ENERGY USE FOR WATER TREATMENT IN DRINKING WATER UTILITIES: OPPORTUNITIES FOR OPTIMIZATION

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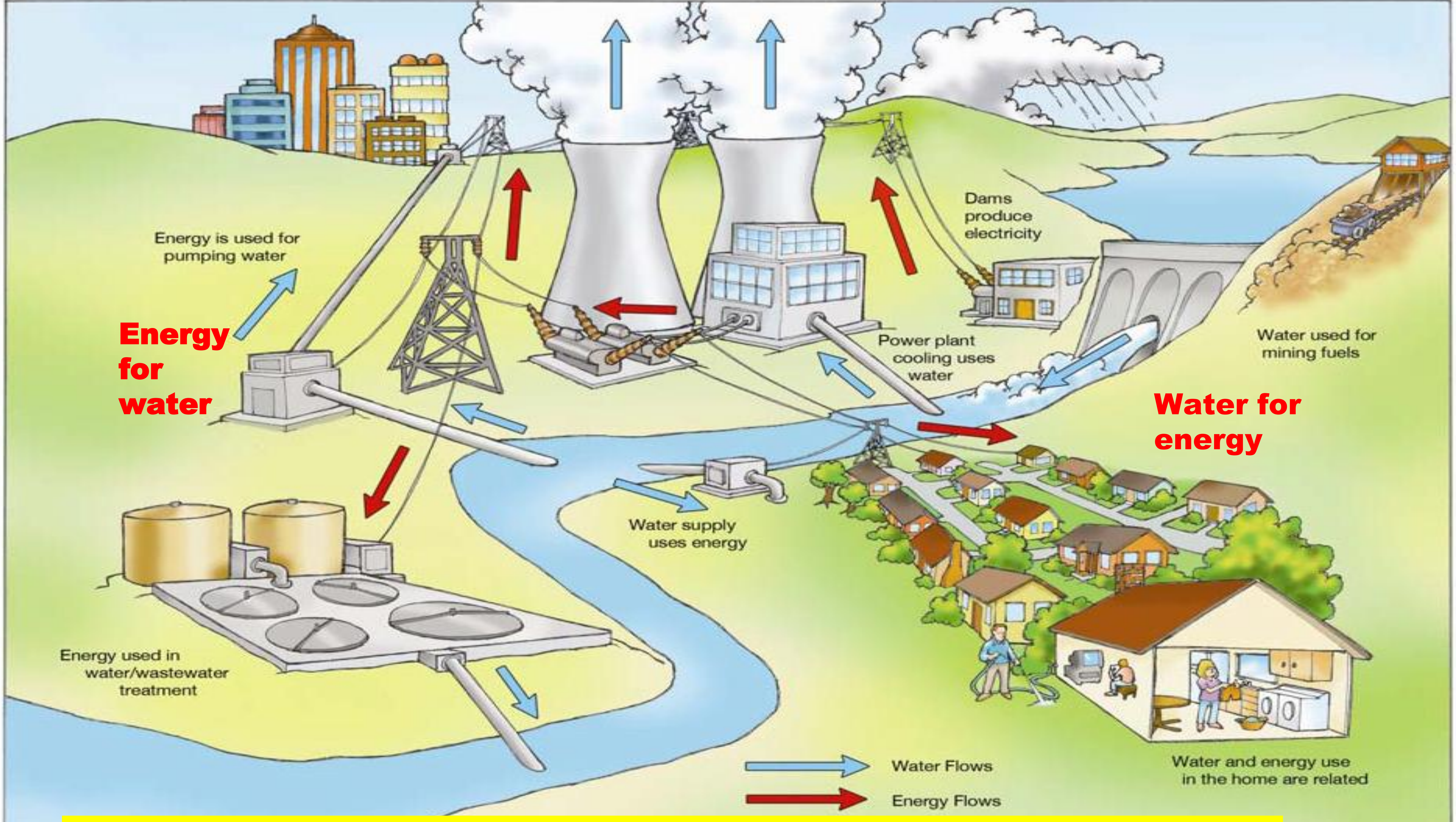
INTRODUCTION

- Water and energy are intricately related ; **shared vulnerabilities & opportunities**

- The integral relationship between water and energy (W-E Nexus) is not widely understood/ insufficiently exploited through uncoordinated, semi-holistic efficiency approaches in policy formulation("Silo mentality").

