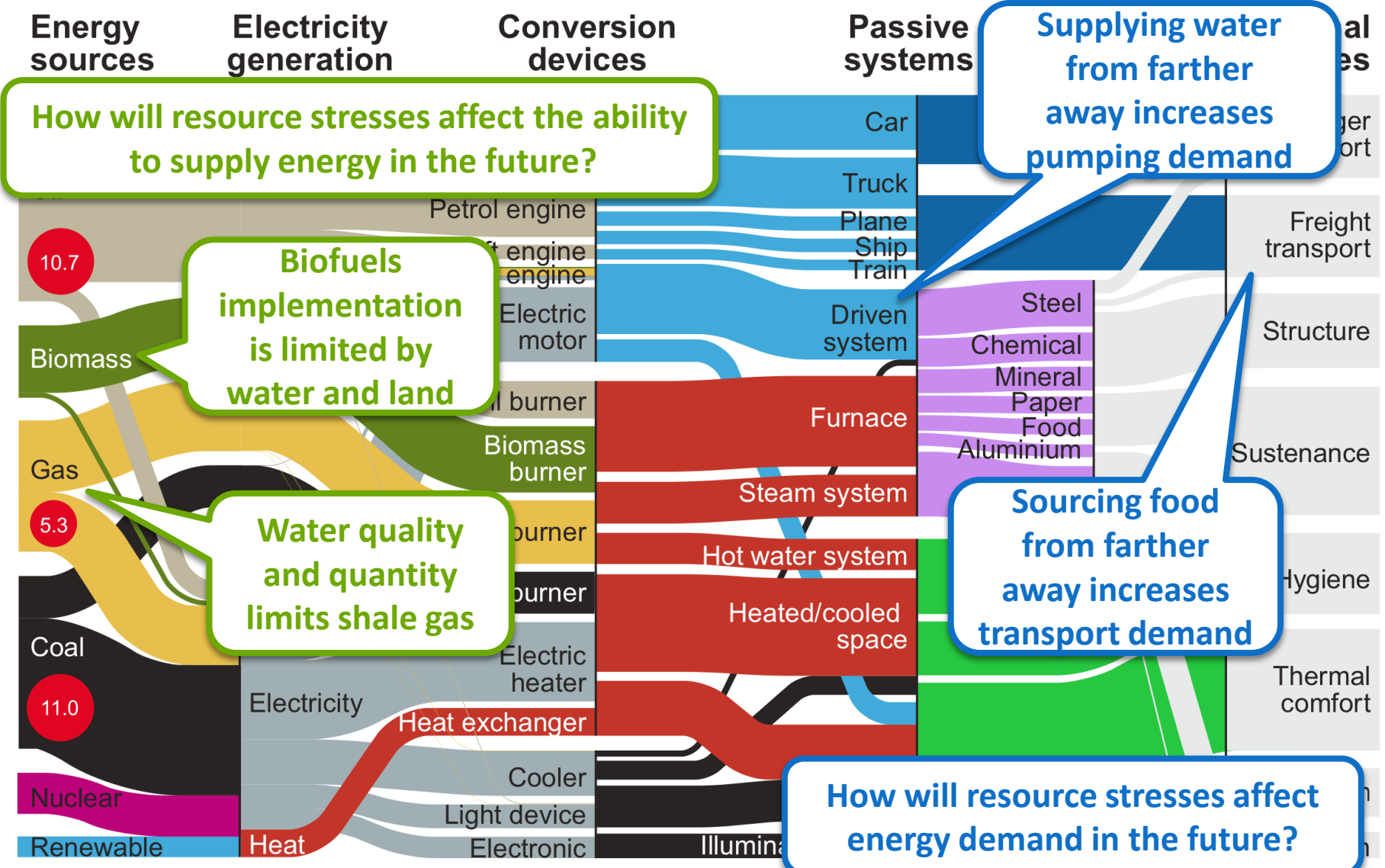




# Illustrating the water-land-energy nexus

**Dr. Liz Curmi**

# Starting Point: Global energy use



Global energy demand in 2005, total = 475 EJ

● Global carbon emissions in 2005, total = 27 Gt CO<sub>2</sub>

JM Cullen and JM Allwood  
*Energy Policy* 38 (2010) 75–81

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- Assess the **connections** and **trade-offs** between water, energy and land (food, ecosystems) over time and under user defined scenarios
- Present clear **visually** direct, **physically based** predictions of future resource flows requirements, flows and availabilities arising from a variety of demand scenarios;
- Evaluate and illustrate **uncertainty** in future forecasts and will allow sensitivity studies to predict the value of technology innovations;

