Towards an Integrated Water Accounting System for Ontario and the Great Lakes

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Presentation Outline

- Background
- Main objective
- Methodology
- Results
- Conclusions and next steps

Background

- Increasing policy maker demand for the economic value of water resources internationally (e.g. EU Water Framework Directive) and in Canada

- UN System of Environmental-Economic Accounts

  internationally agreed standard concepts, definitions, classifications, accounting rules and tables for producing internationally comparable statistics and accounts

- SEEA-Water
  - Physical flow accounts (e.g. water abstraction by industry and emissions)
  - Physical asset accounts (e.g. water balance, stocks and their depletion)
  - Economic accounts (e.g. costs associated with water use and supply)

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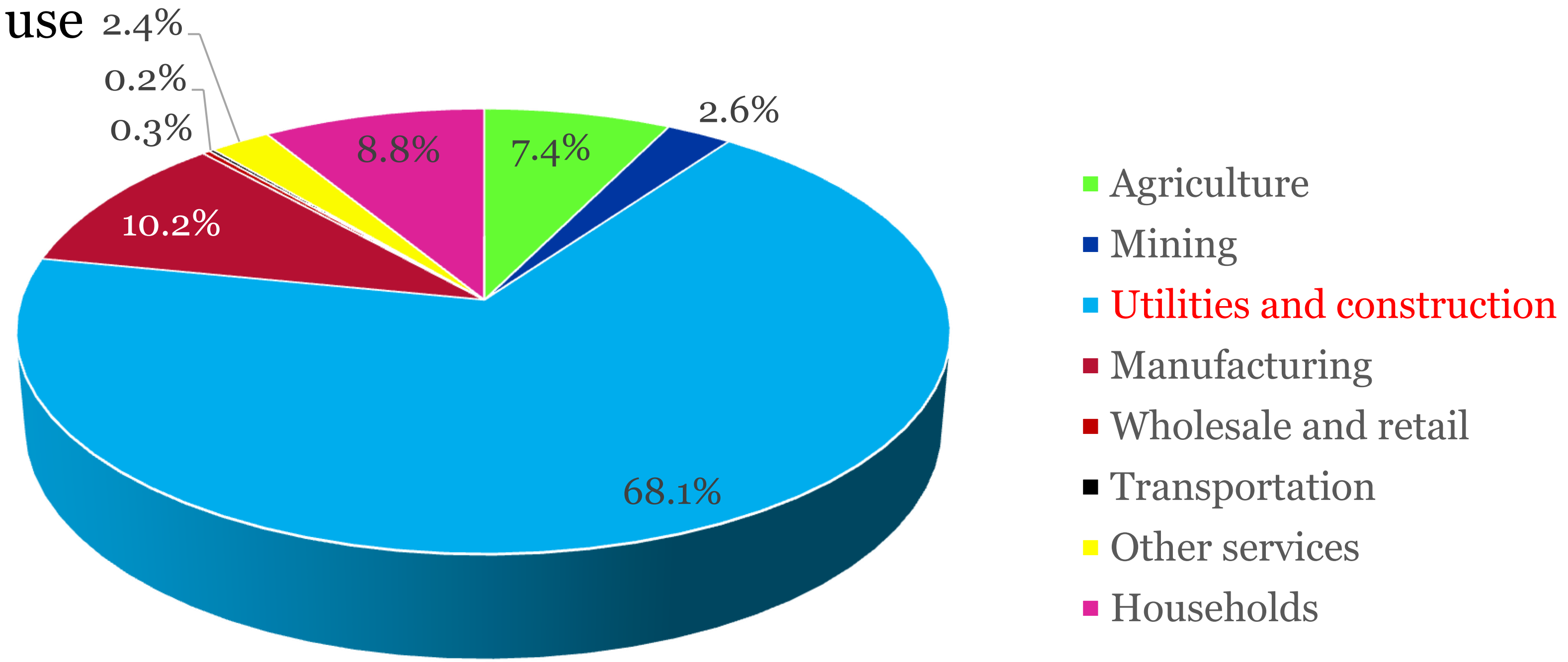
Background

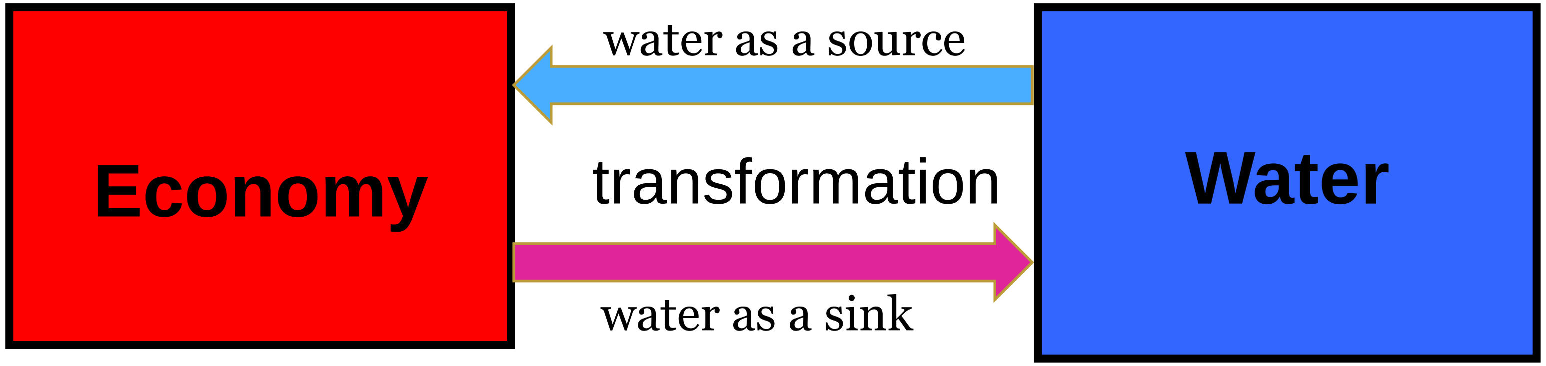
- Statistics Canada, Physical flow account for water use (m^3)
  - Published every 2 years (2005-2015)
  - Industrial and household water use
  - Canada as a whole



