TACKLING TRADE-OFFS BETWEEN WATER AND ENERGY ACROSS SECTORS AND SCALES

World Water Week in Stockholm, Sunday 31.08.2014, 14.00 – 17.30 in Room k22/2

Convener: Swiss Water Partnership

Co-conveners: CSD Engineers; GIWEH; Group E; Cewas; iDE; SoPAS; Ministry of Water Resources of the Republic of Iraq; WRG 2030; EAWAG/SANDEC; Skat Consulting; Swiss Agency for Development and Cooperation (SDC) and Platform for International Water Law, University of Geneva (UNIGE)

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Program

Setting The Scene (14.00) The Challenges; Mrs. Olga Darazs, Swiss Water Partnership.

1. Swiss Advanced Solutions (14.15 - 15.45)

1a) Managing the demand

- Integrated water and energy management solutions; Mr. Alain Sapin, Group E; Mr. Stéphane Maret, CSD Engineers
- More crop per drop with less energy: drip irrigation and solar pumping; Tim Prewitt, iDE; Urs Heierli, SoPAS

1b) Increasing the resources available

- Combined solutions: using energy in drinking water systems and in irrigation systems; Mr. Martin Bölli, Skat Consulting
- Synergies instead of trade-offs: linking sanitation to energy production and agriculture with a business approach; Mr. Christian Zurbrügg, Eawag/Sandec; Mr. Michael Kropac, Cewas/Seecon

1c) Creating shared benefits

- Joint ownership of infrastructure in a transboundary watercourse fostering cooperation of water and energy resources; Prof. Makane Moise Mbengue, Platform for International Water Law of the University of Geneva
- Blue Peace Initiative incentivising coherent policies to manage water and energy in a transboundary watercourse; Mr. Christophe Bösch, Swiss Agency for Development and Cooperation

Coffee Break (15.45 - 16.15)

2. Reality Test (16.15 - 17.30)

2a) Country cases

- Tanzania: challenges and relevance of the proposed solutions; Mr. Anders Berntell, Water Resources Group 2030;
- Water Food Energy Nexus in Iraq and Middle East; Ms. Shirouk Abayache, Ministry of Water Resources of Iraq; Prof. Nidal Salim, Global Institute for Water, Environment and Health

2b) Panel discussion

Panellists: Mr. Bob Nanes, iDE; Ms. Shirouk Abayache, Ministry of Water Resources of Iraq; Mr. Johan Gély, Swiss Agency for Development and Cooperation; Mr. Alain Sapin, Group E; Mr. Anders Berntell, Water Resources Group 2030

2c) Wrap-Up and closure;

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Setting the scene: the challenges

Olga Darazs
Chair of the Swiss Water Partnership

Tackling trade-offs between water and energy across sectors and scale

Main Source: The United Nations World Water Development Report. Water and Energy 2014

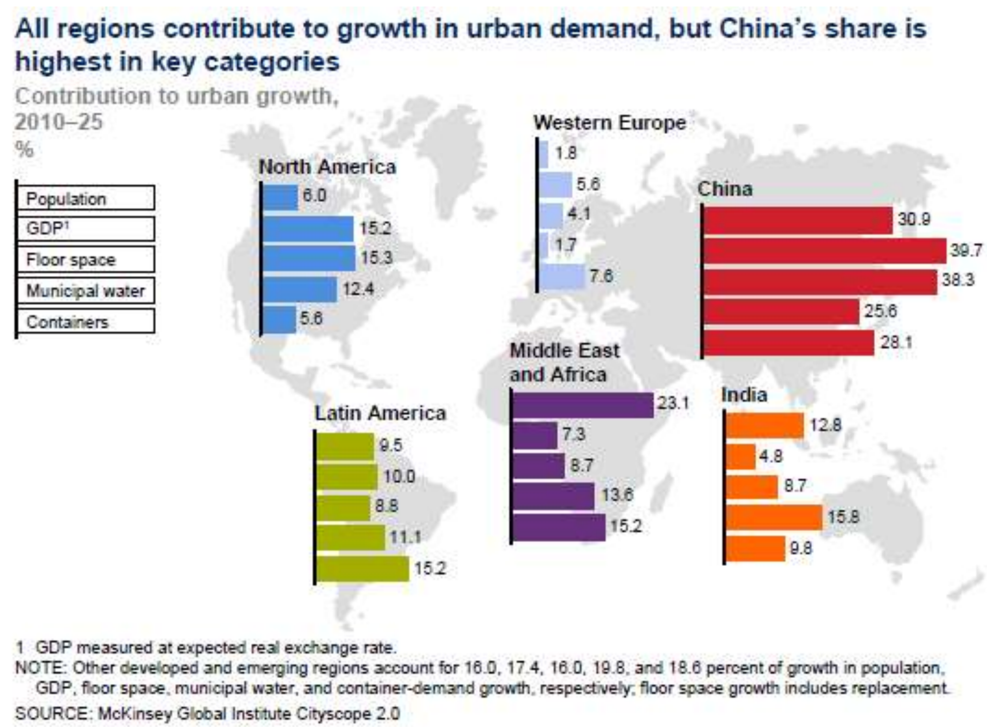
Introduction

- Population and economic growth, as well as changing consumer behaviors are expected to **increase the demand** for food, energy and water.
- By 2030, **nearly half** of the world's population will be living in areas of **high water stress** affecting energy and food security, meanwhile **overuse** of the renewable water resources is estimated to reach **40%.**
- **Global energy consumption** will increase by nearly **50%** by 2035, most of this increase will happen in non OECD countries.
- Climate change is **exacerbating** energy and water insecurity.

Challenge 1: Demography

Between 2009 and 2030 the population is expected to grow by 1.2 billion. This implies:

- 3 billion new middle class consumers in 2030;
- Of which 2/3 live in cities of emerging or emerged countries;



Source: The United Nations World Water Development Report. Water and Energy 2014

▸ **Need to manage this growing demand and to increase the available supplies**

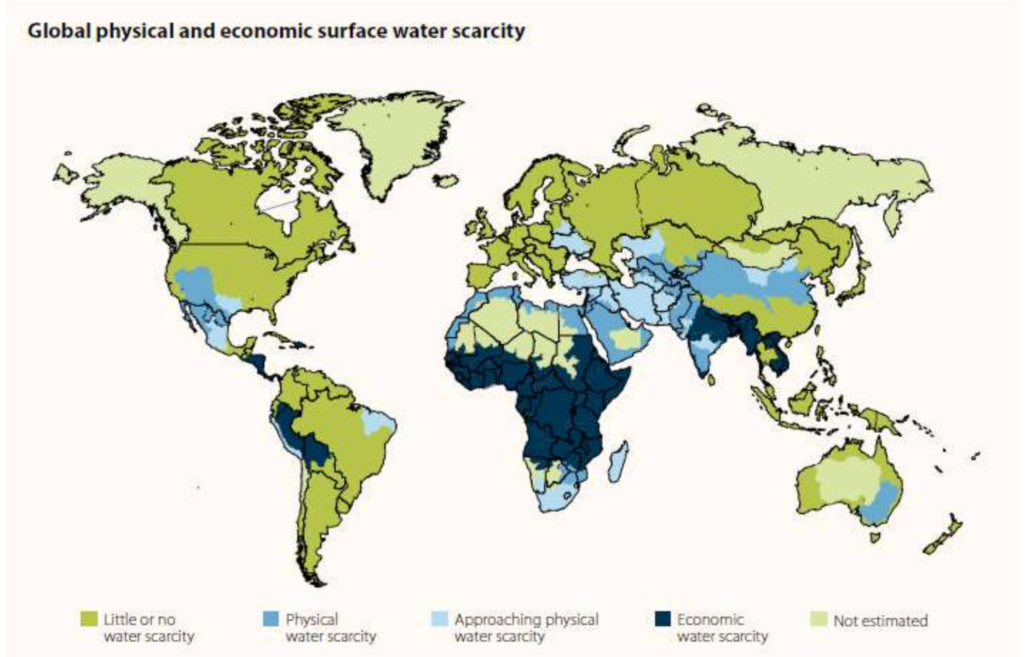
Challenge 2: Water (1/2)

Current Trend: increasing water demand

Total freshwater withdrawals increase by approximately 1% per year (human water consumption seven-folded in the last century whilst the population tripled). Water is used:

- Agriculture (70%)
- Industry, incl.- energy (20%)
- Domestic sectors (10%)

Deterioration of the purification capacity of wetlands (estimated 80% of used water not treated).



Source: The United Nations World Water Development Report. Water and Energy 2014

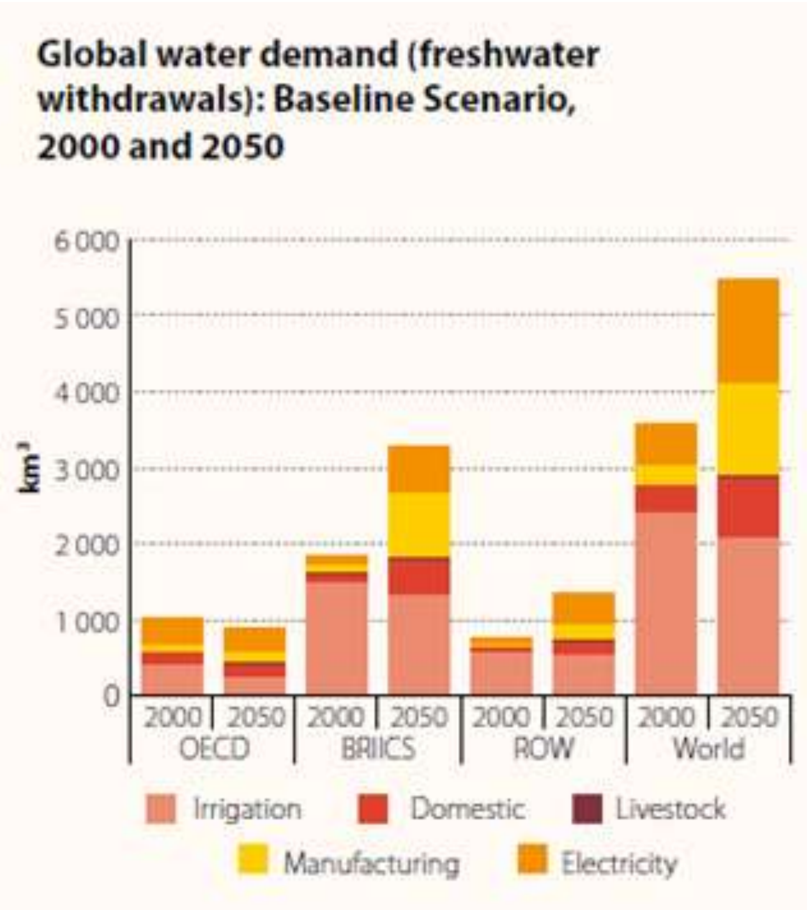
Access

- 748 million people without improved water
- 2.5 billion (40% of the global population) without improved sanitation

Challenge 2: Water (2/2)

Projection

- Largest growth is expected to occur in developing or emerging countries;
- Without improved efficiencies, agricultural water consumption is expected to increase by 20% (by 2050);
- Domestic and industrial water consumption is also expected to increase. Water for energy has the largest share of industrial water consumption is expected to increase by 33% (2010-2035). Non-OECD countries will account for 90% of that increased demand.



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▸ **Need to use water more efficiently (demand side) and increase treatment of used water**

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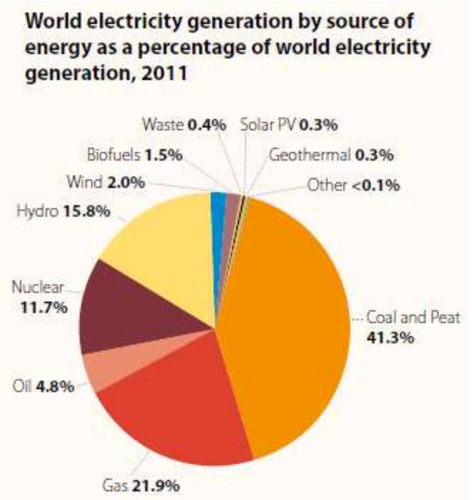
Challenge 3: Energy (1/2)

Current Trend: reliance on fossil fuels

- Thermal power plants responsible for roughly 80% of global electricity production
- Hydroelectricity, largest renewable source of power generation, meeting 16% of global electricity needs in 2010
- Over 2000-2010, electricity generation from wind grew by 27% and solar PV by 42% per year.
- Geothermal marginal

Access:

- More than 1.3 billion people still lack access to electricity
- Roughly 2.6 billion rely on traditional use of biomass for cooking; another 400 million people rely on coal



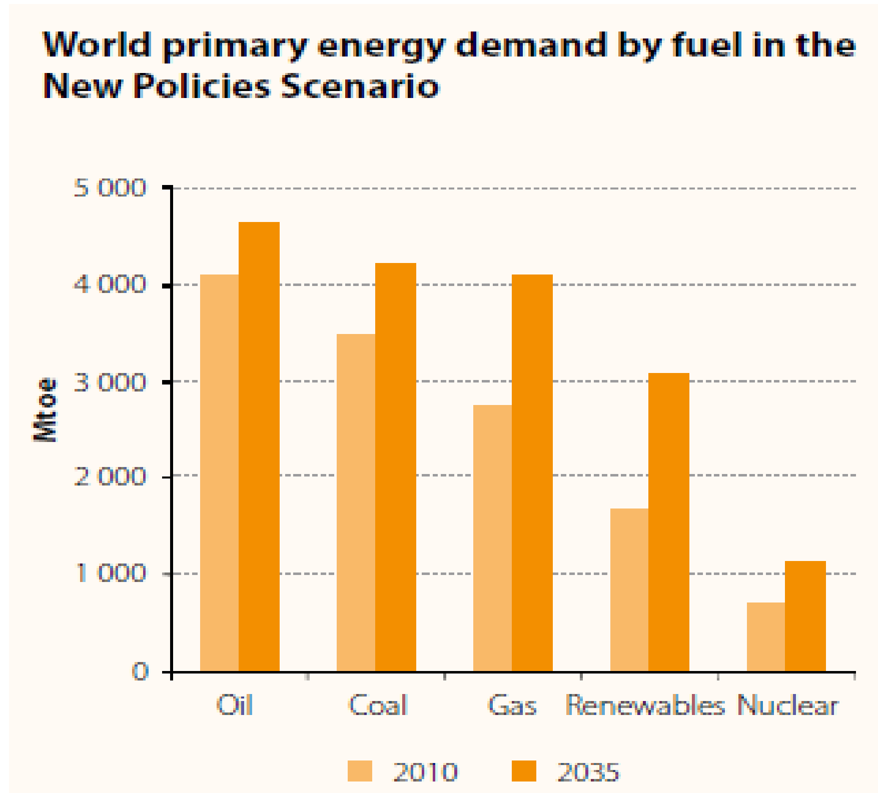
Source: The United Nations World Water Development Report. Water and Energy 2014

Challenge 3: Energy (2/2)

Projection:

- Global energy demand is expected to grow by more than 1/3 over 2014-2035, with China, India and the Middle-East accounting for about 60% of the increase
- Electricity demand is expected to grow by approximately 70% by 2035
- Fossils fuels are expected to remain dominant in the global energy mix

▸ **Need to use energy more efficiently (demand side) and increase energy supplies**



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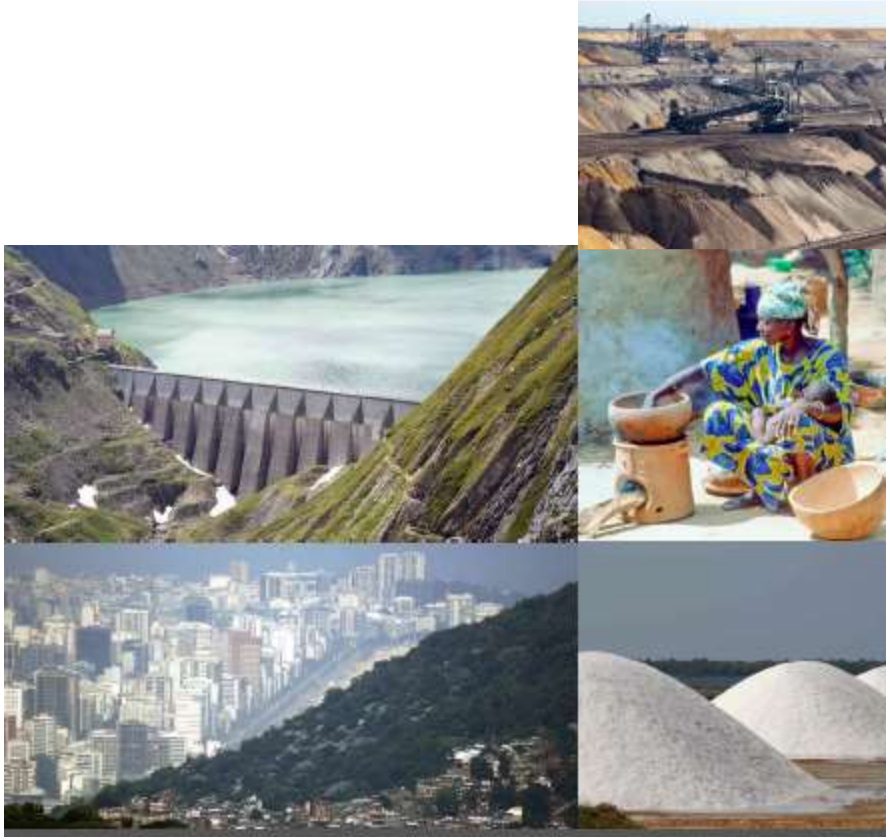
Challenge 4: Interdependencies (1/2)

Features	Water	Energy
Nature	Unique, irreplaceable common pool resource that is difficult to move	Various forms, market-driven commodity, distributed across vast distances quite easily
Legislation and regulation	Focus on extraction, use and discharge Mix of bottom-up and top-down approaches	Focus on production and distribution Usually top-down approach with strong central policies, administration and funding
Size of infrastructure	Most water infrastructure is at community or city scale (exception larges dams, reservoirs etc.)	Energy infrastructures usually cover the entire country and several nations (pipeline networks, power grids)
Geographic scales	water services at local level, surface water and groundwater flow across borders	Power grids and pipelines do not follow natural boundaries but can have geostrategic implications
Costs, financing gap	Most significant costs are in O&M (including energy) Financing gap is critical	Significant costs are related to capital investment. Financing gap
Conceptual thinking	Different views and conceptual approaches: vocabulary, analysis and data sets are different/ not shared.	Little understanding of/ little communication with the other sector
interdependence	Energy is required for the provision of water and sanitation services (i.e. extraction, treatment, distribution, collection and treatment after use). However energy is not the main determinant of water scarcity	Water resources are required in the production of energy (transport, storage and use of it to some extent): to produce fuels, energy crops, crucial for cooling purposes in most power plants and driving force for hydroelectric and steam turbines. Water scarcity threatens energy production

Challenge 4: Interdependencies (2/2)

Current Silo approach:

- Fragmented sectoral responsibilities, lack of coordination, inconsistencies between laws and regulatory frameworks leading to misaligned incentives
- Cross sector implications not understood, little cross sector communication
- Negative trade-offs exacerbated by Climate Change



▸ **Need to identify synergies and shared benefices while minimizing negative trade-offs**

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Approach of Solutions

1/ Managing the demand

- Reduce waste and losses (non-revenue water)
- Identify potentials to improve the industrial ecology of existing processes;
- *Drought-resistant crops; water pricing*

  (not discussed in this seminar)

2/ Supply side (increased supplies)

- Re Use;
- Tailor the quality of resources to different uses;
- Identify and cease potentials available for combined uses;
- *Watershed improvements, soil conservation, solar desalination, self-supply*

3/ Create shared benefits

- Getting policy makers, planners & practitioners from water/food/energy sectors working together for a change in mindset
- From a tradeoff to a shared benefit approach beyond borders.

