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Water Accounting

International Case Studies

Michael Nagy
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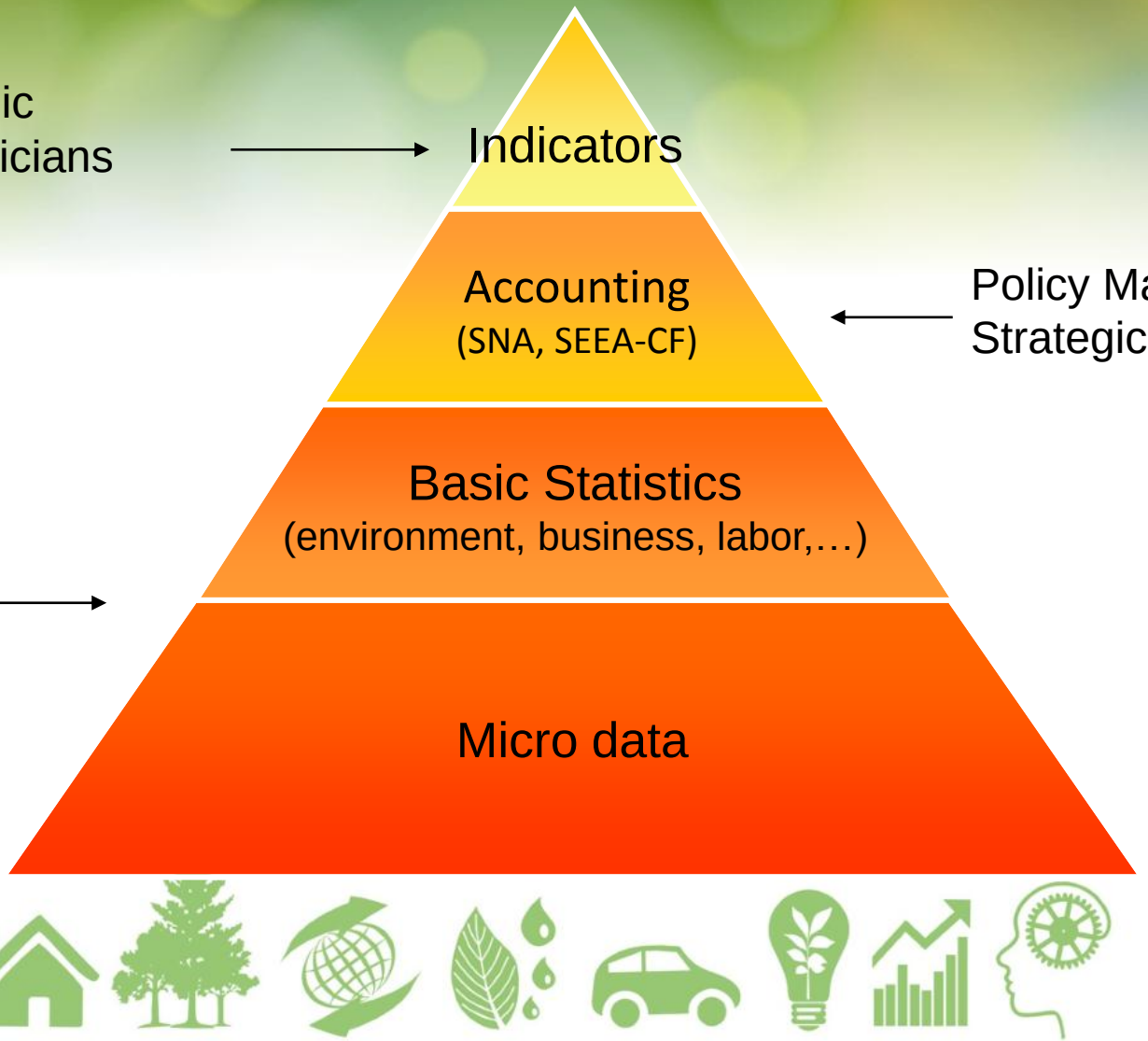
Environmental-Economic Accounting for Water

- SEEA-Water was an interim statistical standard since 2007, now incorporated into SEEA-CF (2012)
- Covers the full water cycle (natural water cycle, water flows within the economy, flows of water from and to the economy)
- Conceptually consistent with water statistics of UN, OECD and Eurostat
- Links physical and economic information
- Provides data for Integrated Water Resources Management
- Provides conceptual links to Water Footprint, Virtual Water and important indicator frameworks (DPSIR, MDGs, SDGs etc.)

Audiences for information

Public
Politicians

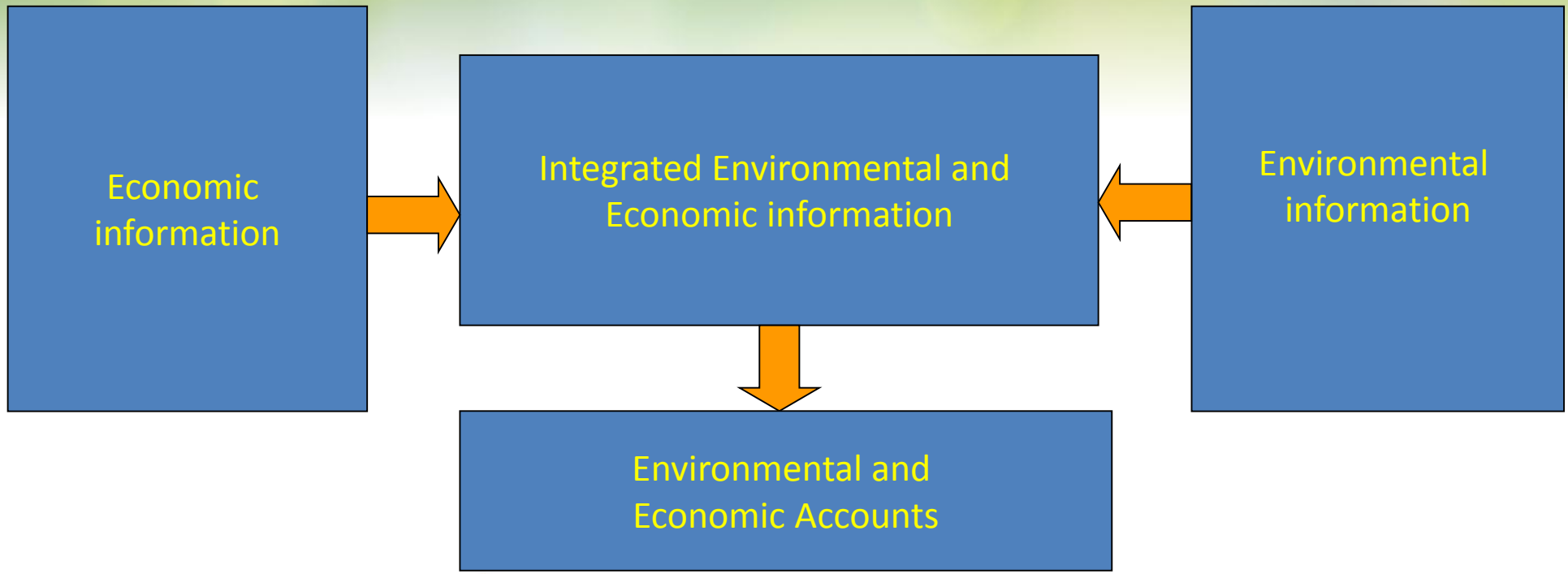


Policy Makers
Strategic planners

Researchers

Environmental-economic accounting

Brings together economic and environmental information



→ Can respond to (complex) policy questions

Typical national water policy questions

- Which industries use the most water? How much water do households use?
- Who pays the most for water?
- Are the levels of pollutants emitted to water acceptable? Are they decreasing? What are the main sources of pollution? What investments are made for the purpose of reducing pollutant emissions?
- Are water resources being used sustainably? Who benefits in the allocation of scarce water resources?
- Is water used efficiently? What's the relation between economic output and use or pollution of water for the different industries?
- What are the opportunities to increase water supply? Is desalination of seawater or reuse of wastewater a possible solution? How much water is lost during transport?
- Are water resources being depleted?
- Have measures to improve water use efficiency been successful?
- What are the investments in water supply and sanitation services? How are the costs being recovered? Are the services affordable to the population?

…

Some water-related targets in the Sustainable Development Goals

Goal 6: Ensure availability and sustainable management of water and sanitation for all

- Target 6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and increasing recycling and safe reuse by [x] per cent globally.

- Target 6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.