Total: 35.7 billion m^3 in 2015

Source: Statistics Canada (2018)

Background


Economy
water as a source
transformation
water as a sink
Water

Main objective

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  - Multiple pressures from different sources of pollution
  - **Economic importance to the economy of Ontario and Canada as a whole**

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  - **Economic importance to the economy of Ontario and Canada as a whole**

- Great Lakes Commission (since 2013)

Blue Accounting

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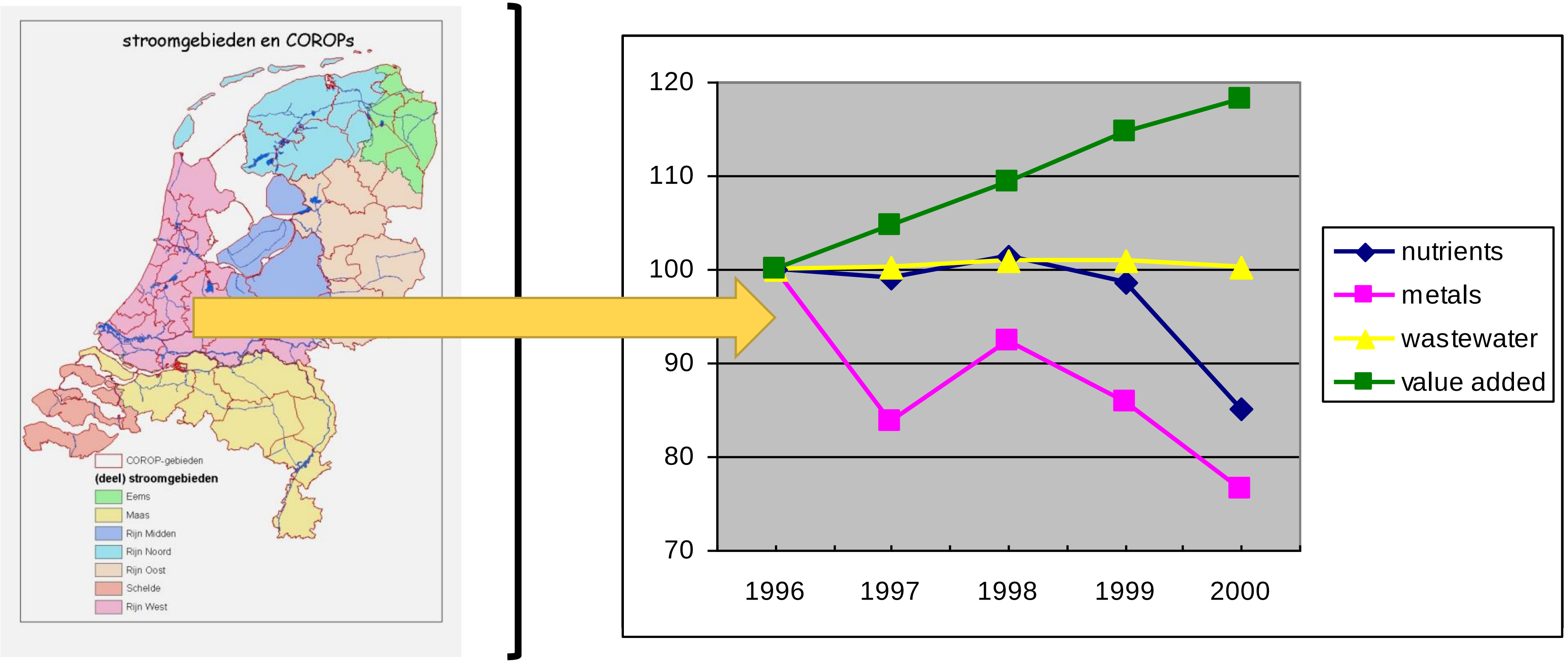
Methodology

	Agriculture	Industry	Households	*Gross output*	Discharge	Emissions
Agriculture	X1	X2	X3	X1+X2+X3	Y1	Z1
Industry	X4	X5	X6	X4+X5+X6	Y2	Z2
Households					Y3	Z3
Value added	X2+X3-X4	X4+X6-X2		GDP		
Extraction	Y4	Y5	Y6		Balance	
Absorption	Z4	Z5				Deposition

Source: Brouwer, Schenau and van der Veeren (2005). Integrated river basin accounting
and the European Water Framework Directive. Statistical Journal of the UN, 22(2): 111-131.

Indicators at national and river basin level



Source: Brouwer, Schenau and van der Veeren (2005). Integrated river basin accounting and the European Water Framework Directive. Statistical Journal of the UN, 22(2): 111-131.