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Mr. Marco Daniel, Swiss Water Partnership

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1a) Managing the demand

Mr. Alain Sapin, Group E;
Mr. Stéphane Maret, CSD Engineers

Integrated wastewater and energy management solutions

INTEGRATED WATER
AND
ENERGY MANAGEMENT SOLUTIONS

Stéphane Maret, CSD (s.maret@csd.ch)
Alain Sapin, Groupe E (alain.sapin@groupe-e.ch)

Stockholm, the 31st of August 2014

CONTENTS

1. Groupe E
2. The Gruyère lake
3. Power Plant Hauterive
4. Drinking Water
5. Environment
6. Security
7. Synthesis
8. Conclusion

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1. GROUPE E : FACTS & FIGURES

Groupe E : Utility Company	Production, distribution, sales & marketing and services in the West part of Switzerland		
Own Production	1 TWh	Turnover	$ 670 M
Power Plants (hydr/therm)	10 / 4	Operational Result	$ 45 M
Dams	8	Cash-Flow	$ 165 M
Staff	700	Balance Sheet	$ 2’450 M
Customers	170’000	Equity	80%

Hydro Power Plant Gruyère - Rossens - Hauterive	
Installed power	70 MW
Energy	220 GWh/Y
Operation Mode	Seasonal / Peak

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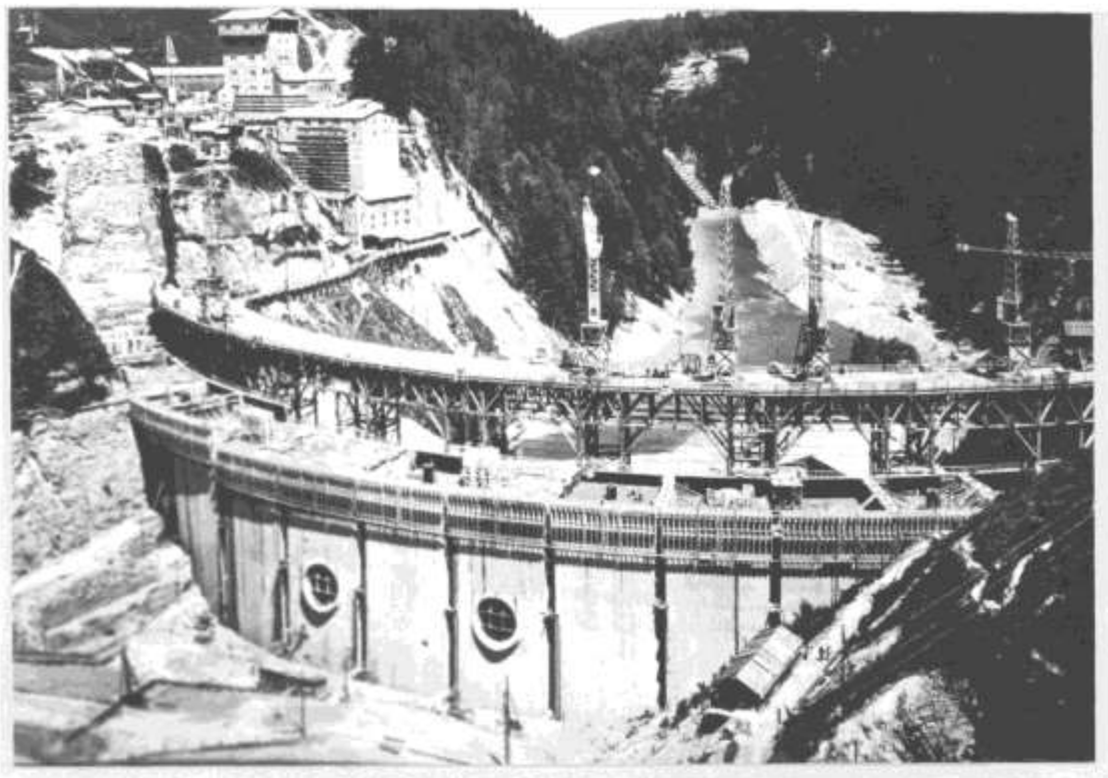
2. GRUYÈRE LAKE: ERECTION OF THE DAM

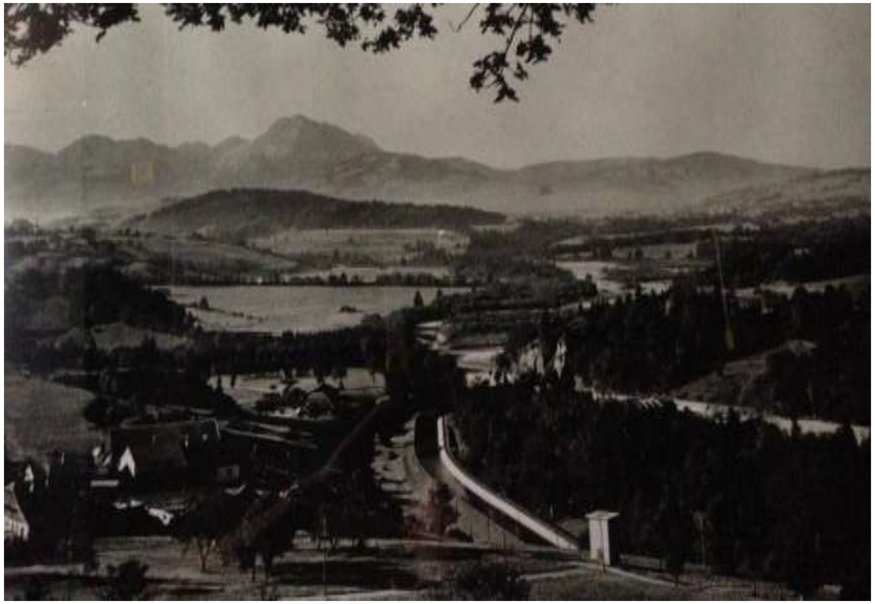


- **Construction : 1944-1948**
- **Dam:**
  High : 83 m
  Width : 28 / 5 m
  Length of Crown : 320 m
  Volume of Concrete : 250'000 m^3

- **Gallery :**
  Length : 6 km
  Diameter : 5 m
  Capacity : 75 m^3/s

- **Discharge Gates:**
  Bottom Gates : 2 x 150 m^3/s
  Surface Gate : 1 x 350 m^3/s
  Intermediate Gate : 1 x 275 m^3/s

2. GRUYÈRE LAKE: THE FILLING



- **18 Farms engulfed by water**
- **46 private properties**
- **200 displaced people (only)**

- **Capacity : 160 millions of m^3**
- **Surface : 10 km^2**

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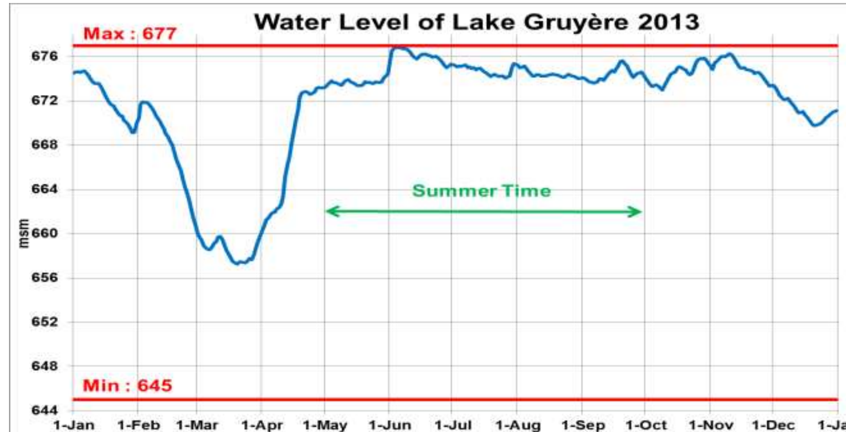
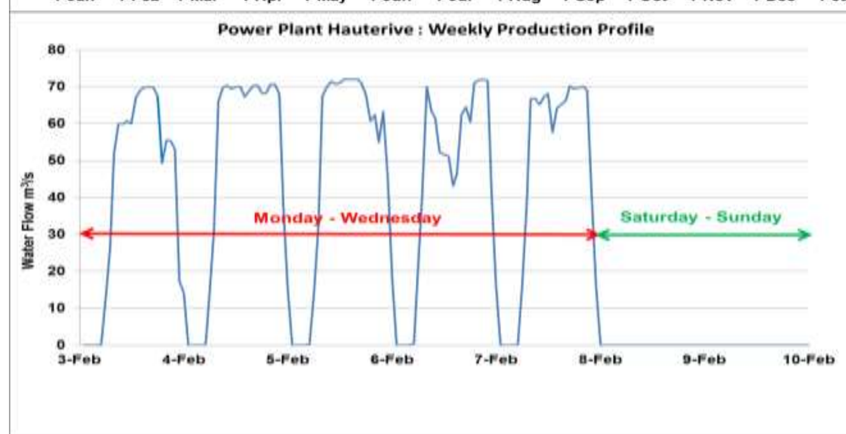
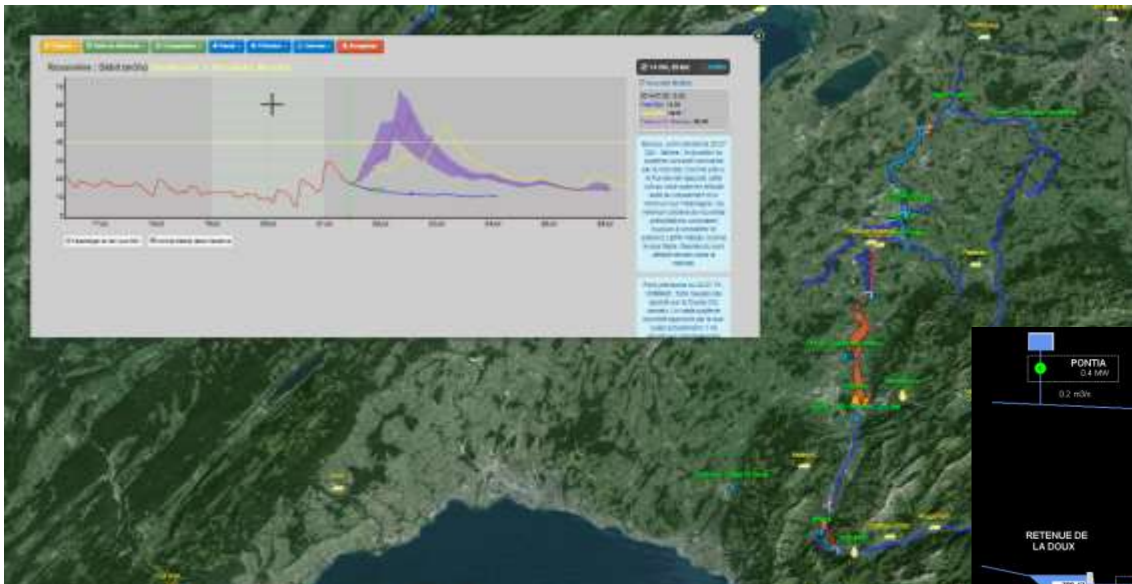
3. POWER PLANT HAUTERIVE : TECHNICAL DATA



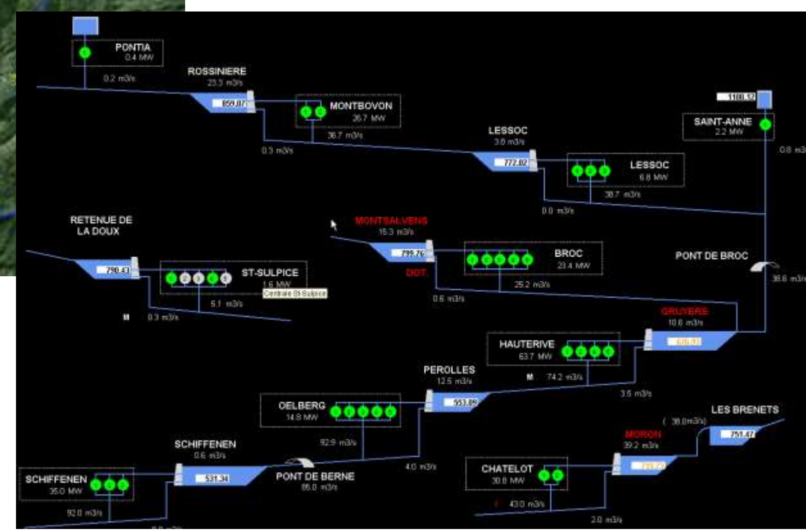


Power Plant Hauterive	
3 x 15 MW	3’200 OH / Y
1 x 25 MW	220 GWh / Y

3. POWER PLANT HAUTERIVE : NUMERICAL TOOLS



- **SCADA (System Control And Data Acquisition)**
- **Remote Control of all devices (Production Units, Gates, Circuit breakers, etc..)**
- **More than 50'000 I/O signals**



- **Weather forecast**
- **Fine modelling of valleys/cascade**
- **Forecast of flows, levels, discharges**

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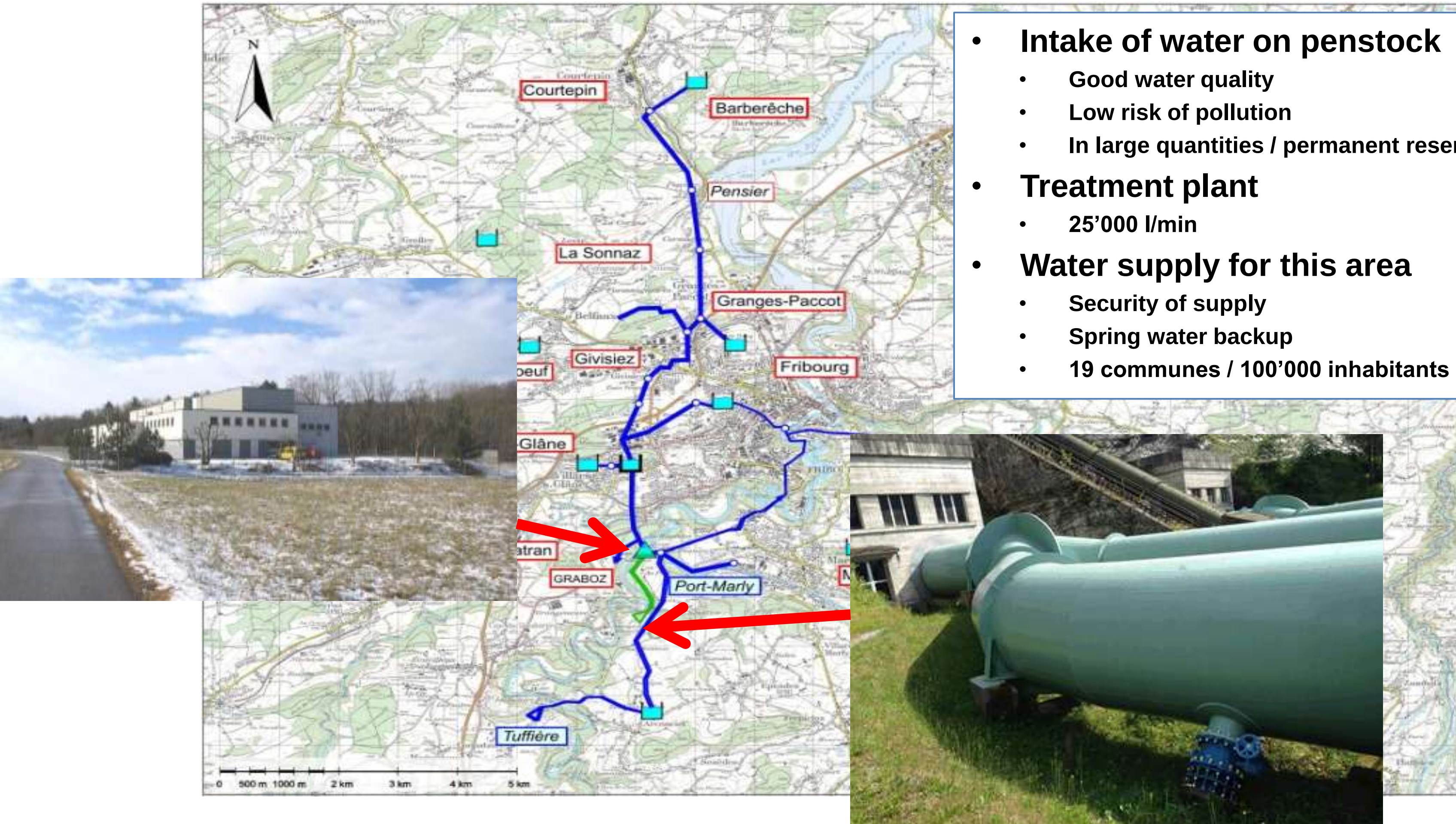
4. DRINKING WATER



- **Intake of water on penstock**
  - **Good water quality**
  - **Low risk of pollution**
  - **In large quantities / permanent reserve**
- **Treatment plant**
  - **25’000 l/min**
- **Water supply for this area**
  - **Security of supply**
  - **Spring water backup**
  - **19 communes / 100’000 inhabitants**