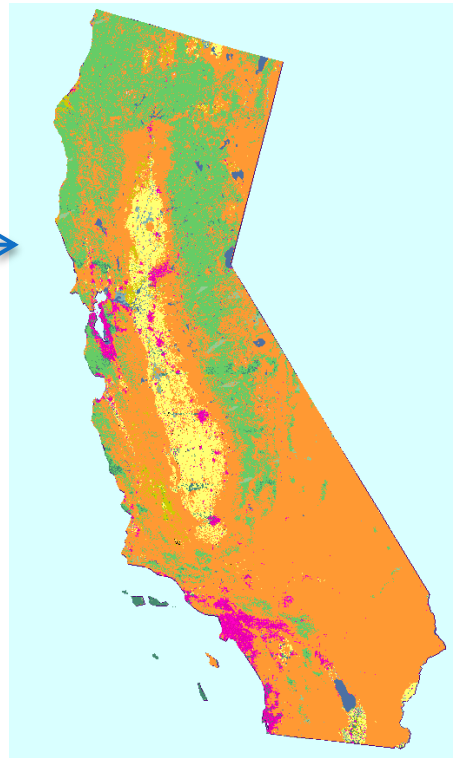
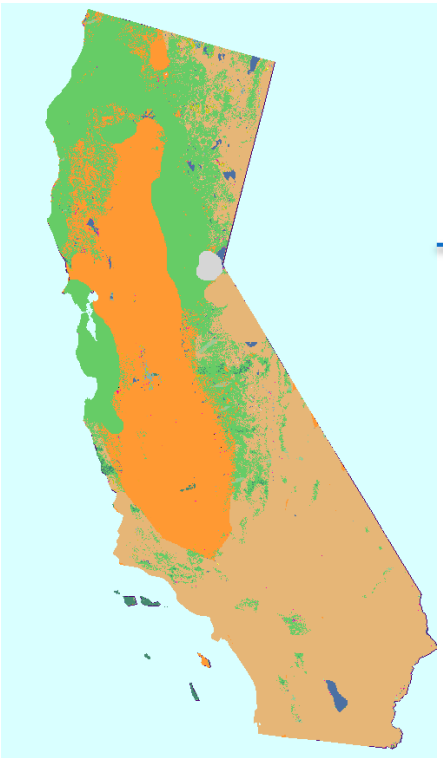
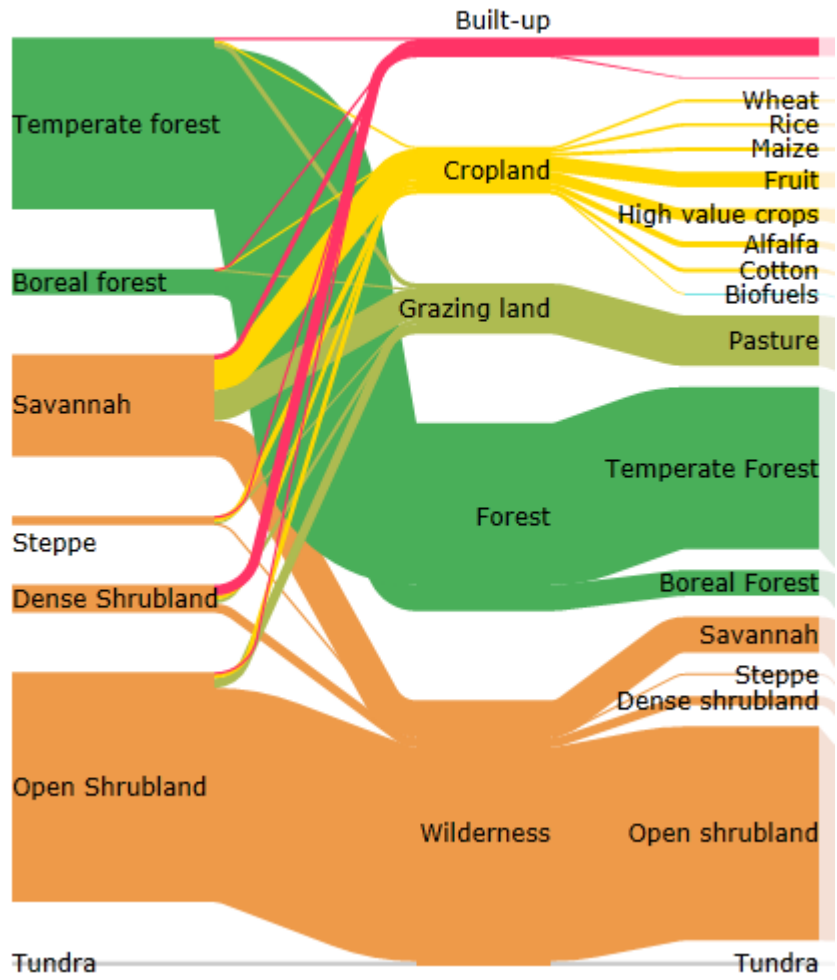
# Land use in California

