Faculty of World Economy and International Affairs

Master's Programme
Environmental Economics and Sustainable Development

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Introduction to Environmental Economics
Part 8: Water Resources & Systems
Lecture 4: Introduction to the Water Sector Economics

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CONTENT

A quick reminder of Lecture 2: specificity of the water sector impacting its costs & financial status.
The Public good dimension of water and water services (essential Good & Service) and the **Human right to water**

!! Ownership rights vs the right to use water resources & systems.

(1) the right to use water: special water use permit vs free use (for HH own needs vs hydraulic fracturing); allocation regime (rules)

Economic rent extracted from using water resources & bodies (natural resource & systems) and Instruments to appropriate the rent. Options for water tax / water use fee base. Other instruments

(2) the right to use water systems (prohibition on privatization of immobile part of fixed assets; delegated management contract, lease & concession agreements).

!! **Prevention of monopoly rent appropriation & Objective function of water system operator**.
Performance-based contracts & most relevant KPIs.

Ultimate sources of finance for water: tariffs, taxes and transfers (3Ts)

- issues related to water pricing (incl. accurate metering); Regulated tariffs vs establishing prices through competitive tender;

- state support to the water sector & vulnerable consumer groups. Tax revenue recycling: ear- marking financial resources for water

!! Factors impacting the economic and financial health of water operators

DSTs: incl**.** for Economic & financial modelling – the case of FPTWU, FEASIBE & WHAT-IF (all by the OECD)

Specificity of municipal WSS impacting its costs & economics: Demand side

- **Water is an essential good, having no good substitutes.**

Essential good (жизненно-необходимый продукт) ==>

- **human right** to water and sanitation recognised by the UN GA; and

- the need to guarantee to each citizen access to water (i) irrespectively of the behaviour of other consumers (==> specific technical requirements to WSS systems), and (ii) irrespectively of his/her expenses for other Goods & Services (**G&S**).

Absence of any good substitute (not to speak about a perfect one) ==> very limited room for indirect competition on the food&drinks market (e.g. from producers of milk, beer or Pepsi) ==> & measures to address water affordability constraints (see below)

- **the Demand for WSS services has low income and price elasticities (typical for essential G&S); and is not procyclical** (unlike the demand for real estate or luxury goods)

Over 1990ies, in many cities in EECCA the water utility (*vodokanal, in Russia*) was top 5-10 employer, and in some towns (e.g. in depressive *marzes* in Armenia) - **the only** employer.

On the negative side, it implies that affordability constraints become more tough when either income falls or WSS tariff increases faster than income grows.

- Further more, the demand for water in each specific settlement very much depends on:

- demography and migration, incl. labour migration (typical for many post-Soviet republics); and

- structural reforms in the economy (e.g. water intensive enterprises & sectors) ==> **high uncertainty over crisis or reform periods**

Specificity of municipal WSS impacting its costs & economics: Supply side

- **Water supply and sanitation (WSS) represent a combination of a public and private good & service (G&S)**

  Good - the amount of water a user gets from the tap

  Service - ability to get water in/near his/her dwelling at any time

  Public G&S are typically provided by the State to everybody for free. While consumers pay price for private G&S they consume

- **WSS - is one of the most capital intensive infrastructure sectors** (per person connected / served)==>

  - large upfront investments; and

  - high O&M costs and capital replacement costs (replacing deteriorated fixed assets).

- Moreover, **fixed assets in the water sector have significant lifetime** (50-100+ years) ==> a long payback period for investment;

- **key elements of water infrastructure systems (e.g. pipeline and pumping stations & treatment plants) has the feature of natural monopoly with a high economy of scale** ==> an obstacle for developing competition on the market

- **High sunk cost & transaction specificity of fixed assets** (the value of assets out of operation is much lower than their historical value on the accounting books) ==> the price of eventual mistakes in making investment decisions could be very high and paid over decades.

- **Significant variation of specific consumption of some main inputs, not least electricity**: unlike processing industries, where the difference in specific electricity consumption (per unit of output) between best & worst performing enterprises might be +/- 20%, in the water sector it could be up to 10-15 times!

Ownership rights vs the right to use WR & Systems

Many countries prohibit privatization of most water bodies (lakes, rivers, GW reserves) - they belong to the whole nation (special case of trans-boundary water bodies)

Even the land within *water protection zones* *(водоохранные зоны)* cannot be privatized (public property), and countries restrict the use of such lands (no civil construction): e.g. in the EU: within XX metres from the river or lake bank, or 300 metres fm the surf line (*линия прибоя*)
Is this requirement excessive? – see https://www.youtube.com/watch?v=HaKuAdrY0pw (linked to obligations of the *insurer of last resort*)

The right to use water:

- special water use permit (разрешение/лицензия/договор специального водопользования). Except water use for own needs of households and small family farms (no special permit, often free use) – social dimension, human right to water
- allocation regime (prioritized uses: Env flow, potable water supply to the population; irrigated agriculture; industries)

Economic rent extracted from using water resources & bodies (natural resource & nature based systems) and Instruments to appropriate the rent: water use fee, water tax. Fines for over-abstraction.

Ideally, the tax/fee rate shall reflect the economic value of water for each specific water use. Options for water tax (water use fee) base:

- water intensive industries: XX national currency units (NCUs) per 1000 m3, or per unit of output (e.g. per 1 hL of beer, or soft drink);
- hydropower: XX NCUs per 1000 m3 or per kWh of electricity generated;
- Irrigation: XX NCUs per 1000 m3 or two-tier tariff (per ha of irrigated land + volumetric), other agriculture : per 1000 m3
- commercial fish farming: per ha of surface water body used
- water transport – per km 2 of water area used for navigation

Instruments to eliminate any damage to WR, or monetary compensate for it (Lecture 5).

Ownership rights vs the right to use WR & Systems - 2

The right to use water systems (prohibition on privatization of immobile part of fixed assets)

Alternative **options for private sector participation (PSP)** - delegated management:
- management, lease or concession contracts. Typically, the private partner is selected through competitive bidding

Criteria:

- Technical (experience, quality of staff and of tech. proposal etc.)
- Financial (for fully-fledged concessions): the theory recommends: minimal tariff profile over the concession period

Risk sharing: each risk is levied on the Party best placed to manage it, at least costs.