- Water and energy efficiency entails provision of quality services at minimal cost, balancing the trade-offs through technical & managerial improvements



Source : DOE, 2006

Fig 1: Summary of Water –Energy Nexus

INTRODUCTION

- Drinking water utilities are energy intensive; > 60% of total operational costs depending on size, age, source and quality of raw water.

- Nevertheless, estimates of as high as 35-45% NR Water losses in the distribution system in some utilities

INTRODUCTION

- Kenya is "water scarce" with per capita water availability highly influenced by **supply/demand drivers**

Water facts	
Per capita water availability (m^3/year)	643
Total water withdrawal (10^6 m^3/year)	3220
Municipal water withdrawal (10^9 m^3/year)	1.18 (37%)
Total water withdrawal per capita (m3/inhab/year)	75.6K (10% of Total Renewable Resources)

FAO, 2012

- Water Act 2002 separates policy formulation, regulation and services provision; defines decentralized institutional framework and allows for the privatization of drinking water utilities.

- Opportunities exist in the water production and distribution cycle for energy savings but **Fundamental Data on Energy use and Efficiency in dwu unavailable /scattered**

METHOD OVERVIEW

Data

- Documentation of energy consumption for water treatment processes in selected drinking water utilities

Scenario building

- Scenario building on energy demand/use as a function of shift in water supply and demand drivers

Energy optimization

- Explore practical intervention measures to optimize energy utilization in drinking water utilities

Energy for water scenarios

- Compile quantitative energy use for water projections consistent with global scenario processes based on three IPCC shared socio-economic pathways (SSPs);
- Harmonize statistical data and modeled estimates of water supply and demand drivers and effect on energy demand/use in Kenya (Wesim Model)
- Explore practical intervention measures for energy optimization and possible trade-offs to be discussed with stakeholders (cost benefit analysis and possible trade-offs)

Energy consumption vs water production

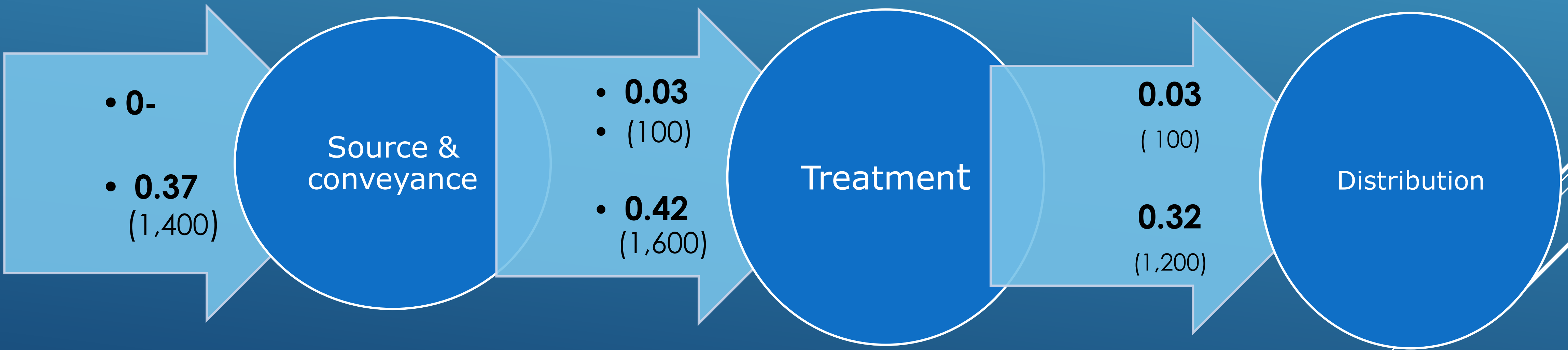
Drinking water utility	Pop. Served	Total monthly water production (M^3)	Energy consumption (kWh/M^3)	Total monthly energy cost (Euro)	NRW	Age of pumps	Pumping efficiency
Kiambere-Mwingi	42,000	4.2 M	0.9	35,000	40%	18 yrs	65%
Nyeri	164,781	20.4 M	0.7	150,000	22%	8 yrs	75%
Thika	190,300	14.8 M	0.9	90,000	37%	20 yrs	65%
Nairobi	3 M	120M	0.85	290,000	38%	10-12 yrs	65-75%

Energy/Water saving intervention measures

Intervention	Energy savings/yr	Water savings/yr	Total cost savings/yr	Other benefits	Payback period
Pressure management (SA)	14M kWh	8,000M^3	3.8M $US	30% (Water loss reduction	3 months
Prepaid metering, behavior change (SA)	15.4M kWh	6,000M^3	3.5M $US	10-95% payment rate increment	<3yrs
Energy Audits (India)	3.8M kWh		336,000$US	10% more supply no additional capacity	<1 yr
maximizing existing pump systems efficiency, storage (Brazil)	88M kWh		2.5M $US with an Investment of $1.1M	88,000 new connections over the original baseline	4 yrs

