

Economics and IWRM: Opportunities and Challenges

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Outline

- 1. Introduction**
- 2. Cases**
 - (a) Valuation
 - (b) Pricing
 - (c) Cost-Benefit
 - (d) Decision-support
- 4. Summary**

General principles

Goals of IWRM and how economic analysis can contribute to them:

- Efficient water use and conservation
- Analysis of alternatives
- Integration across sectors
- Policy design

Case 1: valuation

Why valuation?

- Can't avoid it: do it implicitly or explicitly
- Many applications:
 - Cost-benefit analysis
 - Allocation decisions
 - Source-water protection

Categories of Value

How valuation?

- There are a variety of ways in which a household or firm can benefit from water
- Economists create categories of different types of values: the “Total Economic Value” framework

Valuation of Goods/Services from Water

Use
Values



Non-use or
passive use
Values



Existence
Values

Add these three
together
to obtain Total
Economic Value
(TEV) of water

Derive from
motivations
other than
current personal
use

Derive
from
preventing
destruction
of resource;
no intent of
future use

Value measurement

Indirect methods: uses observed market behaviour and indirectly estimates values

- Travel Cost
- Hedonics
- Averting Behaviour

Value measurement

Direct methods: seeks valuation estimates directly from households-usually through survey

- Contingent valuation
- Choice experiments

Industrial & Comm'l water values (2005\$/m³)

	Manufacturing	Primary Industries	Thermal Power Generation	Commercial		Agriculture (Irrigation)	
Value	0 to 1.41/m ³ (average 0.33/m ³)	0.38/m ³ (mining) 1.01/m ³ (oil & gas)	\$0.70/m ³ (Thermal)	\$0.55/m ³	0.96/m ³	Short Run: \$0.003 to 0.127/m ³ Long Run: \$ 0 to \$0.05/ m ³	\$0.140 to \$1.335/m ³
Region	National	National	<u>Alberta SSRB</u>	National	<u>Alberta SSRB</u>	<u>Alberta SSRB</u>	<u>Alberta SSRB</u>

Household water values (2005\$)

	Quantity	Reliability	Recreation		Amenity (Including health and ecosystem services)		Preservation /Existence
Value			Fish	Swim	Health	Wetlands	
	\$719 per household	\$25.07 to \$34.66 per household per month	\$26.10 to \$53.36 per household per year	\$32.04 to \$95.78 per household per year	WTP of \$294 per household per year	\$218.84 to \$372.65 per person per year	\$34.33 per household
Region	SSRB	National	<u>Hamilton Harbour</u>	<u>Hamilton Harbour</u>	National	<u>Alberta</u>	SSRB

Valuation: summary

- A wide range of techniques available
- While relatively new, growing body of research confirms consistency and validity of estimates
- Direct methods esp. useful for *ex ante* policy analysis and non-use values
- Likely will remain controversial – particularly with noneconomists

Case 2: pricing

Importance of water prices:

- Revenue generation
- Signals costs to consumer
- Informs supplier of valuation
- Promotes innovation

Principles of rate design

- Efficient allocation
- Financially sustainable
- Protect Environment
- Fair
- Promote innovation & conservation