Examples for Indicators from Water Accounting

- Macro trends in total water use
- Macro trends in water pollution
- Decoupling economic growth and water use
- Decoupling economic growth and water pollution
- Industry-level trends

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Jordan

Jordan – Water issues

- Scarcity of renewable water resources
- Depletion of groundwater
- High losses during distribution and weakness in delivery
- Limited capacity of waste water treatment plants
- High population number and ongoing immigration

Jordan – Water Resource

- 70% of the country receives less than 100 mm
- 90% of the country receives less than 200 mm
- North western highland (2% of country) receives around 300 mm

Water resources

- Surface water: Jordan rift Valley, Springs and Floods
- Groundwater: Renewable and Non-Renewable
- Treated Waste Water

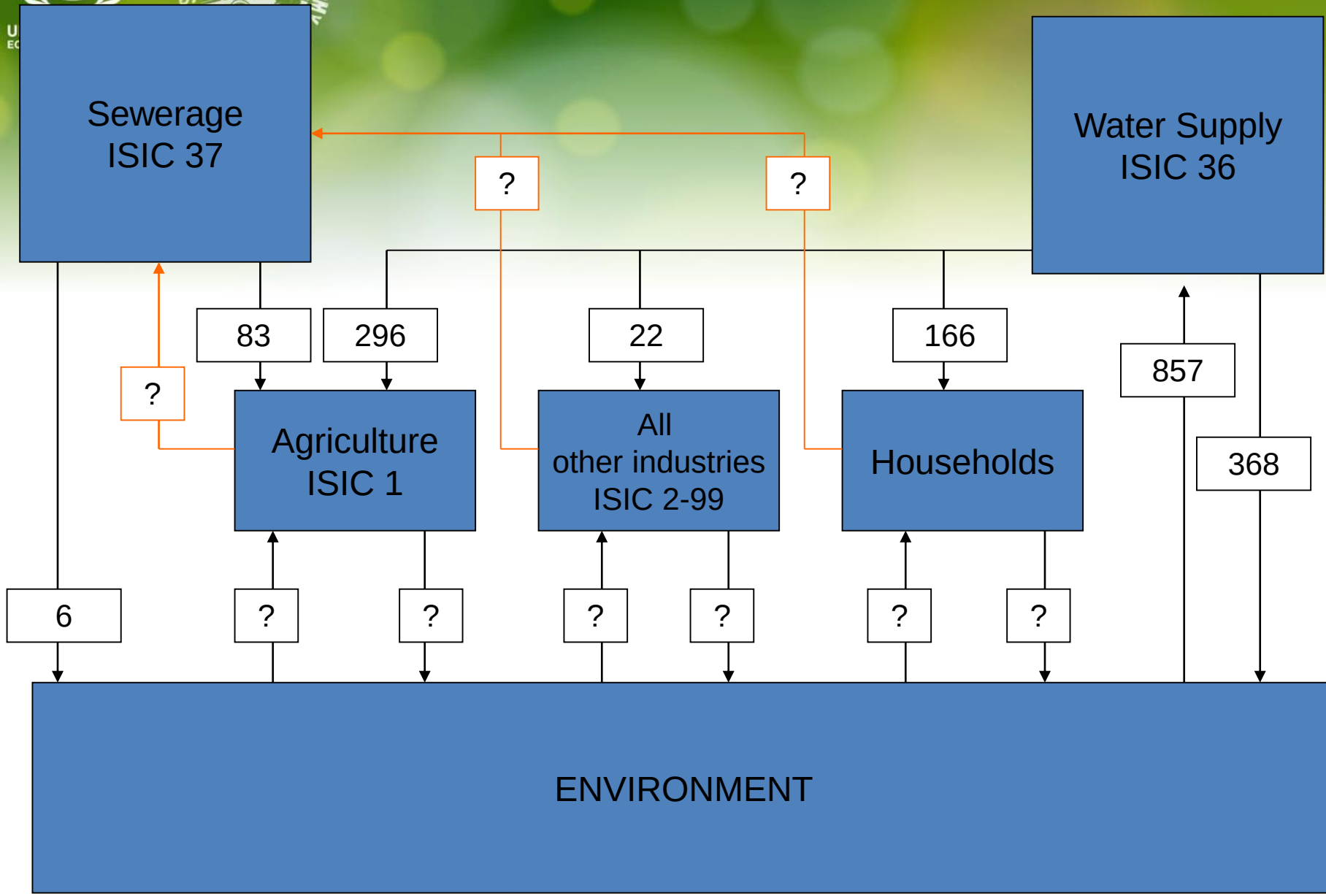
Jordan – data availability

- Surface, groundwater and treated waste water
- Water supplied for municipal and industrial uses
- Detailed information on water use by river basins
- Waste water treatment plants on design and operation capacity
- Some aspects of water quality (e.g. the chemical and physical analysis on drinking water)
- Water supply by source
- Water used for production and waste water generated by certain sectors depending on specialized surveys
- Cost of water consumed as a commodity in some sectors
- Cost of infrastructure projects for water industry

Water accounting in Jordan

- The Department of Statistics began work on water accounting in February 2007
- By June 2007 had data for a simplified physical supply and use table and presented these at Expert Group Meeting on Natural Resource Statistics, held Cairo, Egypt.
- Tables were revised based on comments from UNSD
- The Department of Statistics has engaged with the Ministry of Water Resources and Ministry of Environment to develop a plan for the taking the development of water accounts further

Jordan – Physical Water Supply and Use



Physical use table

Physical units

			Industries (by ISIC categories)								
		1irrig.	1 stock	All except 1,35,36,37	35	36	37	Total	Households	Rest of the world	Total
From the environment	U1- Total abstraction (=a.1+a.2= b.1+b.2):	0	0	0	0	857.4	0	857.4	0		857.4
	a.1- Abstraction for own use	0	0	0	0	368.7	0.0	368.7	0		368.7
	a.2- Abstraction for distribution	0	0	0	0	488.7	0.0	488.7	0		488.7
	b.1- From water resources:	0	0	0	0	857.4	0	857.4	0		857.4
	Surface water	0	0	0	0	351.4	0	351.4	0		351.4
	Groundwater	0	0	0	0	506	0	506	0		506
	Soil water	0	0	0	0	0	0	0	0		0
	b.2- From other sources	0	0	0	0	0	0	0	0		0
	Collection of precipitation	0	0	0	0	0	0	0	0		0
	Abstraction from the sea	0	0	0	0	0	0	0	0		0
Within the economy	U2 - Use of water received from other economic units	379.9	4.446	21.89	0	0	89.4	495.7	166		661.7
	of which : Reused water	*83.6*						83.6			83.6
	of which : Wastewater to sewerage						89.4	89.4			89.4
U=U1+U2 - **Total use of water**		379.9	4.446	21.89	0	857.4	89.4	1353	166		1519

Physical supply table

Physical units

			Industries (by ISIC categories)							
		1irrig.	1 stock	2-33, 41-43	35	36	37	Total	Households	Rest of the world	Total
Within the economy	S1- Supply of water to other economic units	54.2	0.8	4.0	0.0	488.7	83.6	631.3	30.4		661.7
	of which : Reused water						83.6	83.6			83.6
	Wastewater to sewerage	54.2	0.8	4.0	0.0	0.0	0.0	59.0	30.4		89.4
To the environment	S2 - Total returns (= d.1+d.2)	0	0	0	0	368.7	5.7	374.4	0		374.4
	d.1- To water resources	0	0	0	0	0	0	0	0		0
	Surface water				0	368.7	5.7	374.4	0		374.4
	Groundwater				0	0	0	0	0		0
	Soil water	0	0	0	0	0	0	0	0		0
	d.2- To other sources (e.g. Sea water)	0	0	0	0	0	0	0	0		0
S - **Total supply of water** (= S1+S2)		54.2	0.8	4.0	0.0	857.4	89.3	1005.7	30.4		1036.1
Consumption (U - S)		**325.7**	**3.6**	**17.9**	**0.0**	**0.0**	**0.1**	347.3	**135.6**		483.0

United Nations: Assumes all

Jordan – difficulties

- Lack of detailed data related to natural resources. For example little or no data for:
  - stock at the beginning and end of an accounting period for the water asset accounts
  - degradation and pollution of water resources which is expensive
  - valuation of water in agriculture
- Fear of under- or overestimating of water resources
- Need of training on calculation methodologies

Jordan – Developing an implementation plan

Identification of

- resources available
- responsibilities of the different government agencies
- data sources and procedures for accessing data
- a review process prior to publishing & dissemination

A structure for coordinating the organizational units within the Department of Statistics (National Accounts Branch, Environment Statistics Unit, survey areas)

A mechanism for involving key stakeholders (e.g. government agencies, research community, industry representatives, non-government organizations)