Selection of appropriate legal form (affordability constraints):

- Management contract: if the tariff fully covering O&M costs will not be affordable to a large proportion of the population
- Lease contract: the tariff fully covering O&M costs will be affordable but not the tariff covering also capital costs
- *Affirmage* (Fr.: lease with some investment obligations), BOT etc.: tariff will fully covers O&M and capital costs (+ ENV + resource costs)

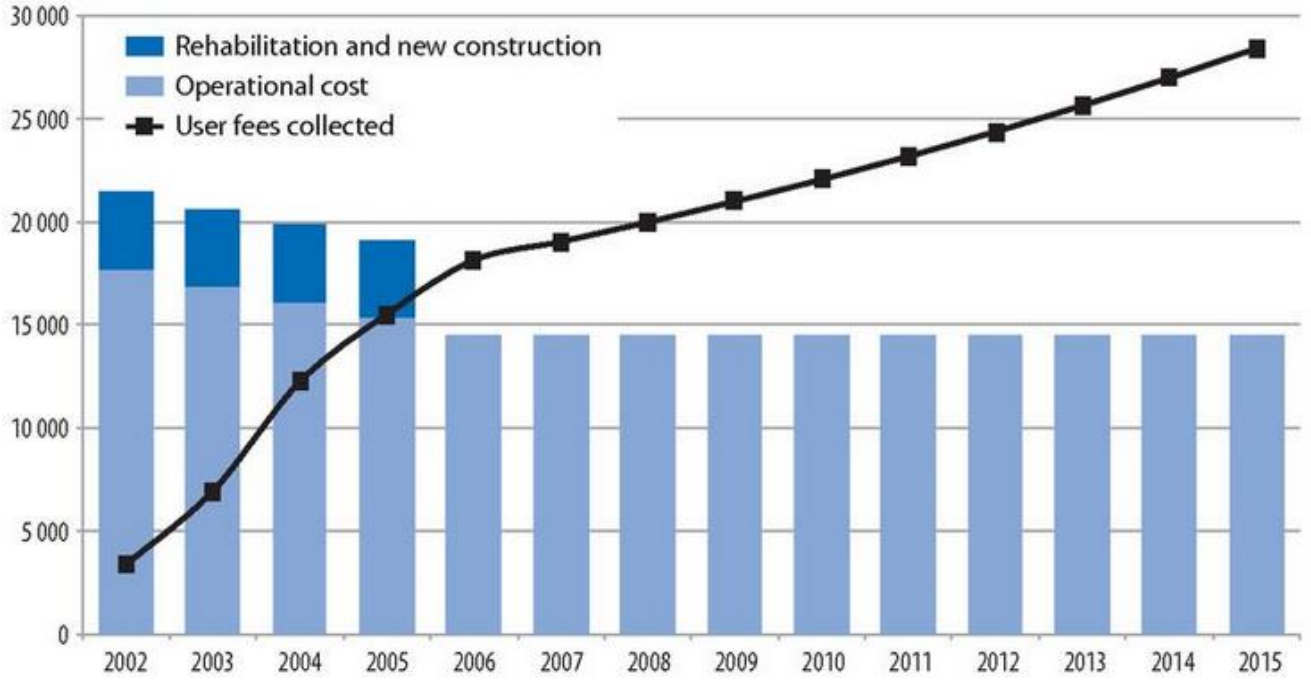
Performance-based contracts & most relevant KPIs: site specific, 3-5 max. Not 40-50 KPIs, please (more details in next lectures)

!! Prevention of the monopoly rent appropriation & Objective function of water system operator: ***no profit maximisation*** (as per Micro - 1, 2)

The objective is to fully cover financial costs of the operator who should get also a fair return on the capital it has invested (in the utility sector: regulated return at some 10-15% per annum. Alternatively, the tariffs as per contract, with regular adjustments to reflect the recent inflation)

Would lease be a viable PSP option in WSS in Armenia in 2002-2005?

Figure 5.2. **Expenditure needs versus collected user charges in Armenia (million dram)**



Source: OECD/EAP Task Force, Ministry of Finance and Economy of the Republic of Armenia (2004), *Financial Strategy for Urban Wastewater Collection and Treatment Infrastructure in the Republic of Armenia* (in English and Russian), prepared by COWI Moscow (*www.oecd.org/dataoecd/51/10/34596126.pdf*).

Factors impacting the costs and financial health of water operators

Technical norms & rules (СНиПы)

ENV regulation (wastewater discharge norms, pollution fees and fines)

Sanitary rules and norms (СанПиНы)

& Economic (tariff) regulation (see next slide & Lecture 5);

Externalities – positive & negative (typically, reflected only on the consolidated balance sheet of all economic agents): Examples

Specificity of (immovable) Fixed assets (out of balance sheet under lease or management contract) & collateral issue;

NRW (factors of water losses: # and size of holes & pressure: **Losses** (in m3 per day) = Coeff*(**Size of the hole**, in sm2)*Sq.root (**Pressure**) – the cases of: (i) water losses in Yerevan City; and (ii) a lake of oil under the industrial site of a refinery.

Collection efficiency & commercial losses, depending on collection mechanism (accounts receivable to cash revenue, ratio; inflation) & working capital turnover rate;

Accounting rules (accrual vs cash basis) matter;

Separate cost accounting by type of activities (options for manipulation and rent extraction).

Ultimate sources of finance for water (3Ts)

Repayable sources vs Ultimate sources

Ultimate sources of finance for water: **tariffs, taxes and transfers (3Ts)**

Tariffs. Issues related to water pricing:

- water consumption norms vs volumetric tariff, and two–part tariff; cost + , RAB and other tariff structures
- the challenge of establishing fair tariffs in settlements with high seasonal population
- regulated tariffs vs establishing tariff through competitive tender.

State support to the water sector & vulnerable consumer groups:

- justification of the support, its forms and **cost-effectiveness**

- affordability criteria: the water bill no more than 2-5% of HH disposable income.

Water Tax / water use fee revenue recycling vs (co-)funding from the general public budget :

- the challenge of assessing the true economic value of water for each specific use
- ear- marking financial resources for water (e.g. the case of France)

IWRM, EU FWD & OECD principles for water sector financing

IWRM Principle 5. Financial stability of water management and the use of economic instruments

The protection and use of water resources should be carefully managed. There is a need for stability in the institutions responsible for water resources and in water policy implementation to maintain the availability of water resources for multiple uses at present and in the future. Among other things, **this requires sufficient financing** for water governance, water infrastructure and the provision of water services. Water demand management should provide strong economic incentives for water conservation and protection, and promote water savings.

Four key principles for sustainable financing of water resources management have been identified (OECD, 2012): the Polluter Pays principle; the Beneficiary Pays principle; Equity; and Coherence between policies impacting the water sector.

Some **well-designed economic instruments**, such as water tariffs and pollution charges, have already been developed to implement these principles (for details see Lecture 5, upcoming).