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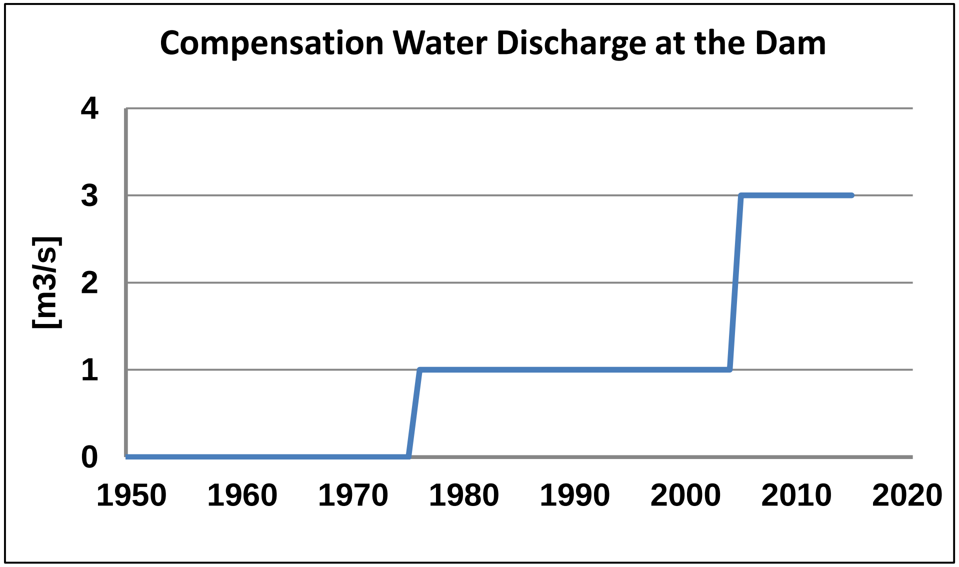
5. ENVIRONMENT : COMPENSATION WATER DISCHARGE



2 Power Plants at Rossens Dam	
1 x 1m³/s	**Operation mode**: 3.5 m³/s from 20th of May until 30th of September, else 2.5 m³/s
1 x 2.5 m³/s	
15 GWh / Y	

Law on the protection of waters (2011) :

1. Reduction of the impact of river flow variation (1 : 1.5)
2. Fish migration
3. Restoration of bed load transport

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groupe e

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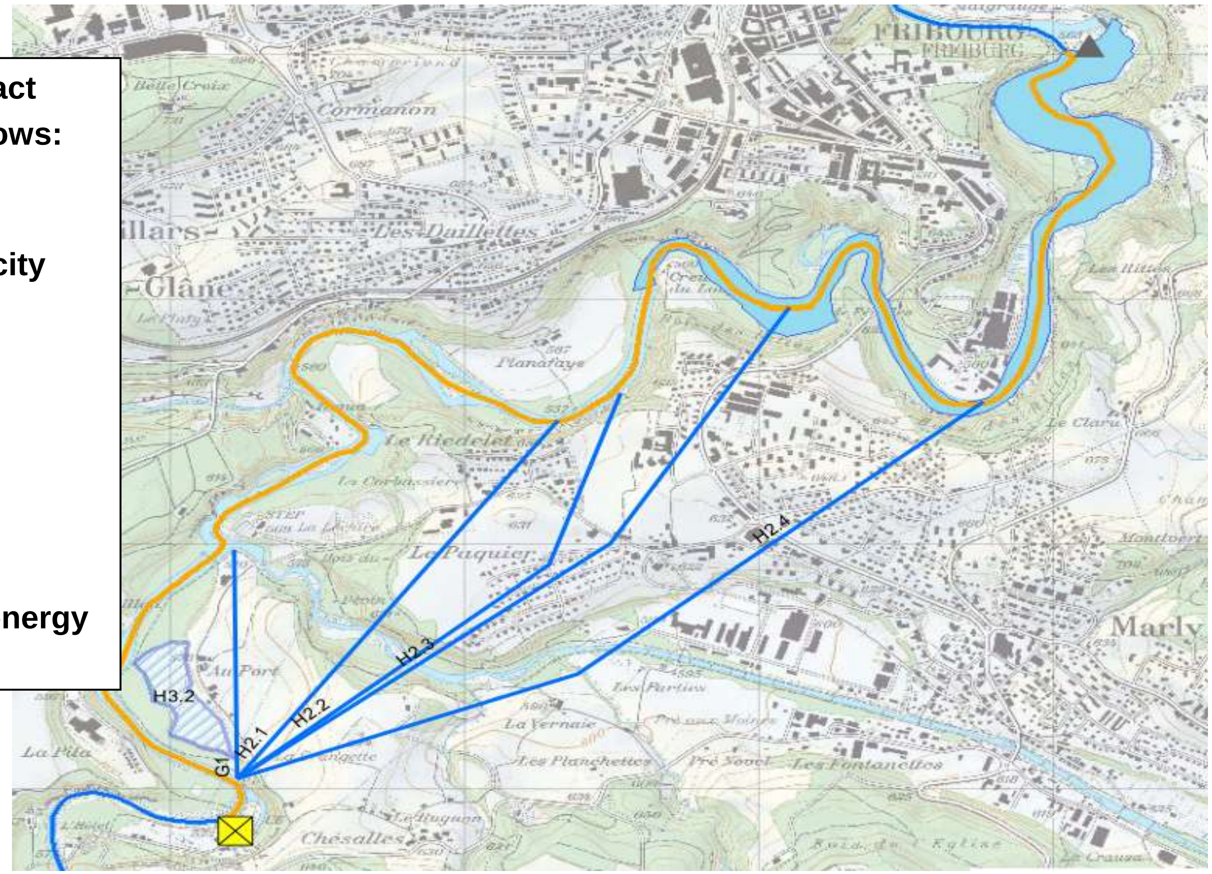
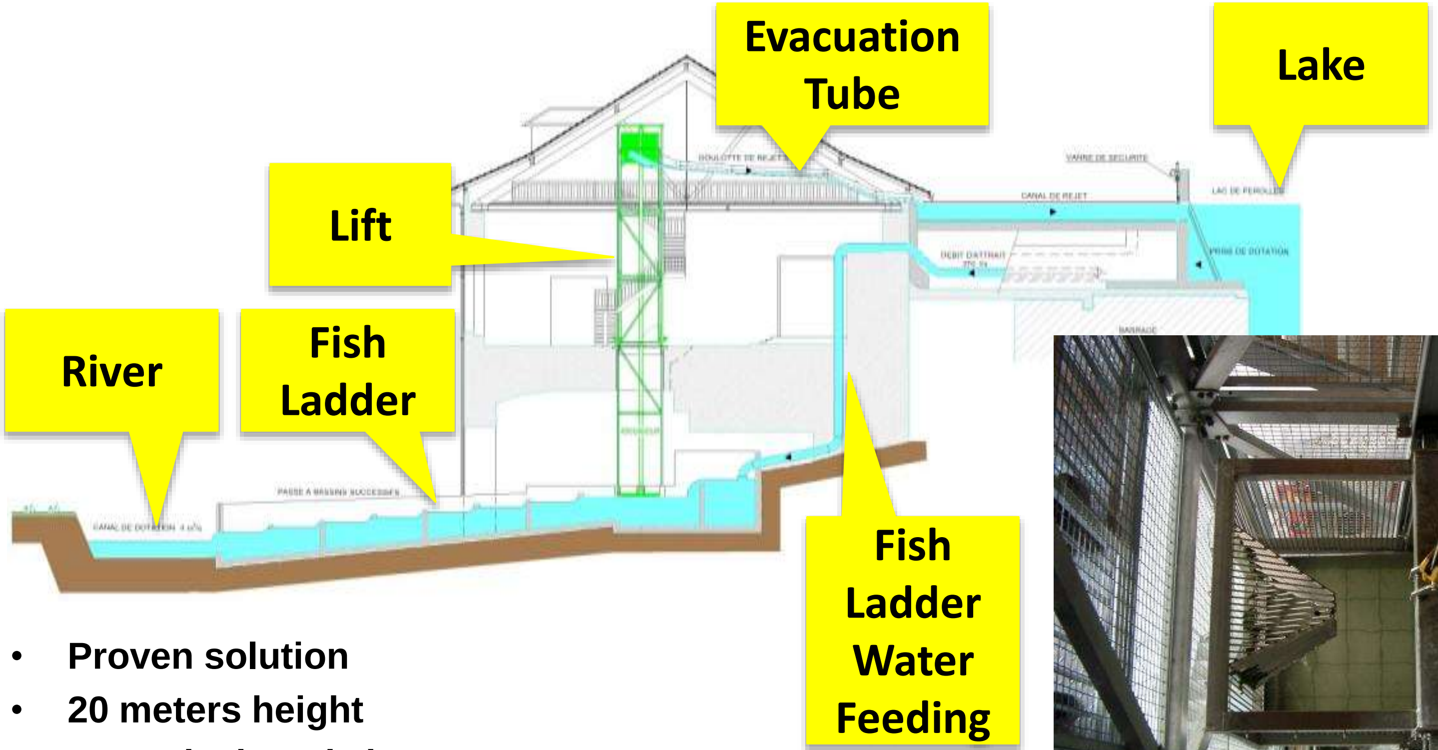
INGÉNIEUX PAR NATURE

5. ENVIRONEMENT : HYDRAULIC SANITATION

- **Federal law: Waters protection act**
  - **Restore adequate water flows: near natural regime**
  - **Until 2030**
  - **Financed by Swiss electricity consumption**
  - **Restauration goals:**
    - **Fish migration**
    - **River revitalization**
    - **Locks water**
    - **Sediment transport**
- **Find the right balance between environment preservation and energy production**



5. ENVIRONMENT : FISH MIGRATION WITH LIFT



- Fish Basket

- Proven solution
- 20 meters height
- Commissioned since 10 years
- About 10’000 fishes / Y

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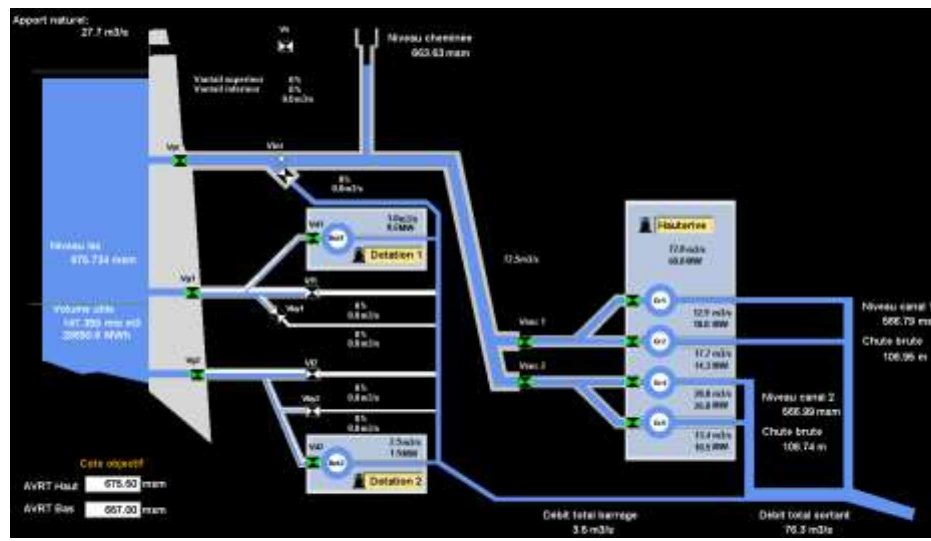
6. SECURITY : PROTECTION IN CASE OF FLOODS

- On-Line Control (Levels, Flows, Discharges)
- Shared information with State Services
- Decision-making process



- Reserve of storage : ~ 15 millions of m^3
- Downstream flow regulation

6. SECURITY : PROTECTION OF BANKS

- **Intensification of banks by wooden boxes**

- **Intensification of banks by rocks**

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7. SYNTHESIS : MISCELLANEOUS STAKE HOLDERS

Power generation...

Drinking water...

Pleasure navigation…

Restaurants around the lake…

Swimming…

Fishing…

CONTENTS

8. CONCLUSION

- In 1944, the dam and the power plant have been built only to produce power for the future, although this power was not yet necessary
- The environmental aspects were secondary
- The water adduction has been extended for Drinking Water Supply
- Over the time, the management of the lake had to take into account increasing sensibilities about environment, security in case of floods and introduction of new aspects : those are now integrated and planed in new projects
- The management of the lake will surely proceed in the future with additional requirements (Sandbank, Environmental Laws)
- This project shows a good example of the integration between water, management and energy strategy, ensuring ecosystems protection

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1a) Managing the demand

Tim Prewitt, iDE
Urs Heierli, iDE

More crop per drop: efficient irrigation technologies combined with solar energy and market approaches

Not a trade-off but a win-win

Water-food-energy nexus:

- *It is possible to achieve a win-win-win situation and produce more food with less water and less energy.*

- *We give first an example of plantain farmers in Nicaragua where over-use of water has decreased the water level of lake Nicaragua. (beaches increased from 50 to 150 meters)*

- *No farmer will just save water, unless he can get more crop per drop. Income is thus the driver for water efficiency.*

- *iDE considers productive use of water in agriculture as an entry point to generate income and food security*

Francisco Ramon, Plantain farmer, Rivas Nicaragua

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Not a trade-off but a win-win

One of many examples:

1. **Plantain farmers in Nicaragua**: The department of Rivas in Nicaragua is home to some 2'000 plantain producers with over 10'000 hectares.
2. **Water consumption per hectare**: We are still determining the precise water use, but provisional figures show the following:

Water consumption plantain in liters per ha	per Ha	Per Banana
Flood irrigation	10 - 15 million	100 - 115 l
sprinkler irrigation	13 - 17 million	120 - 150 l
drip irrigation (low pressure drip)	7 - 10 million	75 - 100 l

3. **Diesel consumption:** Even more significant is the consumption of diesel:

Diesel consumption in liters per ha	Low	high
Flood irrigation	400	600
sprinkler irrigation	670	1120
drip irrigation (low pressure drip)	270	360


With this pump it takes him
1.40 hours with drip and
3.5 hours with sprinklers.
Using 360 litres versus
1120 liters of diesel per
hectare

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Not a trade-off but a win-win

However, introducing drip irrigation with plantain farmers is not easy:

1. **Behavior Change**: irrigating with drip is different. For flood irrigation, farmers flood the field once a week. With drip they need to give water every day. Many farmers did not believe that drip provides enough water.
2. **Convince cooperative**: APLARI is the largest cooperative of plantain farmers in Rivas and they have undertaken a study to show their members that they get same or better results with drip irrigation. Next year solid follow up study planned.
3. **Cooperative as retailer**: IDE is promoting low pressure drip systems at affordable prices (1200 $ per hectare), but these prices can only be so low, if local farmers can do the design and installation.
4. **Credit is a must**: plantain farmers have a relatively good market: they earn a net income of around 2’800 US $ per hectare. For installing drip they would need a loan with at least 2 years duration at good conditions.

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Water lifting

Water lifting in Africa

- To irrigate even a small plot of 1’000 m2 one needs to transport 2 tons of water every day. This is a lot of work and mostly done by hand. It represents a heavy burden especially on women and children and is highly unproductive.
- There may be 10 million bucket farmers in Africa and this is an enormous potential to improve their productivity to produce more “crop per drop” with muss less energy.
- Short film on water lifting in Ghana
- iDE tried to introduce cheap treadle pumps in Northern Ghana. Treadle pumps have unfortunately “failed” in Burkina and many other countries and have a bad image: farmers wanted mechanized pumps.
- iDE is now introducing 2 solar pumps:
- Practica – Sunflower pump
- Sunlight pump

Sunflower pump

Sunlight Pump

Market-based-approach

- Introducing innovations through market-based approaches means building up viable supply chains
- Reaching smallholders means focusing on last-mile distribution: this is usually costly and needs new business models
- We will now also cooperate with larger companies to scale up. They did not yet see smallholders as a market and have asked iDE to cooperate and find ways to reach smallholders
- Conclusion: There is not a simple solution to water scarcity and food scarcity, and all efforts must include and involve the small farmers of this world
- But, it is possible.. IDE is seeking allies to forge an alliance for smallholder irrigation to unfold the potential of more crop per drop with less energy.
- If you have questions, please visit us at the stand of IDE and SOPAS

Questions and Answers

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Program

Setting The Scene (14.00) The Challenges; **Mrs. Olga Darazs, Swiss Water Partnership.**

1. Swiss Advanced Solutions (14.15 - 15.45)

1a) Managing the demand

- Integrated water and energy management solutions; Mr. Alain Sapin, Group E; Mr. Stéphane Maret, CSD Engineers
- More crop per drop with less energy: drip irrigation and solar pumping; Tim Prewitt, iDE; Urs Heierli, SoPAS

1b) Increasing the resources available

- Combined solutions: using energy in drinking water systems and in irrigation systems; Mr. Martin Bölli, Skat Consulting
- Synergies instead of trade-offs: linking sanitation to energy production and agriculture with a business approach; Mr. Christian Zurbrügg, Eawag/Sandec; Mr. Michael Kropac, Cewas/Seecon

1c) Creating shared benefits

- Joint ownership of infrastructure in a transboundary watercourse fostering cooperation of water and energy resources; Prof. Makane Moise Mbengue, Platform for International Water Law of the University of Geneva
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Mrs. Olga Darazs, Swiss Water Partnership

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1b) Increasing the resources available

Mr. Martin Bölli,
SKAT Consulting Ltd.

Combined solutions: using energy in drinking water systems and in irrigation systems

From Large to Micro hydropower

- Power supply for large cities or small hamlets
- Connected to the national grid or isolated grids only

From High to Low Head

- High pressure or high amount of water?

KW Campocologno, Switzerland
50 MW, 13m³/s
Foto: Rätia Energie / Isopermaproof

KW Niedergösgen, Switzerland
49 MW, 380 m³/s
Foto: halfin.ch

Estimation of the power potential (simplified)

$$P = Q \times h \times 7$$

- P: electric Power in Watt
- Q: Available flow in litre per second
- h: Available head in meters
- 7: constant [m/s^2], based on the gravity constant and the efficiencies of the equipment

Impact of a 10 kW Micro Hydropower Plant

60 MWh Electricity per year …

- Electricity consumption of 15 Households HH in Switzerland
- Electricity consumption of 100 HH (rural village in Africa)

- Replaces > **20,000 lt Diesel** (Diesel generator) per year

- Similar production to 375 m^2 Photovoltaic Panels

Where are the energy potentials?