Potential Natural Vegetation [ha]

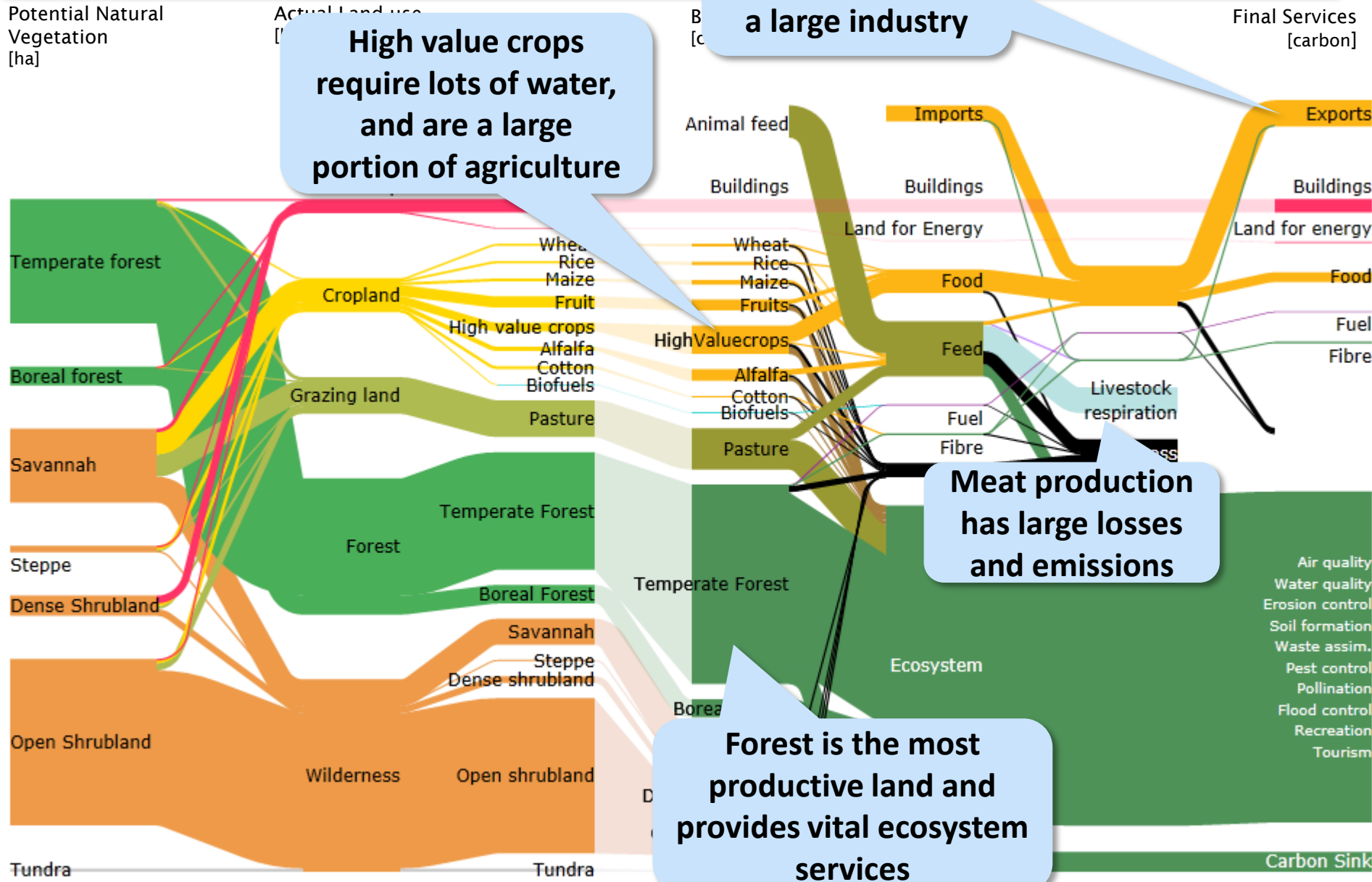
Actual Land-use [ha]