A timetable and milestones

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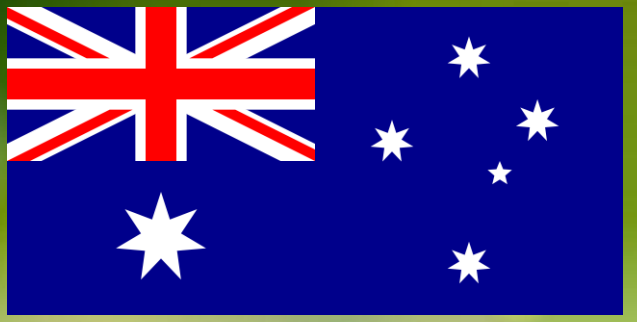
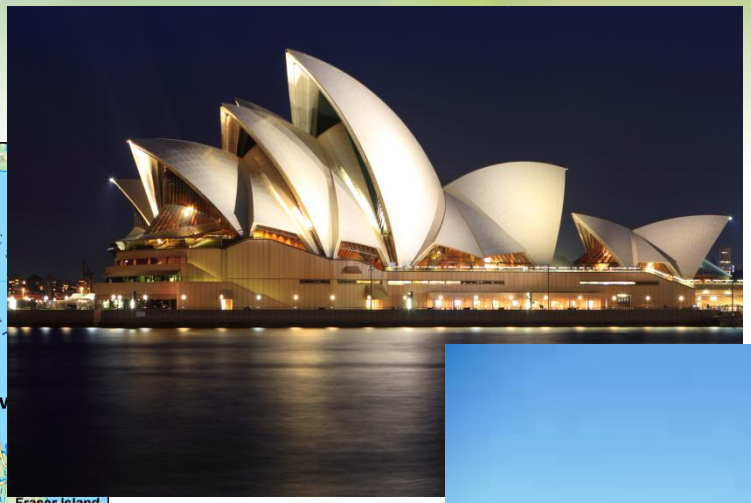
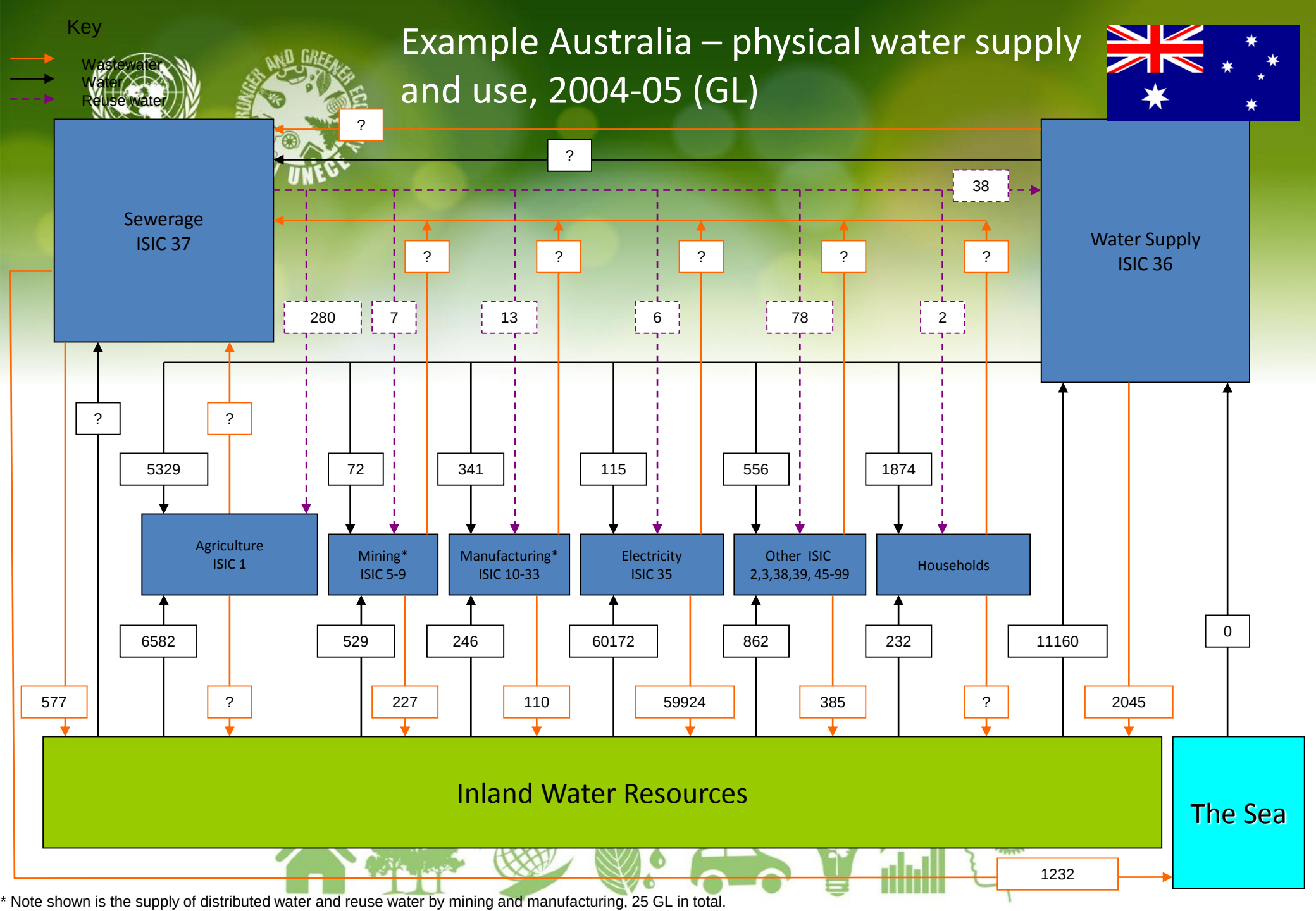
Australia





Example Australia – physical water supply and use, 2004-05 (GL)



* Note shown is the supply of distributed water and reuse water by mining and manufacturing, 25 GL in total.

Example Australia – monetary water supply and use, 2004-05 (million AUD$)

* Note shown is the supply of distributed water and reuse water by mining and manufacturing, 25 GL in total. No monetary available for these.

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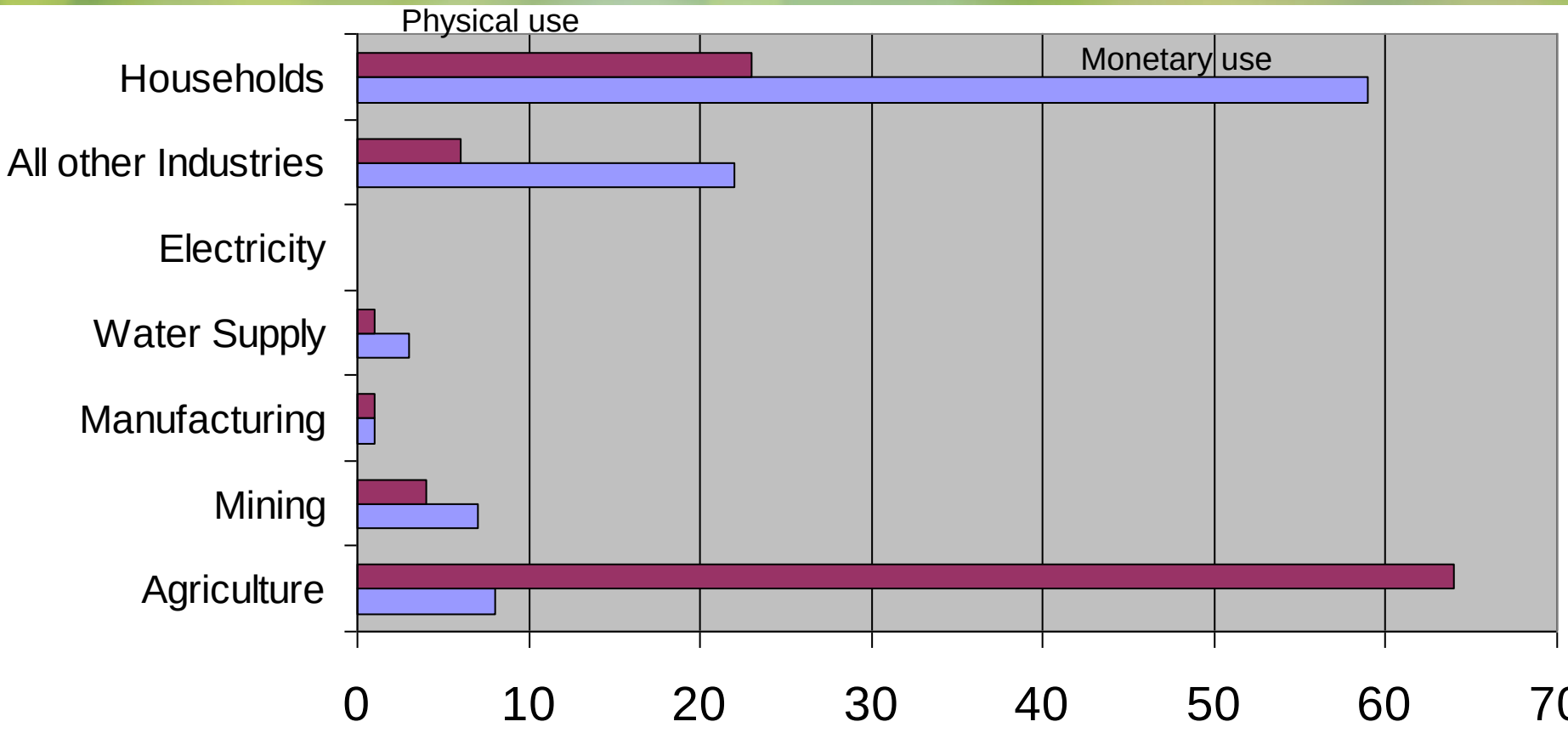
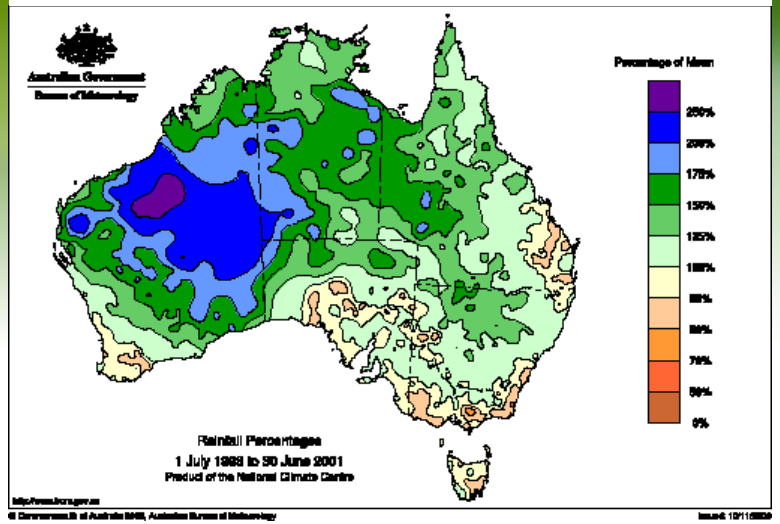
Example Australia: Monetary versus physical use of distributed water (% of total use)