Methodology

- Explore the possibility of combining different data and information sources

- Two-step approach

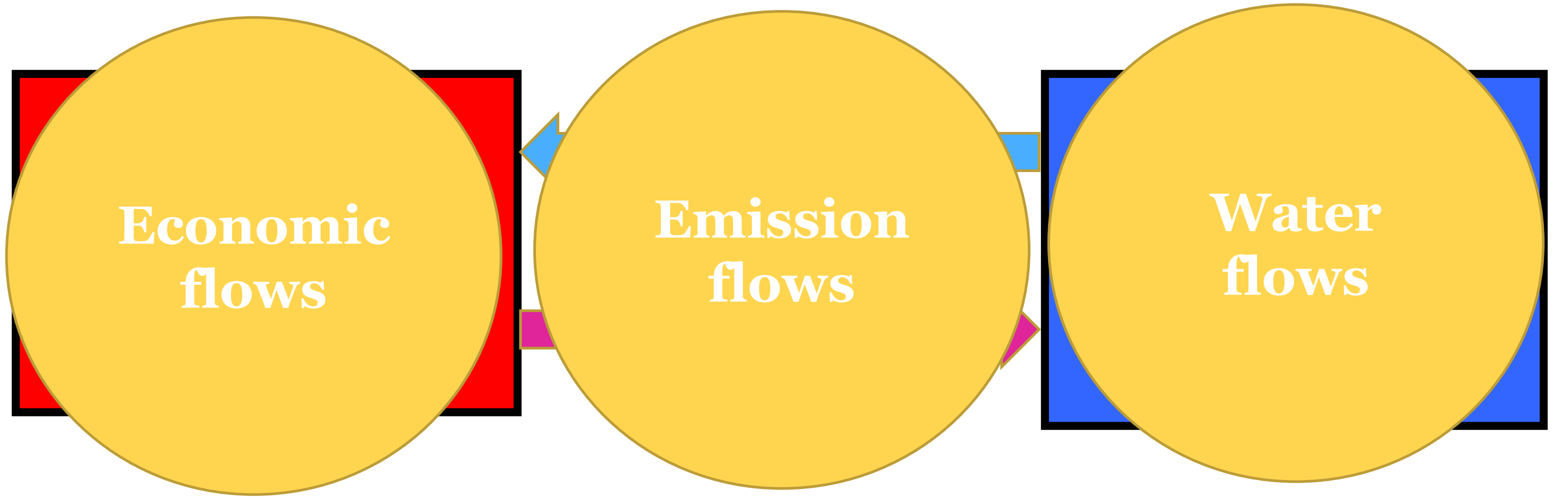
1) Link available economic and physical water data sources (across the same years)
2) Spatial upscaling or downscaling of the available data to (sub-)basin(s) and province

Methodology

- **Step 1**

ECCC

Annual Reporting by National Pollutant Release Inventory (NPRI) **1994-2016**
Annual Effluent Regulatory Reporting Information System (WSER-ERRIS) **2013-2017**



Statistics Canada
Annual provincial Supply and Use Tables
2012-2016
(IO tables 1997-2011)

Statistics Canada
Bi-annual national water use accounts **2009-2015**
Bi-annual agriculture water survey **2010-2016**
Bi-annual industrial water survey **2005-2015**
Bi-annual drinking water plants survey **2006,2009,2011,2013,2015**

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Methodology

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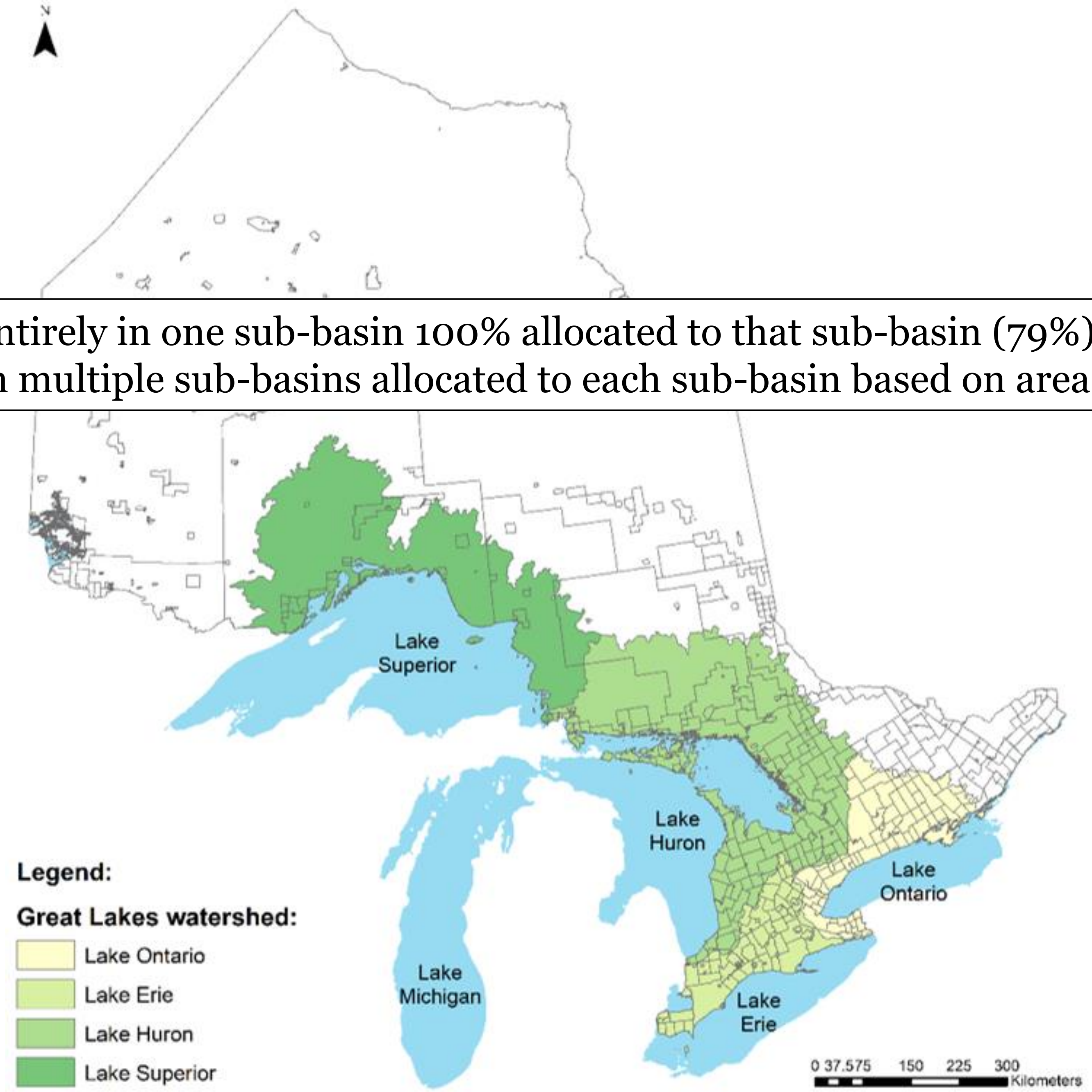
- CSD highest spatial resolution at which job data are available per sector
- Economic activities grouped according to the North American Industry Classification System (NAICS) in provincial SAUT's
- Activities allocated to Great Lakes sub-basins based on # jobs per CSD

