



Navigating the NEXUS

A methodology for assessing the Water-Food-Energy-Ecosystems NEXUS in
trans-boundary river systems

by

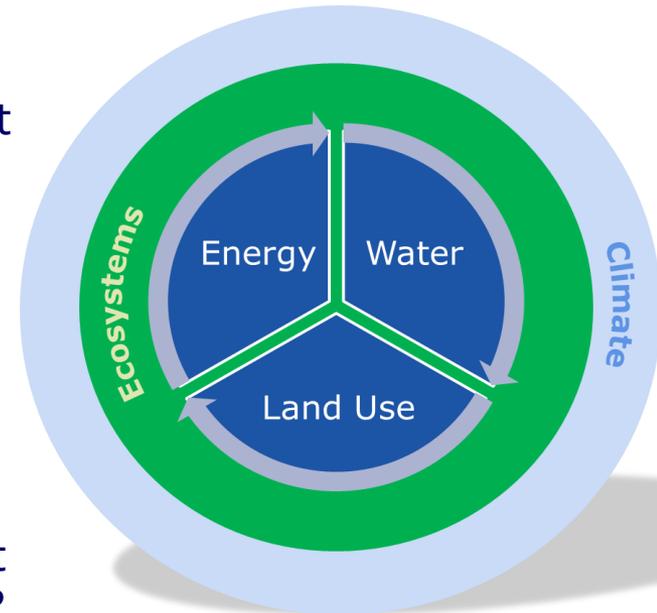
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Mark Howells

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Why a NEXUS assessment?

Some specific questions that can be answered using such an approach are:

- How can we meet common **development needs** (food, water, energy) in a sustainable manner without compromising the availability of natural resources (ecosystems)?
- Which **technologies** and what combination and configurations of them are best going to help?
- What **policies** are going to make this feasible and economically viable – and thereby help reduce future tentions?
- How to **harmonize the actions of authorities** that share the same resources in trans-boundary systems?
- And what happens **if we do nothing?**
- What are possible **implications of climate change** on the NEXUS system and what future challenges will we face?

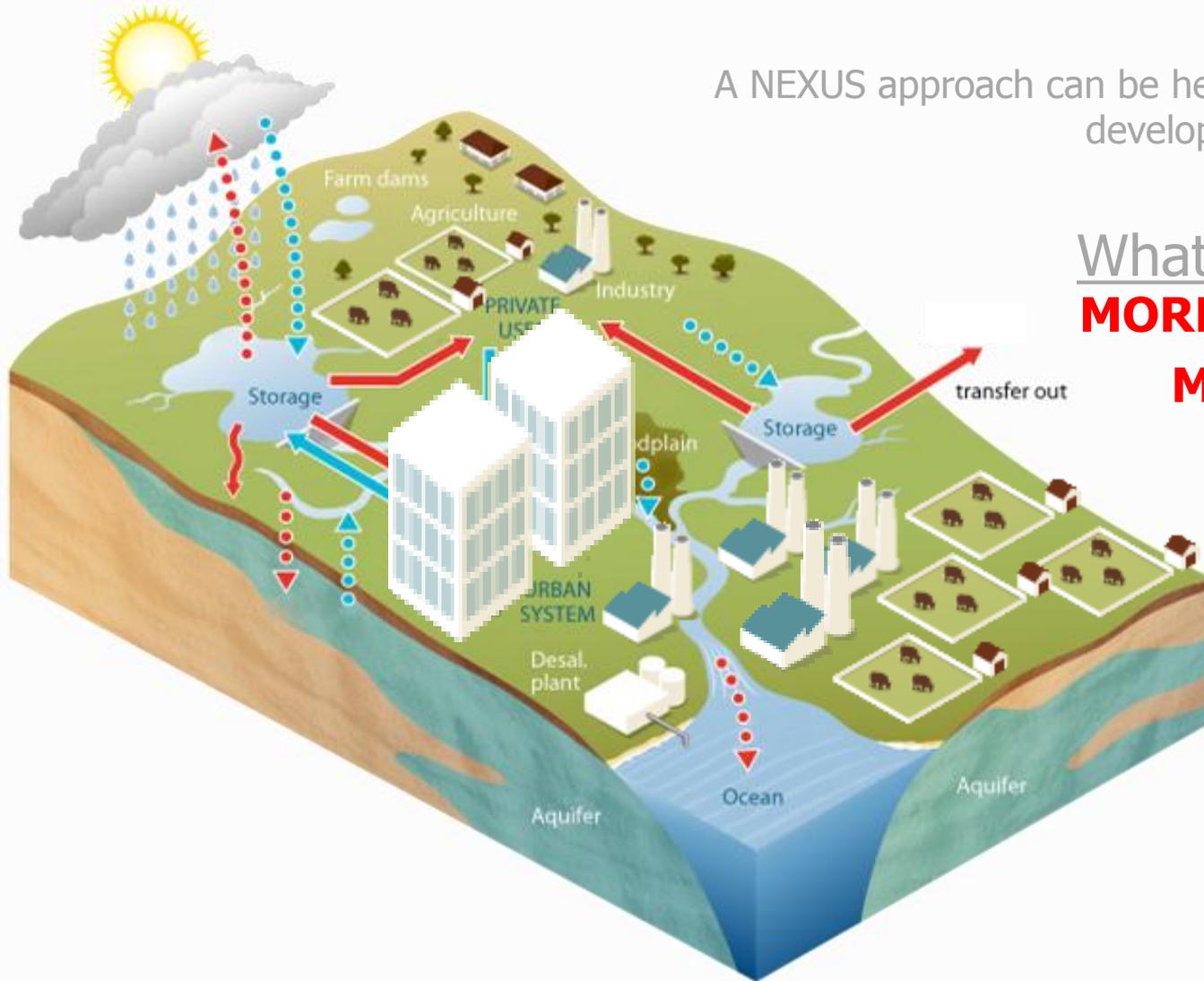


NEXUS connections illustrated – developing a story line

A NEXUS approach can be helpful and illustrative to develop future developments.