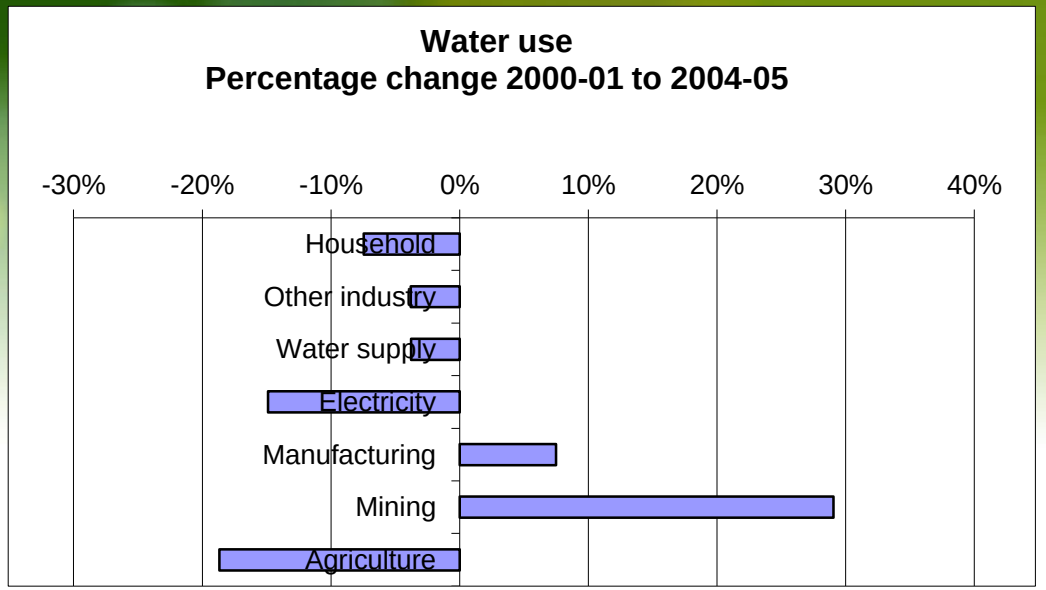


Australia: Analysing changes over time

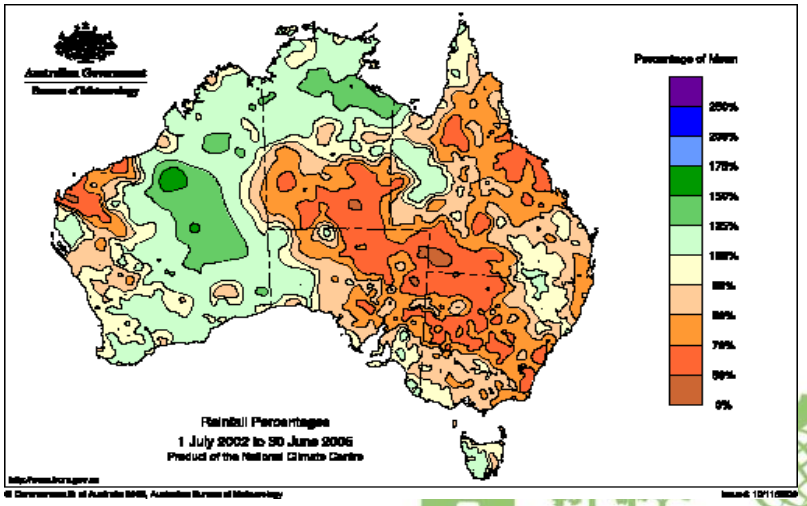
Percentage of mean annual rainfall
1998-99 to -2000-01



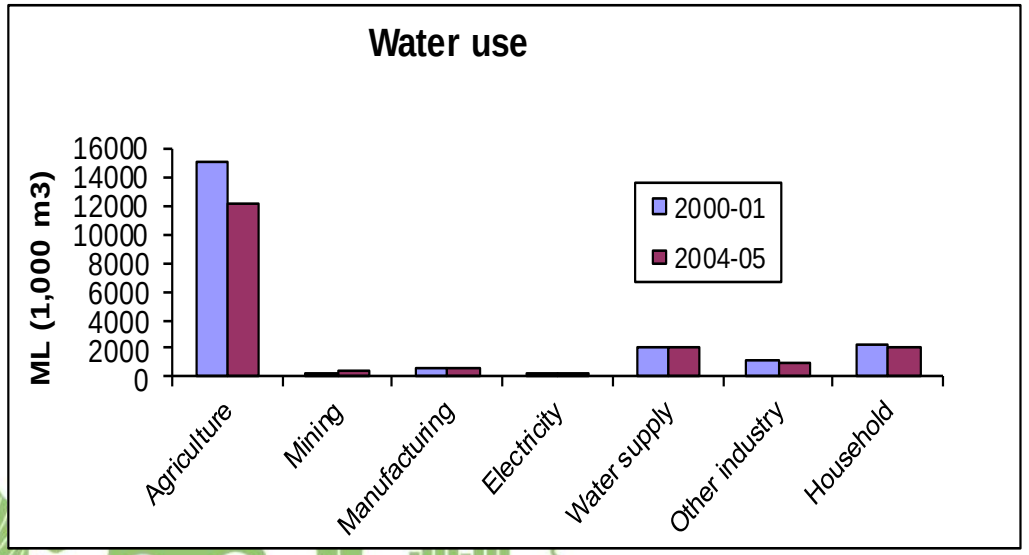
Water use
Percentage change 2000-01 to 2004-05



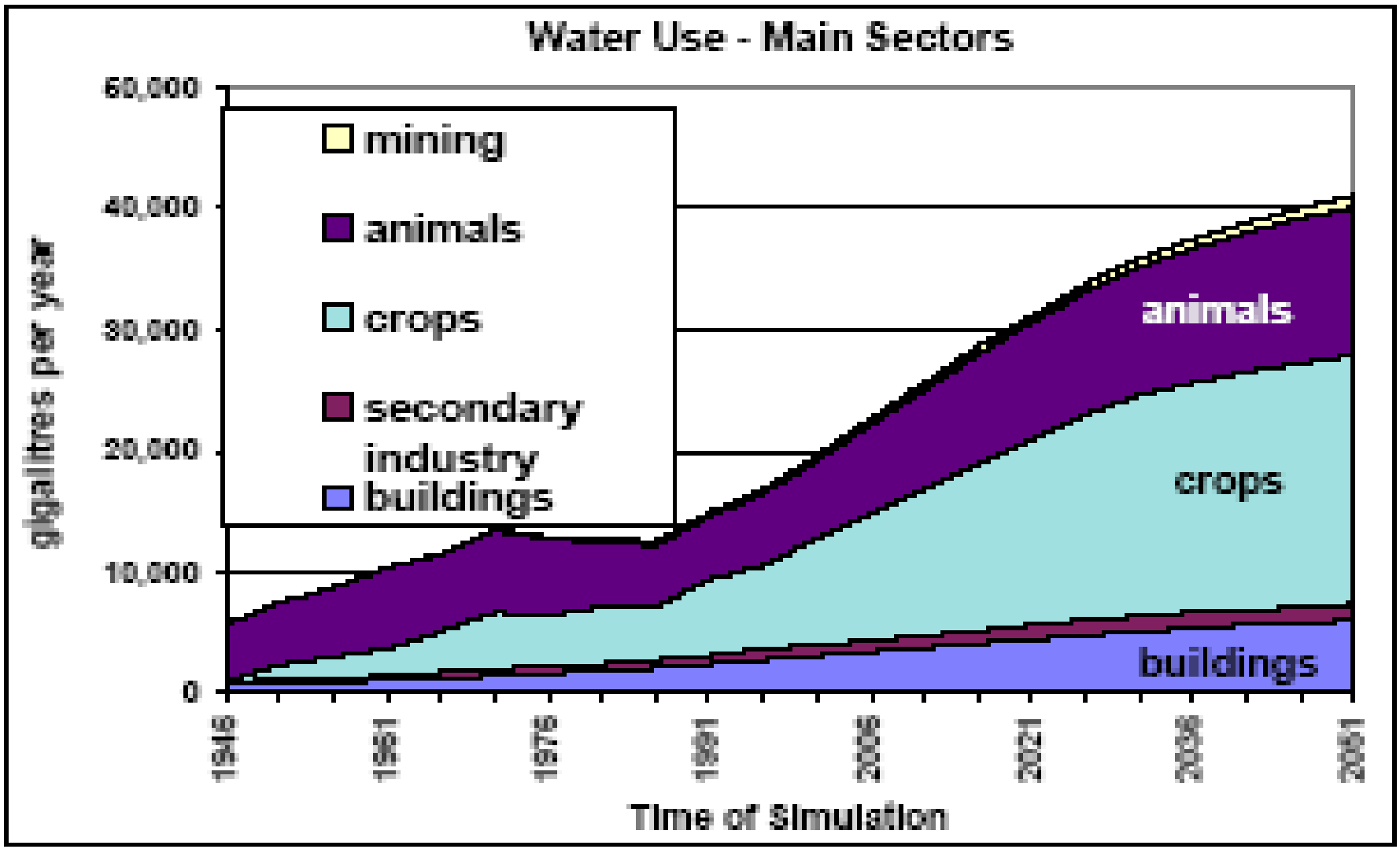
Percentage of mean annual rainfall
2002-03 to -2004-05