Indicators for (hidden) energy potentials:

- High flow / water demand, or
- High pressure / head available
- High energy costs
  - → Energy efficiency potential

Example Drinking Water Supply (Tunisia)

Drinking Water Turbine in Switzerland

Example Irrigation Channel (Azerbaijan)

(20,000 l/s, 14m → ca. 2 MW)

Examples Waste water turbination

Morgental, St. Gallen, Switzerland
190m, 850 l/s, 1,300 kW

Profray Verbier, Switzerland
449m, 100 l/s, 380 kW

As Samra, Jordan
104m, 2,500 l/s, 1,660 kW

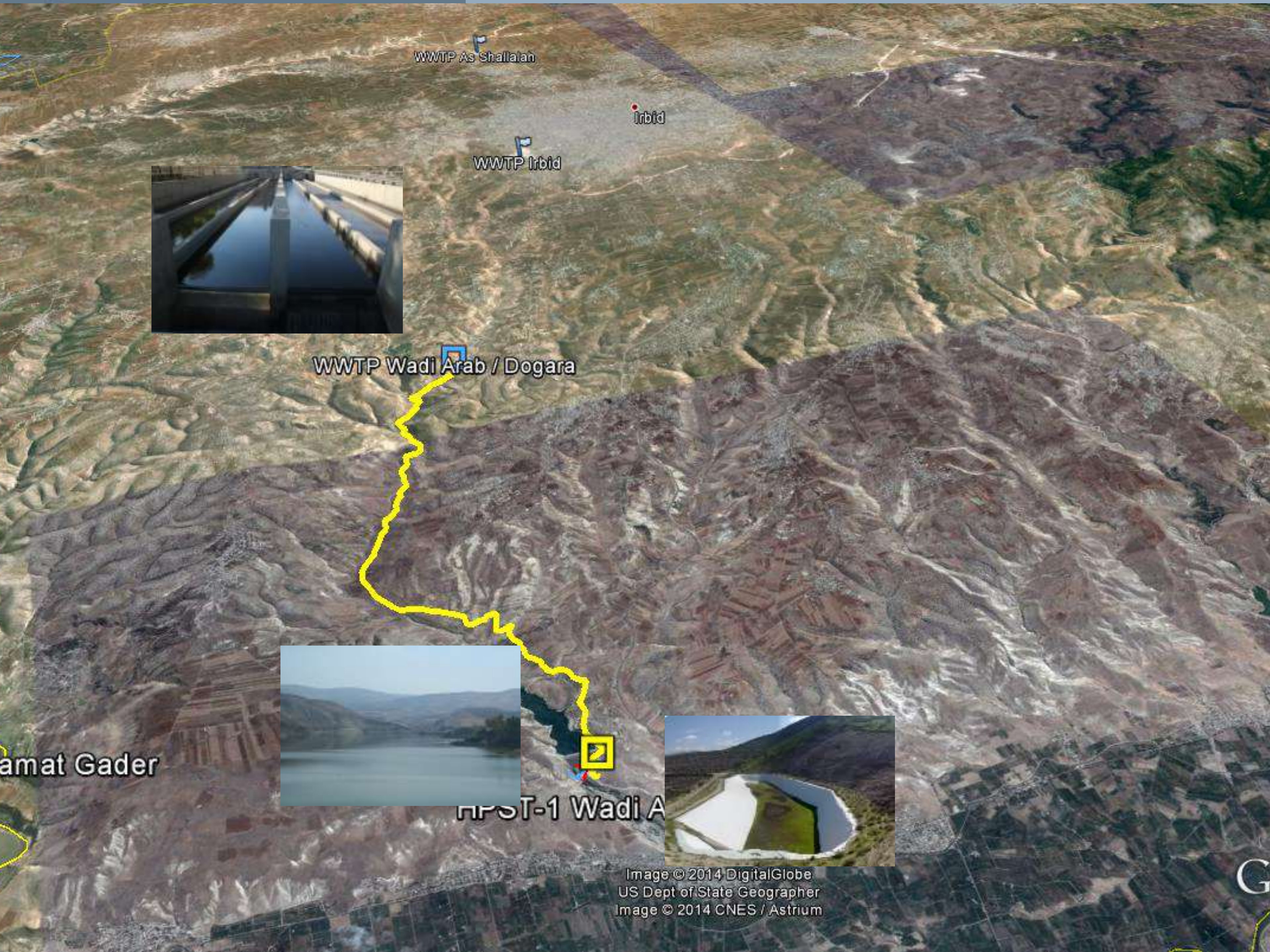
Cooling water of thermal power

Challenges (I)

- Sufficient head available?
  - Pressurised system!
    Replacement of the existing pipeline required (pressure requirements)?
- Electricity Production depending on the available amounts of water
  - Quantity?
  - Flow continuity?
  - Water Quality?
    (waste water: gas, solid parts; sea water)

Challenges (II)

- Electricity demand in the vicinity?
  - Pumps, industry, villages
  - Grid
- Sector coordination!
  - Awareness creation
    → to identify potentials as early as possible!
    → to allow to use synergies!



WWTP As Shallalan
Irbid
WWTP Irbid
WWTP Wadi Arab / Dogara
amat Gader
HPST-1 Wadi A
Image © 2014 DigitalGlobe
US Dept of State Geographer
Image © 2014 CNES / Astrium

Thank you for your attention!

Martin Bölli

Skat Consulting Ltd.

martin.boelli@skat.ch

www.skat.ch

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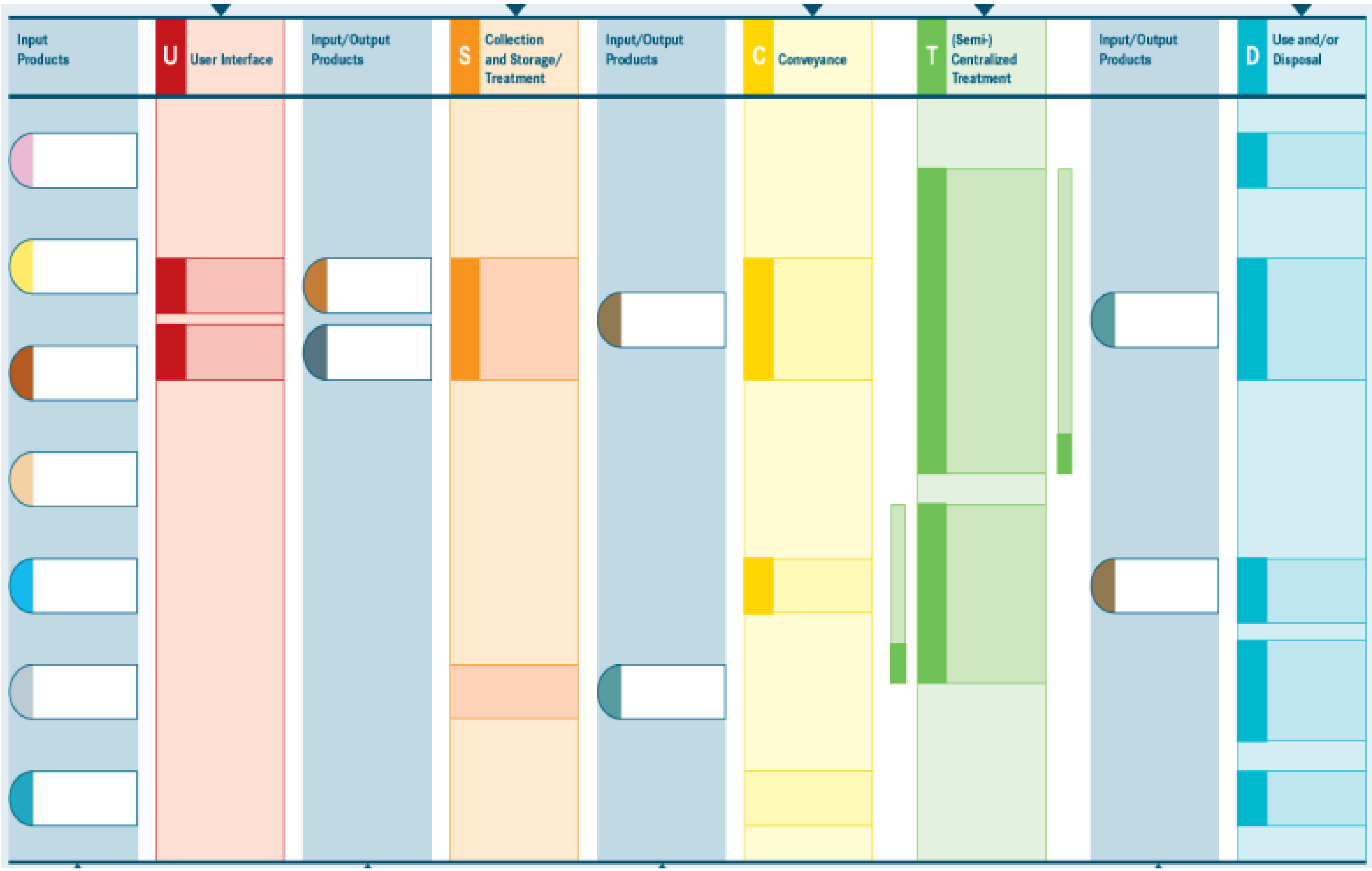
1b) Increasing the resources available

Mr. Christian Zurbrügg, Eawag/Sandec;
Mr. Johannes Heeb, Cewas/Seecon

Synergies instead of trade-offs: linking sanitation to energy production and agriculture with a business approach

Why not start at the end of the chain?

«waste derived products» in a market based & system approach



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Potential Synergies in Recovery - «waste derived products»

Ecosystem services	WASH	Energy Production	Food Production
Water, GHG	Waste	Gas, Biomass	Fertilizer
Soil quality	Waste	Char	Biochar
Water, GHG	Waste		Fertilizer
Water, GHG	Waste		Animal Feed
Water	Wastewater		Irrigation
Retention	Supply	Hydropower	Irrigation
Ecology	Supply	Hydropower	Irrigation

Examples of synergies

	WASH	Energy Production	Food Production
Composting	Waste		Fertilizer
Anaerobic Digestion	Waste	Gas	Fertilizer
Larvae processing **Sludge drying**	Waste		Animal Feed
Slow Pyrolysis & Biomass combustion	Waste	Char/Pellets	Biochar

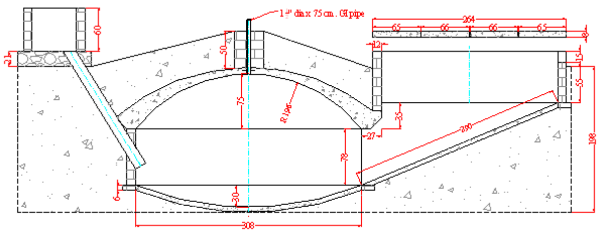
Case study – Bangladesh «Bulta composting facility»

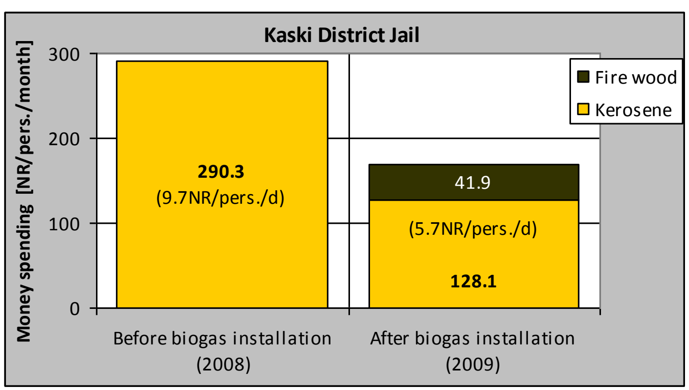
The high value of organisational setup, leadership, quality control

- Processing an average of 60 t/d market waste, (3300 t/d organic waste in Dhaka) producing 20 t/d compost (fertilizer consumption ~12’000 t/d)
- Obtained certification by Ministry of Agriculture
- Compost distributed country wide through “Farmers-Supplies” company, whereby demand exceeds supply
- High level of quality control, enhanced by CDM certification

Zurbrügg, C. (2013): Assessment methods for waste management decision-support in developing countries.

Case study – Biogas sanitation «Nepali Prisons»



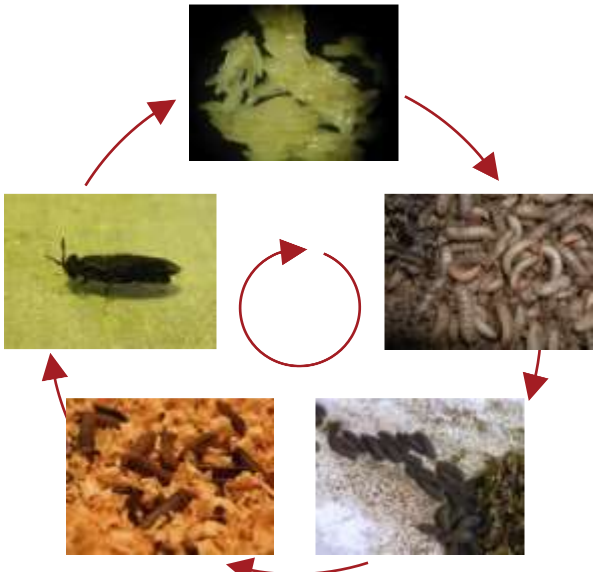


Improved sanitation - incentives by fuel savings

- $10m^3$ and $20m^3$ digesters for excreta and kitchen waste
- average gas production 26 L/person/day (only human waste), and 62 L/person/day (adding kitchen waste)
- fuel savings 17-41%
- payback on investment 1.5 – 5.5 years
- provision of renewable energy source (alternative to wood and kerosene)
- improvement of kitchen environment
- digestate not used for agricultural purposes due to organizational barriers.

Lohri, C. et al (2014): Ensuring appropriateness of biogas systems for prisons : Analysis from Rwanda, Nepal and the Philippines. In: Technologies for Sustainable Development. Springer.

Waste and faecal sludge as protein source for animal feed



Pilot facility, Costa Rica (Sandec/Eawag)

High value protein source for animal feed

- 1 ton of waste can generate 200 kg of larvae (40% protein and 30% fat)
- Reduces waste by 65%
- Business viability proven in South Africa
- Demand for "magmeal" exceeds supply

Agriprotein Technologies: http://www.agriprotein.com/technology.html

S. Diener, et al. (2009). Are larvae of the Black Soldier Fly (Hermetia Illucens) a financially viable option for organic waste management in Costa Rica.

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Faecal sludge a source for animal fodder

Using planted drying beds grow animal fodder (Antelope grass)

- Sludge loading rates of 100-200 kg TS/(m2 year) on planted drying beds can generate 15-24 kg DM/(m2 year)
- Crude protein content 12% (leaves) – 6% (stems) above critical levels required for growth of small ruminants.

Kengne I.M. et al. (2008). Effects of faecal sludge application on growth characteristics and chemical composition of Echinochloa pyramidalis (Lam.) Hitch. and Chase and Cyperus papyrus L. Ecological Engineering,34, 3, 233–242.

Ngoutane Pare, M. M. et al (2009). Nutritive value of Echinochloa pyramidalis, a forage plant used for treating faecal sludge and wastewater.

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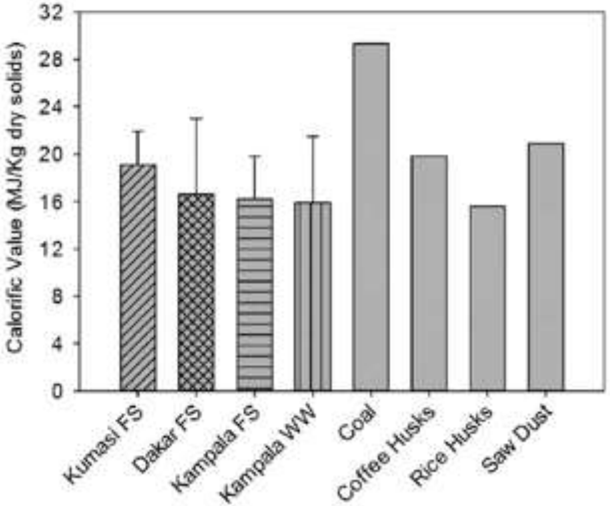
Faecal sludge as biomass fuel

Calorific Value of dried sludge similar to other biomass

- sludge must be a dried < 28% dry solids
- footprint of sludge drying needs to be reduced
- main potential market is the industrial sector but needs to be in a similar form (as current biomass)
- disposed sludge in Kampala represents a fuel potential of 84,900 GJ/year equal to a value of USD 4200–1,130,000 per year (coffee husks – engine oil).



S. Diener et al.(2014). A value proposition: Resource recovery from faecal sludge—Can it bethe driver for improved sanitation? Resources, Conservation and Recycling 88 (2014) 32–38.

A. M. Muspratt et al. (2014). Fuel potential of faecal sludge: calorific value results from Uganda, Ghana and Senegal. Journal of Water, Sanitation and Hygiene for Development

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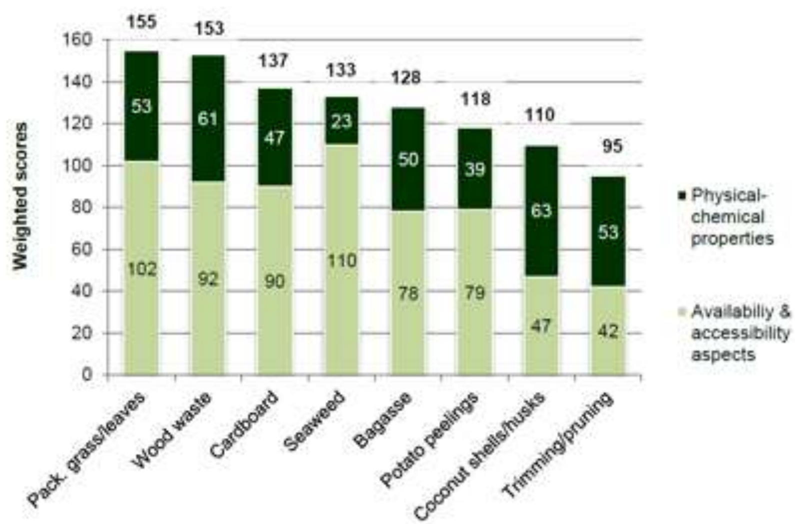
Waste to Char – Slow Pyrolysis

Char from waste, substitutes wood-based charcoal

- dry organic waste (<25%), can be converted to char powder by slow dry pyrolysis with average char yield of 40% (dry weight basis)
- urban waste sources suitable (Dar es Salaam: 12% of the total municipal solid waste)
- collected and carbonized this could substitute ~10% of the daily consumed wood-based charcoal
- options for wet waste are being explored (HTC)



Lohri, C. et al. (submitted) Urban Biowaste for Solid Fuel Production – Waste Suitability Assessment and Experimental Carbonization in Dar es Salaam, Tanzania. Waste Management and Research

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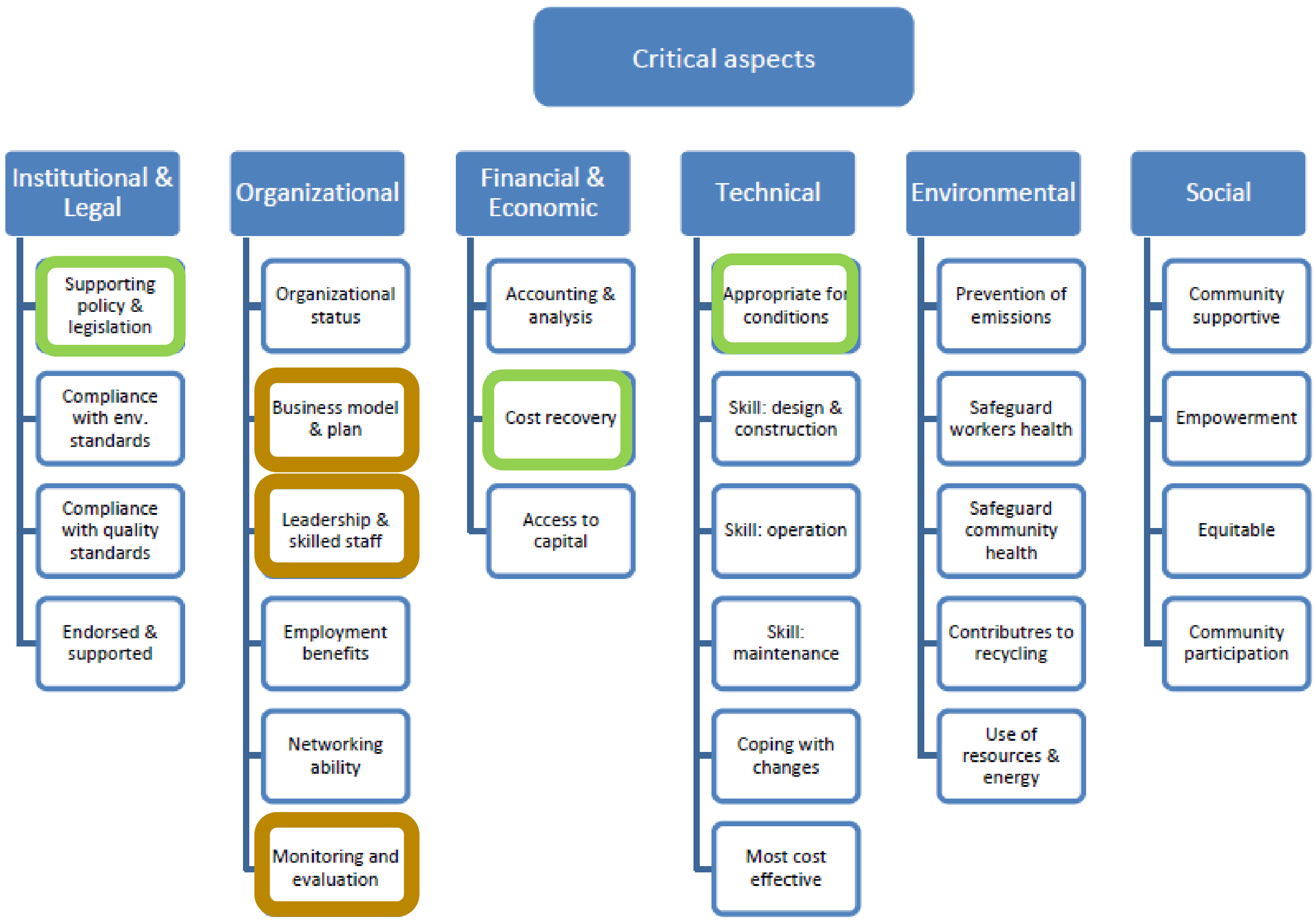
Critical aspects of success



Zurbrügg, C. (2013): Assessment methods for waste management decision-support in developing countries.