Methodology

- **Step 2**

- CSD located entirely in one sub-basin 100% allocated to that sub-basin (79%)
- CSD located in multiple sub-basins allocated to each sub-basin based on area size (21%)



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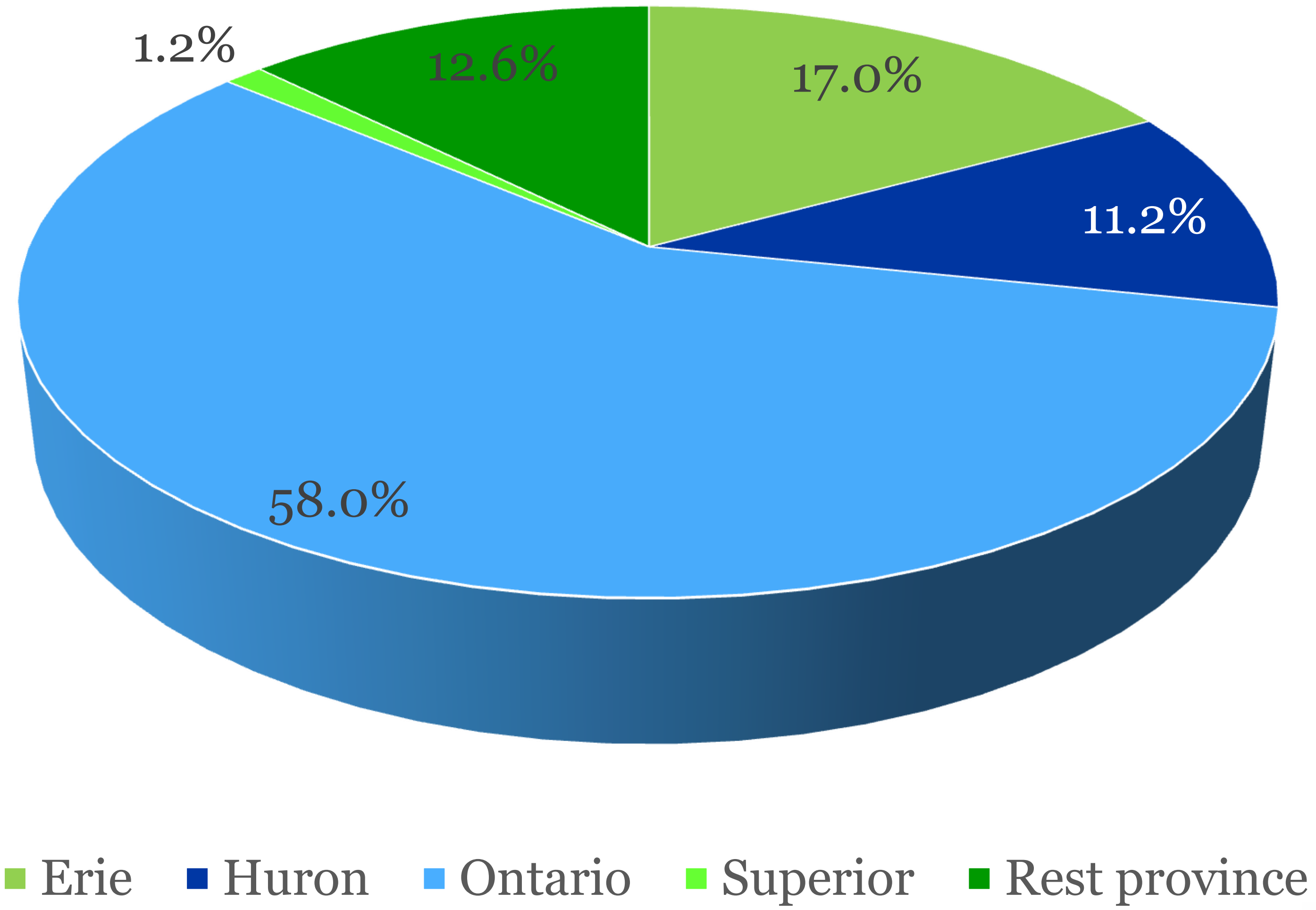
Results