Water use



Projecting future water demands Australia 2050



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Modelling Effects of Price Changes: Murray-Darling River Basin Australia

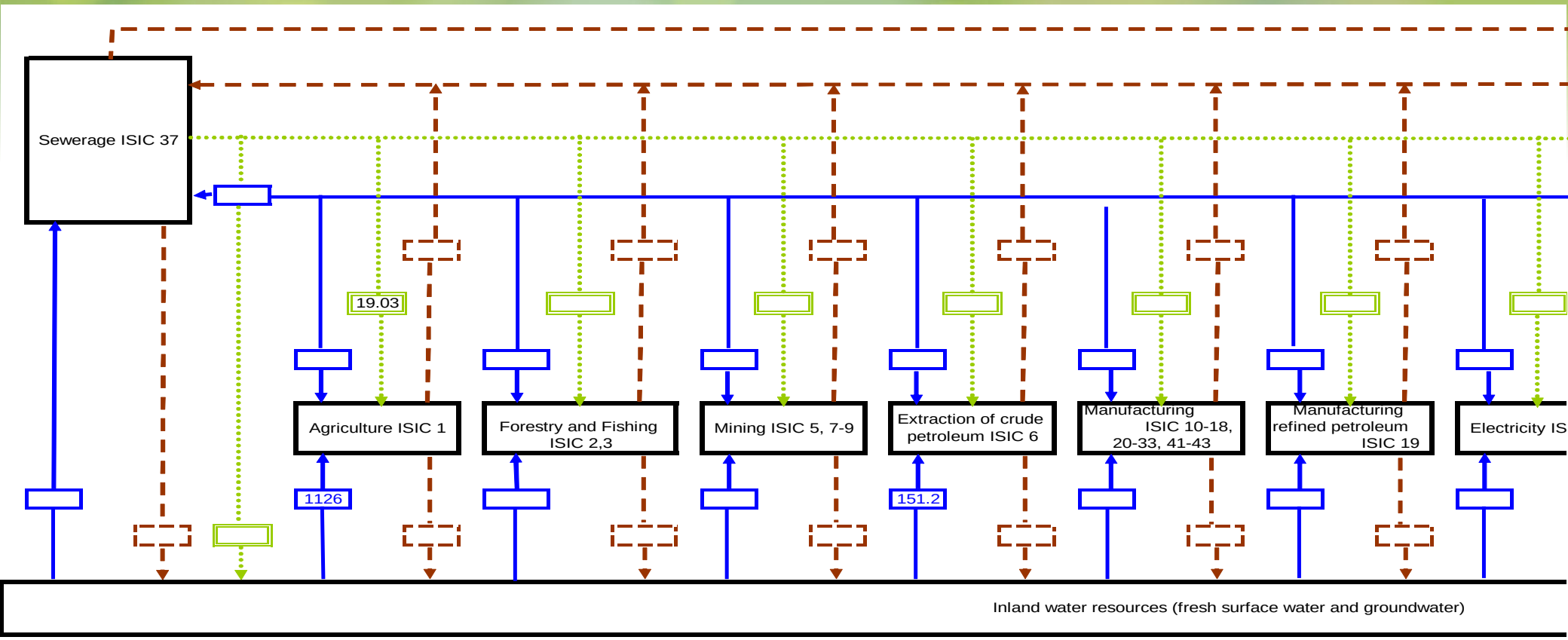
Based on historical water use & price data, simulated impact on GDP of doubling water prices and the expected increases in water use efficiency (WUE) of 1-2%

	Increase in GDP, A$million	
	1% increase WUE	2% increase WUE
Irrigated agriculture	-24	78
Dryland agriculture	-51	-112
Food and fibre processing	44	97
Other industries	262	410
Total impact on GDP	253	521

Pilot Water Accounts for Oman and Bahrain

Pilot Water accounts for Oman

Trial population of physical supply and use diagram



Pilot Water accounts for Bahrain

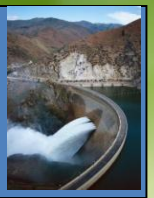
Desalination plant

104.5

Losses .5

104

Water Supply Industry ISIC 36



5

4

Losses 1

Industrial
5-33
41-43

5

148.5

Losses 28

120.5

49.5

Losses .5

50

7

Domestic

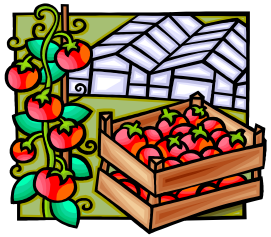
7

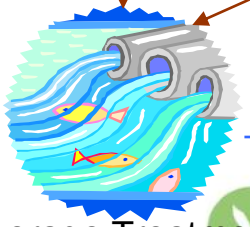
Ground water

80

128

Agriculture
ISIC 01





21

Sewerage Treatment
ISIC 37

Mean Annual Water Consumption for All Uses (million cubic meters)
الاستهلاك السنوي للمياه لجميع الاستخدامات بالمليون متر مكعب

% use			Grand total				Treated Water	Desalinated Water				GroundWater						
نسب الاستخدام %			المجموع الكلي				مياه معالجة	مياه تحلية				مياه جوفية						
صناعي	زراعي	منزلي	المجموع	صناعي	زراعي	منزلي	زراعي	المجموع Total	صناعي	زراعي	منزلي	المجموع	صناعي	زراعي	منزلي	المتوسط اليومي لاستهلاك الفرد لاغراض الاسرة L/D	X 1000عدد السكان	السنة
INDUSTRIAL	AGRICULTURE	DOMESTIC	TOTAL	INDUSTRIAL	AGRICULTURE	DOMESTIC	AGRICULTURE	TOTAL	INDUSTRIAL	AGRICULTURE	DOMESTIC	TOTAL	INDUSTRIAL	AGRICULTURE	DOMESTIC	Mean Domestic Use per Capita	Population*1000	YEAR
4	52	44	192	7	100	85	0	43	1.9	0.4	41.0	149	5	100	44	573	383	1985
4	53	43	207	8	109	90	0	50	2.2	0.5	47.4	157	5	109	42	596	391	1986
3	53	43	220	8	118	95	0	44	2.0	0.4	42.2	176	6	117	53	617	400	1987
4	51	46	217	8	110	99	2	49	2.2	0.5	47.0	166	6	108	52	634	408	1988
3	51	46	230	8	117	105	2	49	2.2	0.5	46.4	178	6	114	58	656	417	1989
3	53	44	243	8	128	107	4	54	2.4	0.5	51.7	184	6	123	55	658	426	1990
3	53	44	241	8	128	105	6	56	2.5	0.6	53.5	178	5	121	51	631	436	1991
3	55	42	262	8	144	109	8	62	2.8	0.6	59.1	192	6	136	50	636	454	1992
3	54	43	273	9	148	116	8	58	2.6	0.6	55.7	205	6	139	60	648	472	1993
3	57	40	287	9	163	115	11	60	2.7	0.6	57.1	215	6	151	58	617	491	1994
3	59	38	292	9	171	112	12	53	2.4	0.5	50.1	227	7	159	62	574	511	1995
3	60	37	307	10	183	114	13	59	2.7	0.6	56.7	233	7	169	57	564	532	1996
3	60	37	318	10	192	116	13	58	2.6	0.6	55.2	247	7	178	61	552	554	1997
3	60	37	322	10	193	119	12	60	2.7	0.6	57.3	250	8	181	62	544	577	1998
3	59	38	315	9	185	121	14	61	2.8	0.6	58.5	239	6	170	62	532	600	1999
3	56	41	315	10	175	130	15	81	3.7	0.8	77.6	219	6	160	53	556	625	2000
3	51	46	301	9	154	138	15	90	4.1	0.9	86.0	195	5	137	52	570	651	2001
3	51	46	309	9	158	141	16	91	4.1	0.9	87.3	201	5	142	54	559	677	2002
3	50	47	314	9	156	149	19	99	4.4	1.0	94.1	195	5	136	54	567	705	2003
3	48	49	322	10	156	156	19	106	4.8	1.1	100.9	190	5	130	55	575	734	2004
3	48	49	329	10	158	161	21	110	4.9	1.1	104.6	190	5	128	57	572	764	2005