Entry Points to Scaling-Up and Scaling-Out

- Proven RRR Business Models
- Sector Entrepreneurship
- Match-Making
- Integrity-Management

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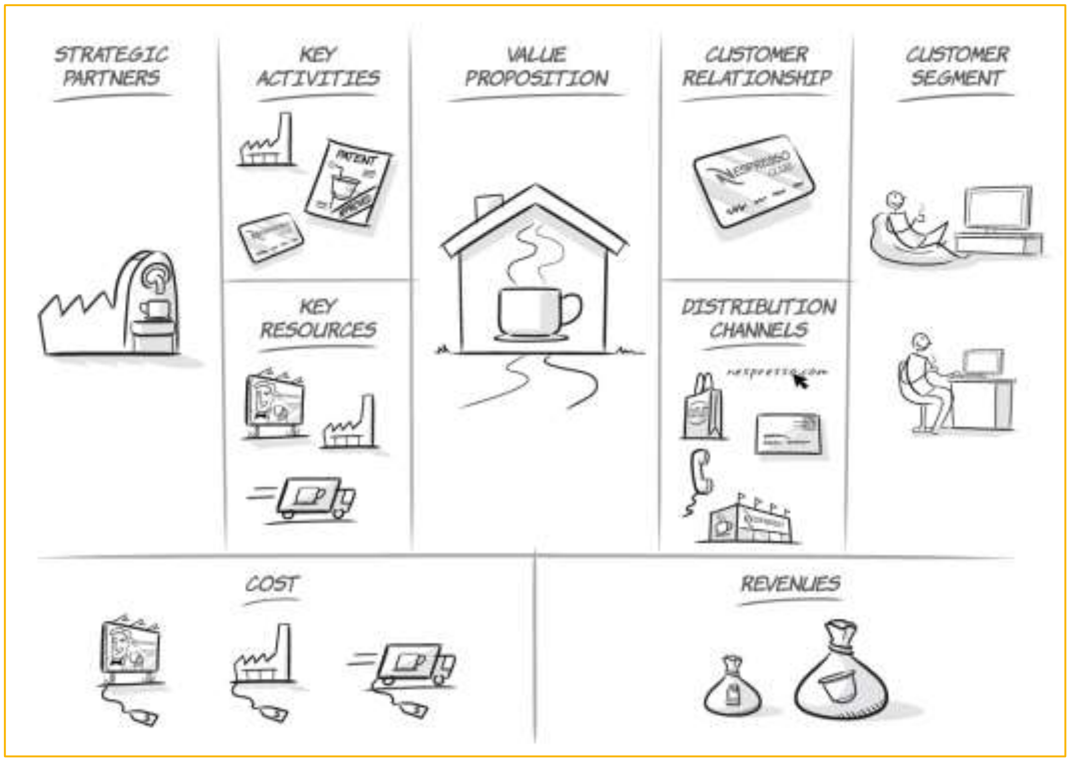
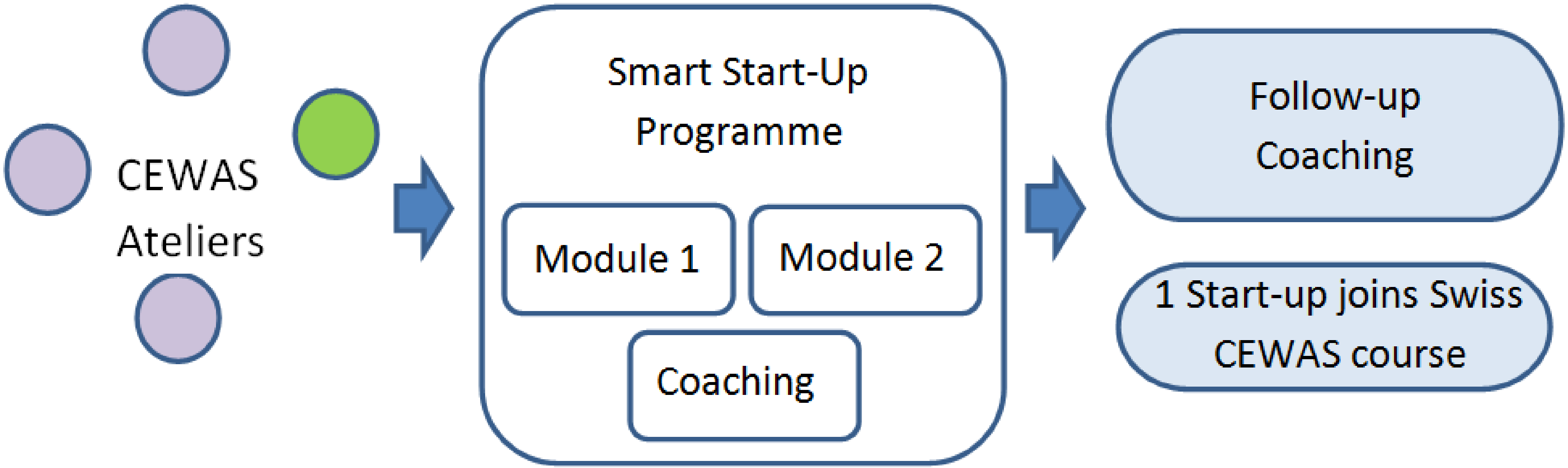
Proven Business Models



Based on:

- Socio-Economical Sustainability
- Environmental Sustainability
- Health Risk Management
- Integrity Management

Sector Entrepreneurship



Smart-Start-Up Program

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Activation of Investment - Match Making

Business Model based Integrity Management

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Many thanks for your attention

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Questions and Answers

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Prof. Makane Moïse Mbengue,
Platform for International Water Law, Faculty of Law
University of Geneva

Joint ownership of infrastructure in a transboundary watercourse fostering cooperation of water and energy resources

Manantali and Diama dams

Joint ownership of infrastructures

The Senegal River is located in Western Africa and is the second longest river of West Africa with a length of 1,790 km. The basin spreads over Guinea, Mali, Mauritania and Senegal.

I. The Legal Framework Regulating Cooperation over the Senegal River Basin

- **1972** - Statute of the Senegal River Development Organization (OMVS)

- **1972** – Statute on the Senegal River

- **1978** – Statute relating to the Common Works

II. The Principles Governing the Joint Ownership and the Sharing of Benefits

- *Indivisibility*
- *Joint ownership*
- *Solidarity*

III. Perspectives for reinforcing Benefit-sharing and Joint Ownership within the Senegal River Basin?

- The Waters Charter and New Paradigms of Benefit-Sharing
- The Guinea "Equation"
- Is the Senegal River Model of Joint Ownership Transposable?

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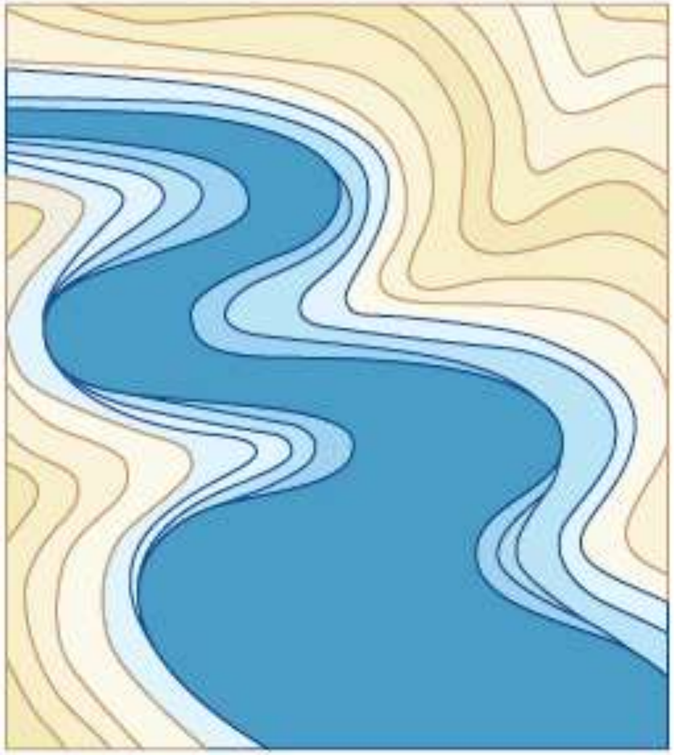


Mr. Johan Gély,
Swiss Agency for Development and Cooperation

Blue Peace Initiative incentivising coherent policies to manage water and energy in a transboundary watercourse

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

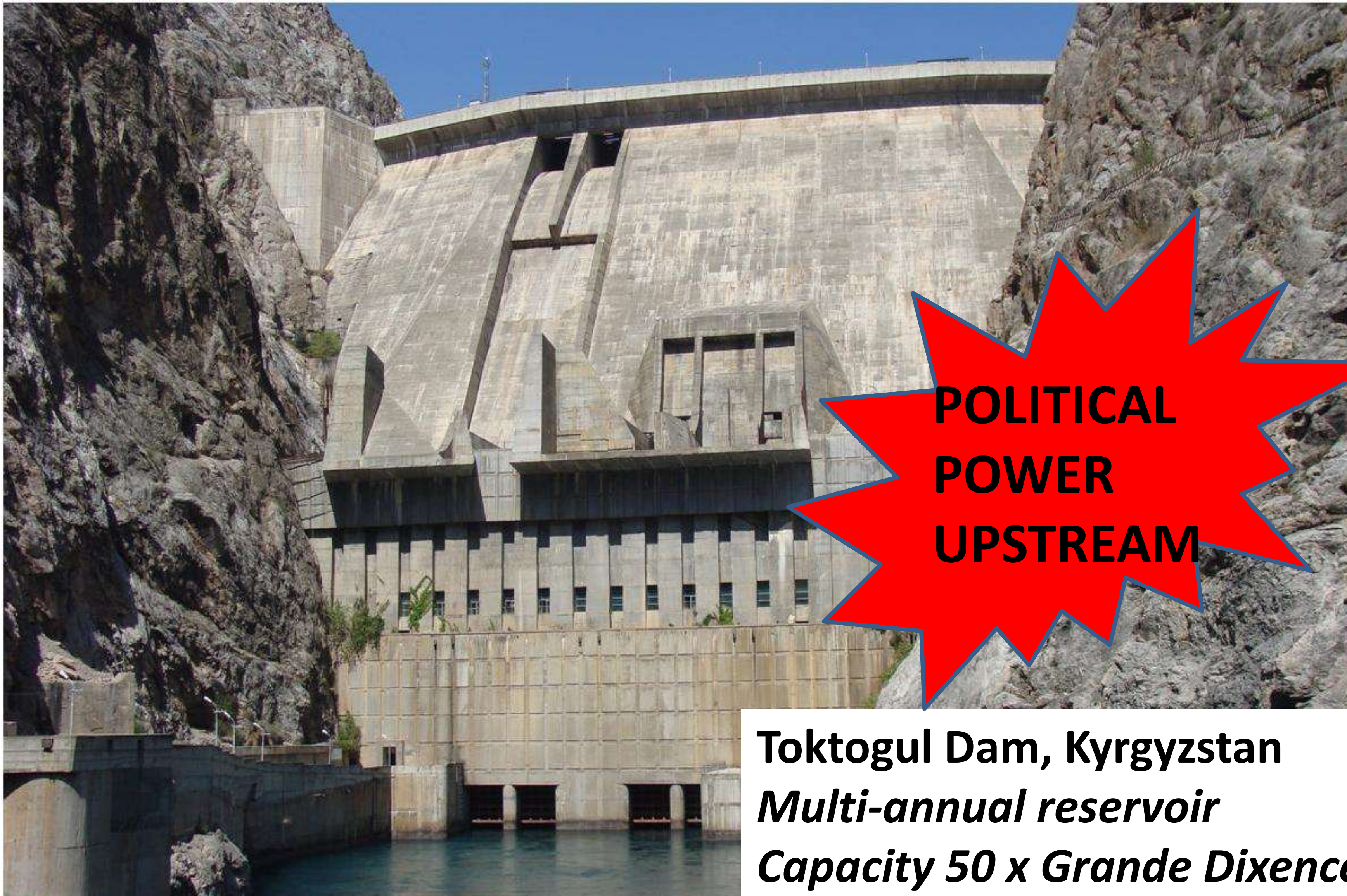
Federal Department of Foreign Affairs (FDFA)
Swiss Agency for Development and Cooperation (SDC)
Corporate Domain Global Cooperation
Water Initiatives

Corporate Domain Global Cooperation
Global Program Water Initiatives (GPWIs)

Presentation GPWIs
Swiss Water Partnership
Shared Benefit

31.08.2014

Technical feasibility☺ Political feasibility



Toktogul Dam, Kyrgyzstan
Multi-annual reservoir
Capacity 50 x Grande Dixence

Water-Energy-Food: Seasonal and Spatial Conflicts

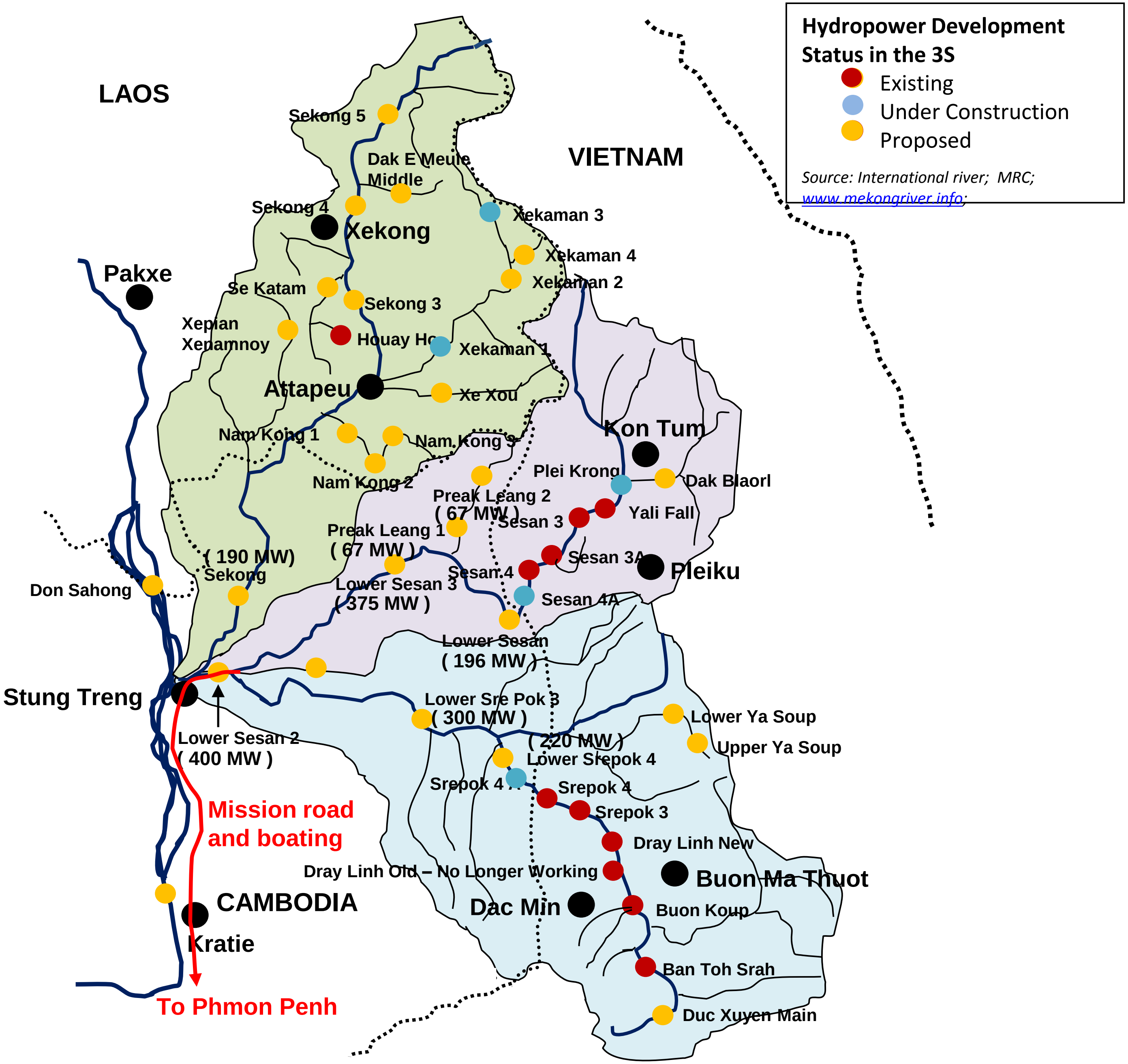
Power (upstream, winter) vs. irrigation water (downstream, summer)