EU WFD: water pricing, based on the polluter pays, beneficiary pays, and full costs recovery principles (including ENV & resource costs) to provide incentives for economic, more efficient water use and water savings, water conservation and protection and for reducing water pollution ;

OECD Council Recommendation in water: Ensuring sustainable finance, investment and pricing for water and water services

It RECOMMENDS that Adherents set up measures for the sustainable financing of water services, water infrastructures, water resources management and protection of water-related ecosystems.

To that effect, Adherents should: 1. Consider the following **four principles** for financing water resources management: Polluter Pays, Beneficiary Pays, Equity and Coherence between policies that affect water resources. 2. Aim for the greatest social returns to investment. 3. Consider diversifying revenue streams and tapping into new sources of capital, where needed and in line with policy objectives. Further,

It RECOMMENDS that Adherents **consider establishing pricing instruments where appropriate and applicable... Considering transaction costs,** including administrative costs, when designing pricing instruments and revenue management schemes

Source: https://unece.org/environment-policy/publications/integrated-water-resources-management-eastern-europe-caucasus-and

Decision-support tools (DSTs) to support economic and financial decisions

(to list just a few) **:**

1. Tools to measure progress towards internationally recognised and domestic water policy targets

1.1 Water-related SDGs and Green Growth indicators

1.2 Sets of Water (Food and Energy) security indicators

2. Planning tools for water at various levels

2.2 River Basin Management Plans

2.2 Planning Tools for MPWI: the case of **WHAT-IF model**

2.3 SFP methodology and **FEASIBLE model** for WSS planning at the national and province levels

2.4 Financial Planning Tool for Water Utility (FPTWU)

3. Tools to assess institutional and regulatory frameworks and apply PSP

3.1 PSP in water infrastructure: OECD Check list for PSP in water infrastructure

3.2 Guidelines for performance-based contracts (PBCs) between municipalities and utilities; and associated Key Performance Indicators

4. Tools to identify areas for improving water (and energy) use efficiency

4.1 Resource use and emissions balance of processing industries, including Water mass balance and Energy balance

4.2 BAT Reference documents (BREF notes) and Technical Standards

5. Applicable Guiding Principles, Guidelines and Methodologies

5.1 OECD Council Recommendation on Water

5.2 OECD Guiding principles on Water Governance

5.3 Guidelines for Reform of Rural WSS

5.4 Ability-to-Pay (ATP) and Willingness-to-Pay (WTP) assessment methodologies

5.5 Methodology for assessing subsidies (state support measures) impacting the water sector

Decision-support tools (DSTs): the case of FPTWU

Overall objective: assist water utilities in the EECCA region to reach operational and financial sustainability.

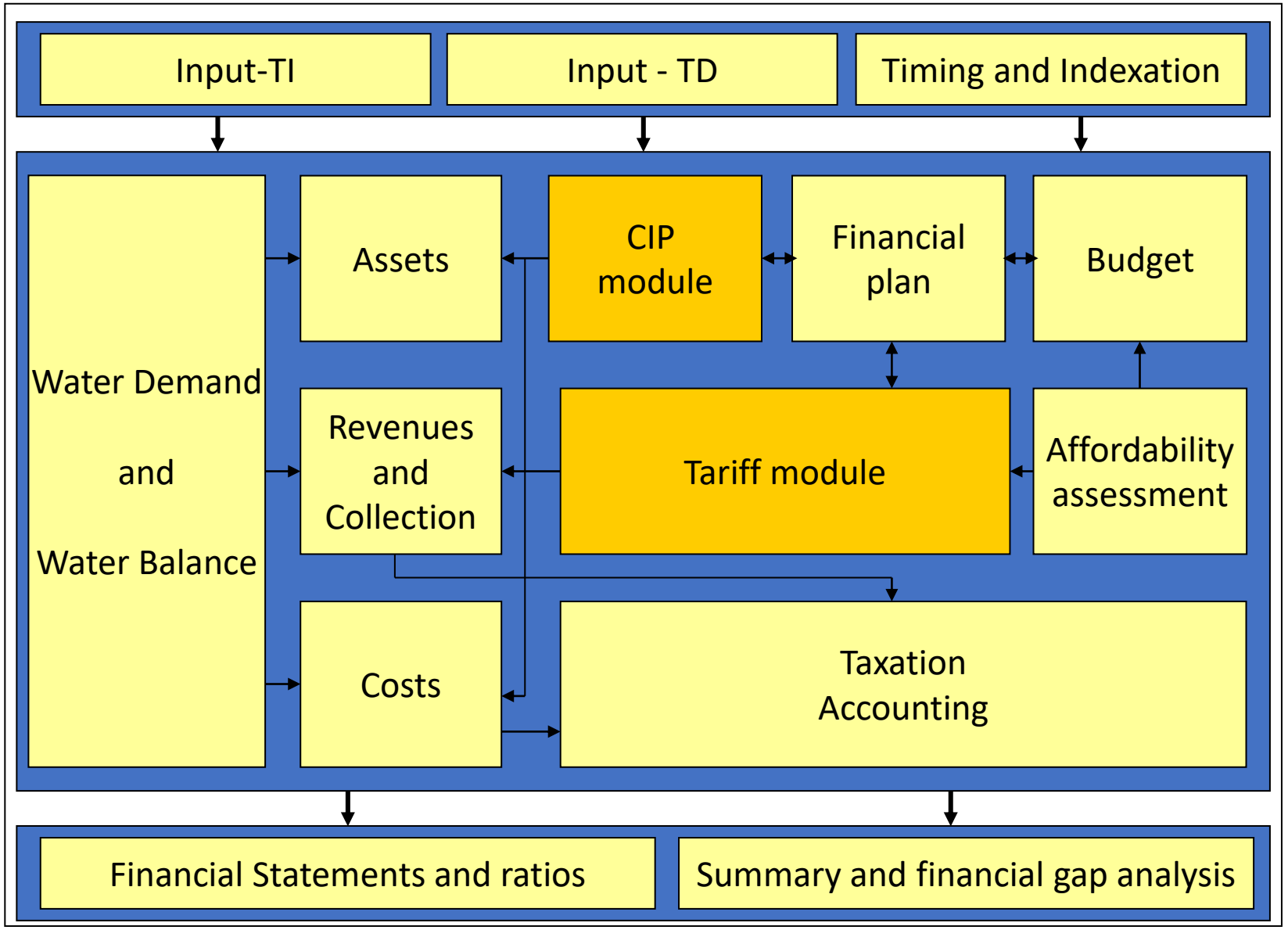
Specific objectives:

- rationalise the way their capital expenditure programme is established;
- determine the conditions for the balancing of their sources and uses of funds;
- improve the monitoring of their overall performance by analysing performance indicators output provided by the tool; and
- in the long run eventually raise finance on their own books.