Example BAHRAIN 2005

Abdulla Ali,
Authority of Electricity and Water

From Tables to Diagrams
Presented in Beirut August 2008

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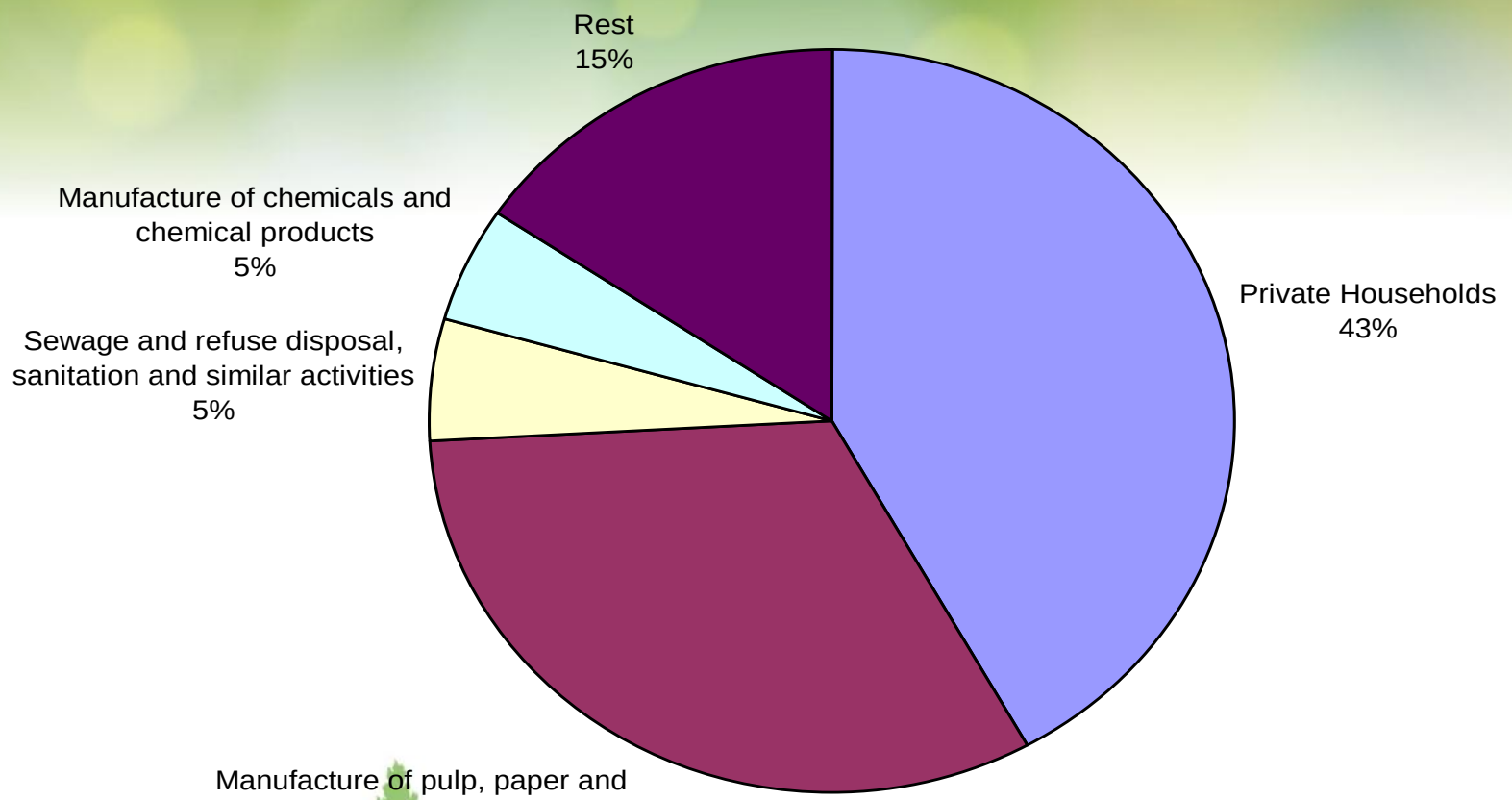
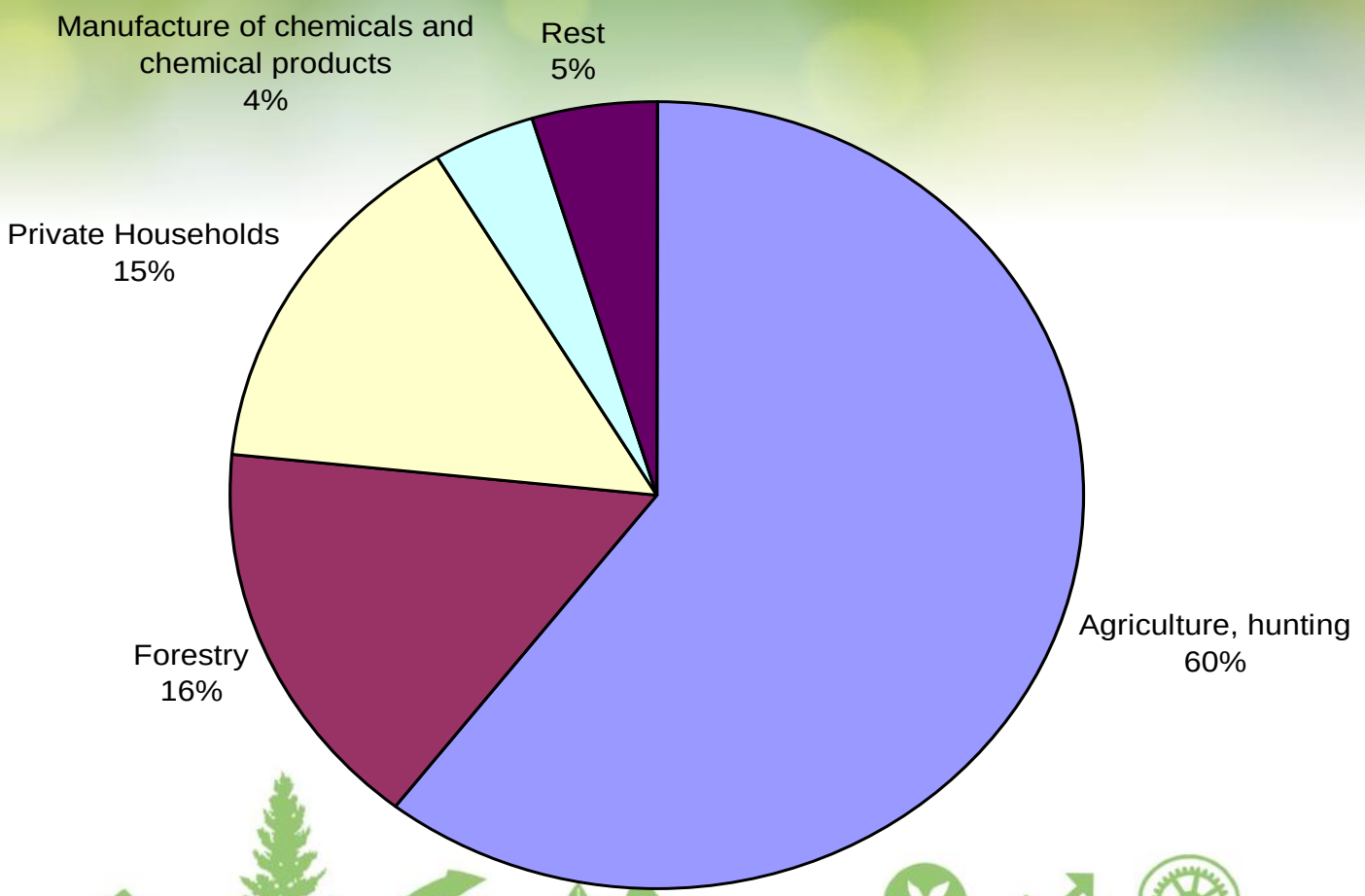
Snapshots from other countries

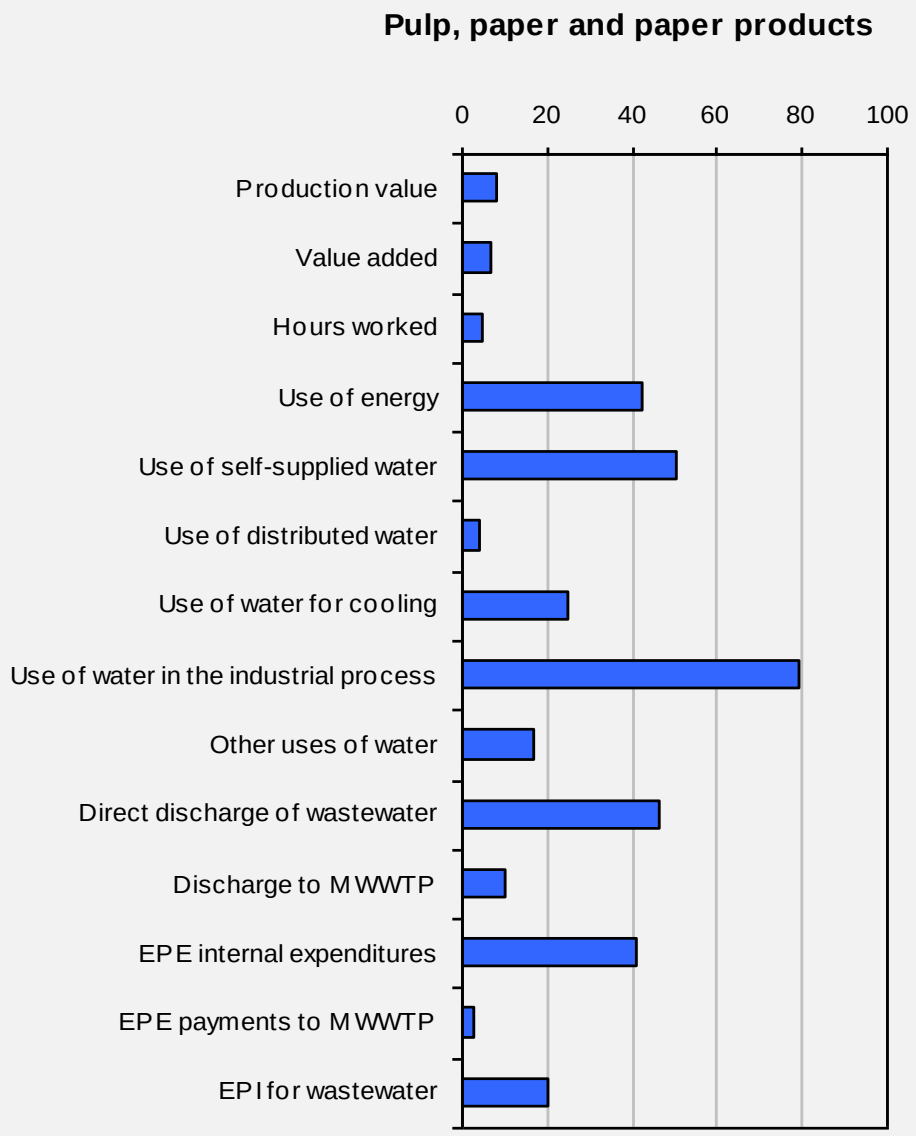
Example (Austria): Share of COD Emissions