Source: Watergy 2007 :**The Alliance to Save Energy**

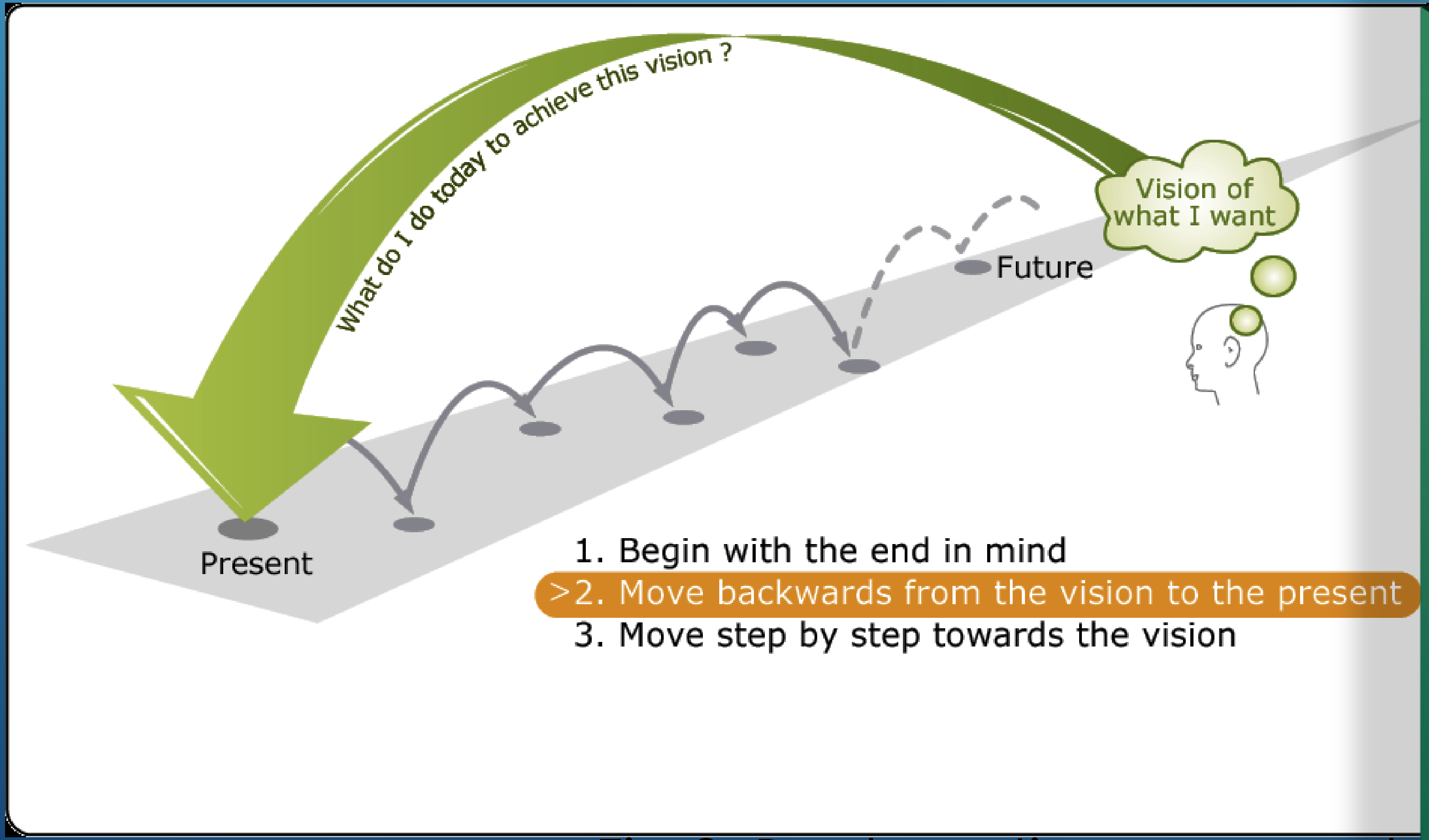
Energy intensities in water treatment processes (kWh/M^3)



MAJOR CHALLENGES FACING DRINKING WATER UTILITIES IN KENYA

- Non-revenue water (illegal connections)
- Aging infrastructure
- Lack of investment
- Technological shifts
- Lack of energy management plans