Planning period - quarterly for 3 years with possibility to extend up to 20 years

Key uses : data for Decision-making, performance Monitoring & Evaluation (M&E), and Reporting

(the tool and its User Manual are in the public domain)

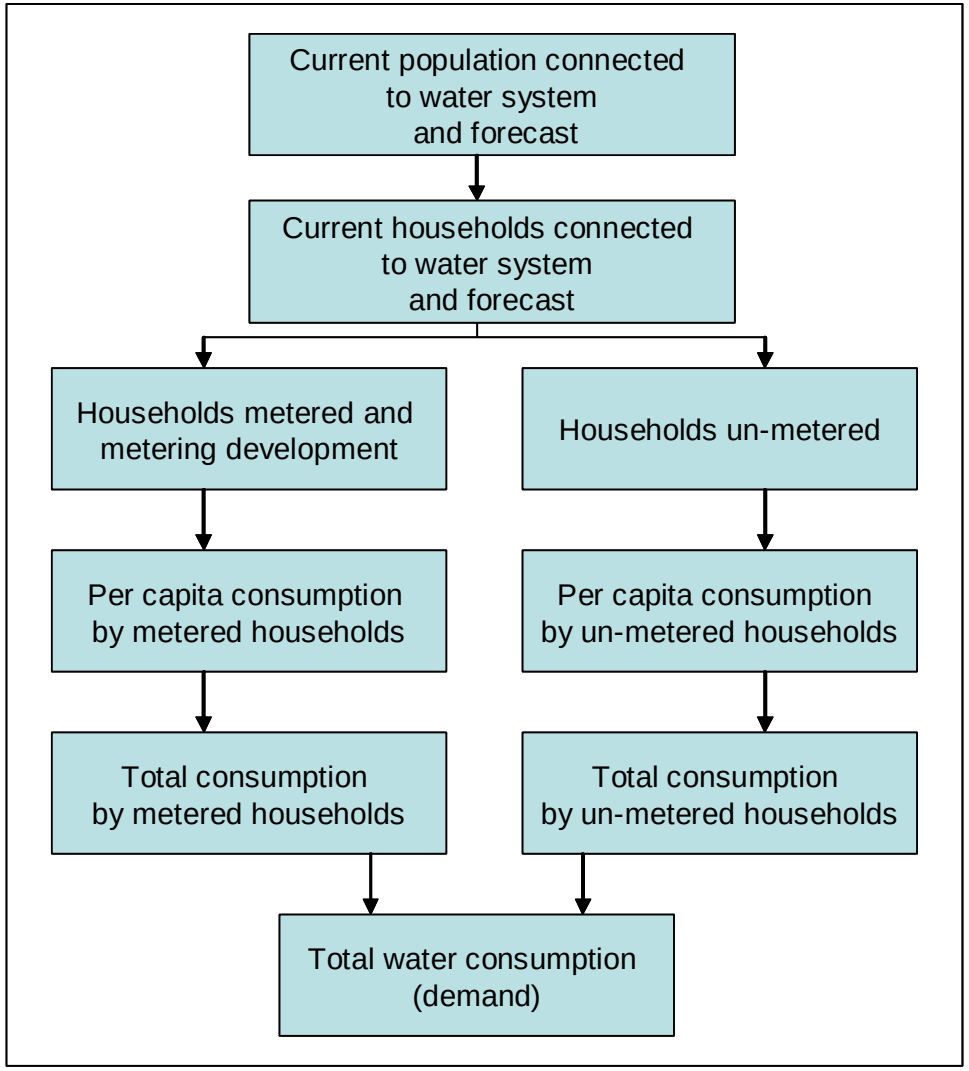


FPTWU Structure

The FPTWU input data and functionalities

DATA INPUT	CALCULATIONS	OUTPUT
• Economic • Financial • Tax & accounting • Capital expenditures • Operating and maintenance costs (fixed and variable) • Technical/engineering • Input unit prices • Demand for services • Tariff formula	• Demand projection • Tariff projections • Tariff revenues • Cost structure • Assets • Service levels • Financing • Tax schedules	• Income statement • Balance sheet • Cash flow • Capex programme • Repair schedules • Financial ratios • Affordability • Graphics module • Sensitivity analysis

FPTWU: water supply and sanitation services demand module



Decision-support tools (DSTs): the case of FPTWU; Input data requirements

Economic data

- –Inflation
- –Exchange rate
- –Interest rate
- –Per capita and household income
- –Population and household demography

Water and sanitation demand data

- –Water consumption by customer categories
- –Wastewater discharge by customer categories
- –Current normative levels
- –Metering practices: current and planned

Water and sanitation services supply data

- –Water and sanitation coverage
- –Water intake and treatment capacities
- –Wastewater treatment capacities

Technical status and assumptions

- –Infrastructure age by categories (pumps, pipes, facilities)
- –Actual or assumed infrastructure wear levels
- –Current service level data
- –Asset lifetime assumptions

Capital/investment costs

- –Asset replacement/rehabilitation plan
- –Investment cost by asset categories
- –Cost of material asset
- –Cost of civil work

Operating costs

- –Energy and input material costs
- –Labour costs
- –Maintenance costs
- –Overheads and other administrative costs
- –Cost allocation to customer categories
- –Cost allocation to water and sanitation services

Financial data

- –Tariff revenues by customer categories
- –Tariff for water supply and sanitation
- –Billing and collection data
- –Household subsidies and exemptions
- –National/regional subsidies
- –Other sources of revenue, if any