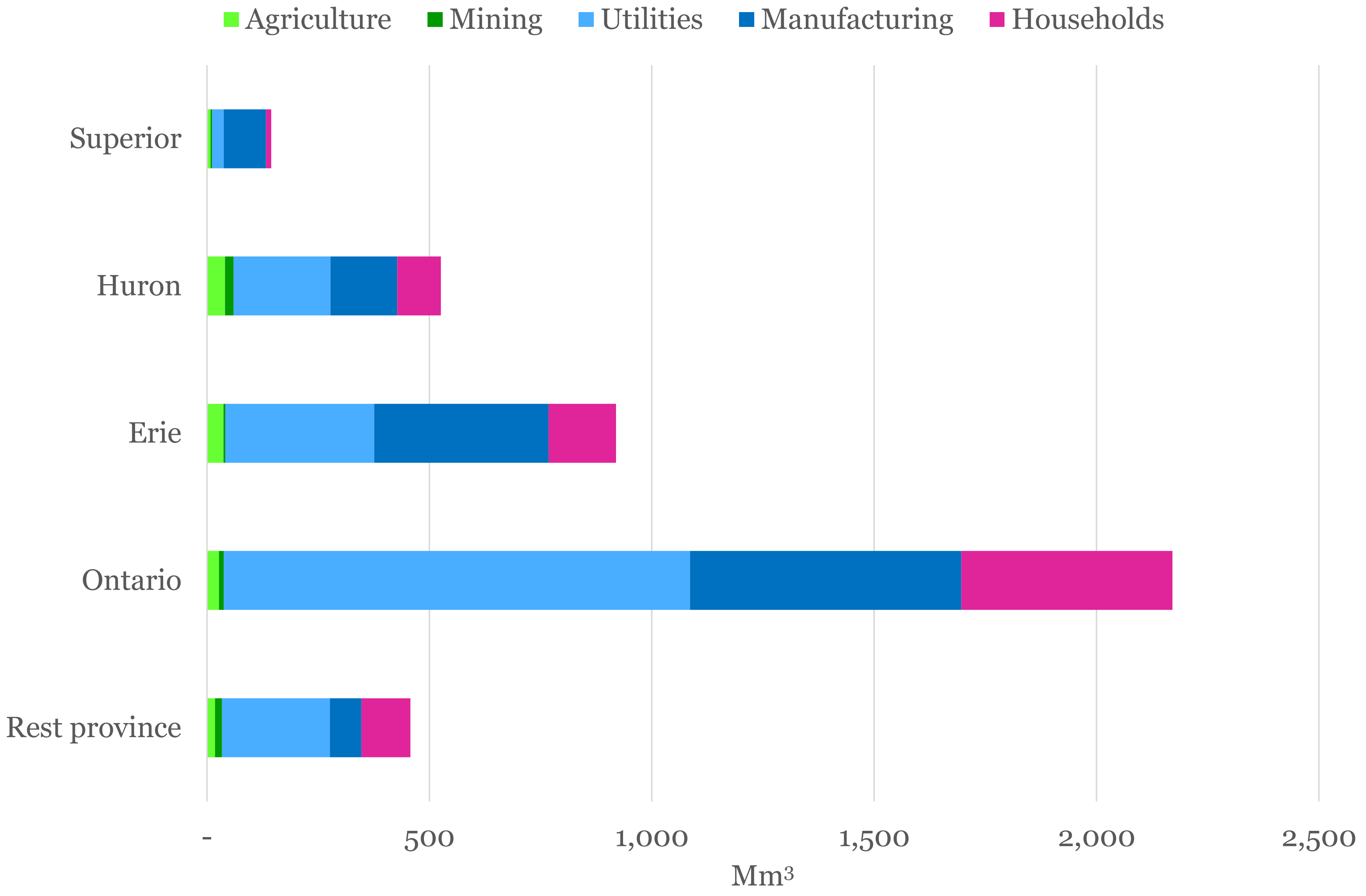
Distribution of value added across sub-basins



Total GDP Ontario in 2016:$741.3 billion

Results

Water use across sectors and sub-basins in 2016



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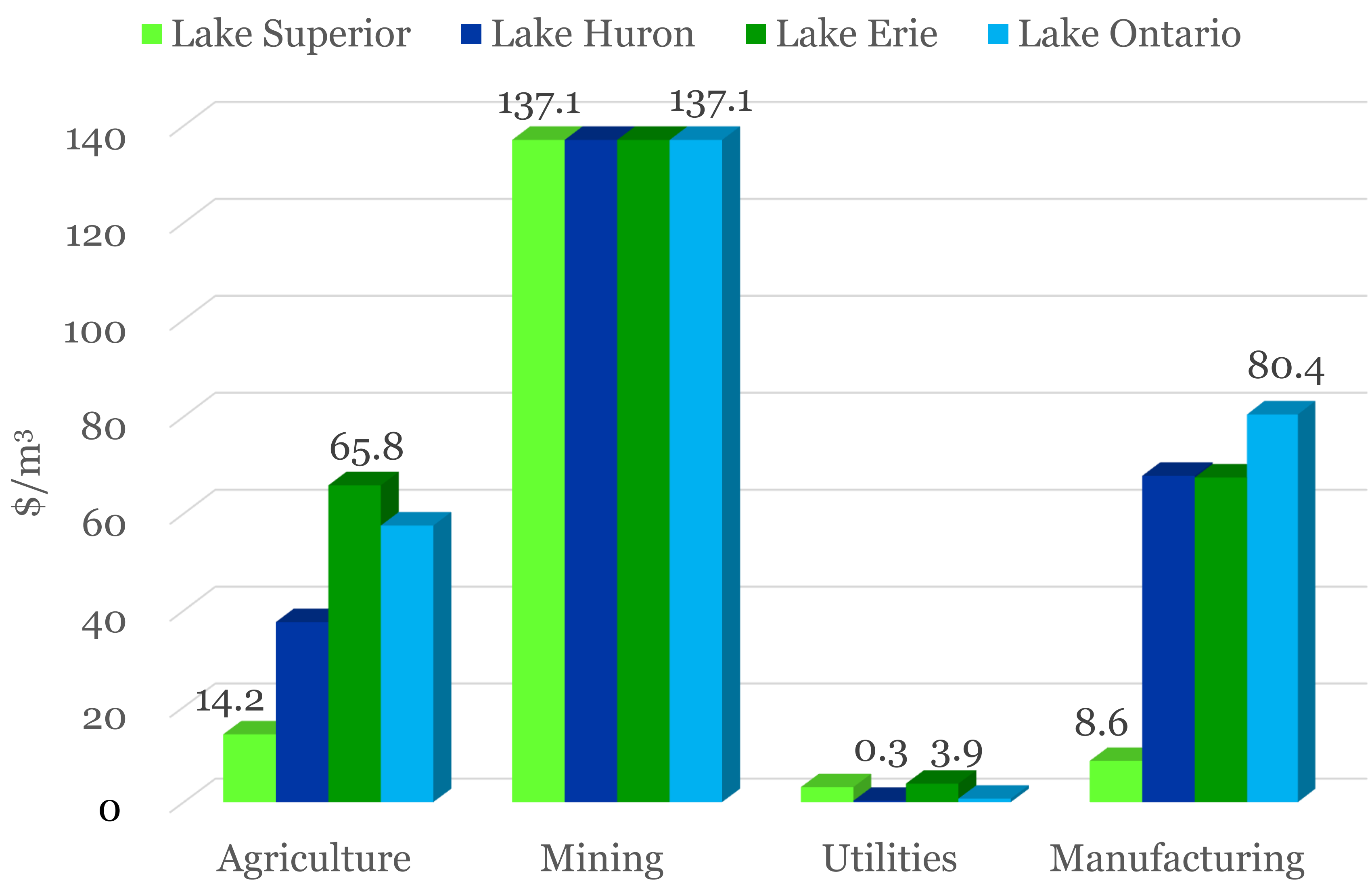
Value added of water use across sectors and sub-basins in 2016