What happens with:
MORE AGRICULTURE
MORE INDUSTRY
BIGGER CITIES

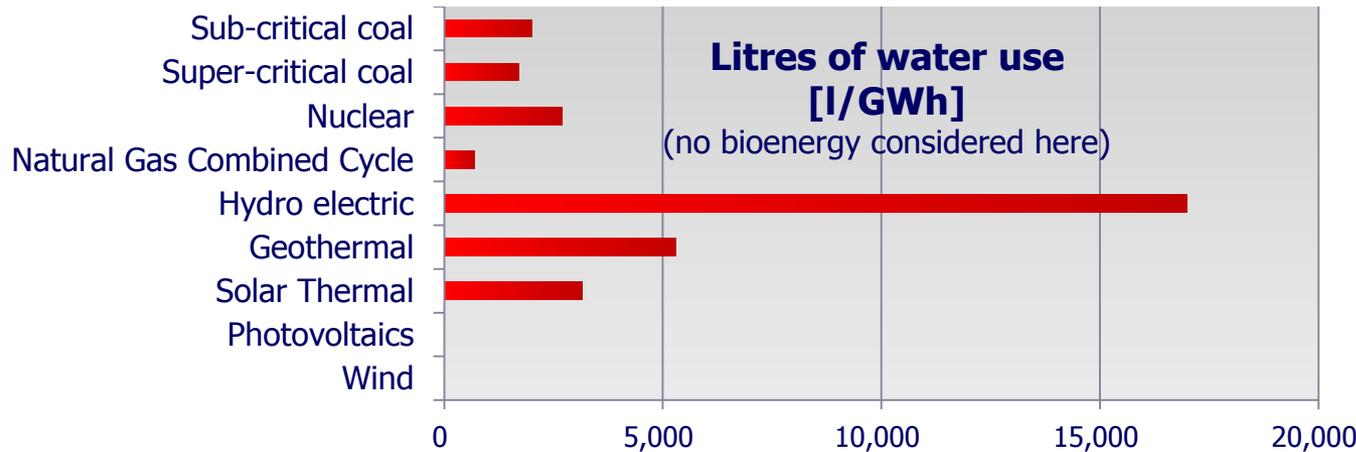
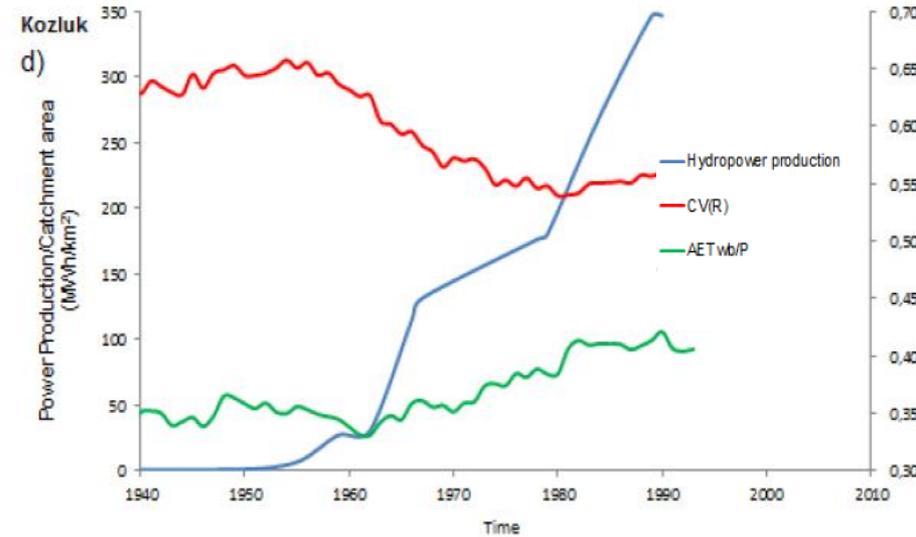
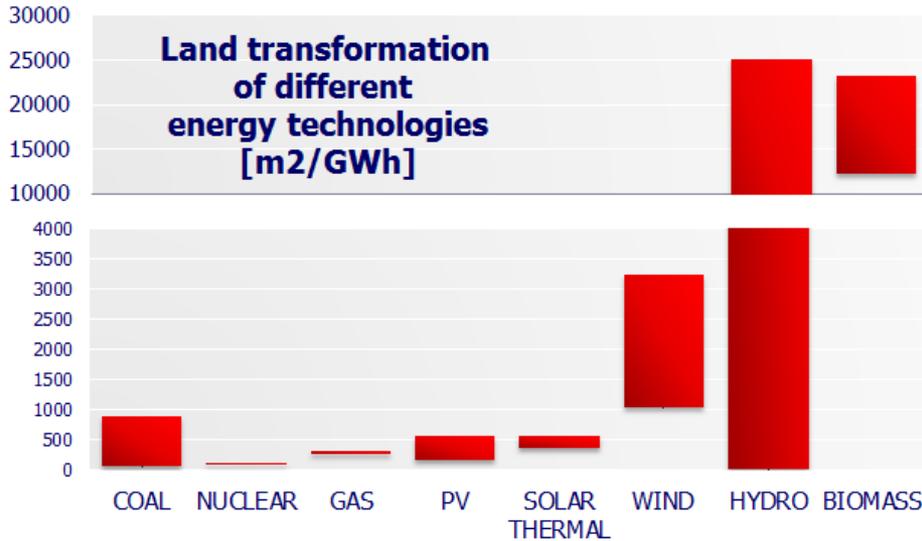
???