Financing

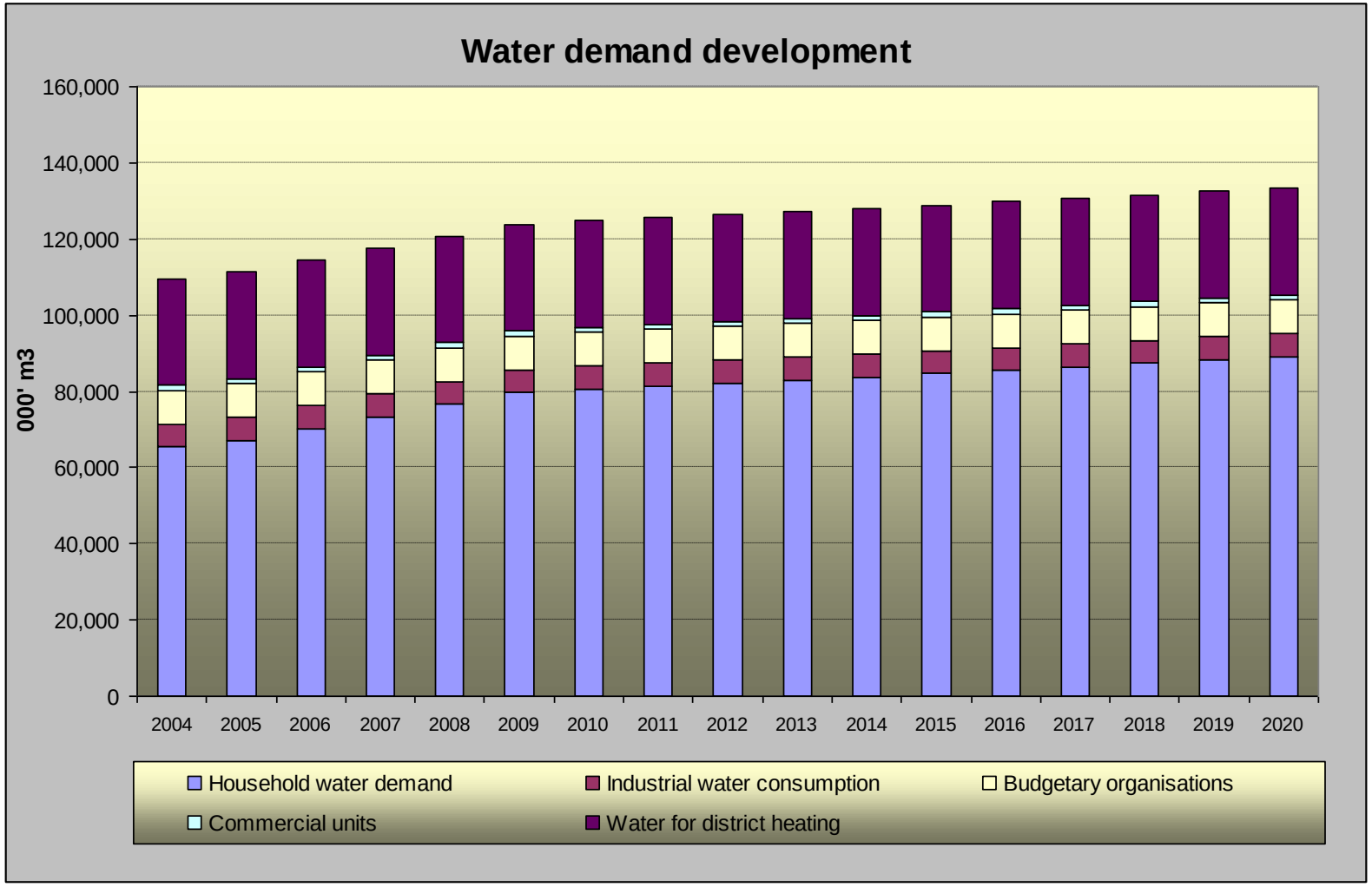
- –Creditworthiness
- –Local loan assumptions
- –International loan assumptions

Accounting and taxation

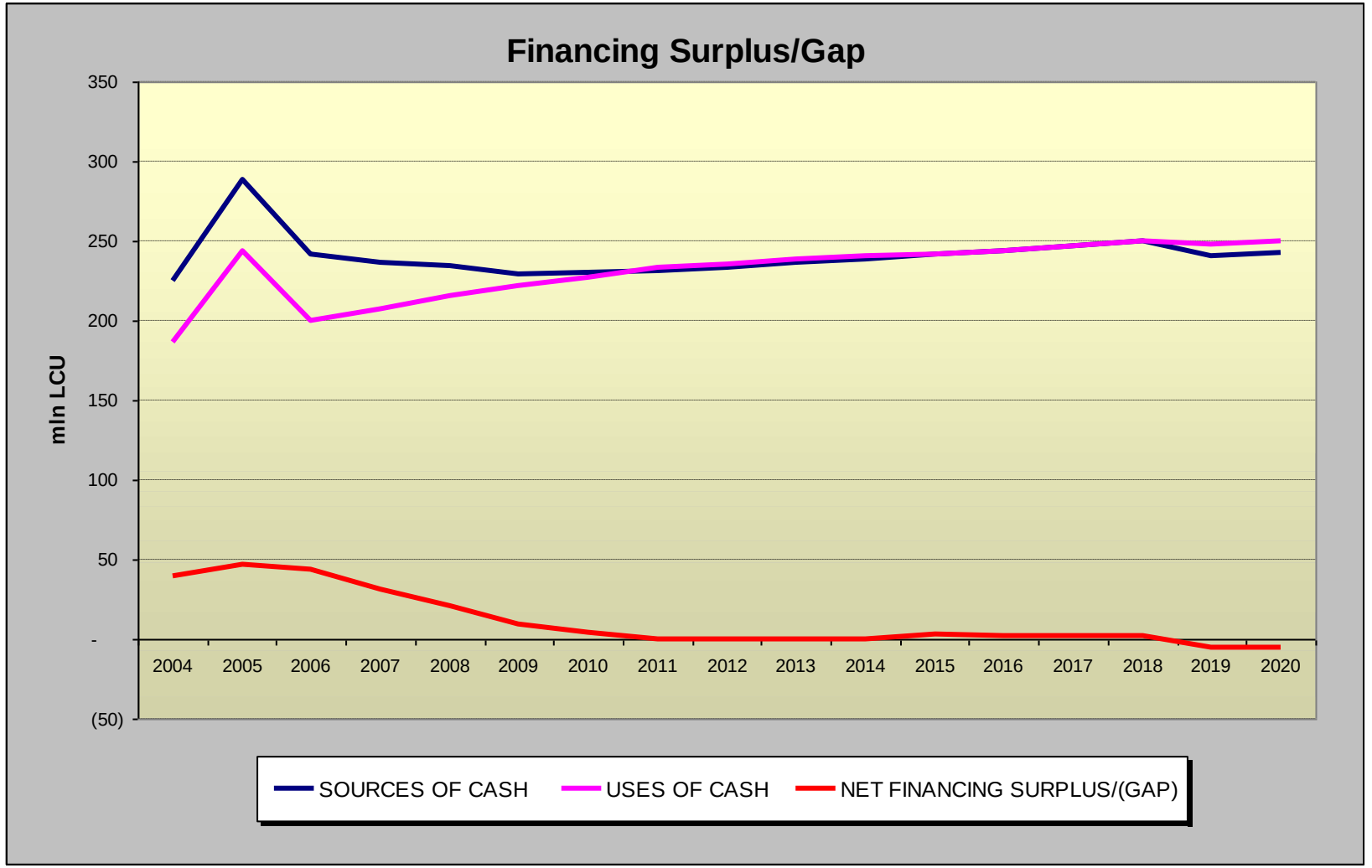
- –Depreciation
- –Corporate tax, VAT, and other tax payments

Working capital assumptions

Demand analysis



Analysis of financial gap (on cash basis)



Decision-support tools (DSTs) : the case of FEASIBLE

Financing for Environmental, Affordable and Strategic Investments that Bring on Large-scale Expenditure (FEASIBLE)

Main intended purpose: to help local policy and decision-makers develop feasible financing strategies for WSS at the national or province level.