Potential Natural Vegetation [ha]

Actual Land-use [ha]



# Land use in California



**High value crops require lots of water, and are a large portion of agriculture**

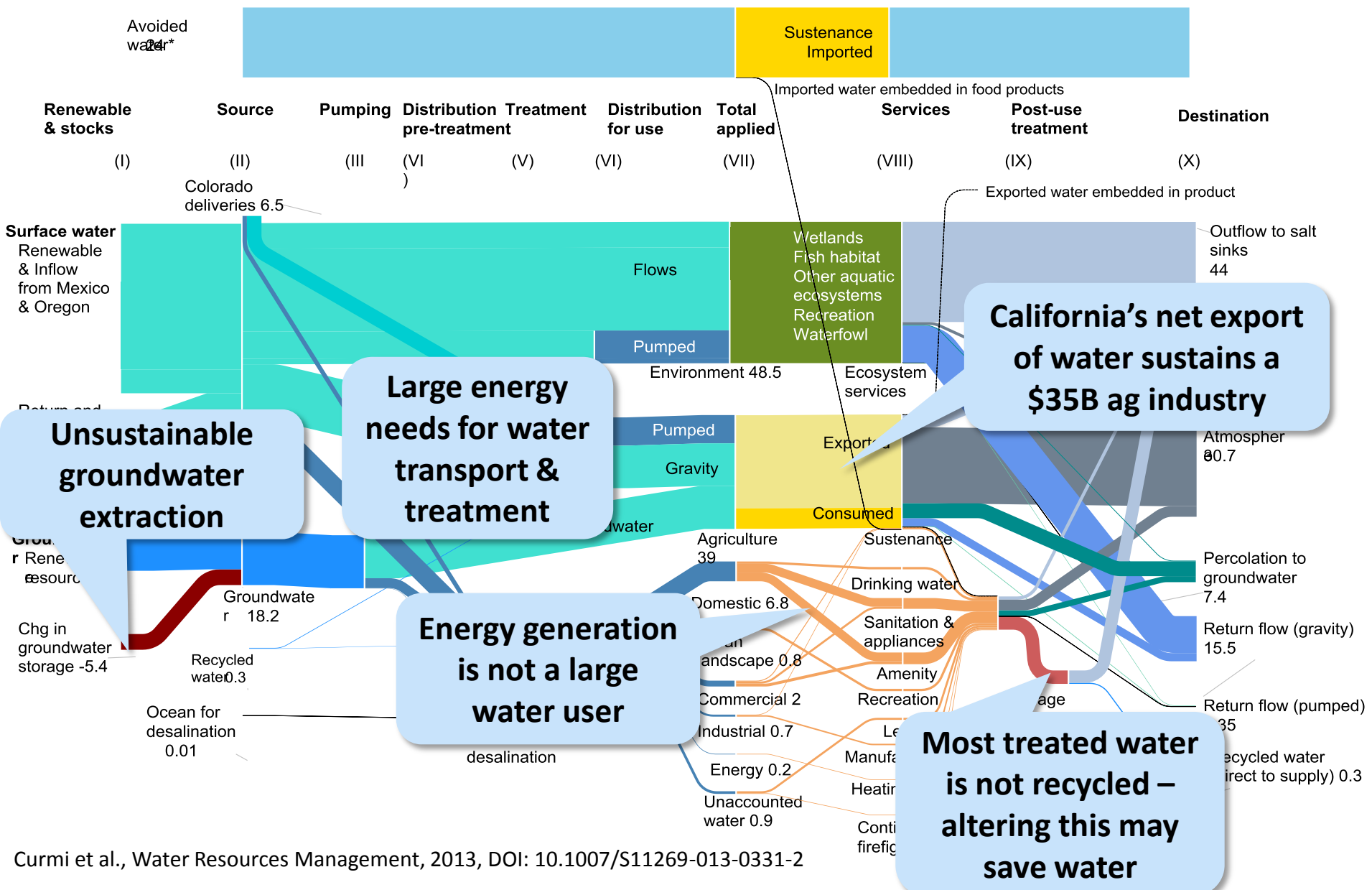
**CA's export of ag. products supports a large industry**

