WORLD BANK GROUP
Water

Financial and economic aspects of Integrated Urban Water Management (IUWM)

Diego Rodriguez, Senior WRM Specialist, WBG

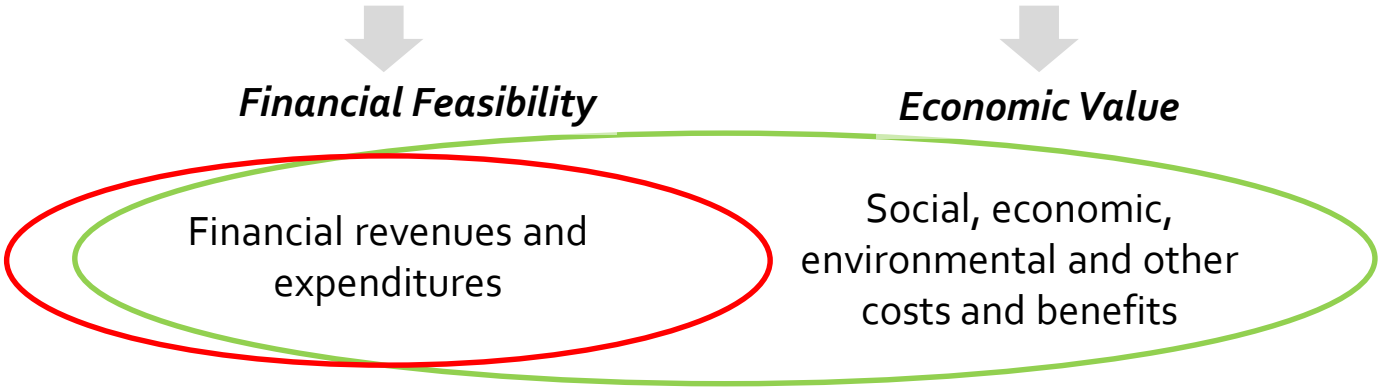
IUWM TDD, September 25-29, Tokyo - Japan

Objectives of this session

- Learn about financial and economic challenges and opportunities of IUWM
- Know the basics of how to do a financial and economic analysis of an IUWM strategy/project
- Understand how to use financial and economic analysis in the design of IUWM strategies and projects that…
  - … are financially feasible
  - … are cost-efficient
  - … yield the highest economic return
  - … are risk and uncertainty robust and adaptive

Financial versus economic assessment

	Financial assessment also referred to as: financial feasibility study or business case	**Economic assessment** also referred to as : Cost Benefit Analysis or Benefit Cost Assessment
Answers the question	Is the project financially feasible? Are funds (public and private) available to finance the project?	Can the cost of the project be economically justified by its benefits to the economy?
Effects	*Financial impact* on *investors* of project infrastructure (*cash flows*)	*All effects* on *all members of society (= the economy)* affected by the project *(cash and non cash)*
Valuation principle	Market prices (*actually paid*)	Economic valuation of costs (removing market distortions; opportunity costs) and benefits (*willingness to pay*)
Result	Financial NPV and financial IRR	Economic NPV and economic IRR



Financial and economic effects: cash and non-cash

A Project has **cash effects**:

- some only negative: preparation, design, construction, O&M costs
- others also positive: user charges

Projects also have **non-cash effects**, both positive and negative:

- Positive: health benefits, habitat improvement, recreation/quality of life, etc.
- Negative: noise, pollution, etc.

  These effects typically do not have a market price, nobody pays for them / receives a revenue.

  As these effects do have a value to society, they are part of the economic assessment.

Financial and economic opportunities and challenges of integrating urban water management