Zooming in on the Energy and its impact on the "Nexus" ...



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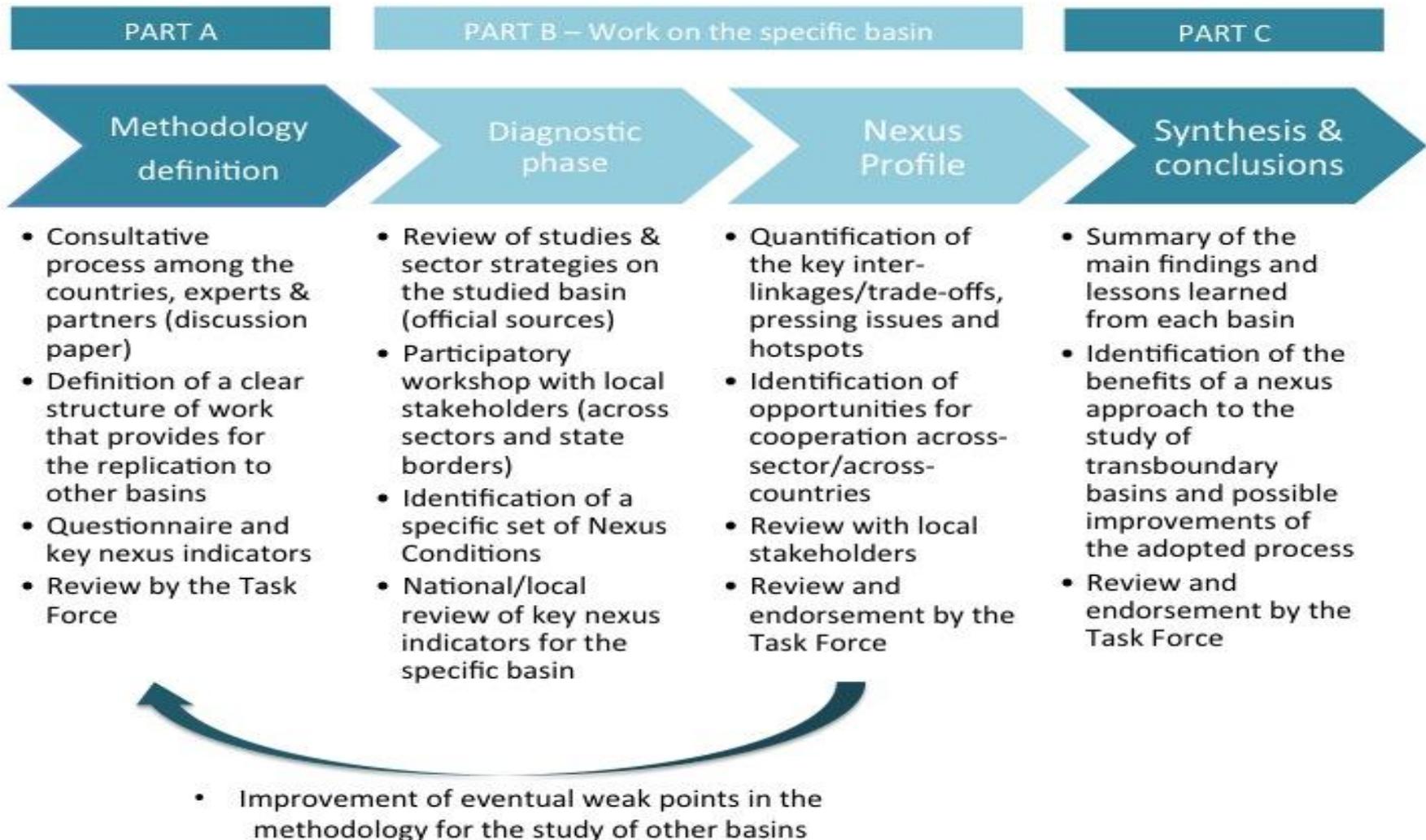


↑
Ref: Levi L., Jaramillo F., Andričević R., Destouni G., Hydroclimatic change driven by land-water-use developments: the case of transboundary Sava River Catchment, South Eastern Europe, 2013

The Steps ...



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Indicators for the energy sectors & interfacing with other sectors: examples

Shares of primary energy sources	%
Energy imports as a share of primary energy consumption	%
Electricity Production	kWh
Shares of electricity production from different sources	%
Electricity consumption per capita (and/or by sector)	kWh / cap.
Energy intensity	kWh / GDP
Electrification rate	%
Bioenergy Production	kWh
Hydropower production	kWh
GHG emissions from energy sector	t of GHG
Energy for water pumping	kWh/m ³
Cooling water volume	M litres
Energy demand of wastewater treatment	kWh/litre
...	

Some Key Features of the Methodological Approach...

- **Participatory processes** that support ownership by the concerned countries, organizations and various stakeholders;
- Underpinned by **sound scientific analysis** to inform the process;
- **Knowledge mobilization** and awareness-raising;
- **Capacity building** - supporting mutual learning across basins, sectors and State borders;
- **Collective effort** that brings together a broad range of expertise & views (sectors, countries, IGOs, civil society...)

Diagnostic Phase

Using an analogy with the diagnosis of a medical problem, the nexus analysis starts with a large-spectrum set of questions regarding the «state of health» (natural and socio-economical conditions) and habits (human interaction with the environment) of the target basin.