**Meat production has large losses and emissions**

**Forest is the most productive land and provides vital ecosystem services**

- Air quality
- Water quality
- Erosion control
- Soil formation
- Waste assim.
- Pest control
- Pollination
- Flood control
- Recreation
- Tourism

# Water use in California



**Large energy needs for water transport & treatment**

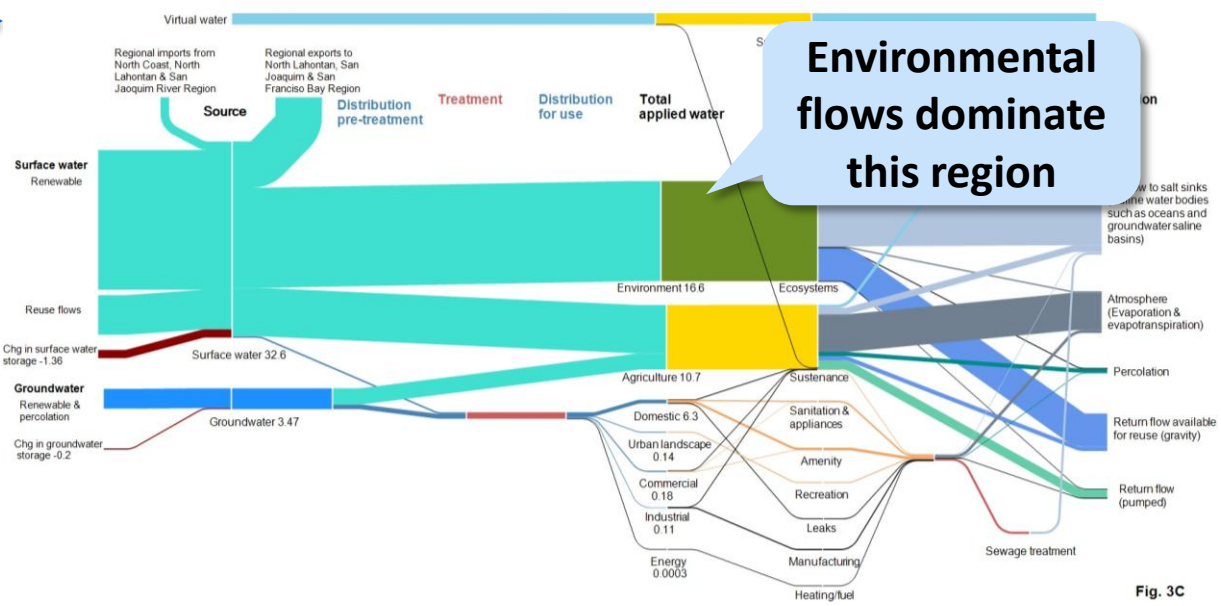
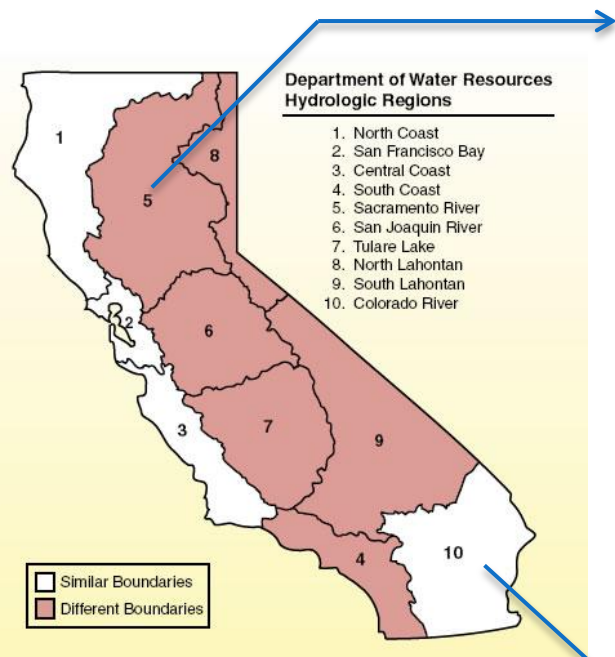
**Energy generation is not a large water user**