<u>Syr Darya Riparians</u>

- **Kyrgyz – upstream – Power need**
- **Tajik- Midstream – power/irrigation**
- **Uzbekistan- Downstream- Irrigation**
- **Kazakhstan – Downstream - Irrigation**

<u>Amu Darya Riparians</u>

- **Tajikistan– upstream – Power need**
- **Turkmenistan- Downstream- Irrigation**
- **Uzbekistan – Downstream - Irrigation**
- **Afghanistan – power/irrigation**



Hydropower Development Status in the 3S
Existing
Under Construction
Proposed
Source: International river; MRC; www.mekongriver.info;
LAOS
VIETNAM
CAMBODIA
Sekong 5
Dak E Meule Middle
Sekong 4
Xekong
Xekaman 3
Xekaman 4
Xekaman 2
Pakxe
Se Katam
Sekong 3
Xepian Xenamnoy
Houay Ho
Xekaman 1
Attapeu
Xe Xou
Nam Kong 1
Nam Kong 3
Nam Kong 2
Kon Tum
Plei Krong
Dak Blaorl
Preak Leang 2 (67 MW)
Sesan 3
Yali Fall
Preak Leang 1 (67 MW)
(190 MW) Sekong
Sesan 3A
Pleiku
Sesan 4
Don Sahong
Lower Sesan 3 (375 MW)
Sesan 4A
Lower Sesan (196 MW)
Stung Treng
Lower Sre Pok 3 (300 MW)
Lower Ya Soup
Upper Ya Soup
Lower Sesan 2 (400 MW)
(220 MW) Lower Srepok 4
Srepok 4
Srepok 4
Srepok 3
Mission road and boating
Dray Linh New
Dray Linh Old – No Longer Working
Buon Ma Thuot
Dac Min
Buon Koup
Kratie
Ban Toh Srah
Duc Xuyen Main
To Phmon Penh


Thank you

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Coffee break

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2) Reality test

Ms. Agnes Montangero, Swiss Water Partnership

Tackling trade-offs between water and energy across sectors and scale

Main Source: The United Nation World Water Development Report. Water and Energy 2014

2a) Country case Tanzania

Mr. Anders Berntell,
Water Resources Group 2030

Tanzania: challenges and relevance of the proposed solutions

2030 Water Resources Group: Water-Food-Energy challenges in Tanzania

Anders Berntell
2030 Water Resources Group

The 2030 Water Resources Group (2030 WRG)

We support governments to **create an enabling environment** for the private sector, civil society and other stakeholders to make **a bigger contribution to sustainable water resource management** by cooperatively identifying and **analyzing risks and opportunities**; **sponsors platforms for multi-stakeholder dialogue**; and contributing to **collective actions to closing the gap** between long-term water resource needs and water resource availability in a sustainable and equitable manner.

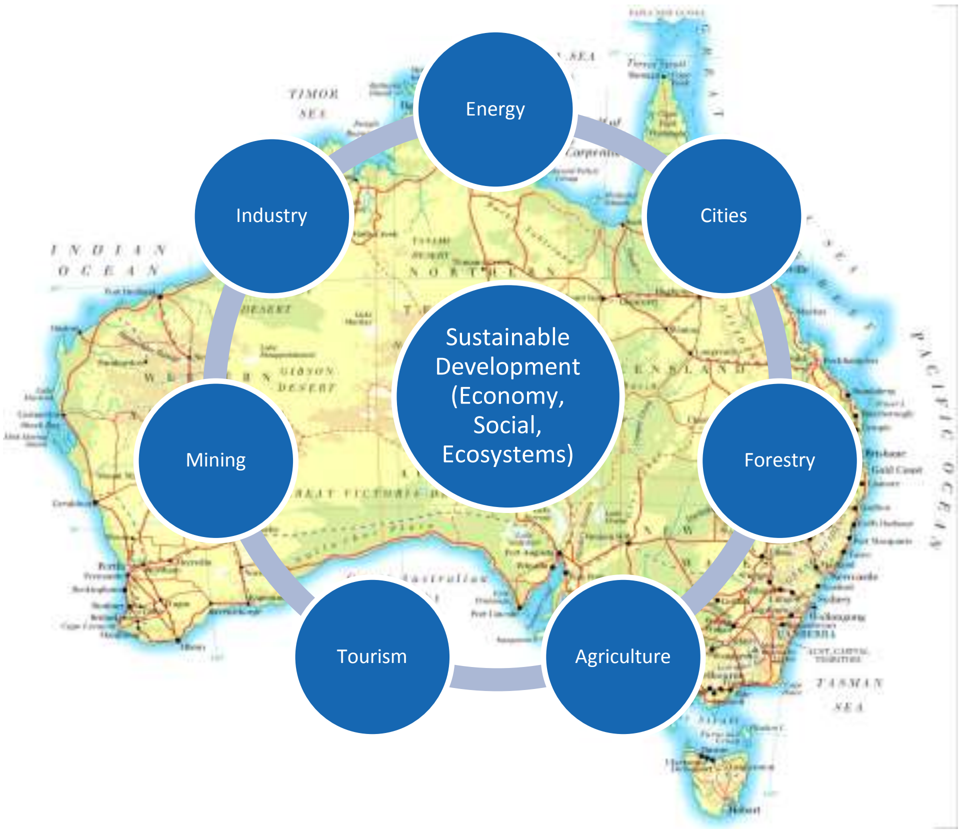
Partnership on two levels:

-Global

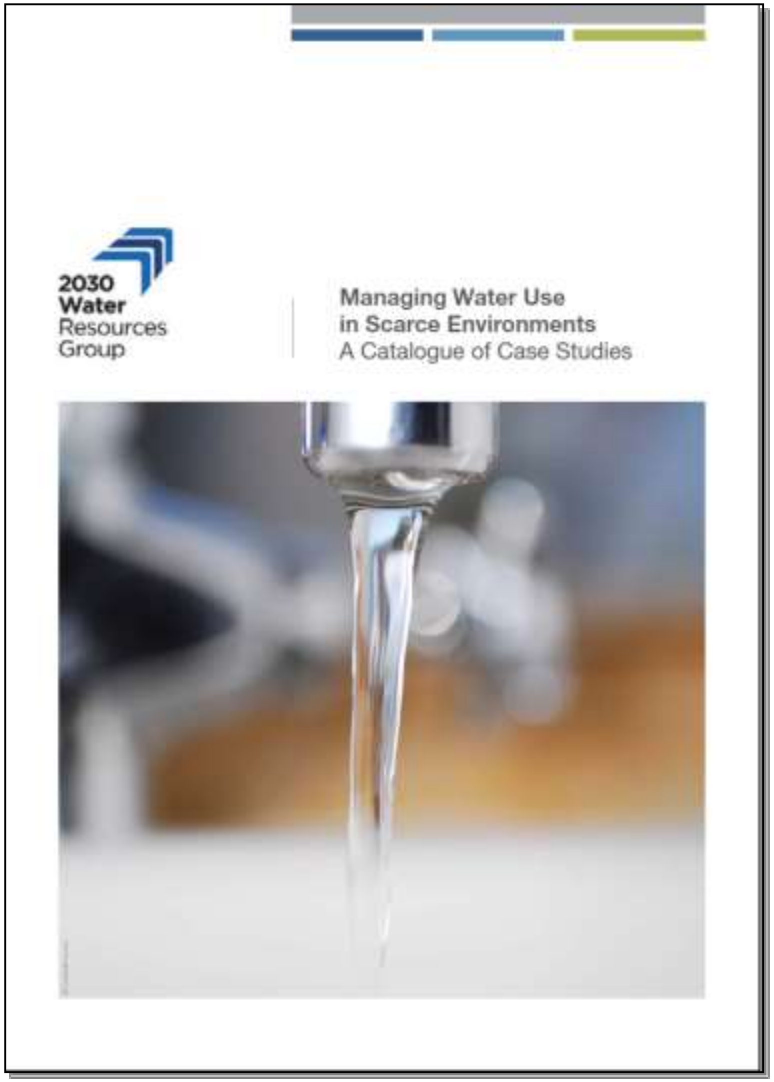
-Local/National

Leading to action at national/local/watershed level

-Initiated by a few Multinational Companies, Donors and Development Banks (IFC)
-Incubated within WEF (World Economic Forum)
-Since March 2012 a part of the IFC (World Bank Group)

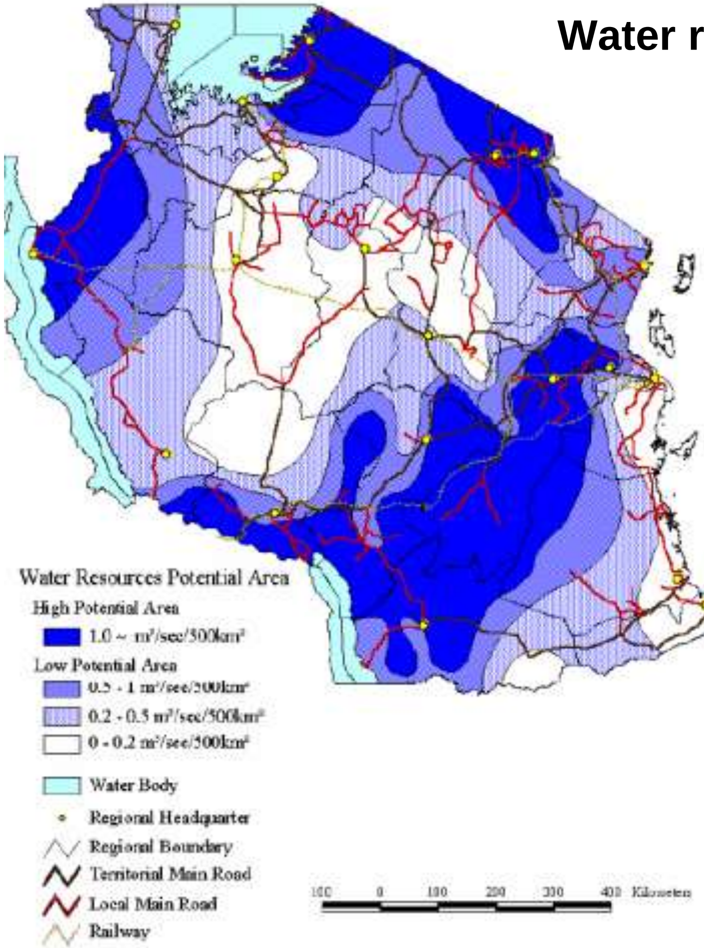


Energy
Cities
Industry
Sustainable Development (Economy, Social, Ecosystems)
Mining
Forestry
Tourism
Agriculture



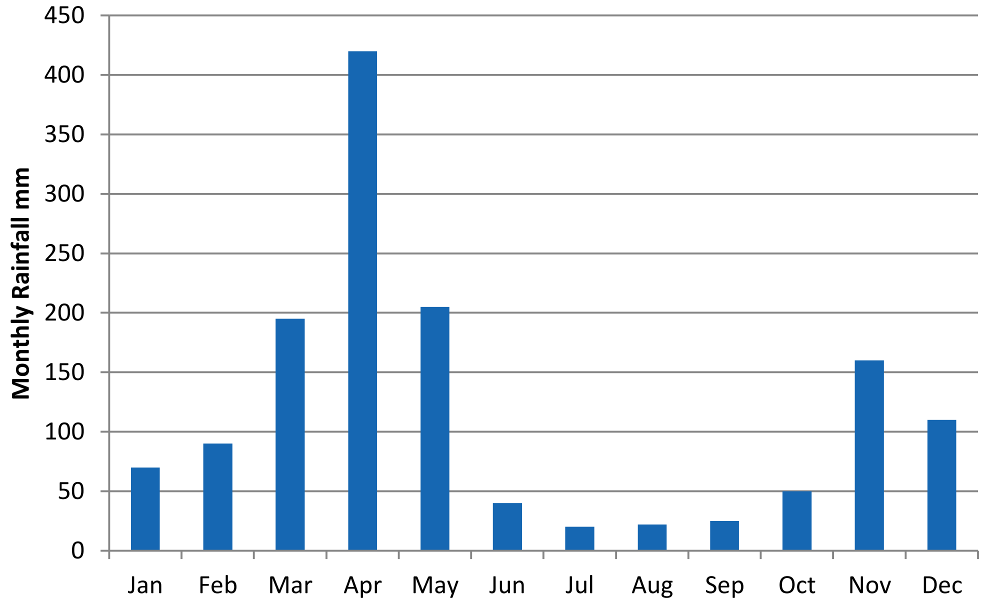
2030 Water Resources Group
Managing Water Use in Scarce Environments
A Catalogue of Case Studies

Tanzania has apparent abundant water but availability in the right time and right place has always been a constraint



Water resources potential

Seasonal rainfall (Arusha)

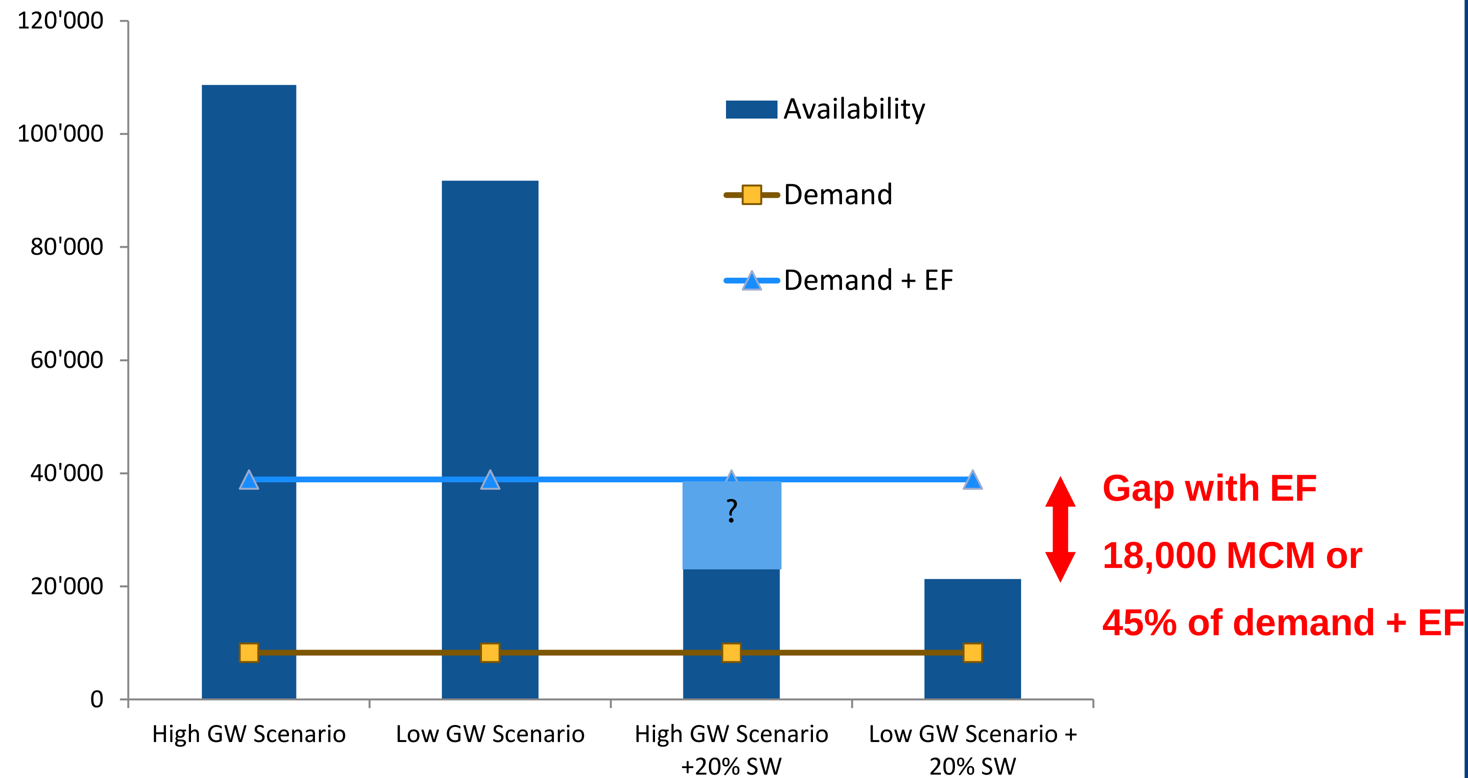


Source: National Irrigation Master plan (2002)

Nationally, Tanzania is close to or below long term sustainability in water resources in 2012

When the sum of [human] Demand and Environmental Flows (EF) is compared with the sum of groundwater and 20% of surface water flow, a resource gap exists

Water Availability and Demand, MCM

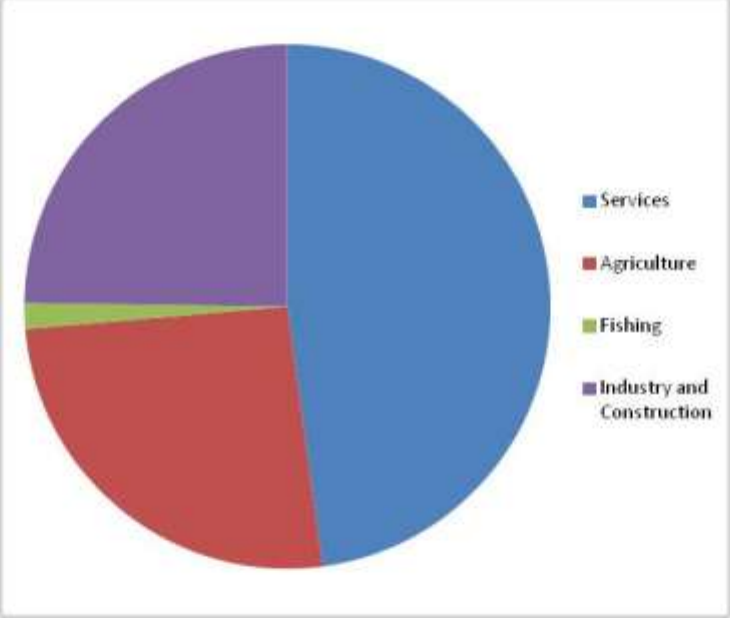


SOURCE: Tanzania's Integrated Water Resources Management and Development Plans

Water is key to social and economic development in Tanzania

Traditional agriculture continues to dominate the economy and the livelihood of 75% of Tanzanians

- Agriculture
- Energy
- Industry and mining
- Livestock
- Fisheries
- Wildlife
- National Parks