This performed by:

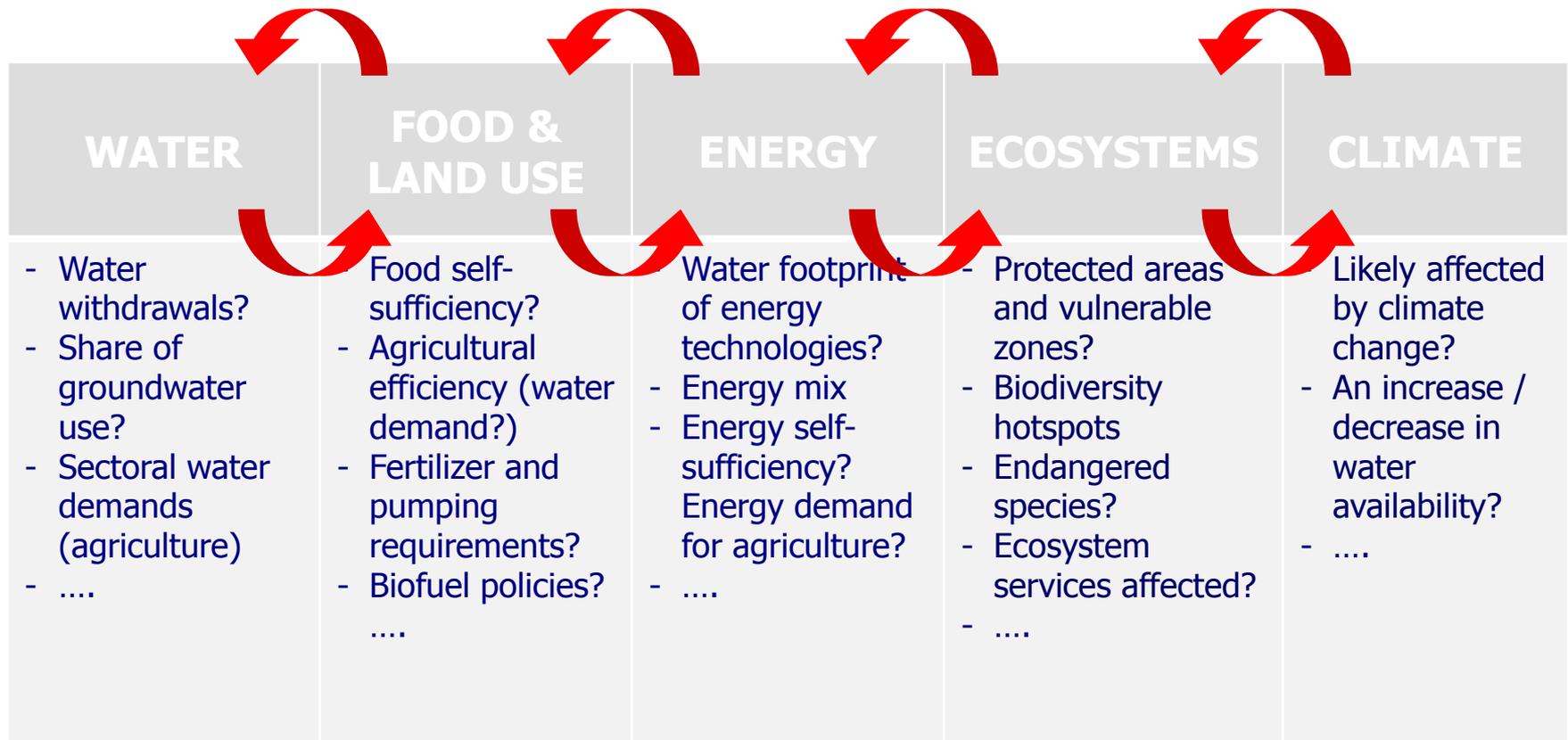
- Joint identification of the pressing inter-sectoral issues with national sectoral administrations and basin stakeholders (workshop)
- Develop and distribute a «diagnostic questionnaire»
- Using available statistics data and indicators



Pollution? **Water scarcity?**
Biodiversity?
Irrigation? **Floods?** **Erosion?**
Growing demand? **Climate Change?**

