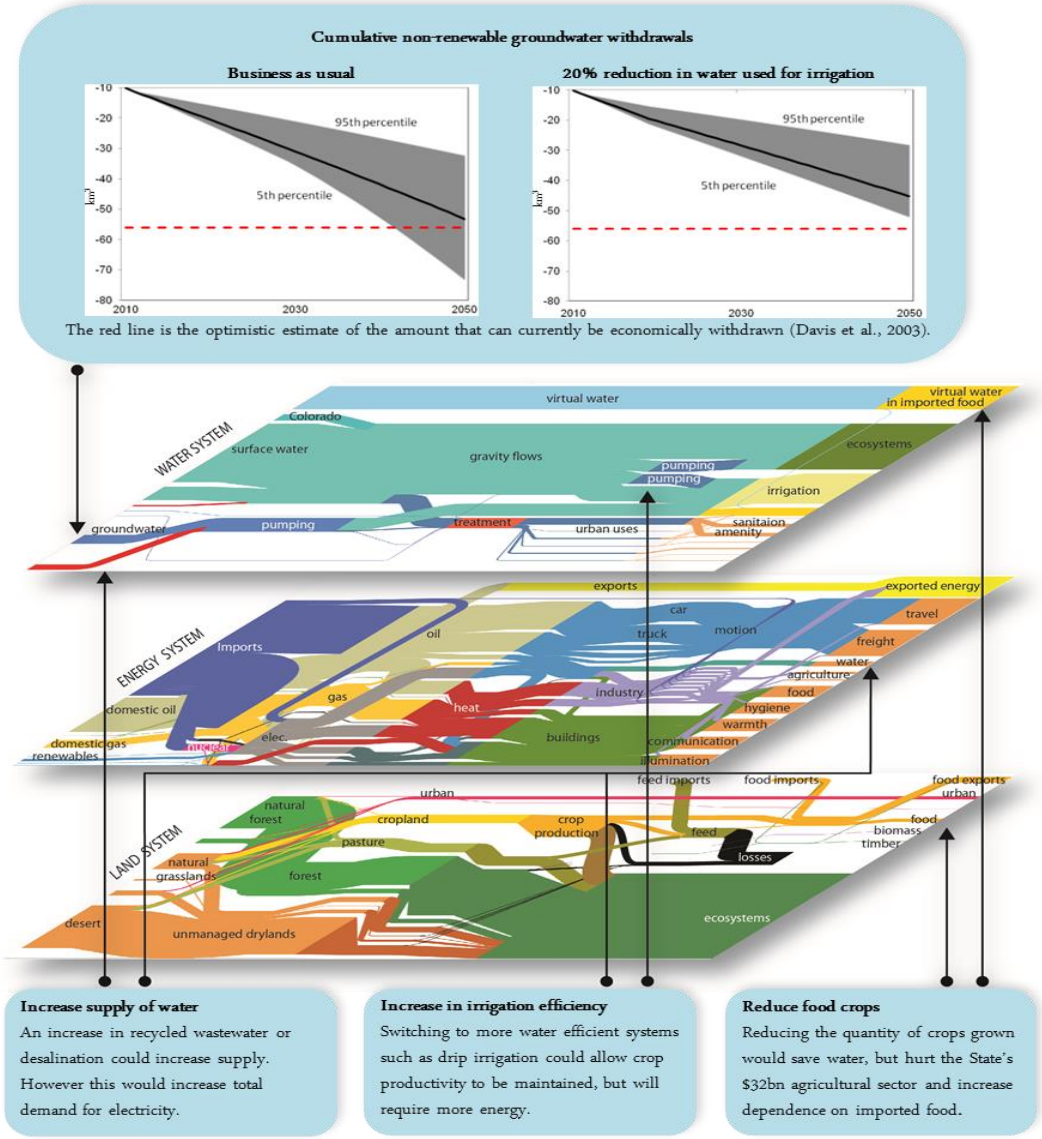

Figure 3: A diagram showing the linkages between water, energy and land Sankey of the Foreseer Tool for (https://www.ForeseerTM.group.cam.ac.uk/Foreseer-tool/)

The tool allows future resource allocations to be iteratively developed to illustrate trade-offs and convergence with economic scenarios. Thus, it can provide decision-support information for policy development towards the management and service delivery of land, water and energy sectors.

Data requirements

The data required for running the Foreseer Tool for current and future resource pathways are summarised below:

Energy - current primary energy sources, energy allocation and end-use conversion devices, passive systems, final services, future energy mix and future demand.

Land - potential vegetation and current land use, soil types, crop types and yield, imported food and fibre, future land use/ land use change scenarios, future food and biomass demand and change in diet.

Water – renewable (surface and groundwater) sources and stocks, precipitation, evapotranspiration, pre-treatment distribution for use, treated water, virtual water, services, desalination and post-use treatment, future demand, climate change/variability and sinks.

Socio-economic - population growth, future policy direction and local and international regulations.

References

1. Cullen, J. M., & Allwood, J. M. (2010). The efficient use of energy: Tracing the global flow of energy from fuel to service. Energy Policy, 38(1), 75-81.
2. Curmi, E., Fenner, R., Richards, K., Allwood, J. M., Bajželj, B., & Kopec, G. M. (2013). Visualising a Stochastic Model of Californian Water Resources Using Sankey Diagrams. Water Resources Management, 1-16.
3. Curmi, E., Richards, K., Fenner, R., Allwood, J. M., Kopec, G. M., & Bajželj, B. (2013). An integrated representation of the services provided by global water resources. Journal of Environmental Management, 129, 456-462.
4. Bajželj, B., Allwood, J. M., & Cullen, J. M. (2013). Designing Climate Change Mitigation Plans That Add Up. Environmental science & technology, 47(14), 8062-8069.