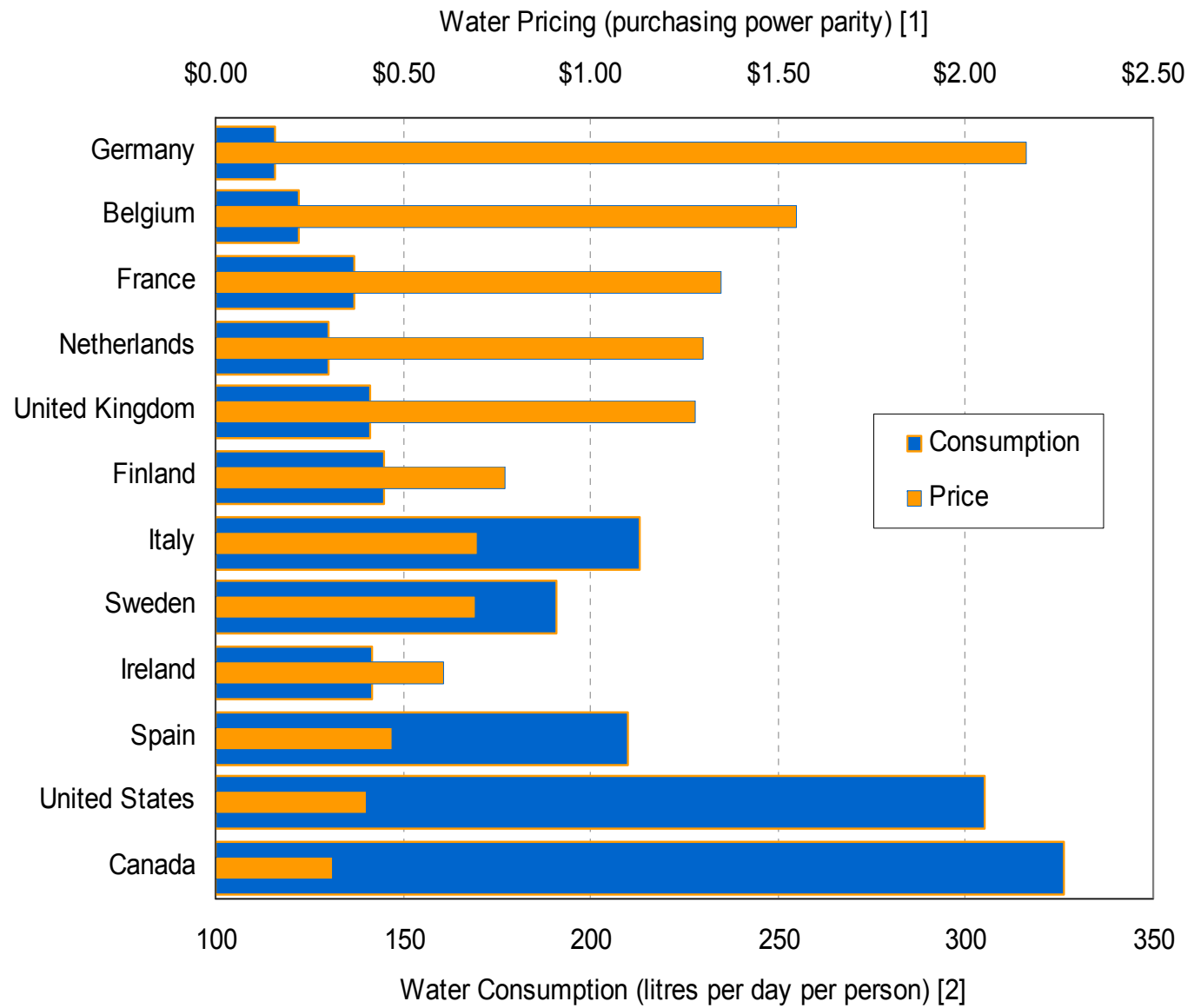
