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**Interconnecting the water and energy cycles:
identifying and exploiting the synergies**

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- In thinking about energy-water interactions, there are two driving questions:

How can government and industry best manage energy-water interactions and *exploit synergies* in their policy and investment decisions?

What are the regulatory, economic and social frameworks that will encourage uptake of existing technologies, and encourage new innovations?

- Four key areas:
 - Energy consumption in the urban water supply chain
 - Water demands in the energy sector (traditional and renewable)
 - Water and energy for food security (including bio-energy generation)
 - Water and energy demands in other industrial sectors i.e. chemical production, paper, transport, mining, beverages...



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Supplying energy requires water

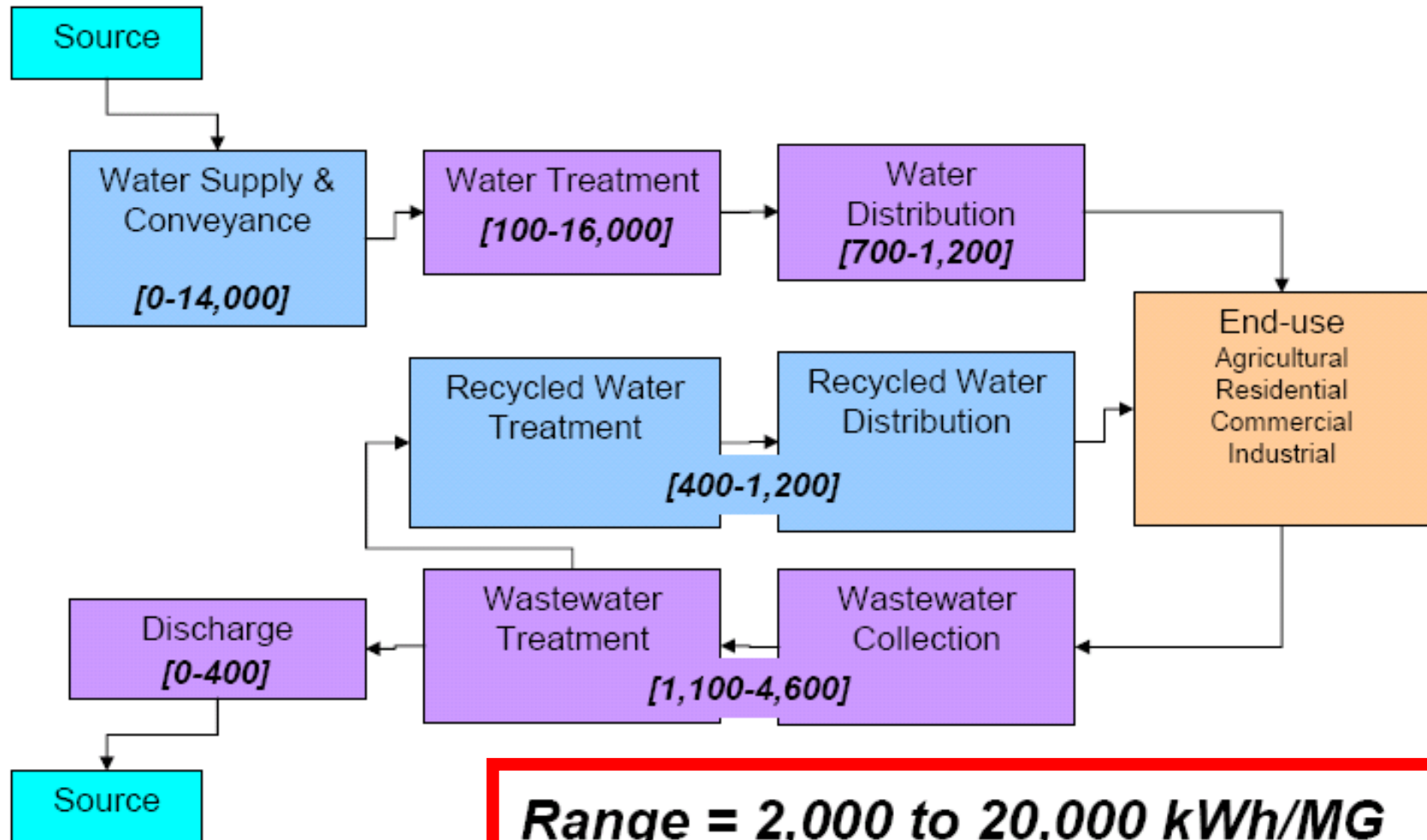
- **Water is an integral element of energy resource development and utilization**
- **It is used in energy-resource extraction, refining and processing, and transportation**
- **It is an integral part of electric-power generation:**
 - **Directly in hydroelectric generation**
 - **Indirectly for cooling and emissions scrubbing in thermoelectric generation**
- **The development of alternative energy supplies, such as biofuels, and the proliferation of hydro and nuclear power, will place even greater strain on water resources**