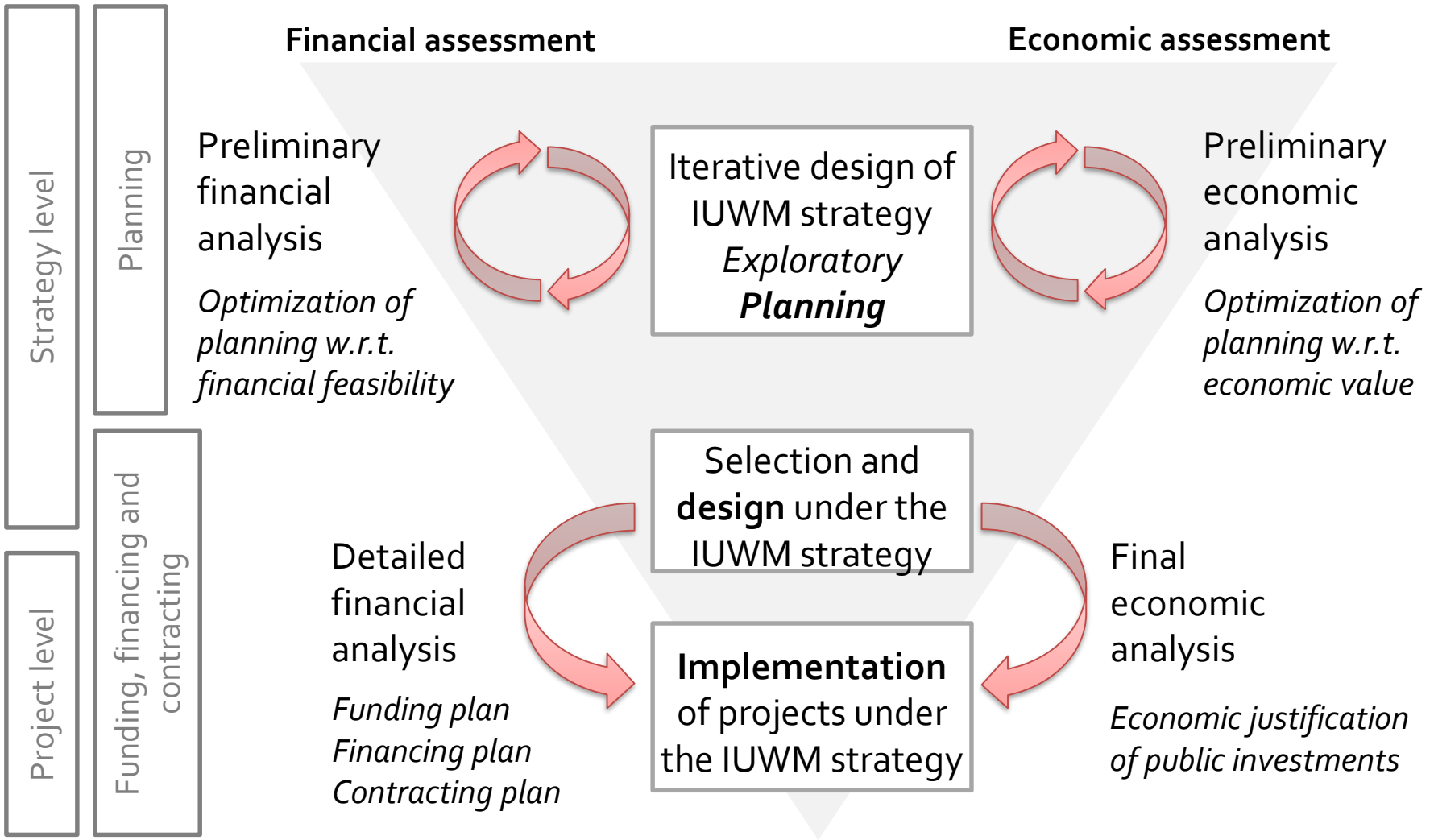
Opportunities

- Reduce costs and create value by exploiting linkages, synergies and long-term planning, including option for water re-use and recovery
- Steer supply and demand with financial instruments
- Fund costs with revenue generating activities
- Design adaptive solutions to respond to risks + uncertainty
- Create additional benefits by combining functions

Challenges

- Funding of lumpy upfront and investments
- Capturing economic value in financial revenues
- Balancing costs, benefits, interests for stakeholders
- Cost coverage of capital and O&M costs
- Transaction and coordination costs due to complex set of stakeholders and institutions
- Long-term horizon and uncertainty (e.g. climate change) needs flexible and adaptive approach

Iterative economic and financial assessment



WORLD BANK GROUP
Water

Financial Analysis

Objective of financial analysis

- Financial analysis = financial modelling of IUWM projects to determine their financial feasibility

- Financial feasibility = sufficient revenues are available to cover the expenditures, including a normal return for lenders and investors commensurate with their risks

- A strategy that is NOT financially feasible, cannot be implemented. It will eventually face obstacles, either in the investment phase (investments can not be carried out, because of lack of financing), or in the operation phase (provision of low quality services, or even the termination of services, due to lack of funds for operations and maintenance)

Funding versus financing

Very important distinction

Financing = sum of money provided to an enterprise or project with the expectation to be **repaid** with a return (interest or dividends) =
- Loans
- Mezzanine financing
- Equity

Funding = sum of money provided to an enterprise or project **without repayment** requirement =
- User payments and other revenues Government budget allocation
- Grants

WORLD BANK GROUP
Water

Sources of funding and financing

Sources of financing

- Commercial banks
- International financial institutions
- Bond market (traditional, green, climate)
- Institutional investors
- Government (as loan/equity provider)
- Development partners - official and NGOs (as loan/equity provider)
- Equity funds
- Project developers and operators