Results

- Emissions to water
  - Point source pollution (industry, wastewater treatment facilities)
  - Non-point source pollution (agriculture)

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Results

- NPRI:
  - Release data various pollutants (e.g. kg's of As, Cd, Hg, Pb, Se, TP, Zn)
  - Sectors (linked to NAICS)
  - Geographical location
  - Employees (>10 FTE)
- Emitting activities allocated to sub-basins based on geographical coordinates
- Emitted pollutant in kg divided by jobs [kg/job]
- Upscaling across CSD in each sub-basin based on jobs/sector

> sub-basin specific emission coefficient [kg/job/sector] x [jobs/sector]

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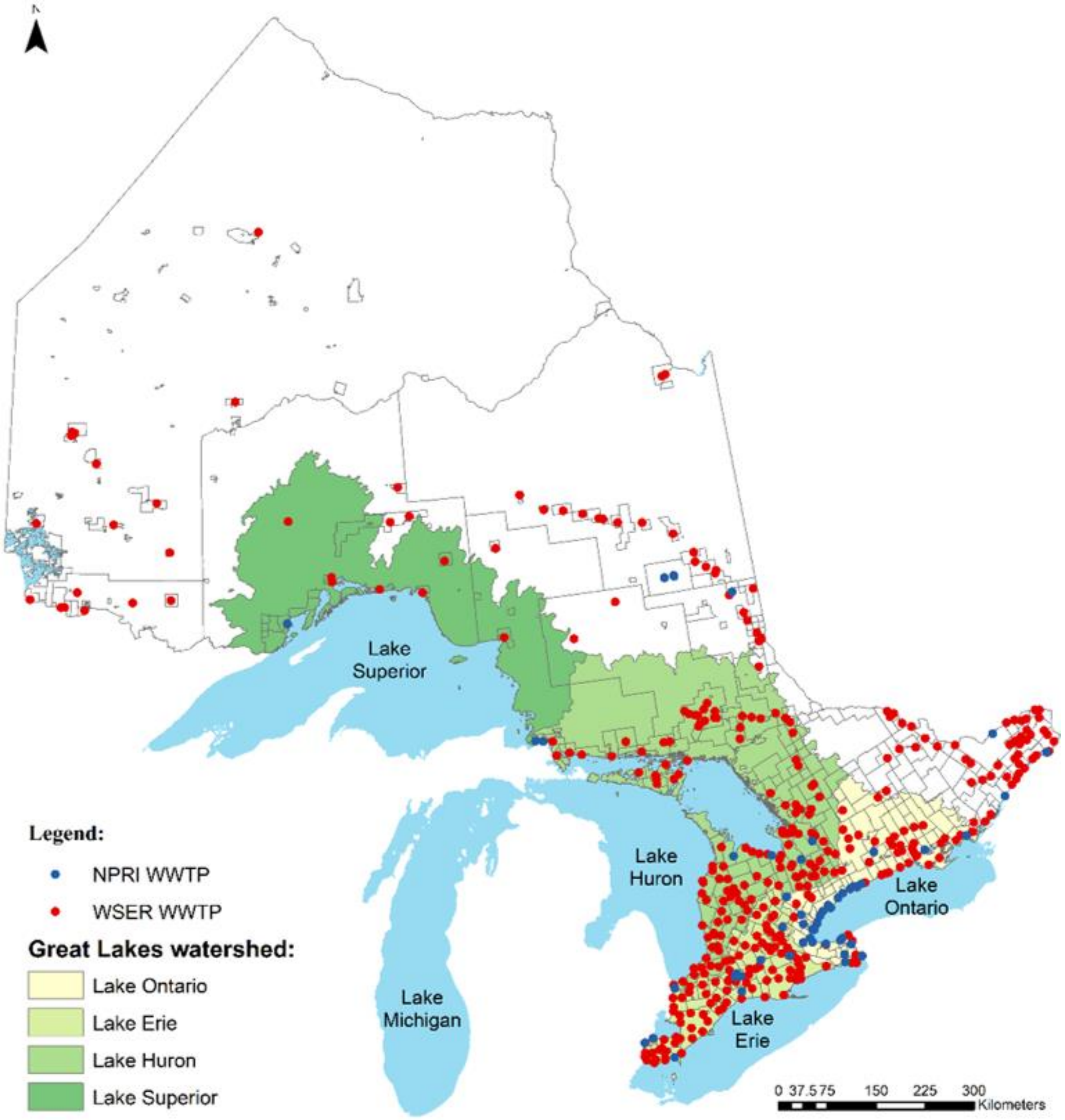
Results

- NPRI observations WWTPs limited to n=
- Cross-validated with WSER-ERRIS data



Results

- NPRI observations WWTPs limited to n=55
- Cross-validated with WSER-ERRIS data (n=437, including 55 in NPRI)

- NPRI: release to water in kg
- ERRIS: effluent volume in m^3

$r = 0.97$

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- NPRI: release to water in kg
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$r = 0.97$

- Upscaling to non-reporting facilities using median value [kg/m^3] for each NAICS sector in each sub-basin