**California's net export of water sustains a \$35B ag industry**

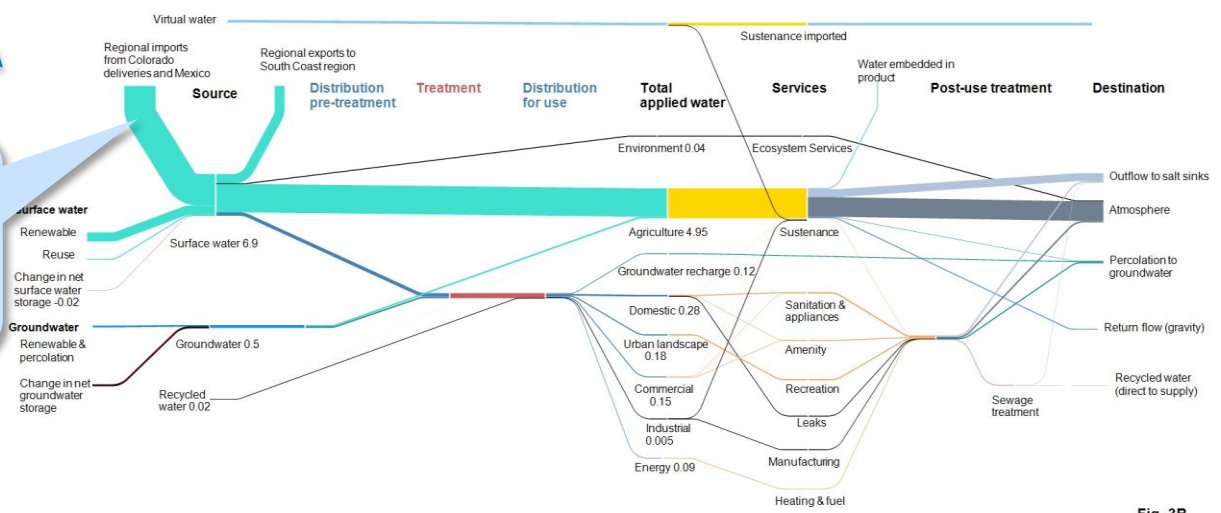
**Most treated water is not recycled – altering this may save water**