Water governance & sector management challenge(s) the tools help address:

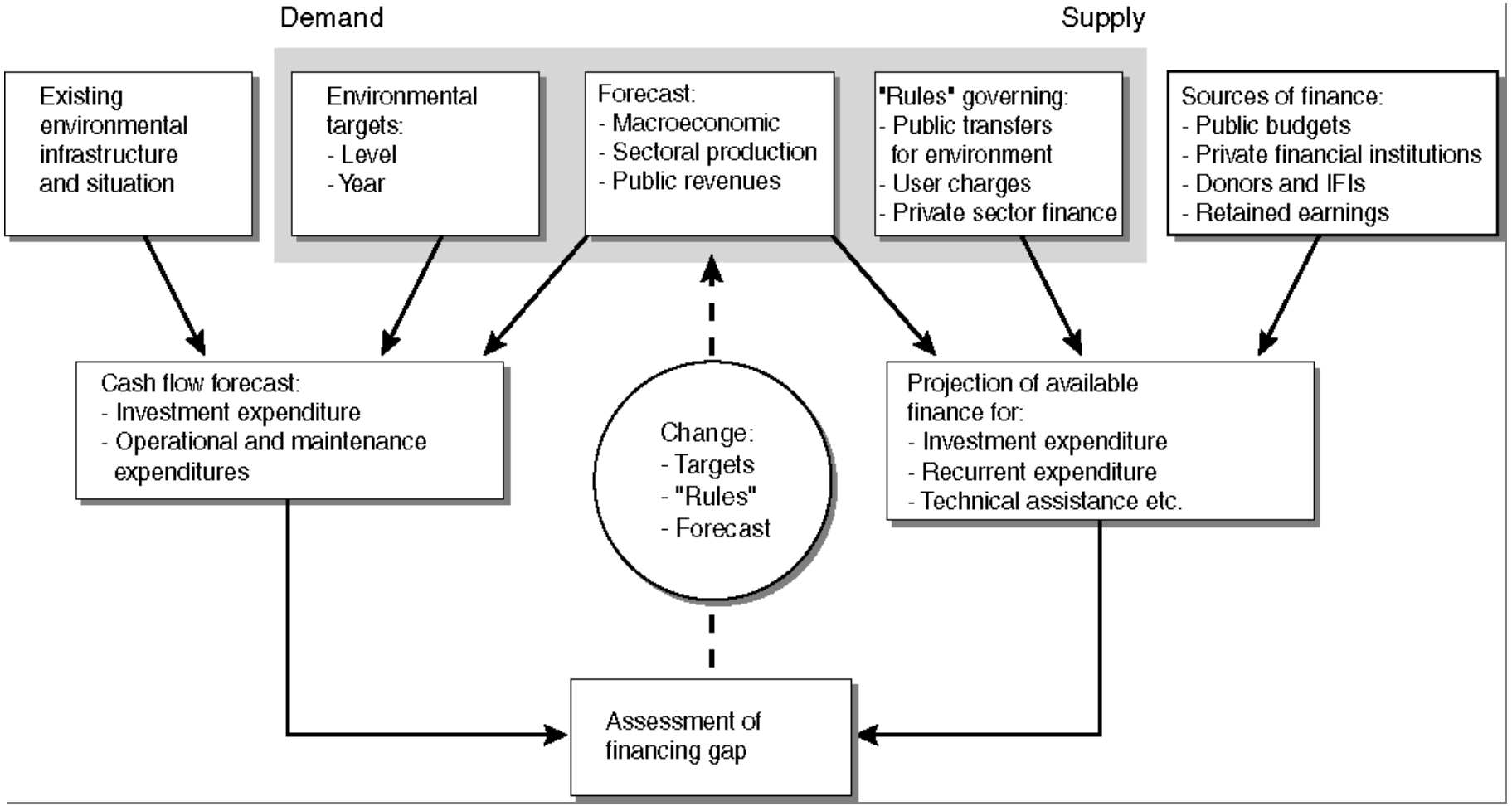
- setting SMART and financially feasible targets for WSS sector development **at the national or province level**, taking into account the affordability constraints for the population (households) and the public budget;

- prioritising the targets for, and related investment in, WSS;