Diagnostic Phase

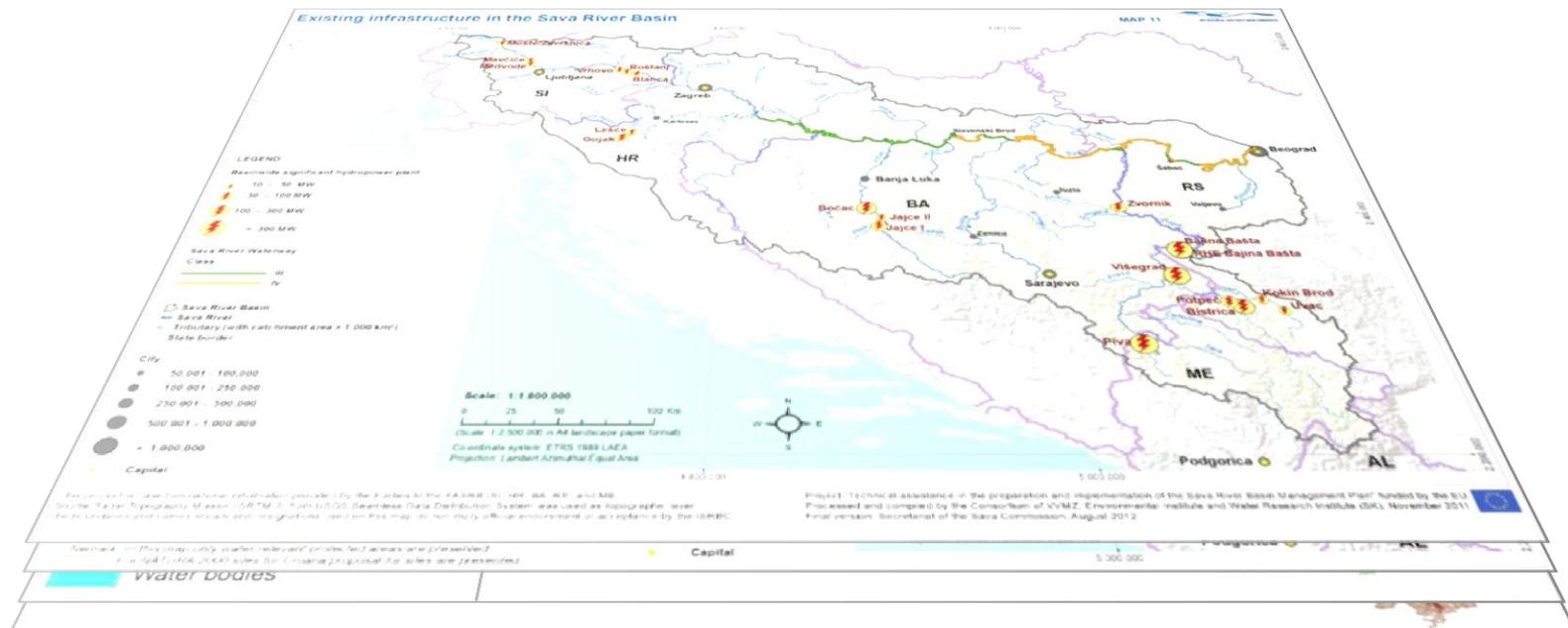
some examples of indicators and their potential interlinkages



Nexus Analysis

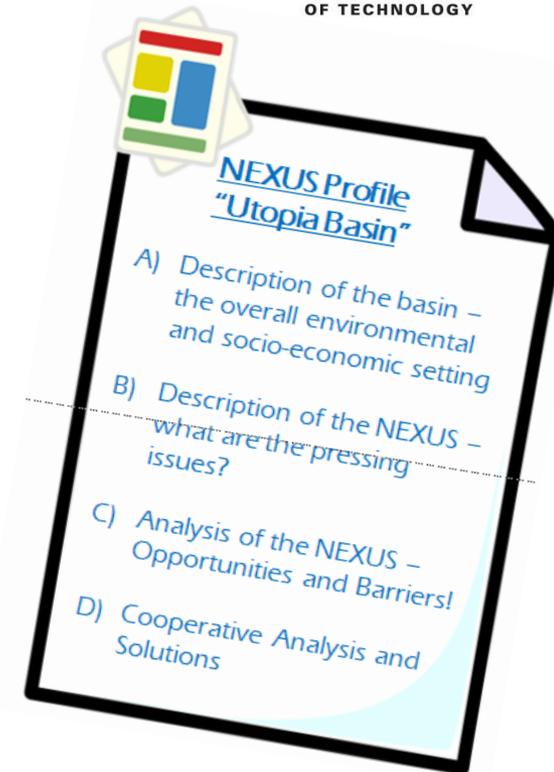
- Following the diagnosis the key issues and problem areas are identified and quantified.
- NEXUS interlinkages are investigated and quantified based on all available data and modelling tools ... e.g.:

Geographical Data + Land Use + Protected Land + Industries



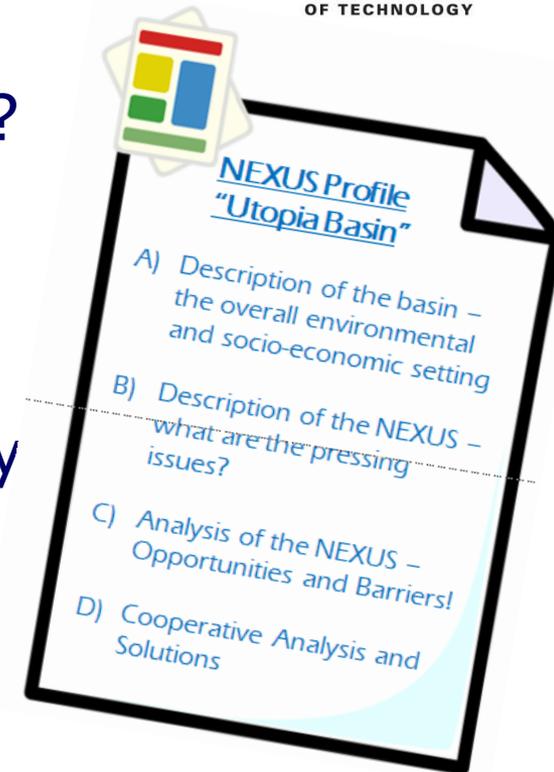
Nexus now and in the future

- Not enough to look at the interlinkages and impacts between the sectors NOW
- What are the trends and anticipated demands?
- What are the concrete development plans — expansion of irrigation? Increase in renewable energies?
- The assumptions about the conditions and availability of resources to achieve this future successfully? What does it require from other sectors?
- Are the different objectives compatibles?



Identification of potential solutions

- How to better reconcile the different uses?
- What opportunities there are to reduce negative intersectoral impacts and enhance positive impacts (synergy)?
- Potential solutions are brainstormed jointly with the riparian countries and between the sectors
- Diverse solutions! — Changes to policies, new policies, management and measures practices, institutional arrangements, ways the infrastructure is operated ...