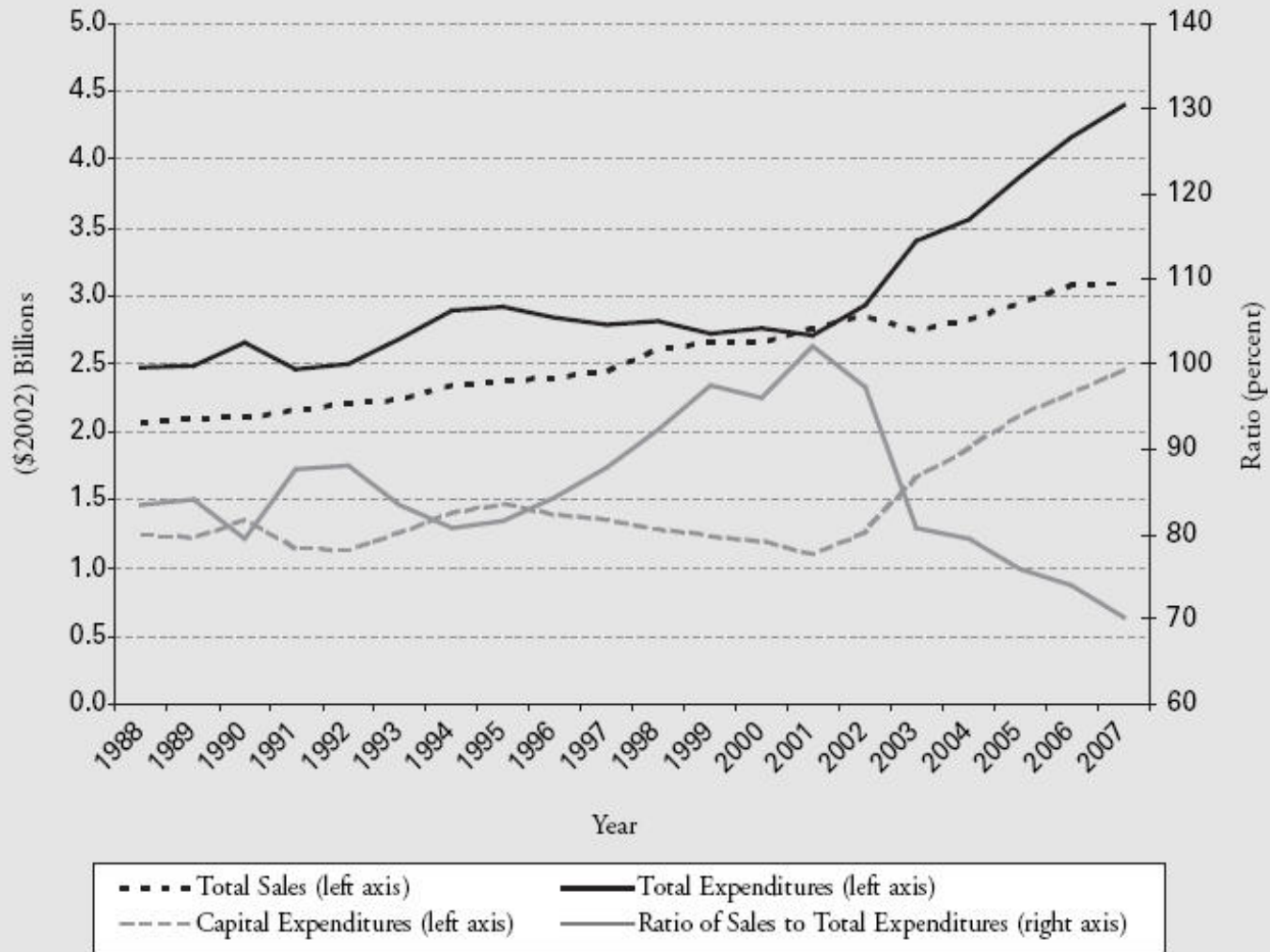