Sources of funding

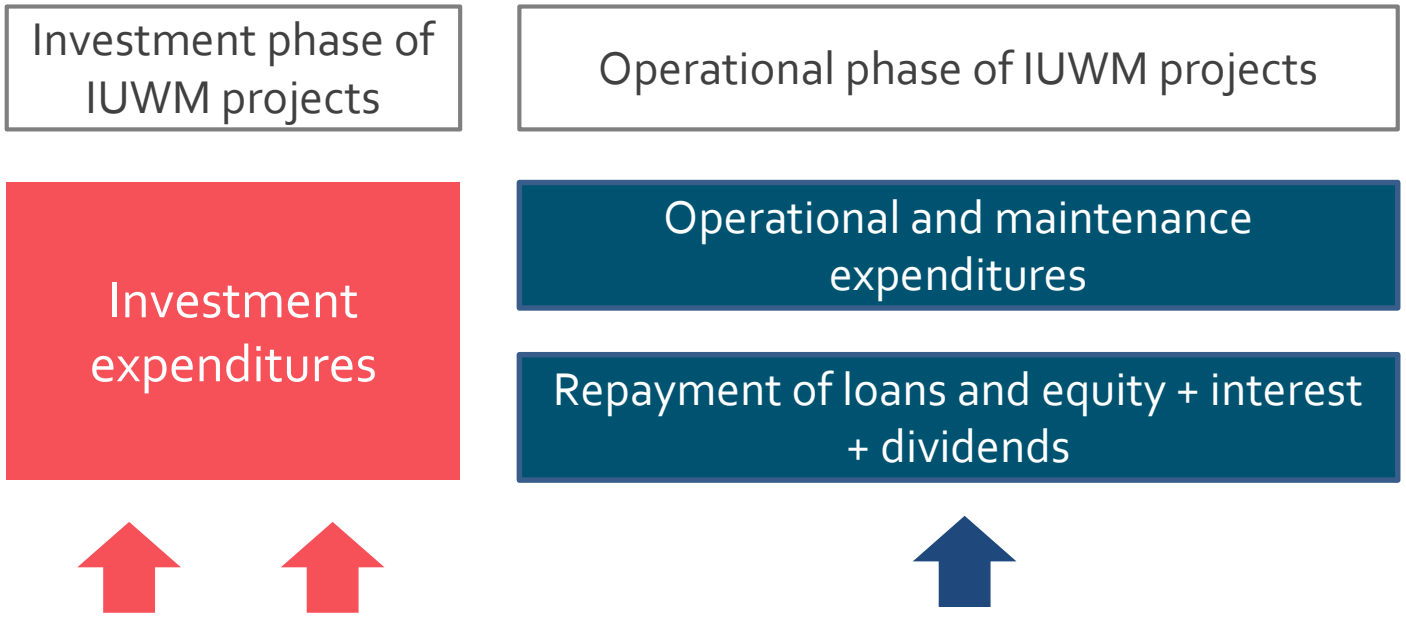
- Private users of facilities/services generating user fees or other revenues
- Government (as payer of government expenditures: own costs, user fees, grants)
- Development partners - official and NGOs (as grant provider)

Different perspectives lead to different financing variables

- *Financiers* focus primarily on *downside*:
  - Not willing to accept too much risk, but requiring low return
  - In case of bad developments, financiers are at the top of the cash waterfall
  - Expected minimum Debt Service Coverage Ratio ≥ required minimum Debt Service Coverage Ratio

- *Investors* focus primarily on *upside*:
  - Willing to accept more risk, but requiring high returns
  - In case of bad developments, investors are at the bottom of the cash waterfall
  - Expected equity return ≥ required equity return

IUWM projects typically require both funding and financing solutions



It's all about risk

- Exact financing structure of a project finance deal depends on risk profile
- Project finance is both about tailor-made financing structures and about tailor-made risk allocations / profiles
- Allocation of project risks to those parties best able to manage them is central to project finance
- Financial markets are a place where project / investment risk is exchanged amongst parties

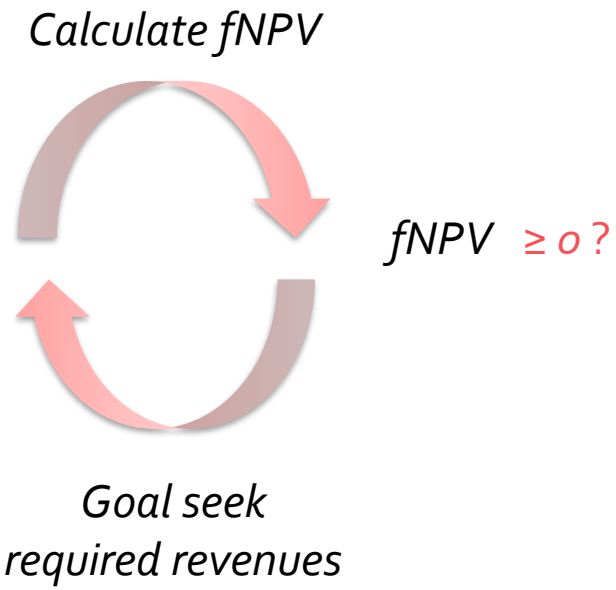
Estimation of expenditures and revenues

- The capital and operating expenditures are based on the estimates of the investment, operating and maintenance costs in the feasibility study (without economic adjustments, including inflation)
- Taxes are determined on the basis of the tax regulations.
- Estimation of revenues:

Affordable?

User payments: determination of demand volume and tariff based on demand analysis

Government budget and grants: commitments and intentions of governments and grant providers



WORLD BANK GROUP
Water

Distribution of expenditures and revenues among stakeholders

- An important output of the preliminary financial analysis is an overview of the financial cash flows by stakeholder or stakeholder group, for instance
  - Central government (by department/agency if relevant)
  - Local government (by department/agency if relevant)
  - Government-owned companies active in the water cycle (by company where relevant)
  - Private companies active in the water cycle (by company where relevant)
  - Water users (by sector: residential, agricultural, geographical if relevant)
- Important input for stakeholder consultations and decision-makers.
- Compare results of the distributional analysis in the economic assessment to check whether there is a good match between payers and beneficiaries, and whether the costs of the strategy are equitably shared.