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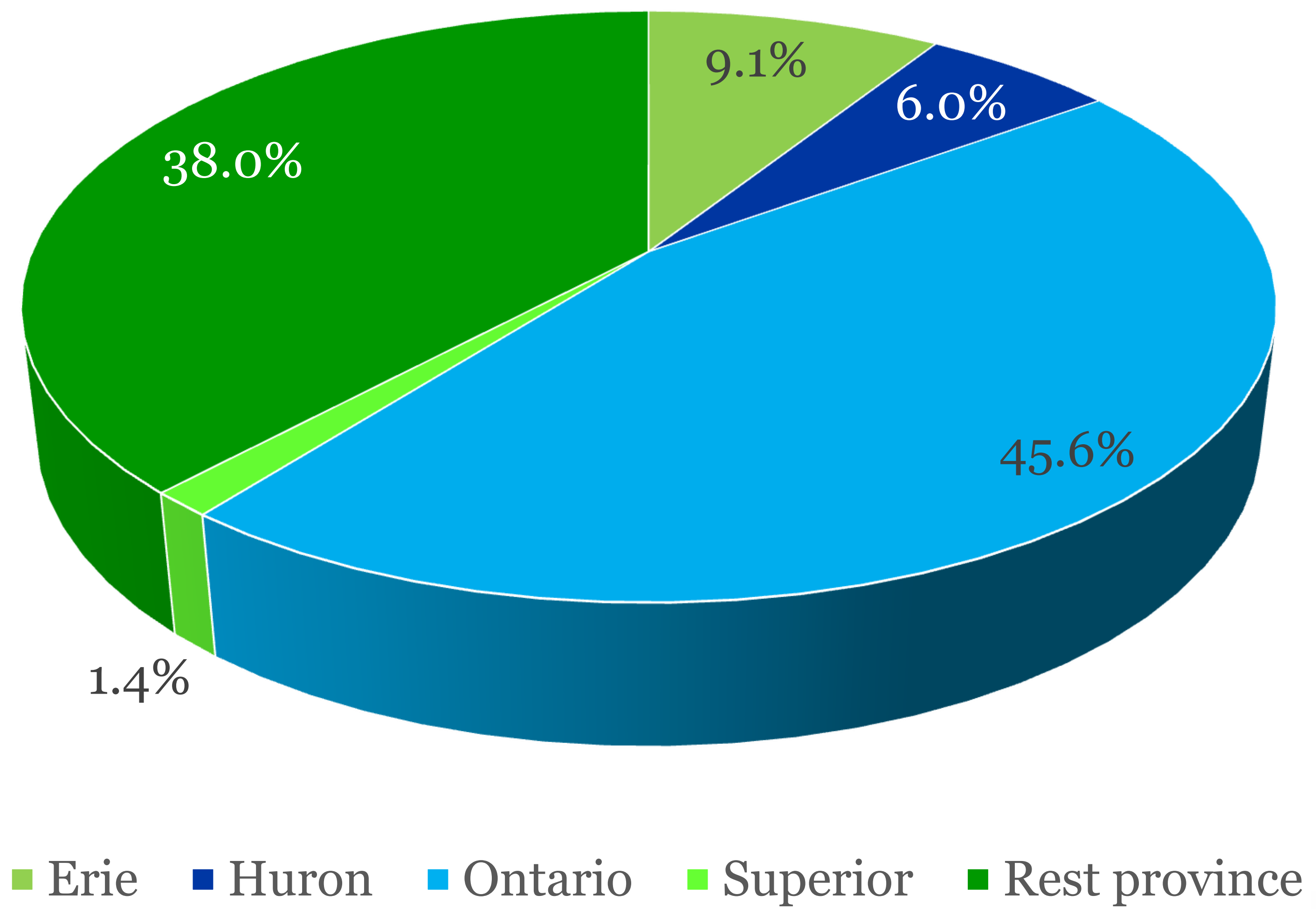
Results

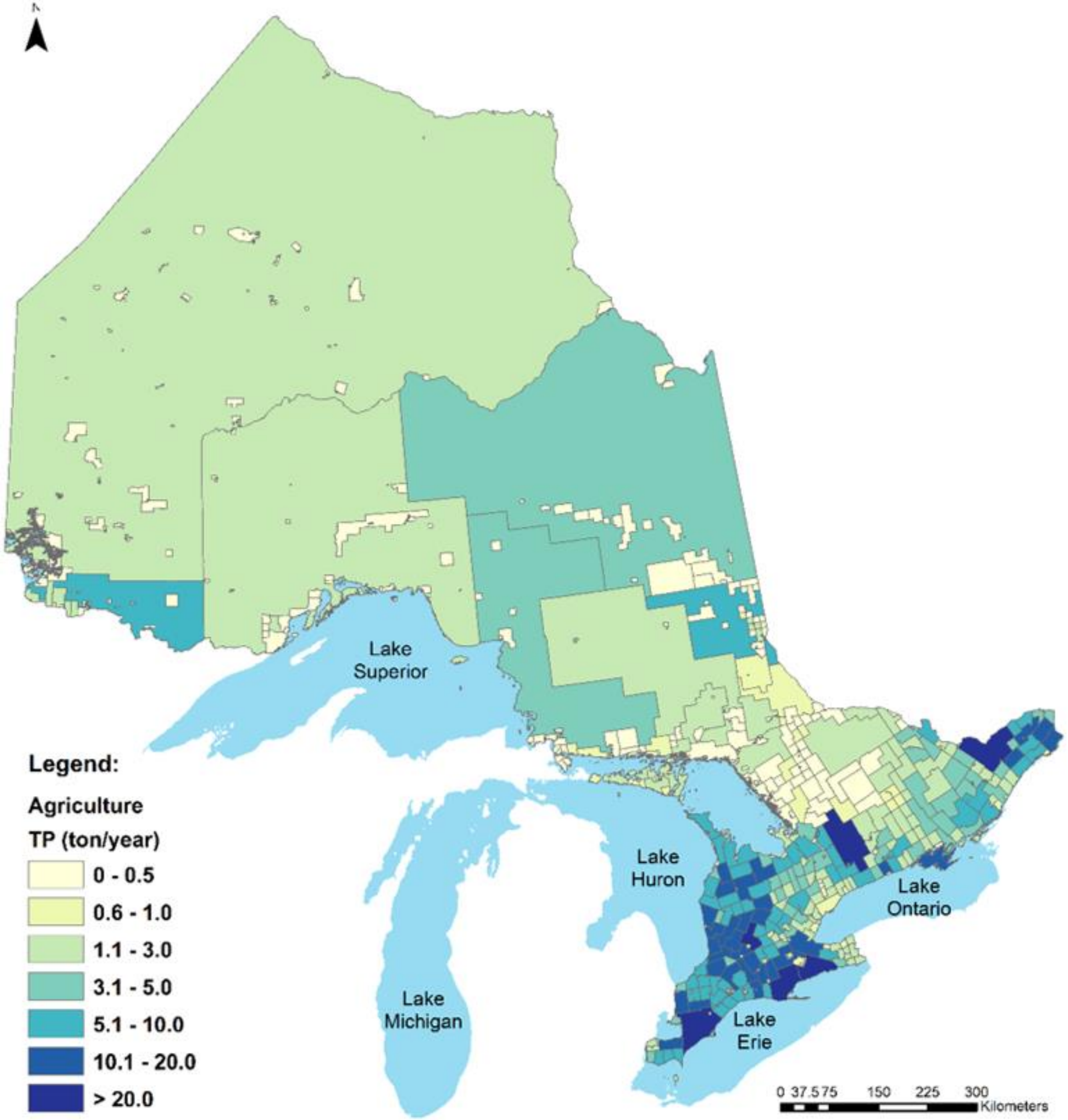
P-release to water from WWTPs across sub-basins