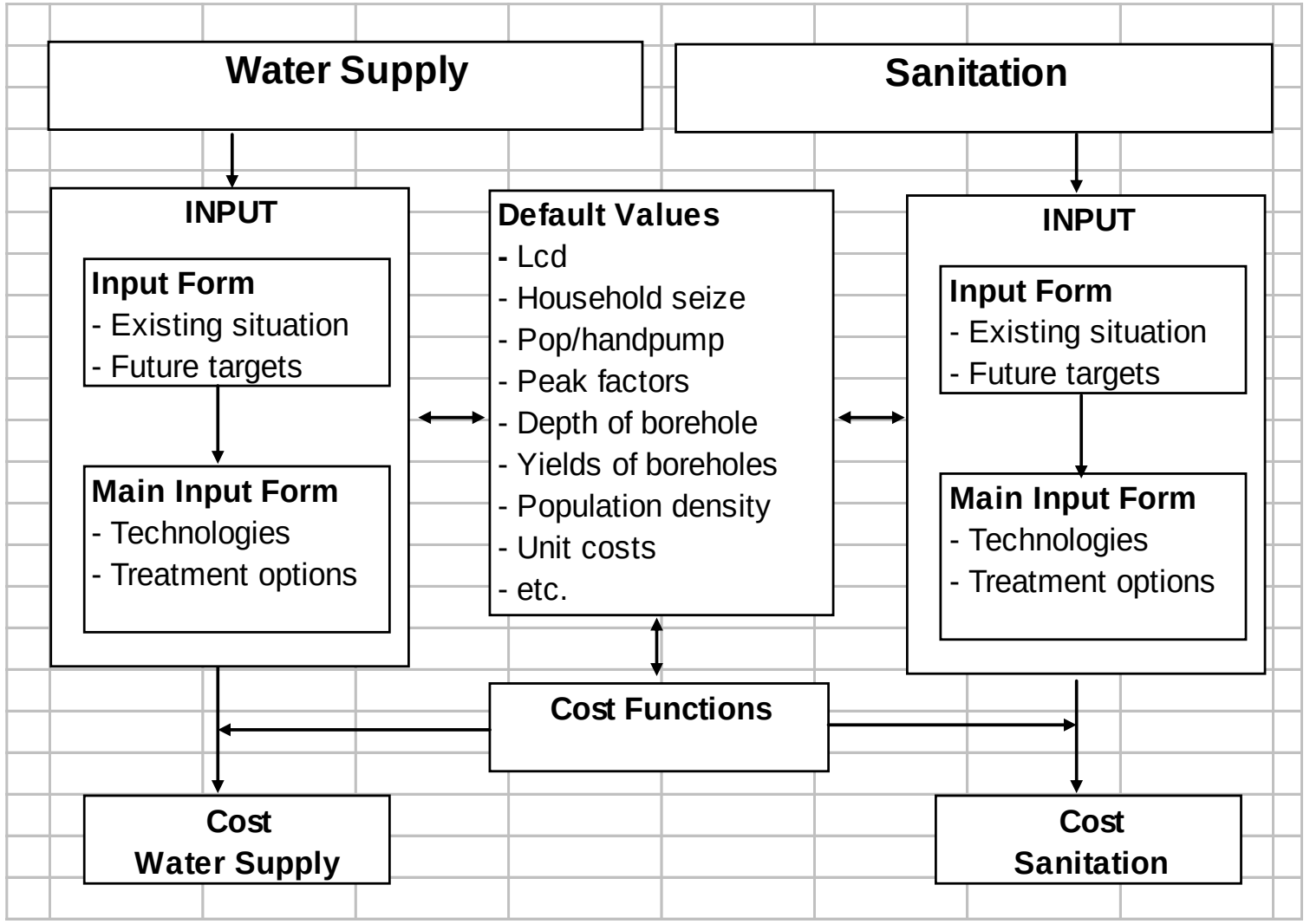
- projecting required and affordable tariff rates profile and state support to the sector from the public budget;

- assessing what PSP options (management contract, lease, full concession with investment obligations) are financially feasible presently and would be feasible over the planning period.

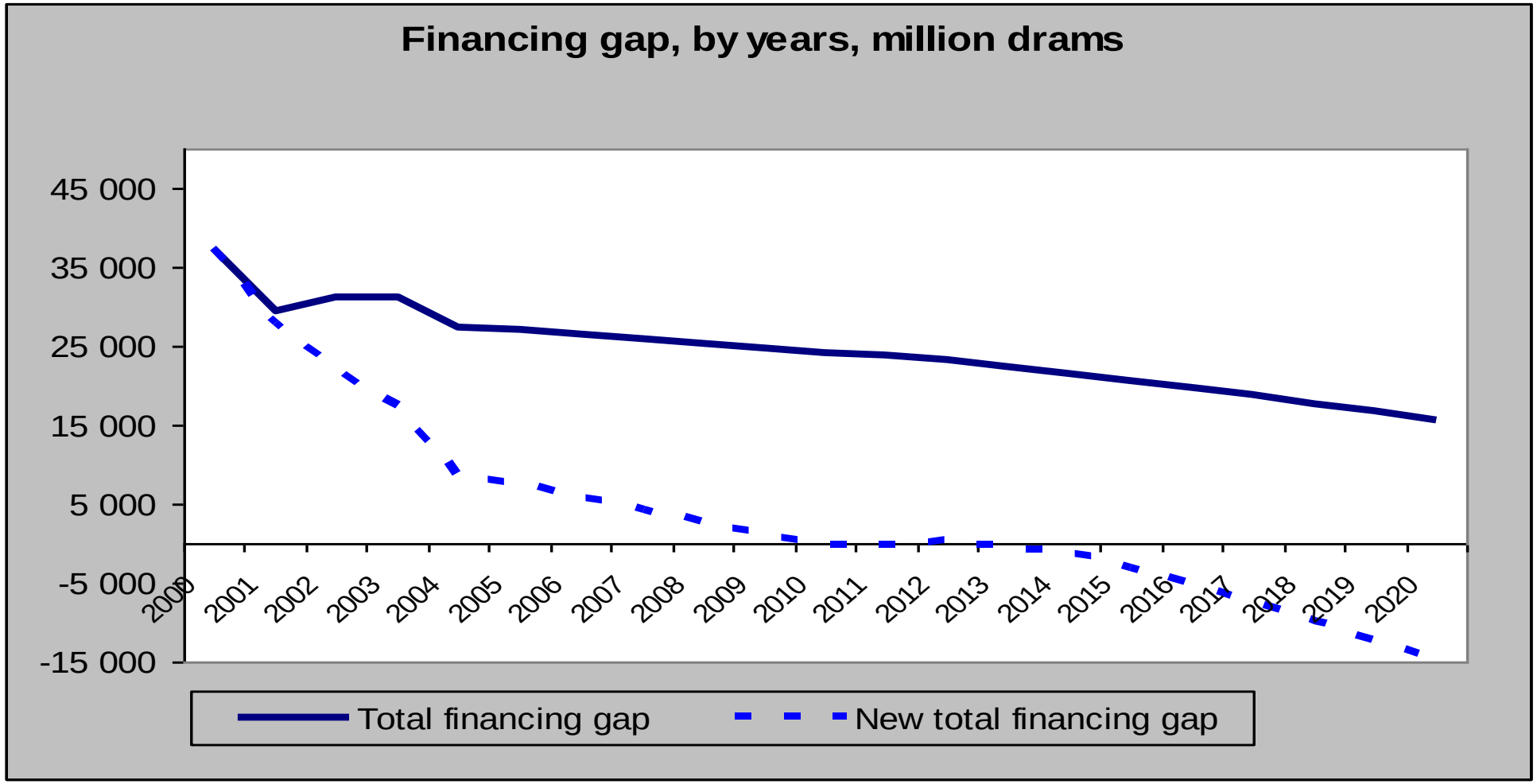
Decision-support tools (DSTs) : FEASIBLE tool structure



Costs calculation in FEASIBLE
(based on generic Cost function, adapted to local prices)



Financing gap in WSS in Armenia



Decision-support tools (DSTs): the case of WHAT-IF

WHAT-IF (Water-Hydropower-Agriculture Tool for Financing and Investment)

Main intended purpose: to help local stakeholders identify and prioritise investments and governance actions (on water allocation, tariffs etc.) associated with a **Multi-Purpose Water Infrastructure (MPWI)** in a certain river basin, to maximise the economic return from the MPWI (contribution to social welfare) and achieve greater levels of water, food and energy security in the country or basin (see Table 3.1 below for more details).