What if the proposed IUWM strategy is financially not feasible?

- For several projects, or for the strategy as a whole:
  - What you get back is less than the costs
    Financial Internal Rate of Return (*fIRR*) < Weighted Average Cost of Capital (*WACC*)
  - AND you do not have enough money to finance the plans
    Financial Net Present Value (*fNPV*) < 0
- Solutions
  - Redesign strategy to reduce costs or to add revenue-generating activities
  - Increase financial contribution from users (to the extent possible given the price sensitivity of demand and affordability limits)
  - Increase financial contribution from the government (provided that such contribution is justified based on the results of the economic assessment)
  - Investment phase: direct government funding of investments
  - Operating phase: operating subsidies, availability and service fees

WORLD BANK GROUP
Water

Economic Cost Benefit Analysis

Economic assessment = Cost Benefit Analysis (CBA)

A CBA sums all present and future, positive and negative effects on the economy as a consequence of a project by expressing them in monetary terms. It is about national benefits/welfare.

The valuation in monetary terms is based on the willingness to pay: how much are the members of society prepared to pay to obtain a positive effect (benefit) or to avoid a negative effect (cost).

The project has a positive economic return to society if the value of the benefits exceeds the value of the costs.

Steps of a Cost Benefit Analysis

Definition	1	Problem analysis	What is the problem we are trying to solve with this strategy? What are the envisioned effects? Do they address the problems?
	2	Definition of strategy alternatives	What are the measures that will be taken in the strategy, compared to the situation without project (base case)
	3	Identification of costs and benefits	What are the positive and negative effects (qualitative) produced by the strategy compared to the base case?
Modeling	4	Estimation of the project costs	What are the investment and O&M costs of the strategy compared to the base case?
	5	Valuation of the benefits and costs	What is the value of the benefits of the strategy compared to the base case? And what are the (non-financial) costs?
Analysis	6	Determination of economic return	Calculation of net present value of the strategy.
	7	Risks, uncertainty, and sensitivity analysis	What are the main risks and uncertainties of the strategy? Are the results robust? How future-proof is the strategy?
	8	Distributional analysis	Who is bearing the cost? Who is experiencing negative effects? Who is benefitting from the strategy?

DEFINITION: Understanding the problem is the starting point of finding a successful strategy

Guiding questions in the first step of the CBA

- What problems are we trying to solve with this strategy?
- What are the envisioned effects?
- Do the envisioned effects address the problems?

Understanding the base case (no new measures) and the problems to be solved

↳ Identify the main objectives of proposed (alternative) strategies

↳ Focus on assessing the main effects in the CBA

DEFINITION: Costs

- In a CBA the **effects** are grouped into **costs** and **benefits**
- The **costs** are the **costs of implementing** the IUWM strategy
  - Costs of planning and preparation of the IUWM project/ strategy
  - Investments in water infrastructure (bulkwater supply, bulkwater treatment, water storage, water distribution, wastewater collection and treatment, stormwater drainage, flood protection,…)
  - Costs of management, operation and maintenance of the proposed infrastructure

***Remark**: cost savings resulting from the strategy can be included in the costs (as negative costs), but are usually categorized as benefits. The way cost savings are categorized is only a matter of presentation and has no influence on the end result of the CBA.*

***Reminde**r: count only the **additional** costs (or cost savings) caused by the implementation of the proposed IUWM strategy (i.e. the difference between the costs in the situation with strategy and the base case without strategy).*

DEFINITION: Benefits

- The **benefits** are **all other effects** of implementing the IUWM strategy except the costs of implementation

- Owing to the wide scope of a IUWM strategy there are many types of benefits. For every IUWM strategy design exercise an open-minded identification of benefits must be undertaken (through desk research and workshops)

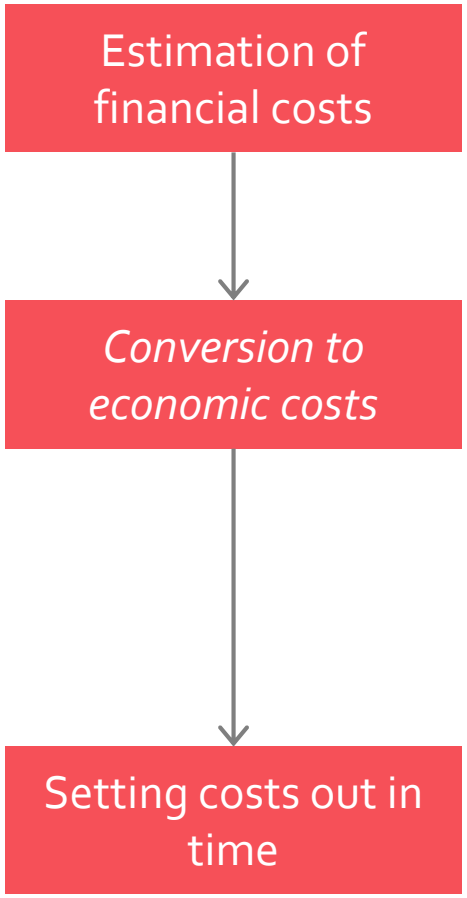
  ***Remark**: some effects may be negative (for instance air pollution or need to resettle residents). These could be included in the costs, but are usually categorized as negative benefits. The way negative effects are categorized is only a matter of presentation and has no influence on the end result of the CBA.*

Typical benefits of implementing an IUWM strategy/project

List is not exhaustive!