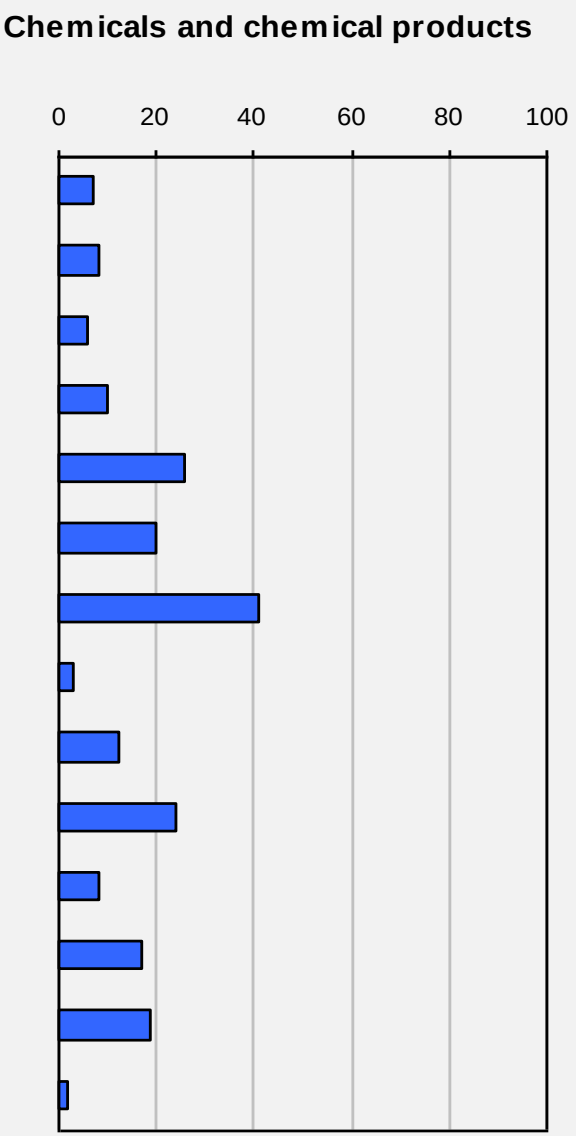


Example (Austria): Share of N Emissions

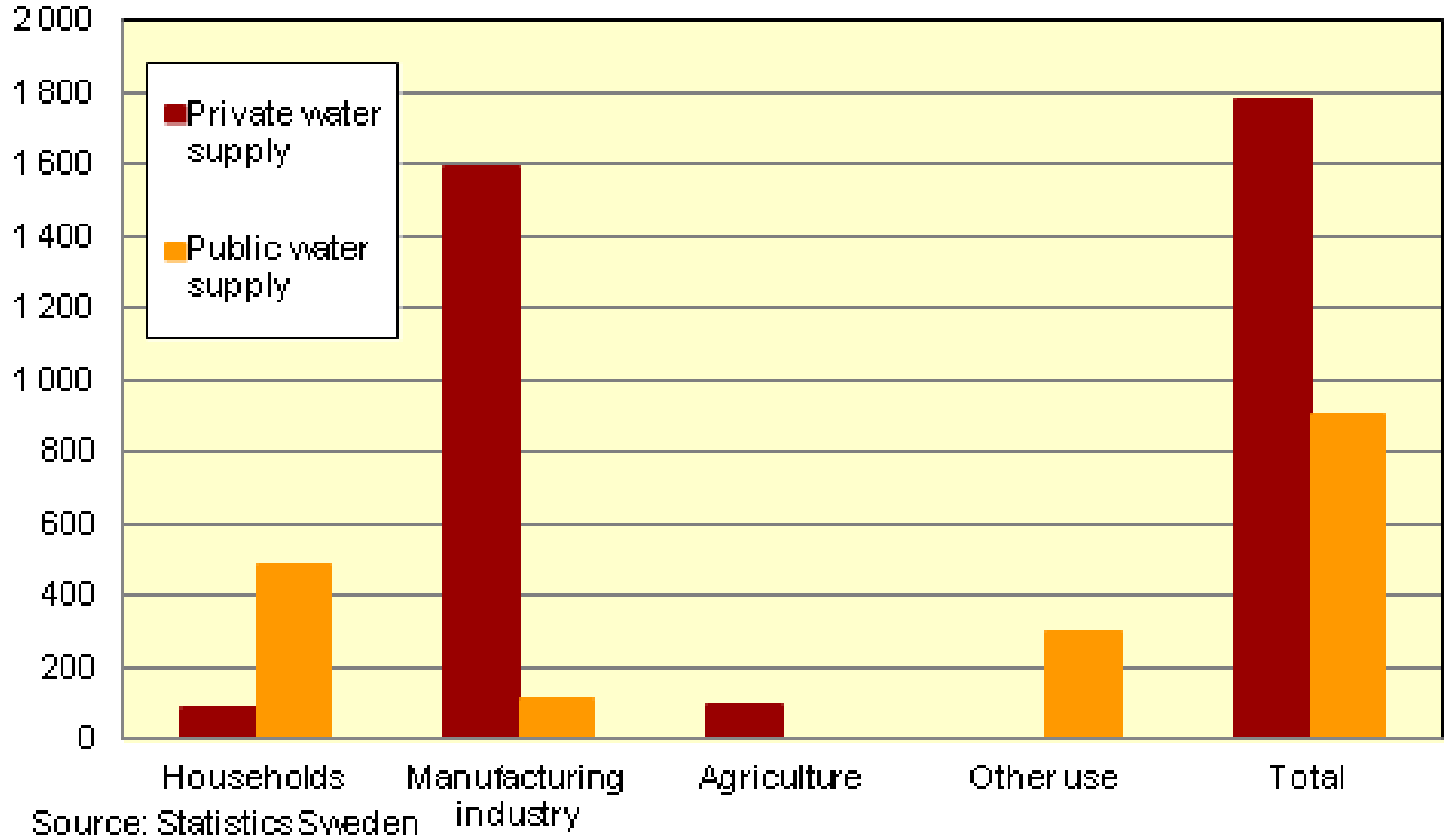


Environmental Economic Profiles
Sweden 1995



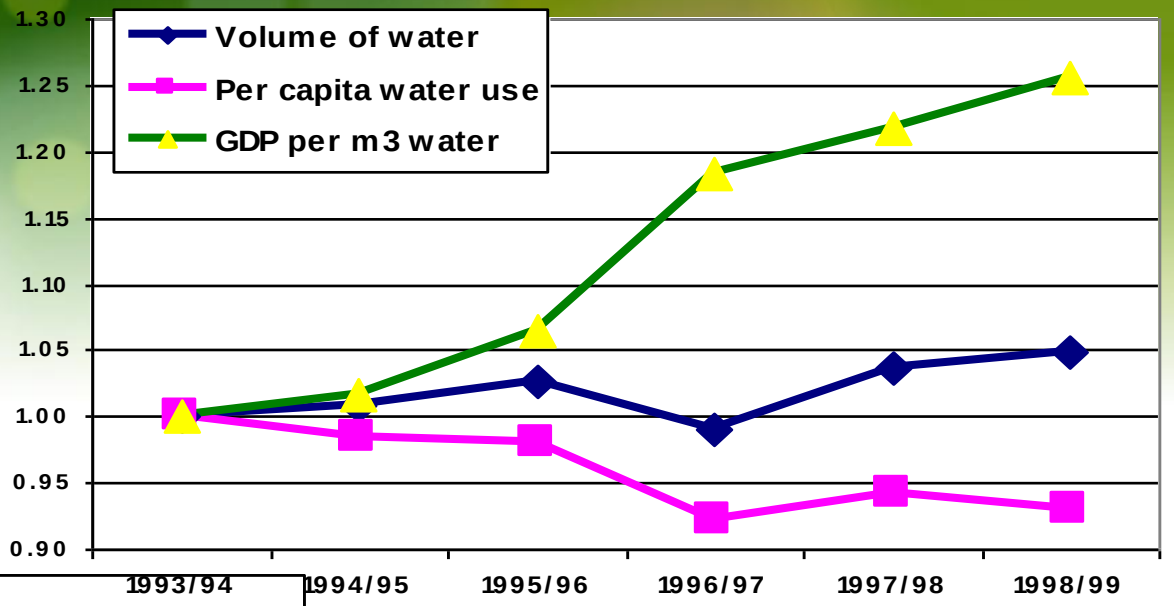


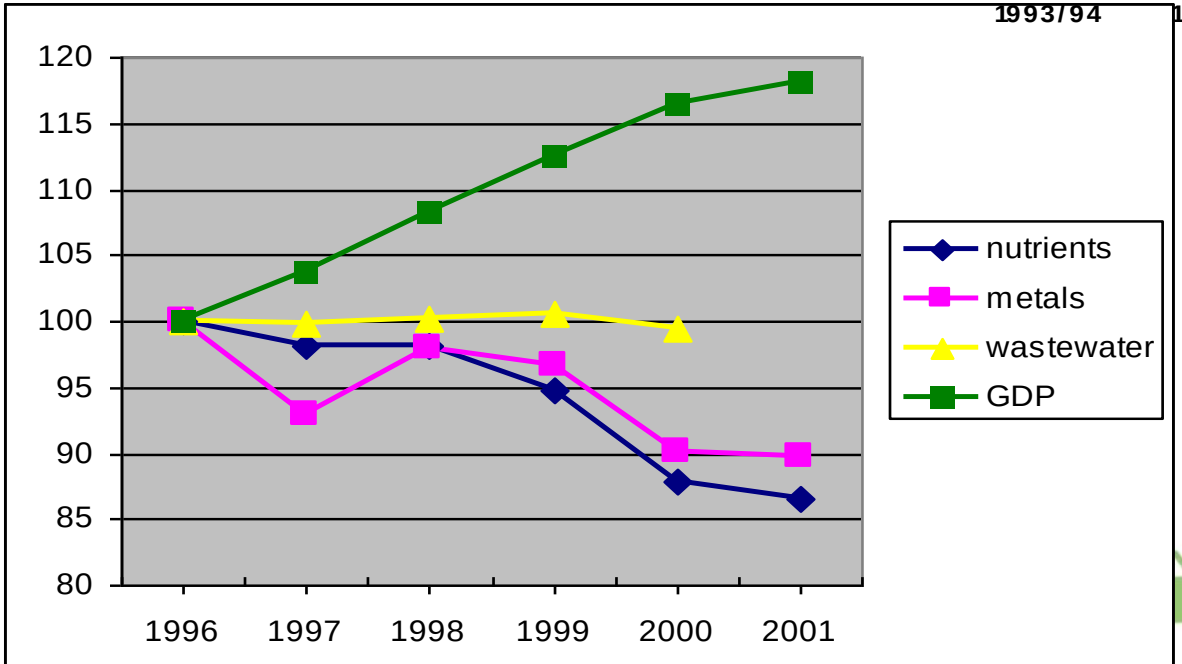
Water use by sectors (Sweden, 2010)



National trends: economic growth and water pollution

Botswana: water use and economic Growth, 1993-1998





Netherlands: water pollution and economic growth, 1999-2001

Netherlands: Green Growth Indicators

Preliminary Scores of Green Growth Indicators

Group	Indicator	Time series	Trend	Policy targets
Environmental efficiency	Production-based greenhouse gas intensity	1990–2009	Relative decoupling	Likely to be met
	Consumption-based greenhouse gas emissions	1996–2009	Relative decoupling	-
	Energy efficiency	1990–2009	Relative decoupling	-
	Renewable energy	1990–2009	Improvement	Unlikely to be met
	Nutrient surpluses	1990–2009	Absolute decoupling	Likely to be met
	Material intensity	1996–2008	Relative decoupling	-
	Water use intensity	1990–2009	Absolute decoupling	-
	Water treatment	1985–2008	Improvement	Likely to be met
Natural asset base	Stocks of standing timber	1990–2005	Improvement	Unlikely to be met
	Fish inputs	1996–2008	Deterioration	-
	Natural gas reserves	1996–2010	Deterioration	-
	Land conversion into built-up land	1900–2006	-	-
	Threat to biodiversity	1994–2005	Deterioration	Unlikely to be met
Quality of life	Pollution induced health problems	1980–2000	Imporvement	-
Policy responses	Green patents	2000–2006	Increase	-
	Share of green taxes	1990–2009	Increase	-
	Energy prices	1990–2009	-	-
	Carbon trade	2005–2009	-	-
	Environmental investments	1990–2007	Stable	-
	Green jobs	1995–2008	Increase	-

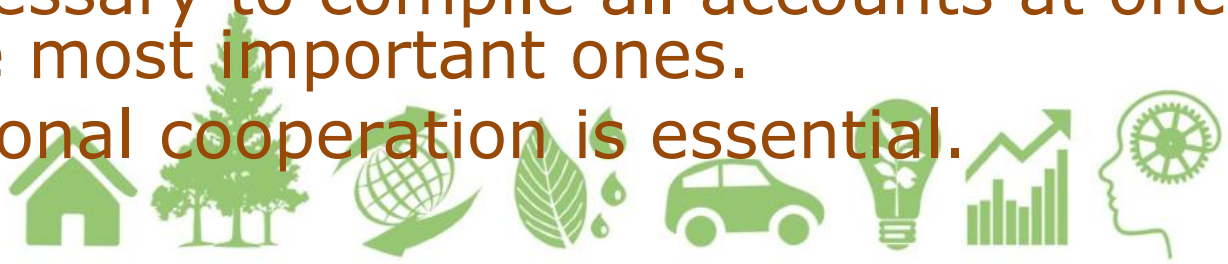
-not possible to score, no policy target identified or inconclusive trend

Some take-home messages

Water Accounts provide a single set of trusted information for multiple purposes, e.g.:

- Water Policies
- Natural resources management
- National and international indicators
- Integration with other accounts (combined presentations)
- Analysis and modelling

- A flexible system in that its implementation can be adapted to countries' priorities and policy needs while at the same time providing a common framework and common concepts, terms and definitions.
- Not necessary to compile all accounts at once. Start with the most important ones.
- Institutional cooperation is essential.



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Thank you for your attention!

michael.nagy@unece.org

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ANNEX

Non-exhaustive list of water-related indicators which can be derived from water accounts

Indicators of water availability derived from Water Accounts

Per capita renewable resources

- Ratio between Total renewable water resources and population size. (WWDR 2003, Margat 1996)

Water Exploitation index

- The total annual volume of ground and surface water abstracted for water uses as a percentage of the total annually renewable volume of freshwater. (UN, 2001)

Consumption Index

- Ratio between Water Consumption and Total Renewable Resources. (Margat, 1996)

Per capita renewable resources derived from water accounts

$$\frac{\text{Total renewable water resources}}{\text{Population}} = \frac{\text{Water Asset account: Returns + Precipitation + Inflows –Evaporation – Outflows}}{\text{Population}}$$

Consumption Index derived from Water Accounts