Agenda

- Introduction
- Development directions
- Collect questionnaire and evening homework
- An intro to cross cutting issues: Climate
- Group work: Sectors
- Group work: Interactions
- Transboundary scenarios and futures: why a 'nexus' approach
- Information and indicators
- Next steps

Current NEXUS Case Studies (I)

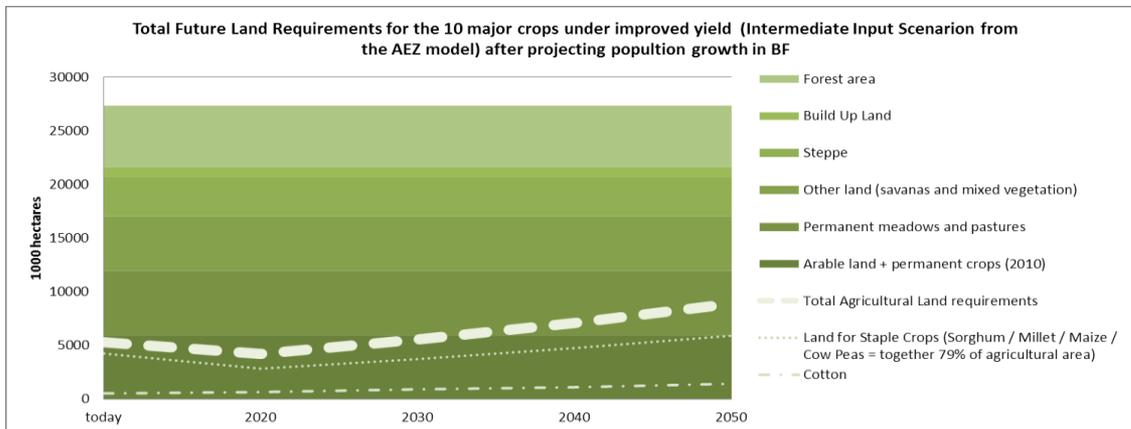
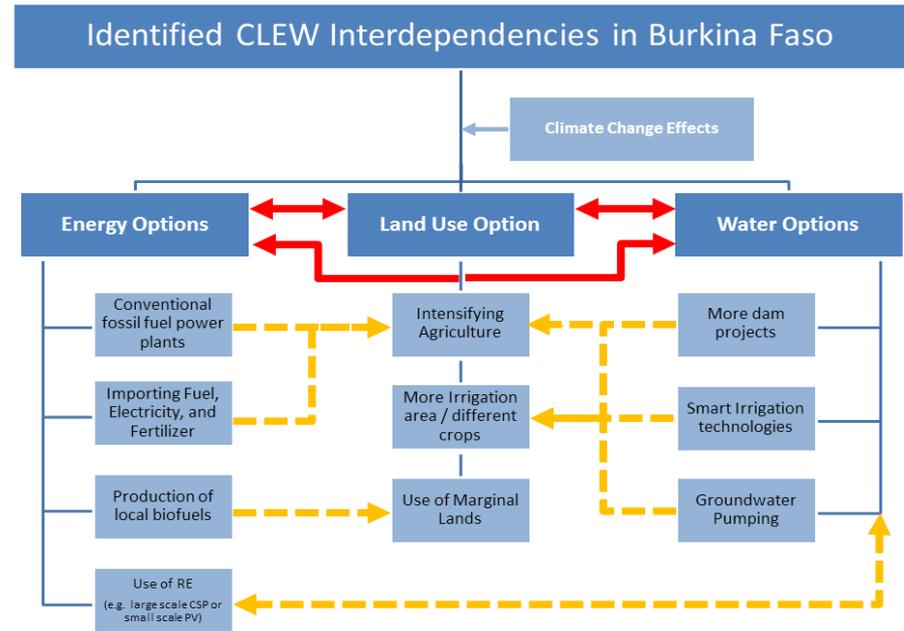


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Burkina Faso

.... has to fight with a number of development challenges these include resource scarcity, population growth and vulnerability to climate change.

Our NEXUS analysis looks into potential future development scenarios and what they mean for future LAND, ENERGY and WATER resources in the country, also taking into account possible Climate Change effects.



Left side:

Agricultural land use projection based on an in an intensified agricultural sector and improved increased yields.

In this scenario energy and water input in the agriculture is increased to a so called “intermediate input level”. Intensification of agriculture includes a higher mechanisation and more fossil fuel input but results in increased yields catering for an increased population while approximately maintaining agricultural area.

Current NEXUS Case Studies (II)



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Mauritius

.... the Government of Mauritius formulated a vision for making Mauritius a sustainable island focussing on reducing dependence of fossil fuel and reducing GHG emission.

The Mauritius-NEXUS modelling framework was used to assess the energy, water and land-use system in the context of improved local energy generation (bioethanol from sugarcane) under different future climate change scenarios.