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Water use cycle energy intensities (kWh/MG)



Range = 2,000 to 20,000 kWh/MG

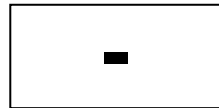
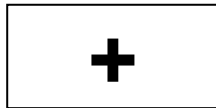


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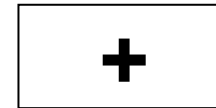
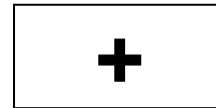
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Energy-Water Interactions

Water Security



Goal: to identify and implement synergistic policies and technologies



Goal: to avoid conflicting policies in water and energy, and/or in knock-on sectors such as food



Energy Security

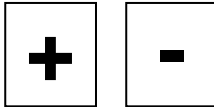


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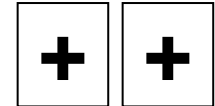
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Energy-Water Interactions

Water Security

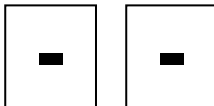


- water and wastewater treatment plants
- decentralised rainwater harvesting systems
- groundwater pumping
- interbasin transfers
- desalination

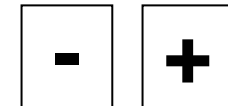


- Energy and water conservation (dd mgt)
- irrigation efficiency, soil management, better farm management practice
- cutting-edge technologies and thinking
- combine renewable energy + water treatment plants (and vice versa)

Goal: to IDENTIFY and IMPLEMENT synergistic policies and technologies



- bioenergy production: net negative energy generation + increase in water consumption + impact on world food prices
- badly positioned hydropower plants
- carbon capture and storage?
- groundwater pumping (Spain, India)
- inappropriate agricultural crop production (driven by social/economic factors)



- expansion of hydropower
- expansion of bioenergy production
- introduction of CCS
- shift from coal to gas in urban areas
- underground thermal energy systems for urban households
- Concentrated solar thermal

Goal: to avoid conflicting policies in water and energy, and/or in knock-on sectors such as food

Energy Security

“...technologies are available that can reduce water use in the electric sector, including alternative cooling for thermoelectric power plants, wind power and solar photovoltaics, but cost and economics, among other factors, have limited deployment of these technologies.”

Report to U.S. Congress on Energy Demands on Water resources. 2006.



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Innovation and Regulation

- **Innovation rarely happens in a vacuum. It will be driven by:**
 - a real or perceived need
 - a financial incentive