Category	Effects/benefits
Availability of water for users (quantity and quality)	- Comfort - Health (better hygiene and less water-borne diseases) - Cost and production level of water-using economic activities - Value of water for downstream users (comfort, health, economic activities)
Reduced depletion of non-renewable water resources	- Future value of water resources
Flood protection	- Prevented damage and loss of life - Prevented disruption of economic activities
Multi-purpose / green infrastructure	- Greener cities, higher quality of city life - More efficient use of space
Ecosystem creation/restoration	- Economic value of ecosystems (ecosystem products, recreation, urban quality, carbon capture, biodiversity…)
Labor market	- Employment - Human capital development
Other, depending on urban functions	- Benefits related to transportation, energy, etc.
Cost savings	- Cost savings in the water system due to efficiency gains

MODELING: Estimation of the costs of implementation of the IUWM strategy



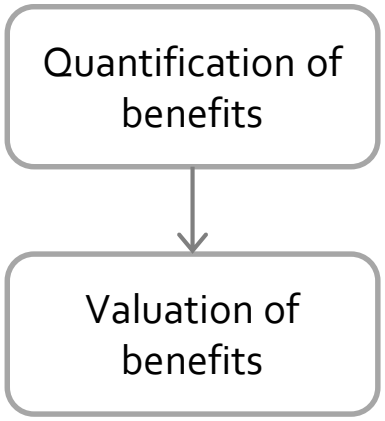
- Engineering studies
- Cash expenditures on resources required to realize the IUWM strategy (labor, materials, good, services,…), based on market prices
- Information on costs of comparable activities elsewhere & existing service providers

- Economic cost = real cost of resources to the economy = opportunity cost = highest-valued alternative use of resources
- The economic cost is obtained by correcting the financial costs:
  - Removal of inflation
  - Indirect taxes and subsidies
  - Imported inputs
  - Unskilled and low-skilled labor

- Initial investment costs spread over construction period
- Structural maintenance/re-investment costs
- Annual operating and maintenance costs

MODELING: Valuation of benefits

- Recall:
  - Benefits are all effects of the IUWM strategy except the costs of the implementation of the strategy
  - Negative effects (if any) are expressed as negative benefits
- Valuation of benefits is carried out in two steps



- Expression of quantified effect in monetary terms (USD, other monetary unit)
- Basis of valuation is the Willingness To Pay (WTP)

  = maximum amount that an individual is willing to sacrifice to obtain a benefit or to avoid a negative effect

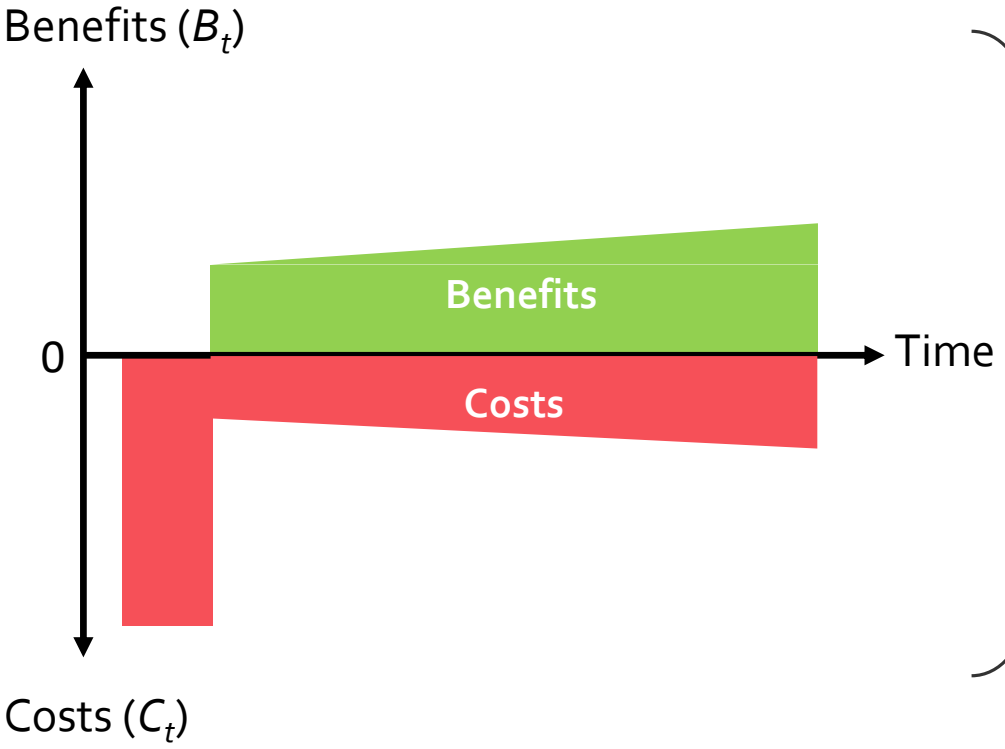
Remark: some effects can not be valued or even quantified due to lack of information. If they are important, they are described in quantitative (if possible) or qualitative terms. If not important, they are left out of the CBA.