Figure 1: Revenues and Expenditures of Canadian Municipal Water Agencies, 1988 to 2007



Source: Statistics Canada (2008).

Evaluation of current pricing

Current pricing rules perform poorly:

- Based on incomplete cost accounting
- Inefficient: don't reflect costs of service
- Do little for environmental protection
- Unfair: poorly understood cross subsidies
- Do little to promote innovation

Some old results

	Residential	Non Residential	Sewage
MC (\$/m ³)	0.873	1.49	0.521
P (\$/m ³)	0.323	0.734	0.128
DEV (%)	47.52	62.87	13.44
DWL (\$)	0.252	0.312	0.818

Reforming water prices

General principle: set prices to inform consumers of **marginal cost** of supply

Specific form: depends on goals (efficiency, revenue stability, concern for poor), what information is available and agency's capacities

Pricing: summary

- Municipal water prices have significant shortcomings
- Some positive initiatives in Ontario:
 - full cost accounting and pricing
 - recovery of source water protection costs

Case 3: Cost-Benefit Analysis

- Procedure for assessing whether a project raises or lowers social welfare
- Used for bridges, environmental clean-ups and major govt policies
- Use economic model to predict impact of project on incomes, prices and other factors influencing welfare → **benefit** of project
- **Costs** of project: usually engineering study

Cost-Benefit Analysis

- Decision rule:

Benefits $>$ Costs \rightarrow net welfare \uparrow \rightarrow Proceed

Benefits $<$ Costs \rightarrow net welfare \downarrow \rightarrow Stop

Cost-Benefit Analysis

Complications:

- Costs and benefits can occur in different time periods: calculate *present values*
- Distribution of costs and benefits may be relevant
- Non-economic goals

Hamilton Harbour

- One of 42 Areas of Concern
- Remedial Action program: multi-stage process with strong citizen involvement
- Goal is to restore beneficial uses
- Clean-up proposals costed but benefits not measured

Areas of Concern in the Great Lakes - St. Lawrence River Basin



- Legend**
- Canada
 - U.S.A.
 - Delisted AOC
 - Connecting Channels

Hamilton Harbour



Hamilton Harbour

Problems included:

- Restrictions on fish and wildlife consumption
- Degradation of fish and wildlife populations
- Presence of fish tumours or other deformities
- Bird or animal deformities, reproduction problems
- Degradation of benthos
- Eutrophication with undesirable algae
- Beach closures
- Degradation of aesthetics
- Degradation of phyto-plankton and zooplankton communities
- Loss of fish and wildlife habitat

Hamilton Harbour

Remedial Actions included:

- Up-grade wastewater treatment plants
- Decouple combined sewer-storm water outflows
- Up-grade water treatment at steel & chemical plants
- Remediate contaminated sediments
- Maintain and enhance fish and wildlife habitats

Results

Our estimates of the present value of
Hamilton Harbour RAP activities for the
period 1990-2015:

Benefits = \$68 million

Costs = \$240 million

Hamilton Harbour benefit estimates

Benefit Category	Estimated Annual Value
<i>Direct Use Values</i>	
Swimming	0.429
Fishing	0.188
Boating	0.746
<u>Birdwatching</u>	0.224
<i>Future Use Values</i>	
Swimming	3.098
Fishing	2.360
Boating	1.381
<i>Non-Use Values (Passive or Existence)</i>	1.011
TOTAL	9.437

Cost-Benefit: summary

- Valuable framework for assessing policies
- Limited application in Canada water management

Case 4: decision-support

- Water management requires data on impacts and alternatives
- Economic analysis can support decision-making:
 - trade-off analysis
 - impacts of water policies on economy
 - impacts of pursuing non-economic goals

Decision-support example

- IJC appointed Study Board to consider alternative Regulation Plans for Lake Ontario and St. Lawrence River
- Large, complex ecosystem
- Many competing users
- SB built sophisticated 'hydro-economy' model-showed impacts of alternative Plans