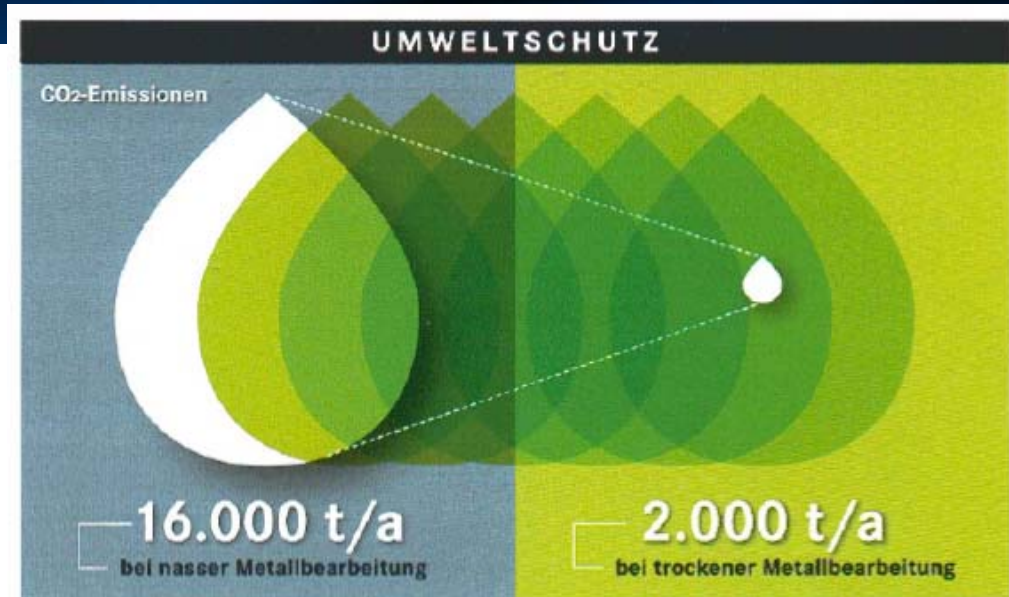
- **The financial incentive will be provided by either:**
 - the market
 - **Government**



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The Daimler Example



14.000 Tonnen CO₂ können allein bei der Produktion der neuen Dieselmotoren eingespart werden.

- Daimler: high proportion of energy consumption in the production of Diesel engines lay in the metal processing work required in the production of wheel-carrier assemblies
- By altering the process of metalwork from one which required lubricants (oils) and coolants (water), to dry metal processing, the company was able to reduce its CO₂ emissions by 80% in that part of the product cycle
- It also reduced its water consumption by 900 tons per year *but that was an added bonus rather than an intentional objective*

- **Massive financial outlays – like that required in the energy and water sectors - rarely happen in a vacuum:**
 - **Minimise risk on CAPEX**
 - **Maximise return on investment**
- **Which in turn relies on:**
 - **Regulatory certainty in the sector (legislation, standards)**
 - **Consumer demand and acceptance**



Perspectives from a Hedge Fund Manager...

“The technologies to deal with water scarcity and energy security already exist. The problem is only that it is very, very expensive to implement them. What we need is the finance – big finance – and that’s where we come in.”

“I’ve just come back from Bahrain where groundwater resources will be depleted within 12 months. We were there to provide the finance for the development of desalination and waste water treatment plants...The technology is available, it’s the finance that matters now.”

“Water is a public good as long as we have enough of it. After that, it’s an economic good just like oil...”

“The energy-water nexus is obviously very important, but it’s not something we think about. Actually, as long as you get the price of water right, it should be reflected in investment costs anyway...”



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Drivers to exploit synergies

- **Legislation**: potentially create new legislation, but more likely *existing* legislation should be adapted and implemented – regulatory framework essential for technology investment and uptake
- Refining and applying **existing tools** and mechanisms (incl. economic tools)
- Coordinated **institutions** and public administration
- Awareness, communication, participation and **education** – key role for tertiary institutions, professional associations and media



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Recommendations

- There is an important role for government in ensuring the energy-water nexus is part of both the R&D and technology-uptake equation
 - Better **integration** between the energy and water policy frameworks
 - Environmental Impact Assessment
 - Integrated Water Resource Management
 - Ensure **existing tools** in both sectors are implemented correctly
 - Full-cost recovery pricing for water, ETS to set carbon price

- Set clear guidelines for industry about where the policy framework is going and whether incentives will be made available

- **The Daimler example (and many others) illustrates that the uptake of new processes and technologies is driven by regulation, incentives and consumer demand**
- **It is not the responsibility of financiers to understand the links between energy and water – their job is to find technologies that will eventually make a return on investment**
- **Minimising risk to the business and finance sector is crucial to the uptake of technology - all forms of finance exist in a regulatory framework that is set by governments**
- **Providing a clear regulatory framework shows industry and finance sectors what the expectations are and therefore where the opportunities lie**