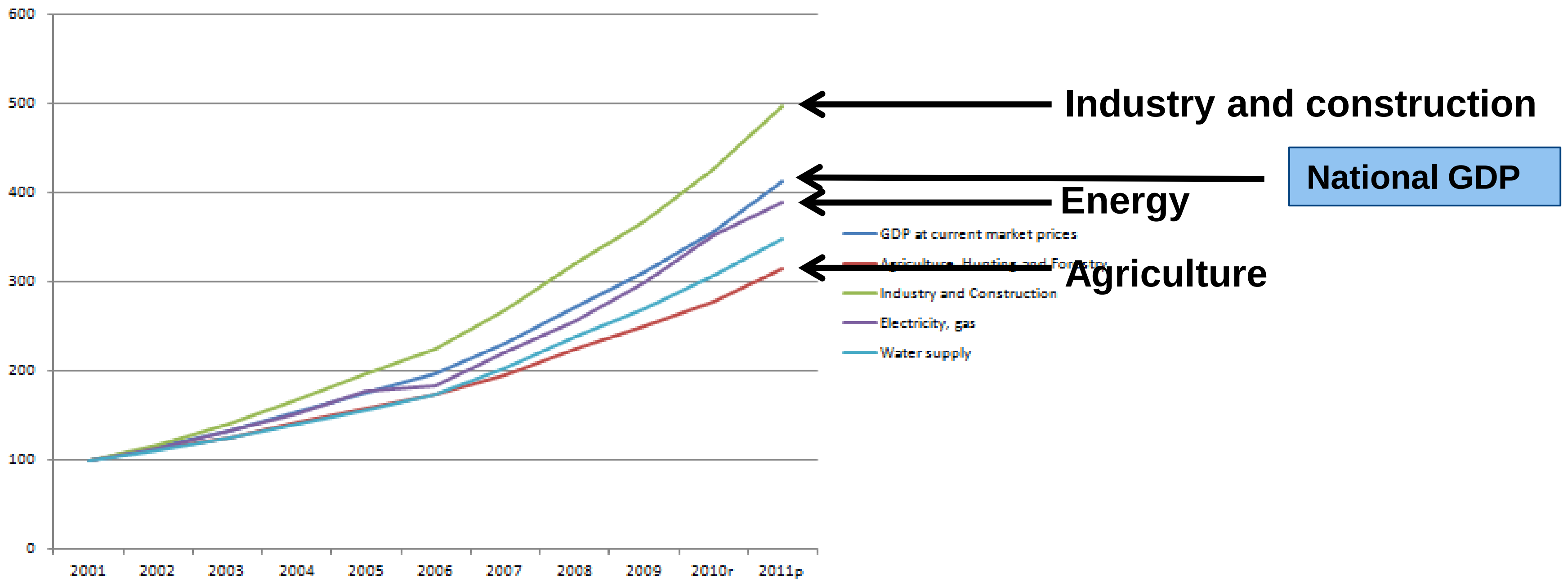


- **Strong interdependence of sectors for water resources**
- **The 75% of the workforce in agriculture produce 97% of the nation's food and 26% of GDP**
- **The urban population (23%) generates 51% of GDP**

SOURCE: National Accounts of Tanzania Mainland (NBS) 2011; The Urban Transition in Tanzania, World Bank, 2009

The Tanzanian economy is in transformation with growth strongest in industry and construction

Steady high growth over 10 years in GDP masks sectoral differences and a rebalancing of the economy



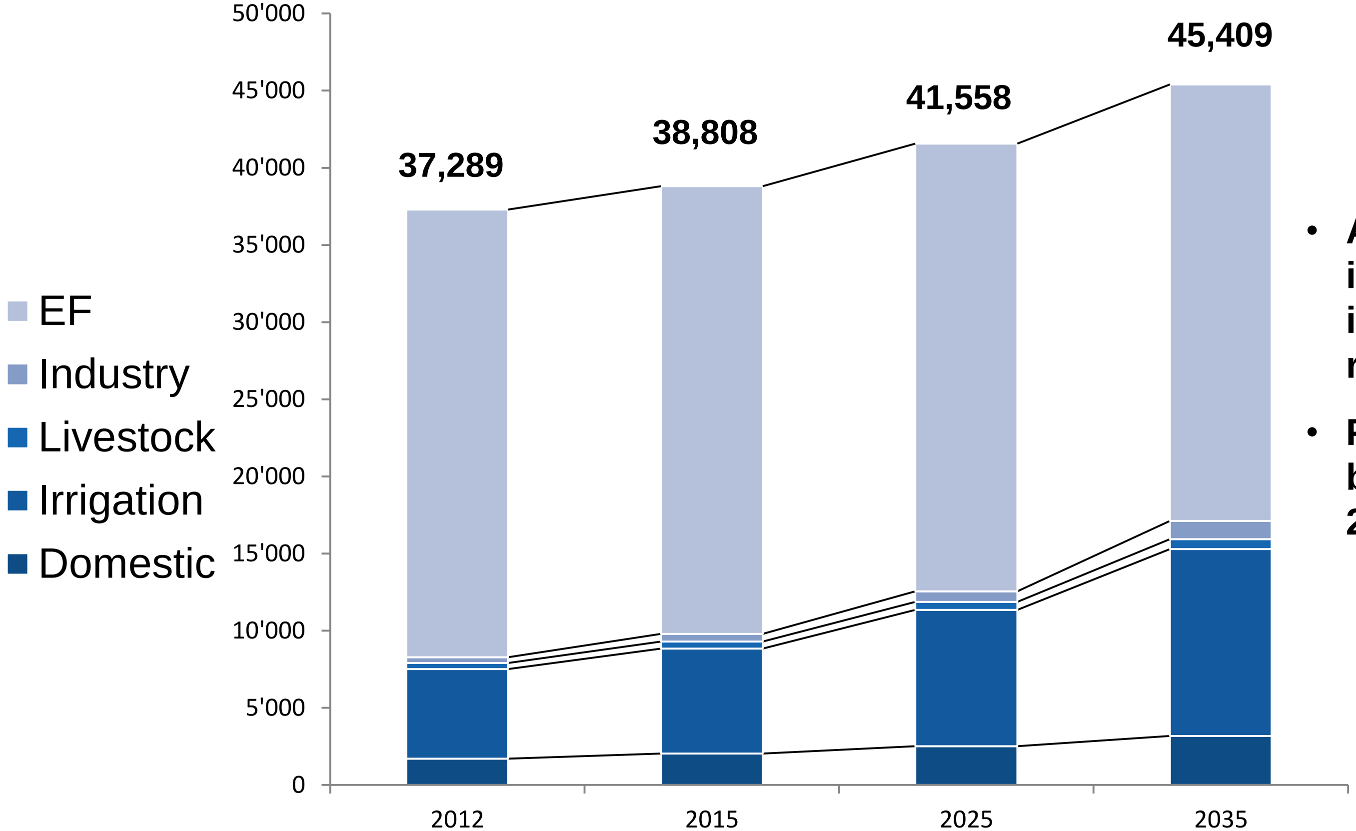
[base 100 in 2001]

SOURCE: National Accounts of Tanzania Mainland (NBS) 2011

High growth in irrigation water demand is required to meet projected national agricultural targets

Sectoral projections of future water demand

Water Demand, MCM

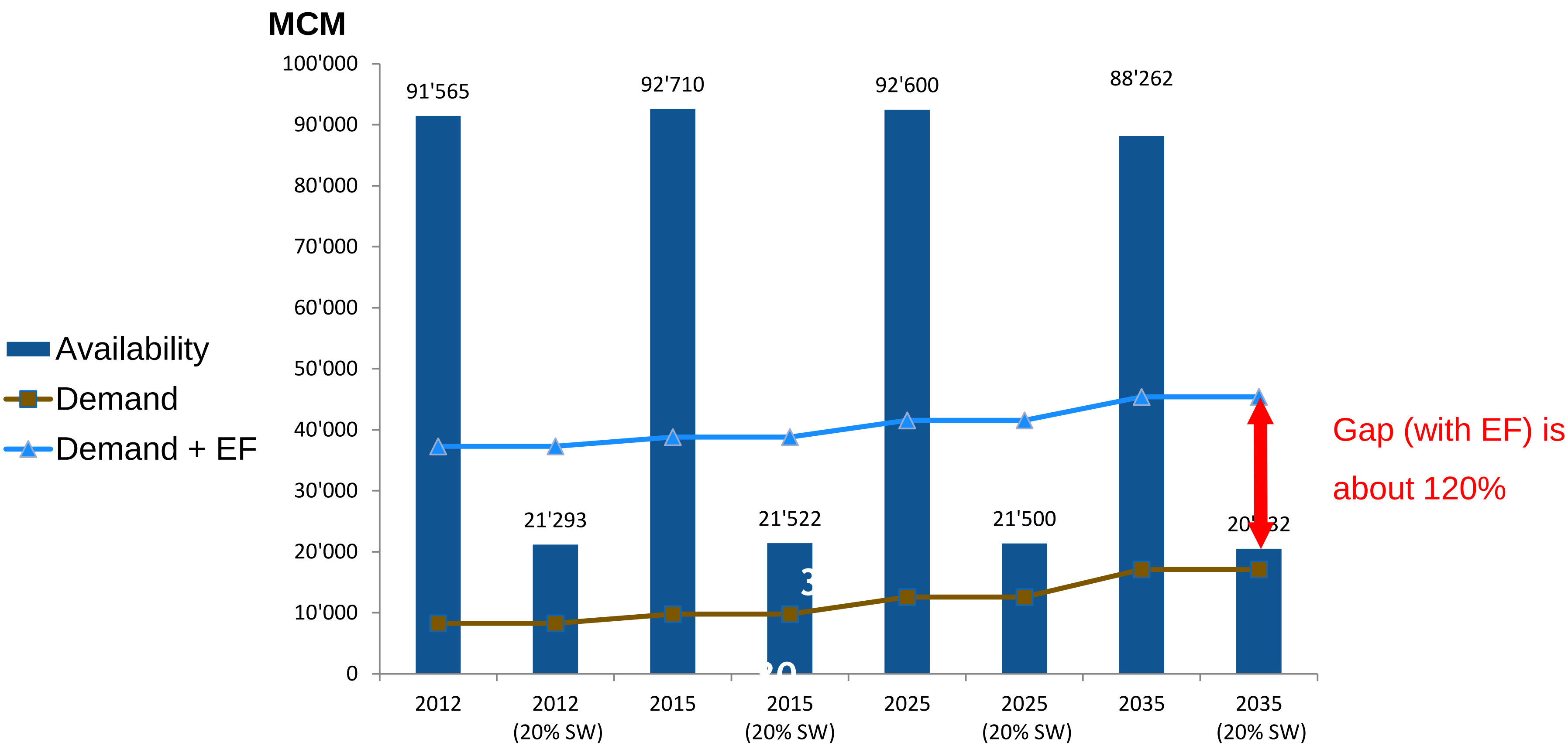


- **Agricultural growth in plans drives irrigation requirements**
- **Population growth by over 100% by 2035**

SOURCE: Tanzania's Integrated Water Resources Management and Development Plans

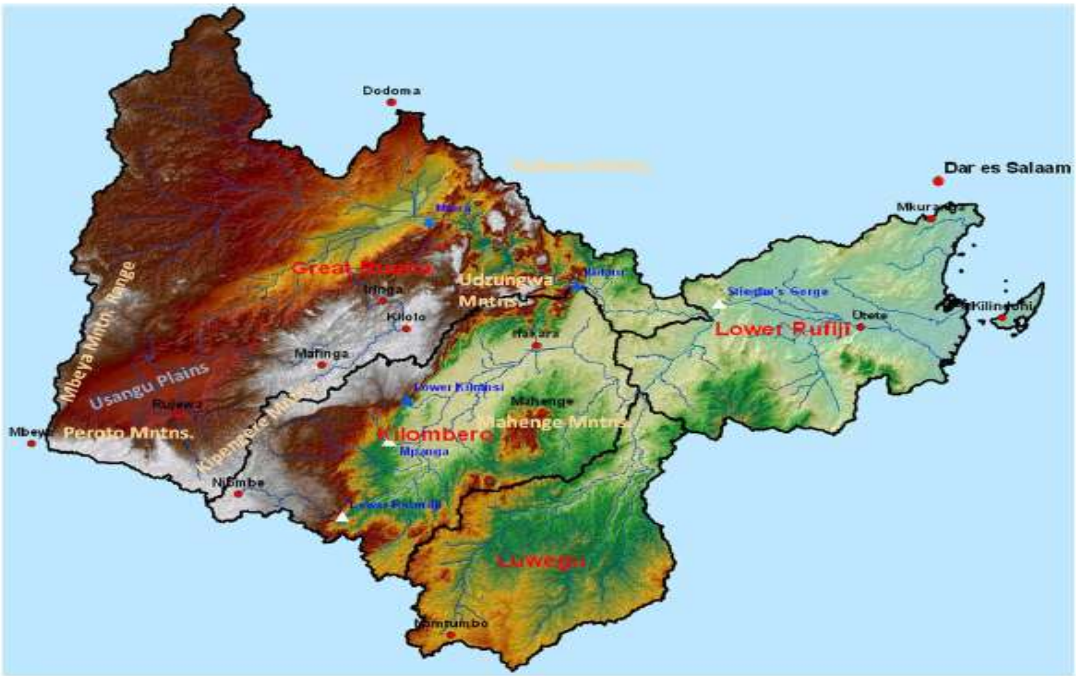
In 2035, there is a gap between water availability and the demand including Environmental flows

Water availability compared to Demand for 2012 – 2035 (Low GW Scenario)



SOURCE: Tanzania's Integrated Water Resources Management and Development Plans

Rufiji is Tanzania's most important water basin with competing demands for water from agriculture, hydropower and for ecosystems



Statistics

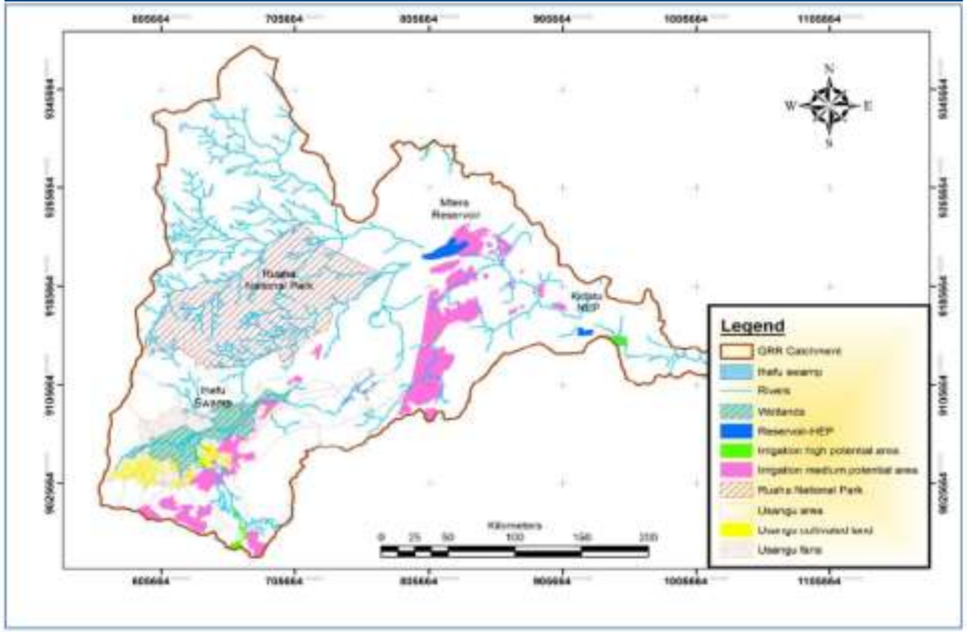
- **Largest Tanzanian basin**
  - 184,000 km^2
  - rainfall 400-1600mm/yr
  - 33% of national rainfall
  - 25% of river flow
- **Including**
  - Kilombero: 62% flow
  - Ruaha: with internationally recognised wetland sites

Due to its scale, activities within the basin have a history of being conducted independently

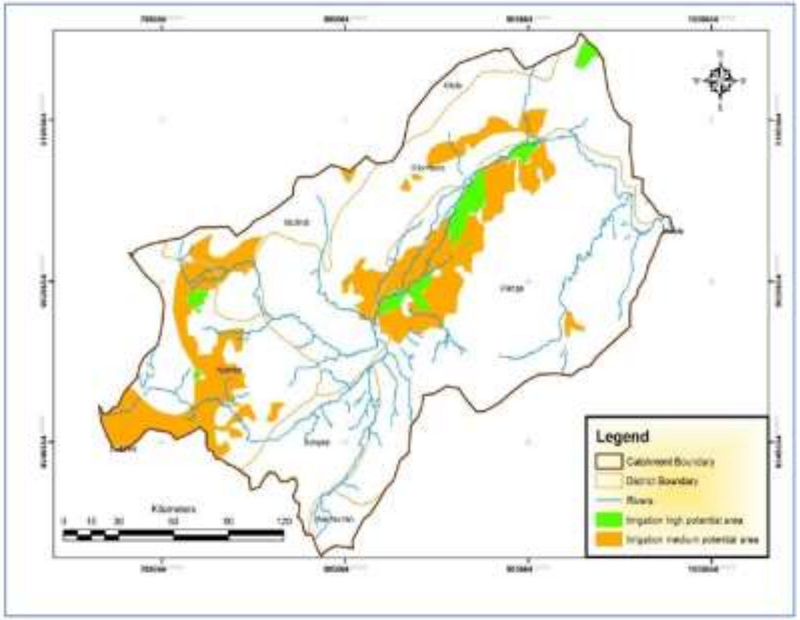
Source: Rufiji IWRMDP Interim Report, 2012

There are plans for extensive areas of irrigated agriculture

Upper Ruaha



Kilombero



- **Planned potential area up to 330,000 ha in the Kilombero (now 16,000 ha)**
- **Large areas of unlicensed irrigation in the Upper Ruaha**
- **Most modern efficient farms in Tanzania are in the Rufiji (many in the Kilembero)**

Source: Rufiji IWRMDP Interim Report, 2012, URT

There are potential large scale hydropower resources

Hydropower could increase by between 5 and ten times		
	Existing	**Planned**
Installed capacity (MW)	420	4,266
Energy output (GWh)	2,155	10,000
Value of Energy output @$80/MWh	*$172m*	*$800m*

Master system planning assumes a 60:40 split for thermal:hydropower generation

SOURCE: POWER SYSTEM MASTER PLAN; Update 2012, URT; Rufiji IWRMDP Interim Report, 2012, URT

High rice yields and/or prices are required to match potential revenues from hydropower

For example, rice must be produced at a yield of 3.7t/ha and a price of 500Tsh/kg to generate the same revenues as hydropower

Yield [tonnes/ha]		Rice - sales price [Tsh/kg]		As % Hydropower revenue (*)
1.0	Probable lowest	300	Wholesale price	**16%**
1.6	National average	300		**26%**
6.1	Very high	300		***100%***
3.7		500	breakeven	***101%***
1.9		960	Equiv. $600/t	***100%***
4.5		960		**236%**

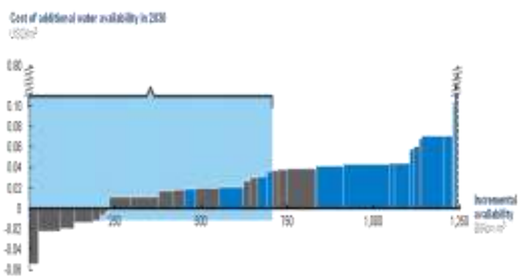
(*) if >100%, irrigated rice is preferred to hydropower on the basis of equivalent revenue

Rufiji IWRMDP Interim Report, 2012, URT; Carter Coleman private comm.