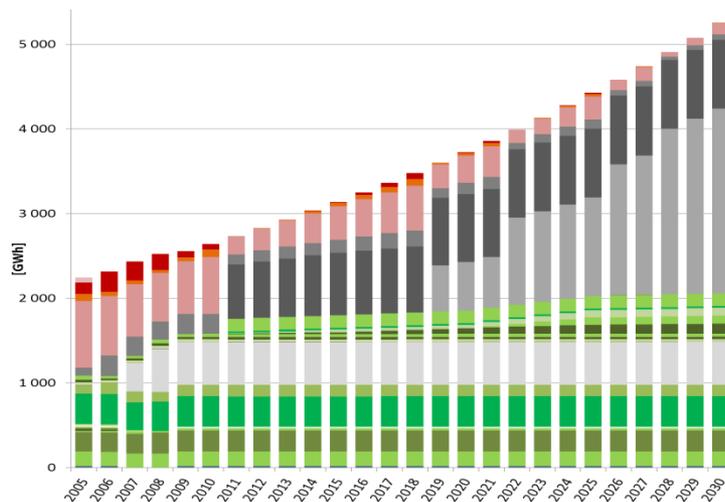
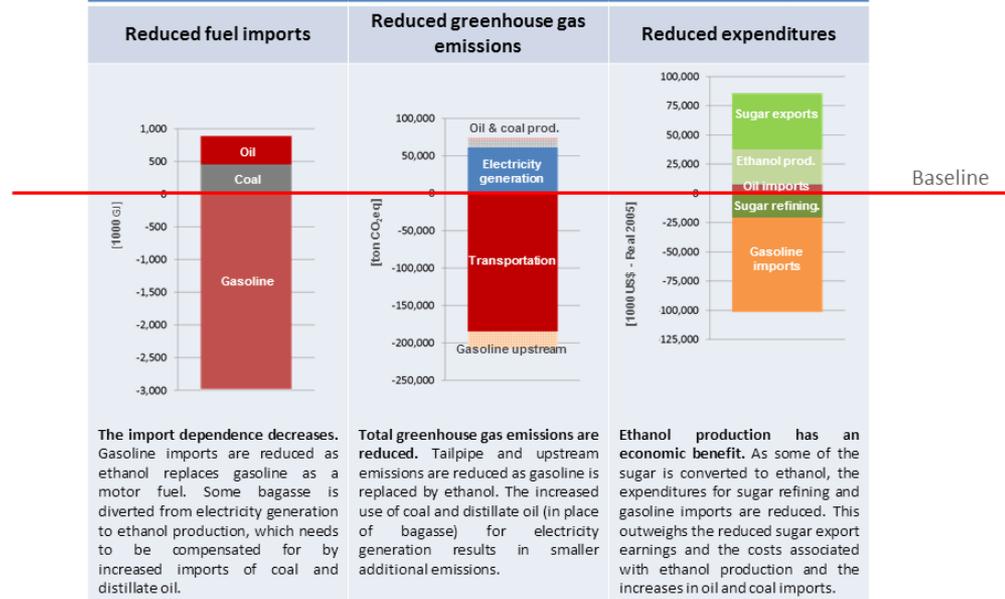


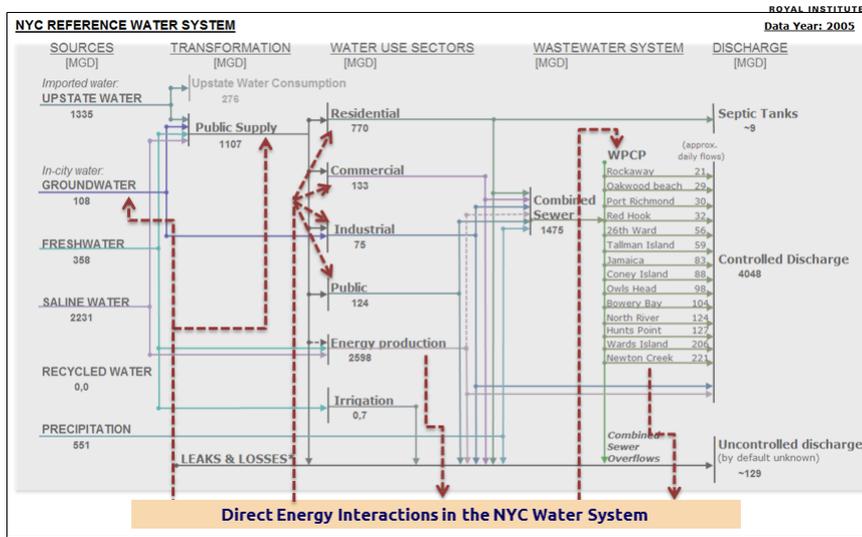
Figure 2: THE IMPACT OF TRANSFORMING TWO SUGAR PROCESSING PLANTS TO PRODUCE 2nd GENERATION ETHANOL (PROJECTED FOR 2020)



Left side:

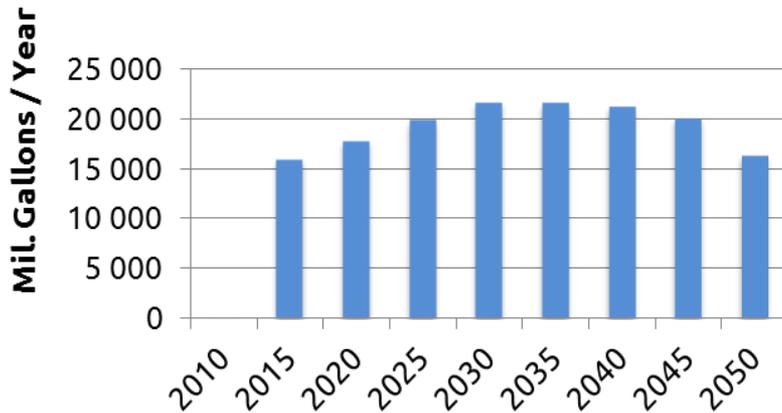
A future energy scenario for Mauritius was developed outlining the potential for local biofuels under different scenarios. Overall GHG balances were made indicating for example that climate change effects will play a significant role through decreased water availability and increased groundwater pumping and desalination needs.