ENERGY MANAGEMENT PLANNING

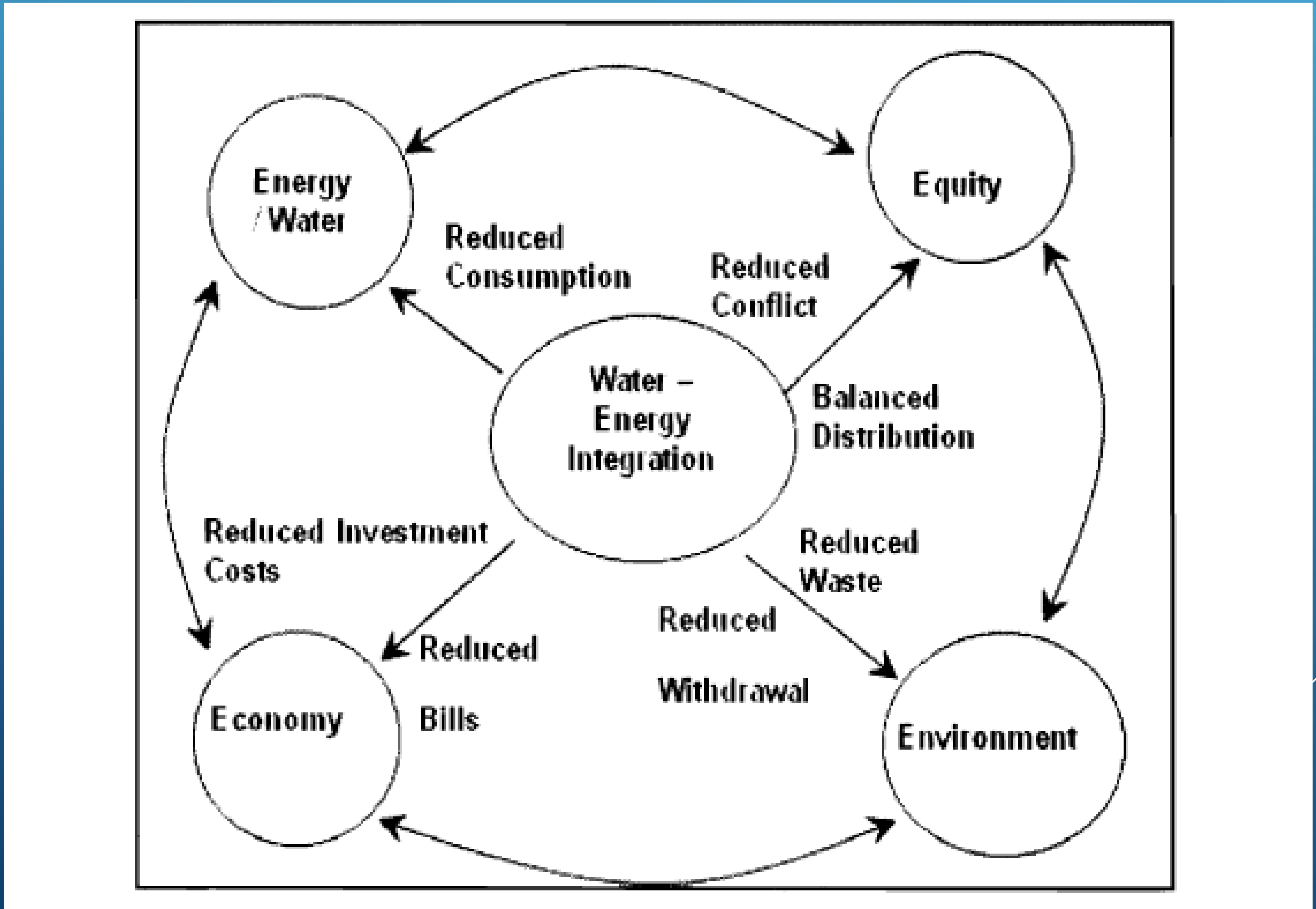


Source : Natural step, 2012

Fig 2: Back casting approach

- Definition of the problem
- Develop a vision for the future
- Decide on means to get there
- Implement and evaluate often
- Adjust accordingly until desired target is achieved

Integrated Water-Energy planning



CONCLUDING REMARKS

- Potential exists in saving energy for water ; energy generation at abstraction points and exploration into renewables.

- Harmonization of Energy and water policies allow for better planning and savings for energy and water

- The success of any intervention measure dependent on technology; local capacity to implement; age of infrastructure

THANK YOU