The 2030 Water Resources Group´s ACT Process

Step 1

▪ **A**nalysis to support better decisions



- Comprehensive fact base with broad agreement.
- Cost, Benefit or Risk analysis depending on countries needs

Step 2

▪ **C**onvening public-private-civil society stakeholders

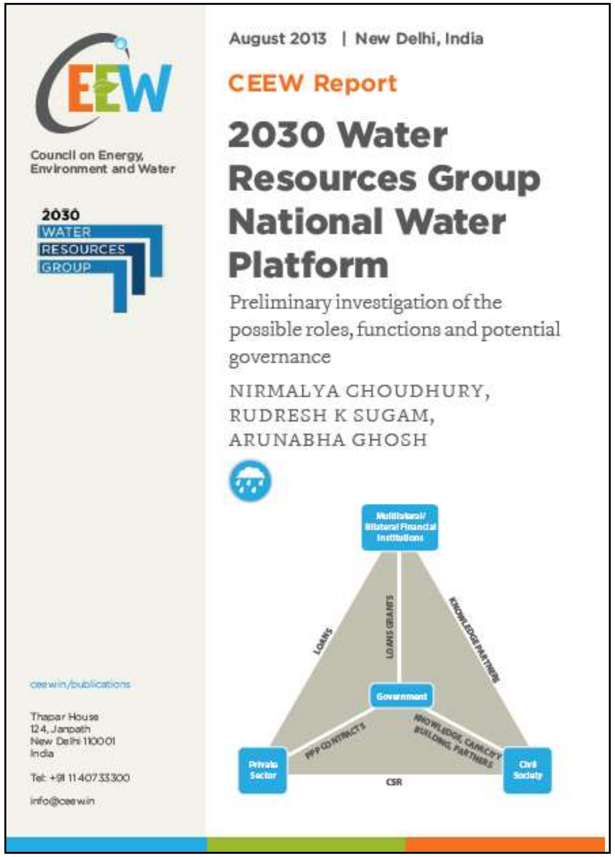
- Multi-stakeholder platforms to help government shape and take forward priority programs, plans and actions

Result

▪ **T**ransformation to higher performance and sustainability

- Concrete proposals to ensure lasting change on the ground
- Can be Programs, Plans, but also concrete PPP-proposals

Multi-stakeholder platforms in different countries



And more being developed in:

- Tanzania
- Mongolia
- Peru
- Karnataka
- India
- Maharashtra
- Mexico
- Bangladesh

Experiences from South Africa

section 6

Members & Partners

The SWPN-SA acknowledges the financial support of the following institutions

The SWPN-SA acknowledges working group chairs

The SWPN-SA acknowledges members whose commitment moves this partnership forward

- Working groups have developed concrete programs for:
  - Municipal leakage control (Incentive program)
  - PPP between upstream Mining and downstream Municipalities
  - Upgrading old an inefficient irrigation schemes

2030 Water Resources Group
Tanzania Partnership

Thank you

- www.2030wrg.org
- www.waterscarcitysolutions.org
- Anders Berntell, ABerntell@ifc.org

Swiss Water Partnership
committed to global water

Program

Setting The Scene (14.00) The Challenges; Mrs. Olga Darazs, Swiss Water Partnership.

1. Swiss Advanced Solutions (14.15 - 15.45)

1a) Managing the demand

- Integrated water and energy management solutions; Mr. Alain Sapin, Group E; Mr. Stéphane Maret, CSD Engineers
- More crop per drop with less energy: drip irrigation and solar pumping; Tim Prewitt, iDE; Urs Heierli, SoPAS

1b) Increasing the resources available

- Combined solutions: using energy in drinking water systems and in irrigation systems; Mr. Martin Bölli, Skat Consulting
- Synergies instead of trade-offs: linking sanitation to energy production and agriculture with a business approach; Mr. Christian Zurbrügg, Eawag/Sandec; Mr. Michael Kropac, Cewas/Seecon

1c) Creating shared benefits

- Joint ownership of infrastructure in a transboundary watercourse fostering cooperation of water and energy resources; Prof. Makane Moise Mbengue, Platform for International Water Law of the University of Geneva
- Blue Peace Initiative incentivising coherent policies to manage water and energy in a transboundary watercourse; Mr. Christophe Bösch, Swiss Agency for Development and Cooperation

Coffee Break (15.45 - 16.15)

2. Reality Test (16.15 - 17.30)

2a) Country cases

- Tanzania: challenges and relevance of the proposed solutions; Mr. Anders Berntell, Water Resources Group 2030;
- Water Food Energy Nexus in Iraq and Middle East; Ms. Shirouk Abayache, Ministry of Water Resources of Iraq; Prof. Nidal Salim, Global Institute for Water, Environment and Health

2b) Panel discussion

Panellists: Mr. Bob Nanes, iDE; Ms. Shirouk Abayache, Ministry of Water Resources of Iraq; Mr. Johan Gély, Swiss Agency for Development and Cooperation; Mr. Alain Sapin, Group E; Mr. Anders Berntell, Water Resources Group 2030

2c) Wrap-Up and closure;

Mrs. Olga Darazs, Swiss Water Partnership

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2a) Country case Iraq

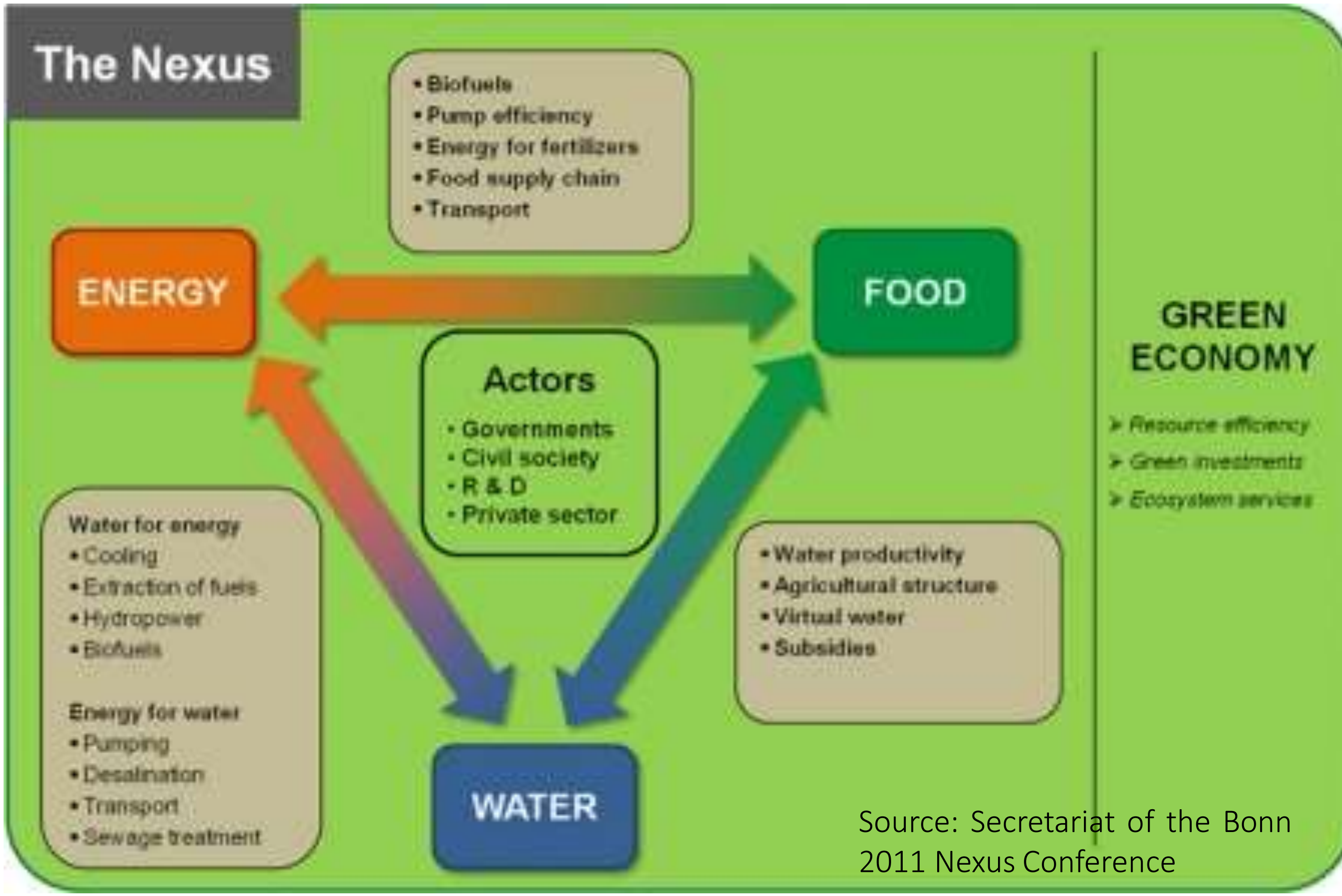
Prof. Nidal Salim,
Global Institute for Water, Environment and Health

Water and Energy in MENA region

1. NEXUS: Water, Energy and Food Security

By 2020 the MENA must create 100 million new jobs

Solutions are needed



Source: Secretariat of the Bonn 2011 Nexus Conference

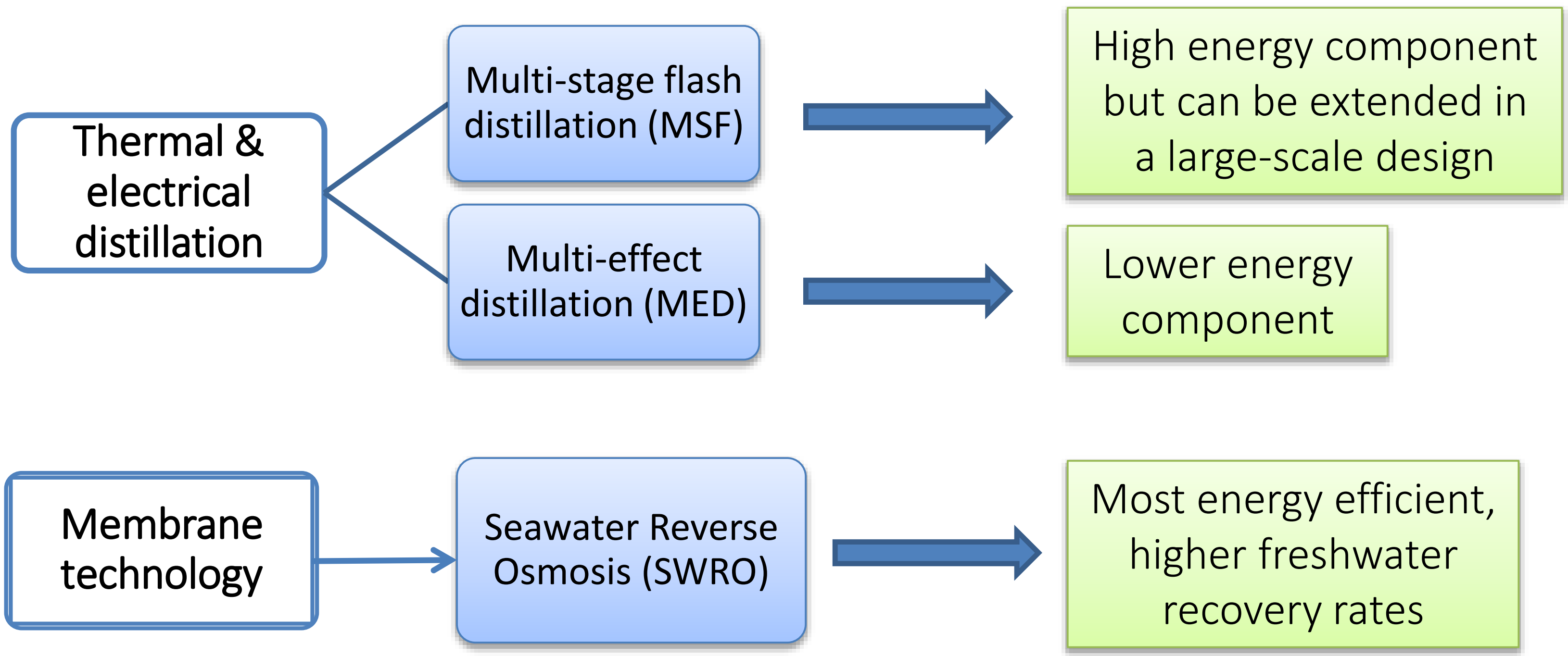
2. MENA Region : Facts

- 6% of the world's population
- Poor water but rich oil:
  - Approximately 1% of global freshwater reserves
  - About 57% of the world’s proven oil reserves and
  - 41% of proven natural gas resources (World Bank)
- The region holds 45% of global potential for renewable energy
- Experiences roughly 300 days of sunlight per year
- By 2035, the region will increase its current energy consumption by 70%

The region's harsh environmental conditions make alternative energy and water resources a factor of survival.

3. Options Available in MENA Region

3.1 Desalination technologies



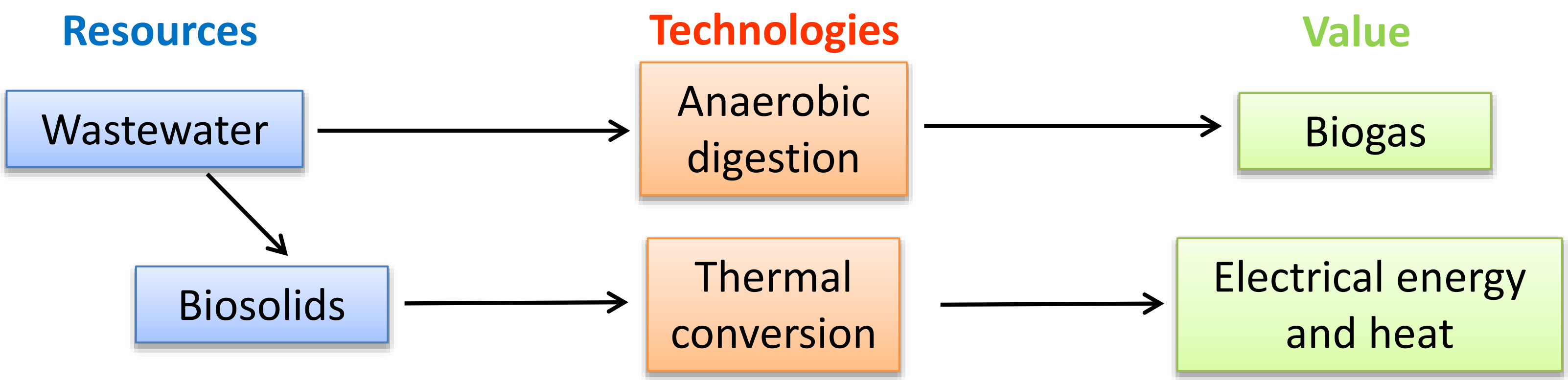
There is an increase of **SWRO** and **MED** technologies because of the cost of energy

3. Options Available in MENA Region

3.2 Waste water

Frost and Sullivan (a market research company) values the region's water treatment sector at **USD 4.7 billion by 2020**.

- **Sewage Water Energy Recovery**



- **Combined Power and Desalination** (especially *Concentrated Solar Power*) to produce drinking water **and** electricity
  - ✓ Alleviates the carbon footprint of desalination due to its heavy reliance on fossil fuel
  - ✓ Decreases of the cost of desalinating water

3. Options Available in MENA Region

3.3 Renewable technologies

Less than 1% of the desalination capacity worldwide

Most used technologies :

1) Solar thermal
2) Solar photovoltaic (PV)
3) Wind

Need INVESTMENT and POLICY for new technologies

Two essential factors : **SCALE** and **COST**

- Technologies classified by **range of application**

Scale

Solar stills | **Solar PV** | **Wind/Geothermal** | **Concentrating Solar Power**

- Technologies that are **competitive** : Solar stills
- Technologies that are **almost competitive** : Wind RO, Solar CSP and Geothermal

4. Examples of Local Initiatives

- **Tunisia** - **Saphon Energy** was created in 2009
  - This "zero-blade" technology, an innovation that differs from traditional bladed turbines, was inspired by the sail boat's process to capture kinetic energy from wind
  - The technology has been patented and is being registered in 70 different countries.

- **Jordan** - **Reyah** is a vertical wind turbine customized to meet MENA's wind speeds where Jordan currently imports 96% of its energy.

- Launched in 2002, **Millennium Energy Industries (MEI)** patented solar desalination and cooling technologies with a core focus on solar heating solutions
  - Between 2008 and 2010 MEI grew over 700% and in 2012 was named Jordan's fastest growing company.
  - In 2011, in Saudi Arabia they engineered and implemented a 25 MW solar heating project, the largest in the world, and now expanding to the EU and Chile.

5. Potential Trade-Offs : Opportunities

- Governments need to **reform planning and monitoring processes**. Integrated planning is necessary to evaluate and address trade-offs where water allocation is often planned irrespective of future demand for power.

- **Transparent and inclusive processes**: Planning and decision-making allow for a thorough assessment of conflict of interests and contribute to designing mitigation and compensation measures to minimize political instability.

- The **private sector**'s is critical for finding commercial opportunities.

- Supportive policies are needed for smaller scales but back-up large-scale dissemination of these solutions.

- **Development actors** need to play an increasing role in facilitating cross-sectorial engagements drawing on their extensive portfolio of technical and financial cooperation projects with local partners.

6. GIWEH's Role

Bringing new dialogue and technologies to the table

- **Work with key actors** to advance the efficiency of processes (a closer alignment between the academic and private sectors)
- **Support strategy and policy** by promoting environmentally-friendly and sustainable long term approaches (combine wastewater treatment, the reuse of energy production from sludge, carbon-neutral solar desalination)
- **Support innovation and creativity in the youth** through training programs
- **Develop innovative and resilient solutions**. Such solutions are to be found in nexus approaches that take into consideration specific socio-economic and political contexts of each country.
- **Support local entrepreneurs** to contribute to sustainable solutions.
- Ensure more funds are focused on clean-technology and renewable energy
- **Enhance research and development** by simply increasing exposure for the players in this field which can generate new incentives and interests.

Thank you !

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committed to global water

Program

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- Mr. M. Sapin, Group E;
- Mr. Anders Berntell, Water Resources Group 2030
- Mr. Chris Zurbrügg, Sandec/Eawag

Moderation

- Ms. Agnes Montangero, Swiss Water Partnership

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2c) Closure

Olga Darazs
Chair of the Swiss Water Partnership

Concluding remarks, next steps and closure

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Many thanks for your attention