Current NEXUS Case Studies (III)

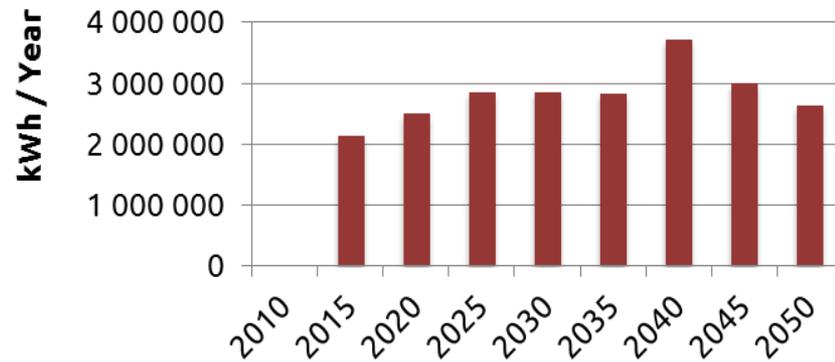


Images from: http://permacbathrooms.ie/york-suite-c-33_250.html

Reductions in Water Consumption



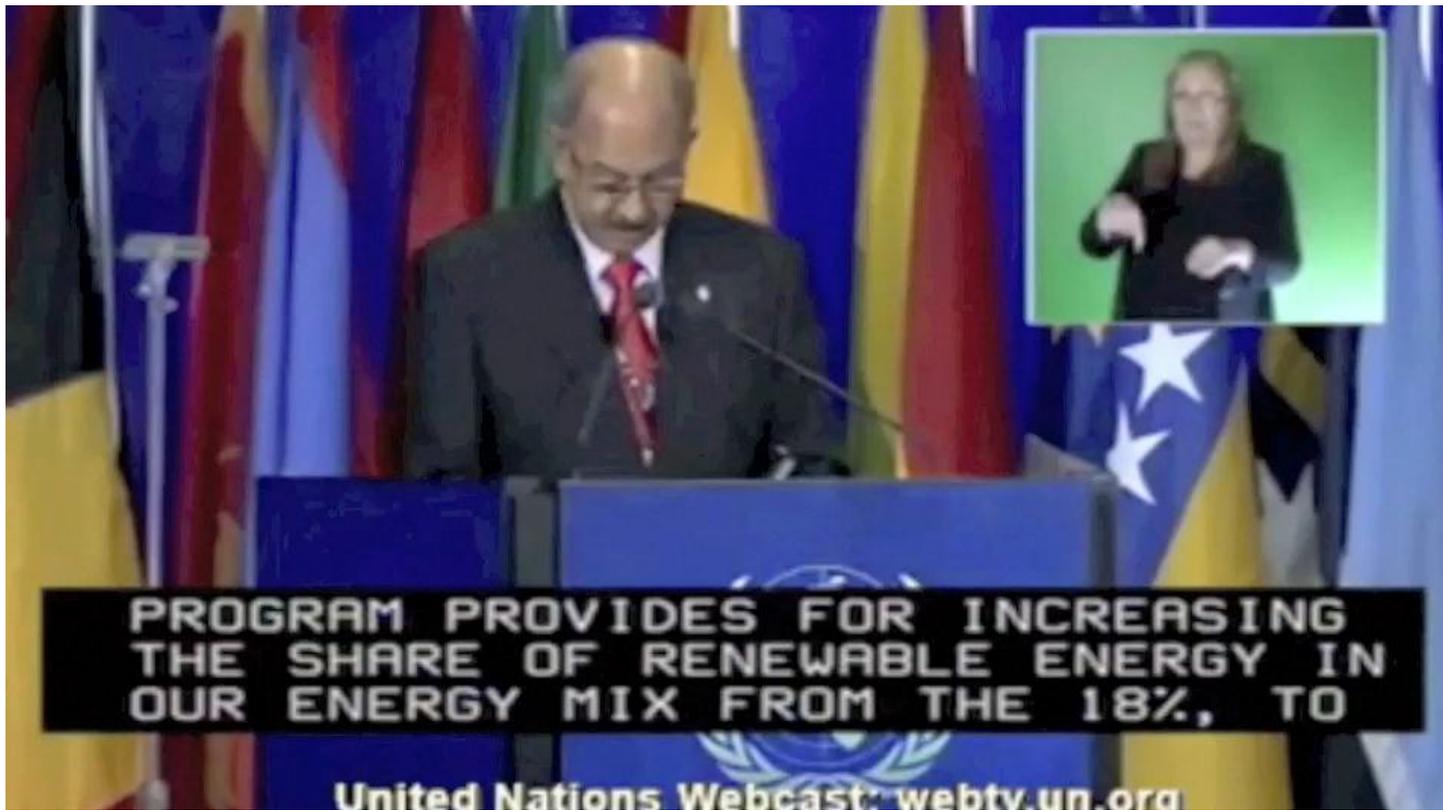
Reductions in primary Energy Consumption



Nexus outputs ...



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Publications



- Howells M., Hermann S., Welsch M., Segerström R.E. , Rogner H. , Alfstad T. , et al. *Integrated analysis for climate change, land-use, energy and water strategies*. **Nature Climate Change**, 2013
- Destouni G., Jaramillo F. and Prieto C., *Hydro-climatic shifts driven by human water uses for food and energy production*, **Nature Climate Change**, 2013 (in press)
- Welsch M., Hermann S., Howells M., Rogner H.H., Young C., Ramma I., et al. *Adding Value with CLEWS – Modelling the Energy System and its Interdependencies for Mauritius*. **Applied Energy**, 2014.
- Hermann S. , Welsch M. , Segerström R.E. , Howells M.I. , Young C. , Alfstad T. , et al. *Climate, land, energy and water (CLEW) interlinkages in Burkina Faso: An analysis of agricultural intensification and bioenergy production*, **Natural Resources Forum**, 2012.