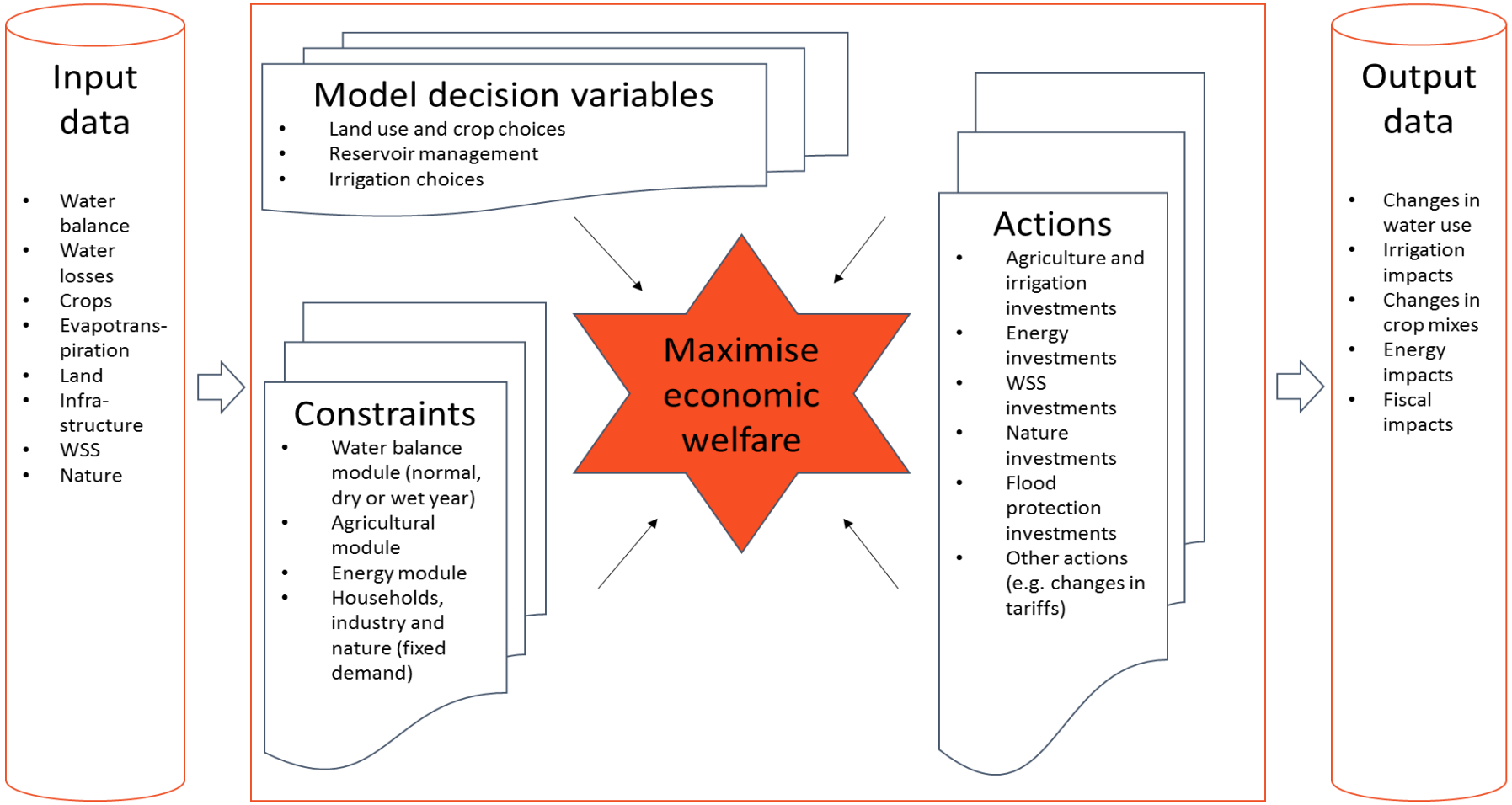
WEFE nexus governance & sector management challenge(s) the tool helps address:

- assessing some important trade-offs in the WEFE nexus;

- identifying and prioritising governance actions (on water allocation, tariffs etc.) and investments associated with a **Multi-Purpose Water Infrastructure (MPWI)** in a certain river basin, to maximise the economic return from the MPWI (thus contributing to the tasks: (i) to allocate water resources to the sectors and uses where they add the most value for the society; and (ii) to ensure greater levels of water, food, and energy security);

- co-ordination of water resources and water systems use and development plans in a respective basin.

Decision-support tools (DSTs): WHAT-IF model structure



THANK YOU FOR YOUR ATTENTION!

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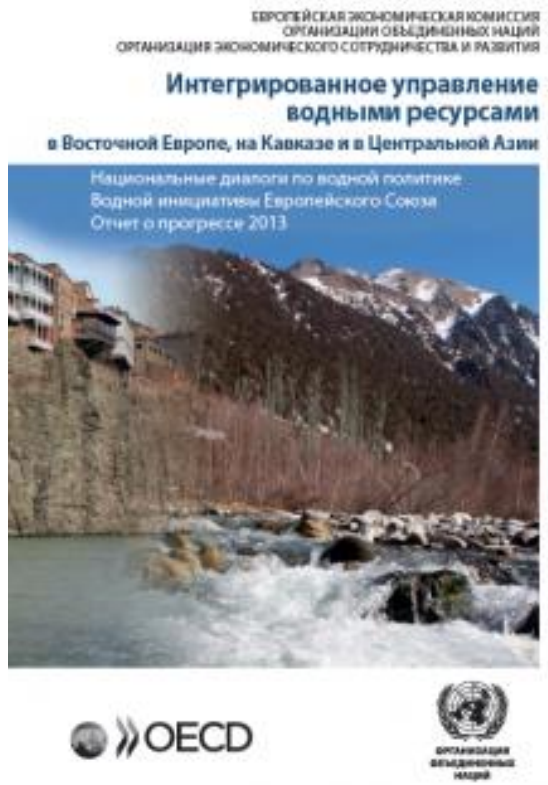


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