Overlapping effects

- Avoid double counting
- Example:
  - The benefits of a flood control scheme are measured by the sum of:
    - the expected avoided flood damages
    - the reduction of the home disaster insurance premium
    - the rise in property values
  - These three measures capture *the same effect* and result in double (or even triple) counting. Only one of the three measures should be included in the CBA.

ANALYSIS: Calculation of economic return

Setting out costs and benefits in time → Discounting of costs and benefits to present time



Economic Net Present Value (eNVP)

$$eNPV = \sum_{t=0}^{T} \frac{B_t - C_t}{(1+s)^t}$$

where s = economic discount rate

WORLD BANK GROUP
Water

Economic Internal Rate of Return

eIRR = discount rate which makes eNPV equal to zero

$$\sum_{t=0}^{T} \frac{B_t - C_t}{(1+eIRR)^t} = 0$$

eIRR > s ⇨ eNPV > 0 ⇨ project creates economic value

- eIRR is easier to communicate than eNPV (more intuitive concept)
- Mostly, but not always, equivalent to eNPV
  - Sometimes eIRR can not be computed (non normal cash flow)
  - In other cases there are several solutions to the above equation, of which only one is correct
  - Sometimes eIRR ranks projects differently than eNPV *(eIRR favors project with early benefits)*. In those cases eNPV gives the correct ranking

→ Always use eIRR and benefit/cost ratio in combination with eNPV

Case: Teresina Programma Lagoas do Norte

The overall results of the CBA indicated the the project was feasible

- The project had a estimated positive NPV of R$141 million
- The IRR was estimated at a rate of 23%

Results of Cost Benefit Analysis

In millions of BRL reales

	Drainage	Streets and Paving	Sewerage	Wastewater Treatment	Water	Total
PV Benefits	81.27	49.12	46.02	5.45	9.5	**191.35**
PV Investment	12.15	6.62	7.55	2.26	2.2	**30.77**
PV O&M	7.78	4.25	4.83	1.45	1.3	**19.59**
NPV Benefits	61.35	38.25	33.64	1.74	1.47	**140.99**
CB Ratio	1.88	3.84	1.85	1.26	1.47	**1.85**
IRR	23.19%	22.22%	24.88%	22.46%	20.26%	**23.09%**

PV = Present Value
O&M = Operation & Maintenance
CBR = Cost Benefit Ratio
IRR = Internal Rate of Return

Case: Rotterdam Climate Adaptation

ROTTERDAM CLIMATE PROOF
THE ROTTERDAM CHALLENGE ON WATER AND CLIMATE ADAPTATION

Results of the quantitative part of the CBA
for a case study area in Rotterdam with 5 potential urban flooding measures

(NPV in € 1,000)	Water square	Higher curbs	Green roofs	Infiltr. pavement	Per-meable gardens
Costs					
Investment (-residual value)	103	62	862		
Maintenance	89	10	155		
Benefits					
Heat stress	2				
Pluvial flooding	22			61	21
Drought	10			148	437
Energy	-				
CO^2	-				
Air quality	-	-	211		
Property value	946	-	-		
Total					
Total costs	192	72	1.016	157	8
Total benefits	981	11	293	209	459
Result	**789**	-62	-724	**52**	**451**

Benefits in both wet and dry times!
Permeable gardens prevent damage to houses (drought= foundation; stormwater = interior) and plants

Benefits during flooding, during drought and an increase in property value due to everyday benefits offset the costs