Physical Supply Table

$$\frac{\text{Water consumption}}{\text{Total renewable water resources}} = \frac{\text{evaporation + transpiration + incorporated in products)}}{\text{Asset account}}$$

Returns + Precipitation + Inflows – Evaporation – Outflows

Indicators for water intensity and productivity from SEEAW

1. Water use and pollution intensity (physical units)		
	m^3 water/unit of physical output	Water use or tons of pollution emitted per unit of output, such as --population, --number of households, or --tons of wheat, steel, etc. produced
	Tons of pollution/unit of physical output	
2. Water and pollution intensity (monetary units)		
	m^3 water/value of output	Water use or tons of pollution emitted per unit of output measured in currency units
	Tons of pollution/value of output	
3. Water productivity ratios		
	GDP/ m^3 water	
	Value-added by sector/m^3 water	
4. Water 'pollutivity' ratios		
	Sector share of pollution/sector share of GDP	

Indicators for opportunities to increase water supply

1. Return flows	
Quantity of return flows by source	May distinguish return flows from treated return flows (from municipal and industrial users) from untreated return flows such as agriculture
2. Water reuse	
Reuse water as share of total industry water use	May distinguish reuse of water within a plant from water recycled by municipal water utility
Recycled water as share of total water use by sector	
3. Losses	
Losses in abstraction and treatment as share of total water production	Both the amount and the reason for these losses are usually known by the water utility
Unaccounted for losses as share of total water use	These losses occur for a variety of causes and it is usually not certain how much each cause contributes

Indicators for cost and price of water supply and wastewater treatment

1. Supply cost and price of water	
Implicit water price	Volume of water purchased divided by supply cost
Average water price per m^3 by industry	Volume of water purchased divided by actual payments by that industry
Average water supply cost per m^3 by industry	Volume of water purchased divided by cost of supply to that industry
Subsidy per m^3 by industry	Average water price minus average water supply cost
2. Supply cost and price of wastewater treatment services	
Implicit wastewater treatment price	Volume of water treated divided by supply cost
Average wastewater treatment cost per m3 by industry	Volume of wastewater divided by treatment cost for that industry
Average wastewater treatment price per m3 by industry	Volume of wastewater divided by actual payments for treatment by that industry
Subsidy per m3 by industry	Average wastewater price minus average wastewater supply cost

Indicators of access to and affordability of water and sanitation services

1. Access to water and sanitation services
Average daily water consumption by households, differentiating rural and urban households
Percent of urban households with access to safe drinking water
Percent of rural households with access to safe drinking water
Percent of urban households with access to sanitation services
Percent of rural households with access to sanitation services
2. Affordability of water
Household expenditures for water as % of total expenditures, differentiating rural and urban
Average price of water to households, differentiating rural and urban
Average price of water for subsistence agriculture (irrigation and livestock watering)