**Unsustainable groundwater extraction**

# Different Scales: Current water use in different regions

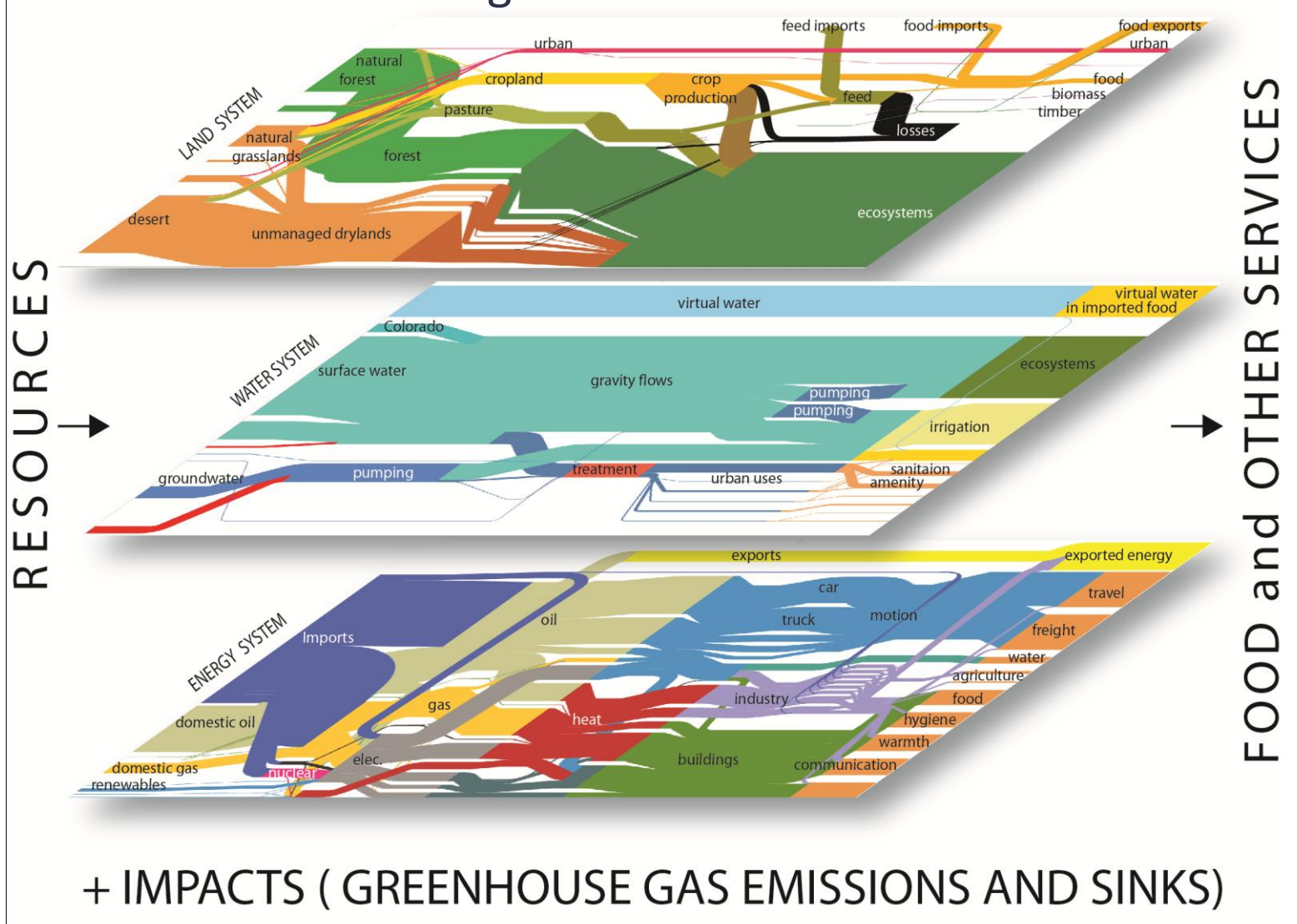


**This region relies on imported water for agriculture**



# Our Process

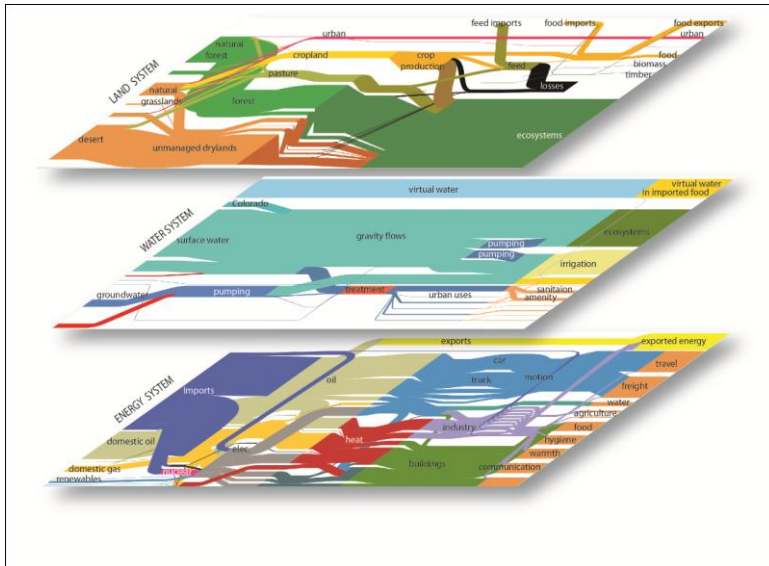
1<sup>st</sup> Step: data collection, analysis & visualisation of current resource flows and connections in a region.