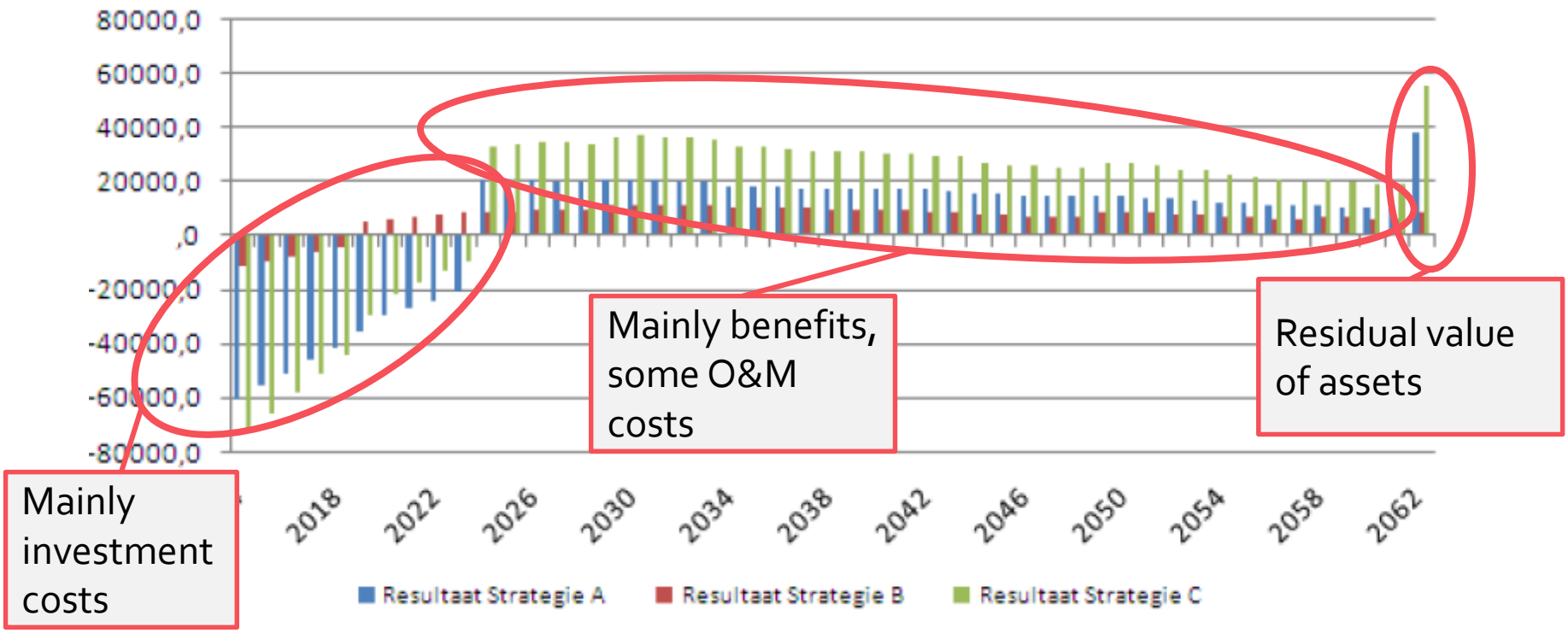
Large benefits but very large investments and O&M costs = negative result

WORLD BANK GROUP
Water

Case: Rotterdam Climate Adaptation

ROTTERDAM
THE ROTTERDAM CHALLENGE ON WATER AND CLIMATE ADAPTATION
CLIMATE PROOF

CBA results of three different climate adaptation strategies



The effect of discounting is visible in the decreasing yearly totals

Risks and uncertainties

- Risks and uncertainties are inevitable in a CBA
  - The effects run into the far future (20-50 years). They are determined by many factors of which the future evolution is not known with certainty (climate change, demographic change, prices, economic growth,…)
  - The water system is very complex. Many physical and behavioral processes and linkages are not known with certainty.

- The identification and analysis of risks and uncertainties is important for decision-making
  - Strategies may have a positive economic return in some states of the world, but not in other ⇨ selection of robust or prudent strategies
  - Some risks/uncertainties can be reduced or their impact mitigated by taking proper actions (such as additional research to improve knowledge about uncertain variables, or contingency plans to reduce the impact of risk events if they should occur)

Distributional analysis

- Separation of costs and benefits and calculation of eNPV by group of stakeholders
- Which groups of stakeholders are distinguished depends on the context. Typical groups are:
  - Residential water users
  - Agricultural water users
  - Industrial water users
  - Neighborhoods (e.g. in relation to stormwater)
  - Social class / gender
  - Upstream/downstream
  - Producers of water services, such as water utility companies
  - Bulk water supply/distribution/sanitation
  - Government
  - National/local government

WORLD BANK GROUP
Water

Conclusions

Why conduct a financial assessment?

- ✓ To assess whether a project is financially feasible

  → An urban water project will face implementation problems if there is no adequate funding strategy, both in the short term (financing of investments) and in the long term (covering of O&M costs)

- ✓ To determine the optimal financing and procurement strategy

  → The financial analysis helps determining how the project can be financed and implemented in the most cost-efficient way (who invests, who finances, payment mechanisms, contract forms,…).

- ✓ To effectively manage risks

  → As part of the financial assessment, a risk analysis is conducted and a risk management plan is established (including allocation of risks among stakeholders and measures for the prevention and mitigation of risks). If risks are not well managed, the strategy could be derailed by the occurrence of risk events.

Why conduct an economic assessment?

- ✓ To design the best IUWM strategy, yielding the highest economic value

  → UWM challenges often can be addressed in several ways (for instance with varying degrees of integration). The economic assessment provides input on which alternative creates the highest net value to society

- ✓ To assess whether the strategy creates economic value, or in other words, whether it is a good strategy

  → An IUWM strategy should only be implemented if the benefits to the economy of the strategy outweigh the costs.

- ✓ To justify government subsidies to the IUWM strategy and its projects

  → Many water projects do not have a positive financial return. Thus, they must be subsidized by the government. This subsidy is justified when the IUWM strategy creates economic value, and the project contributes to the value of the strategy.