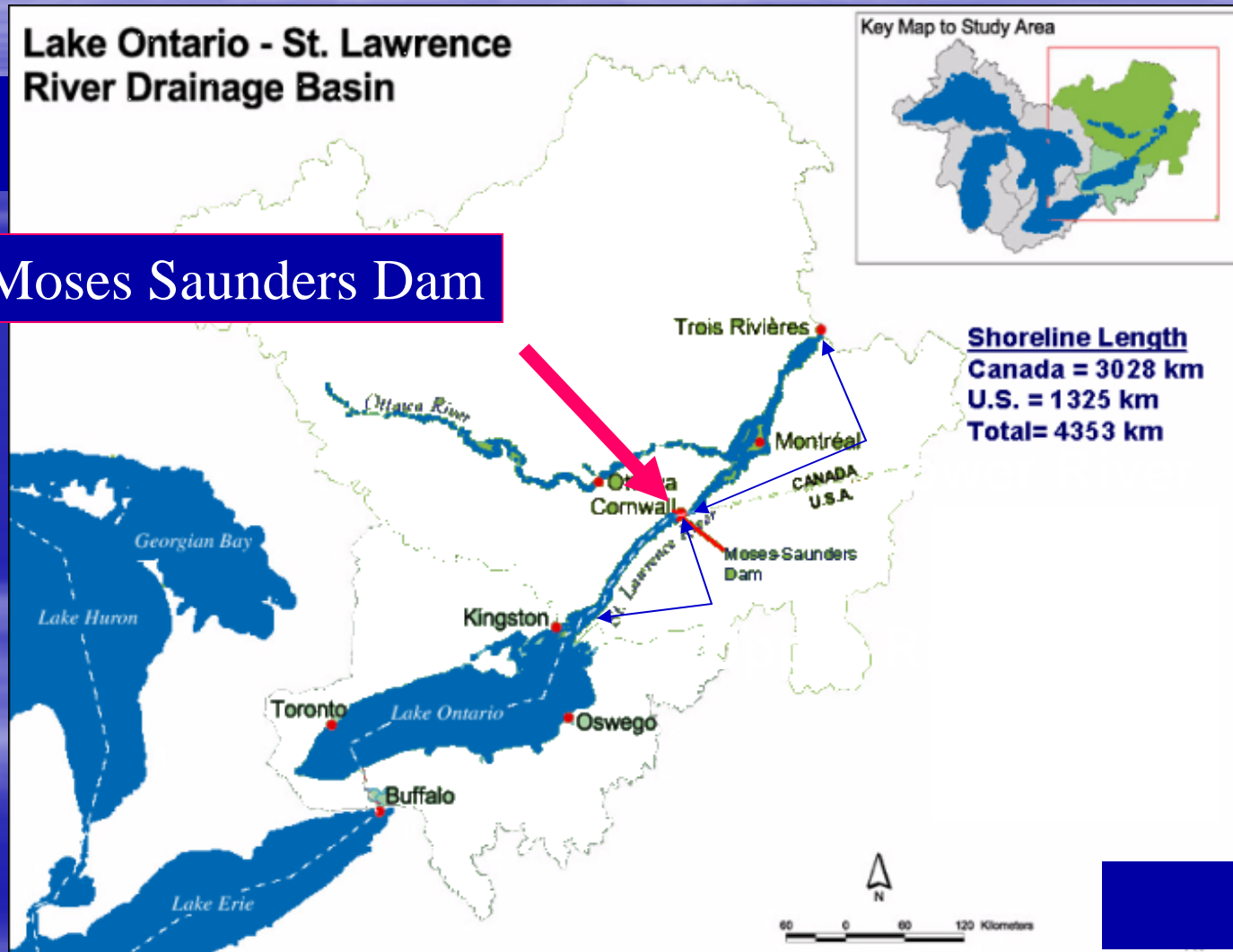
LOSLR

- Relationship between water levels and economic activities summarized in “performance indicator” functions
- Done for hydropower, comm. nav., recreational boating, municipal intakes and coastal properties
- Separate analysis estimated PI’s for plants, animals & wetlands

Complex system

Lake Ontario - St. Lawrence River Drainage Basin

Moses Saunders Dam



Summary of Plan Results

(Average Annual benefits in millions of US dollars)	Plan A	Plan B	Plan D
Environmental Index	1.15	1.41	1.03
Shoreline Property	-\$1.10	-\$2.88	\$.13
Commercial Navigation	\$2.19	\$1.96	\$1.95
Recreational Boating	\$3.18	-\$0.87	\$1.95
Hydroelectric	\$4.97	\$6.11	\$1.02

Decision-support summary

- Water management frequently involves conflicts and trade-offs
- Modeling and decision-support tools can facilitate dialogue and analysis
- Good for representing complex systems and environment-economy linkages
- Expensive and time-consuming

Summary: opportunities

Economic analysis:

- Opportunity cost of decisions
- Assist with trade-off analysis
- Reveal linkages to other sectors
- Policy and instrument design

Summary: challenges

- Whose values?
- Valuation of nonmarket (ecological) services
- IWRM largely about process but economics isn't

Thank you!

Questions?