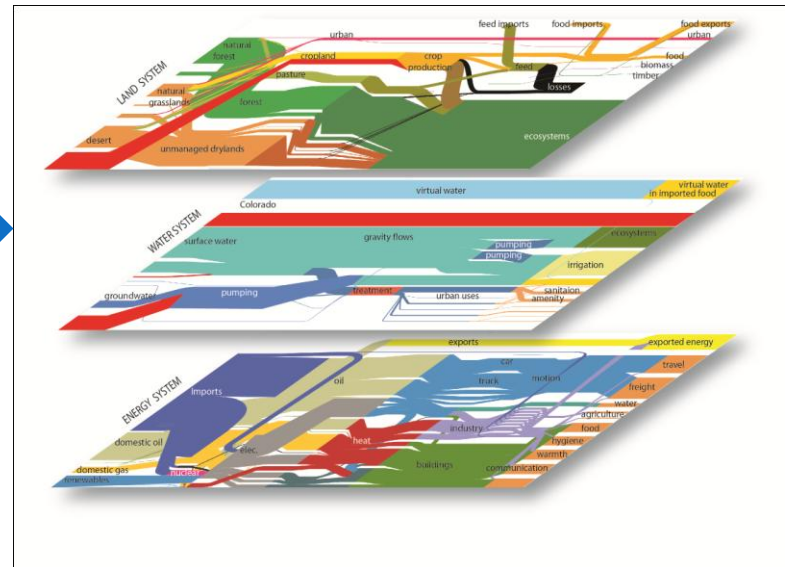


## 2<sup>nd</sup> Step: Modelling and analysis of future scenarios

Now



2050



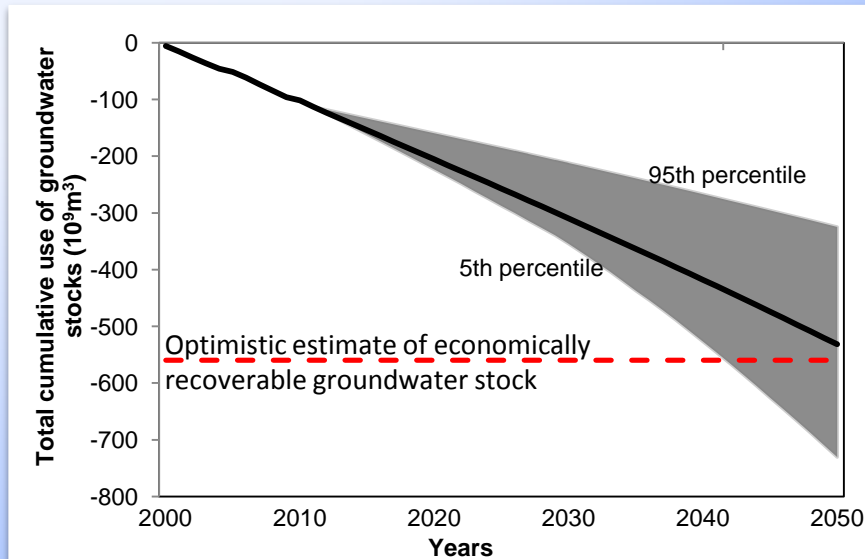
Visualise deterministic results through a web-based tool using **dynamic** Sankey diagrams to show the **connections & trade-offs** between the services provided by water, energy and land under different user defined scenarios

## 3<sup>rd</sup> Step: Modelling of uncertainty: Results

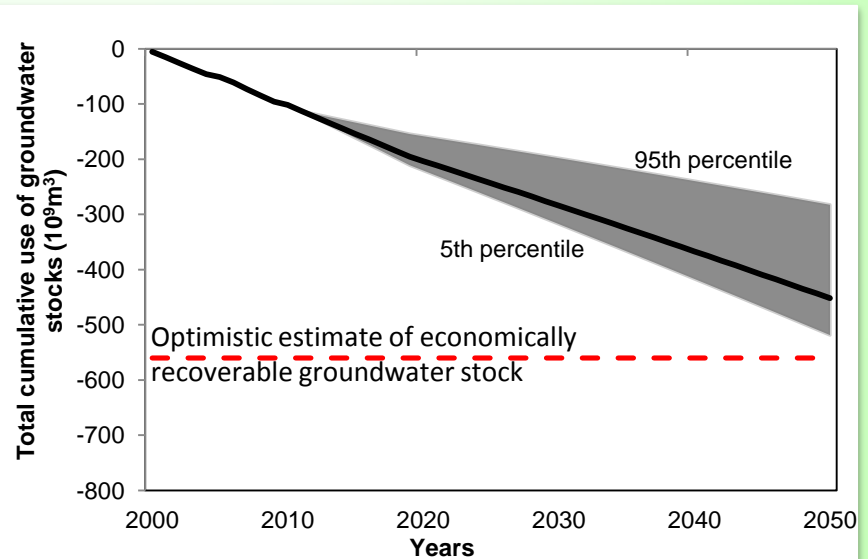
- Climate/Env change      uncertainties about future precipitation patterns
- Technological change    uncertainties about development and uptake of technology
- Socio-economic change   e.g., uncertainties about future dietary habits

Cumulative change in groundwater stocks modelled with uncertainty of future rainfall

### 1. Business as usual



### 2. 20% reduction in irrigation withdrawals



## ✧ **Visual, User friendly and provides a whole system analysis**

Once can compare visually the trade-offs between the three 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)

## ✧ **Influencing national strategic decisions**

Can be used to inform long-term national strategic decisions of economic impact of resource nexus issues

## ✧ **Can be adapted to different scales**

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

For more information contact

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[www.foreseer.org](http://www.foreseer.org)