- ✓ To identify which stakeholders have costs and/or benefits

  → This information provides input for the funding strategy. Stakeholders having costs should be compensated, beneficiaries can be asked for a financial contribution

WORLD BANK GROUP
Water

Thank you

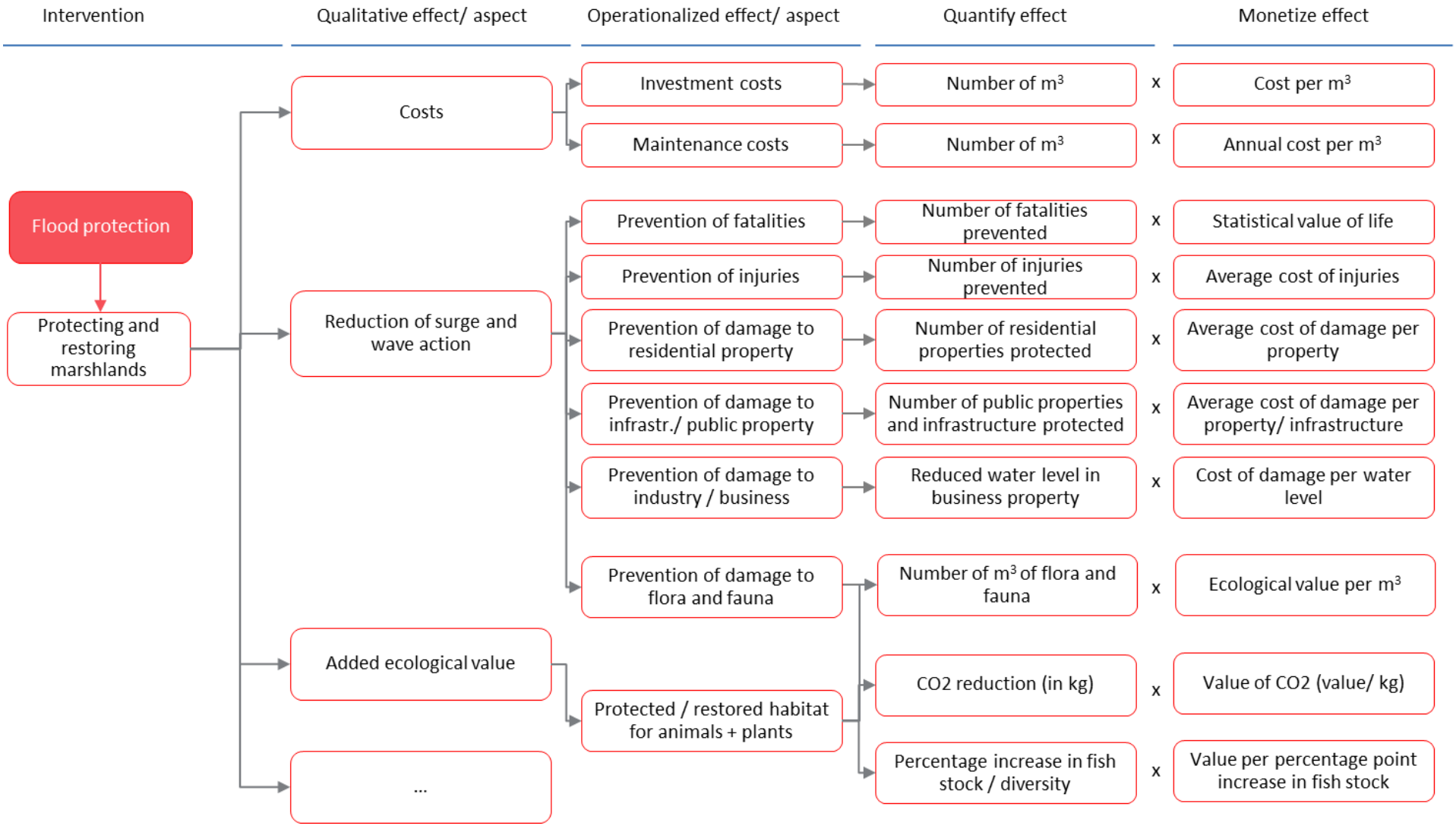
Shadow cost and prices

Shadow price: implicit cost/price derived from cost/price data obtained from related markets

Examples

Cost/benefit	Shadow price
Health benefits	- Avoided medical costs - Avoided production loss due to disease or premature death
View on beautiful water area	- Difference in real estate values of houses with and without beautiful view (hedonic pricing)
Carbon capture of ecoystems	- Carbon price on carbon markets - Estimated costs of future global warming (IPCC)
Flood protection	- Estimated avoided damages caused by floods
Availability of clean water for downstream users	- Costs incurred by downstream users caused by water pollution or shortages (e.g. production losses) - Avoided water treatment costs by downstream users

Example: quantification and valuation measures in effect tree



WORLD BANK GROUP
Water

Determination of economic discount rate

- The resources for the realization of IUWM strategy are withdrawn from/not available for alternative uses
- Two perspectives on alternative use of resources
  - private consumption => "social rate of time preference (SRTP)"
  - private investment => "social opportunity cost of capital (SOC)"
- In the first perspective the value of the consumption foregone today must be at least be equal to the value of the extra consumption in the future as a result of the realization of the IUWM strategy. The latter is given by the Ramsey equation.

$$s = \rho + \eta * g$$

discount rate (RTP)	Rate of pure time preference	Elasticity of marginal utility of consumption	Growth rate of consumption	
3% - 8%	0% - 2%	1 - 2	3%	per annum

= real discount rate, i.e. without inflation
(recall that CBA is by convention carried out in constant price level)