Total P emissions from WWTPs in Ontario in 2016: 1,234,709 kg

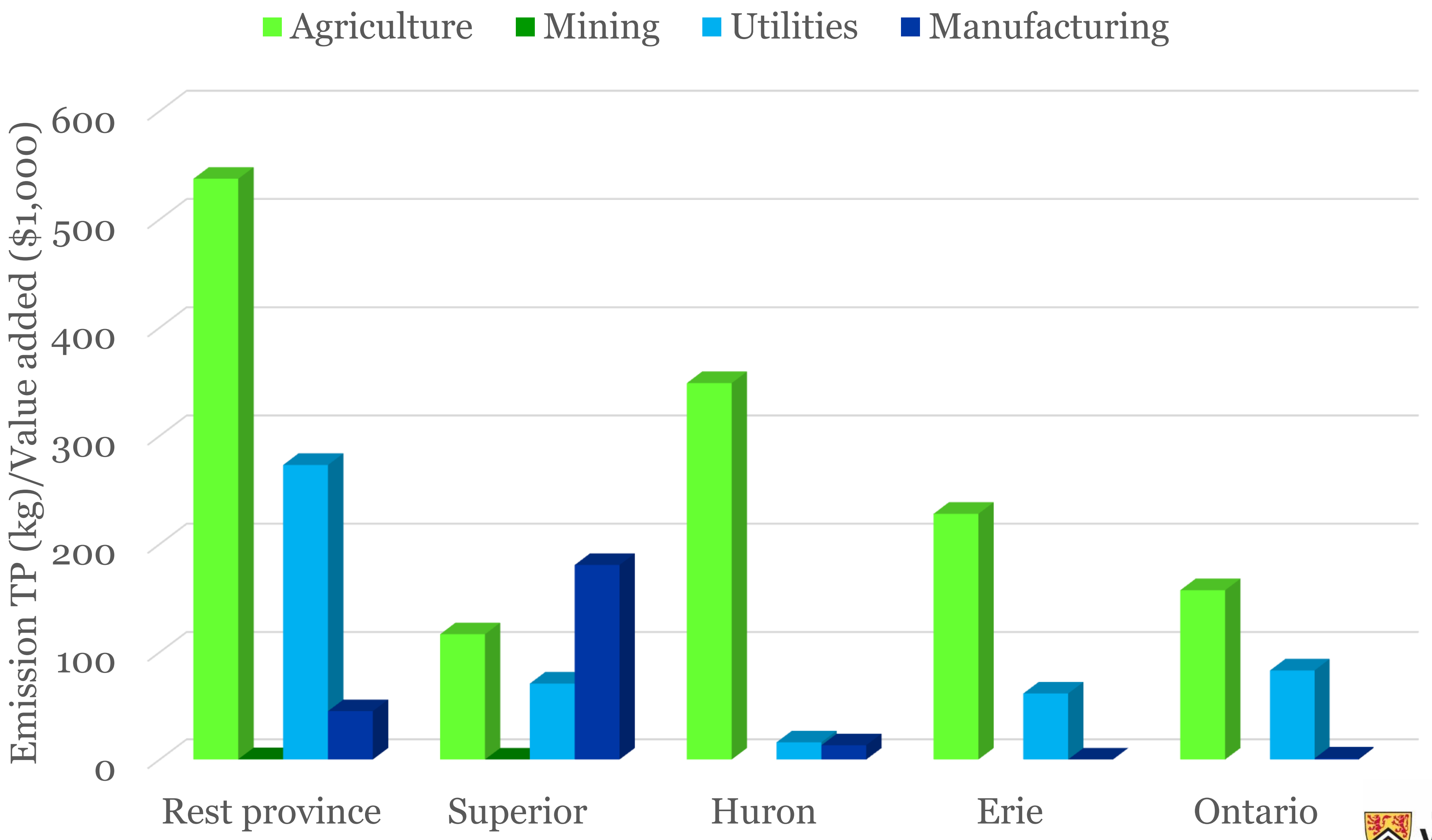
Results

- Substantial P-release from agriculture (crop and animal production) across sub-basins
- Total P emissions from all sources in Ontario in 2016: 3,192 tons



Results

Phosphorous emission intensity economic production across sub-basins



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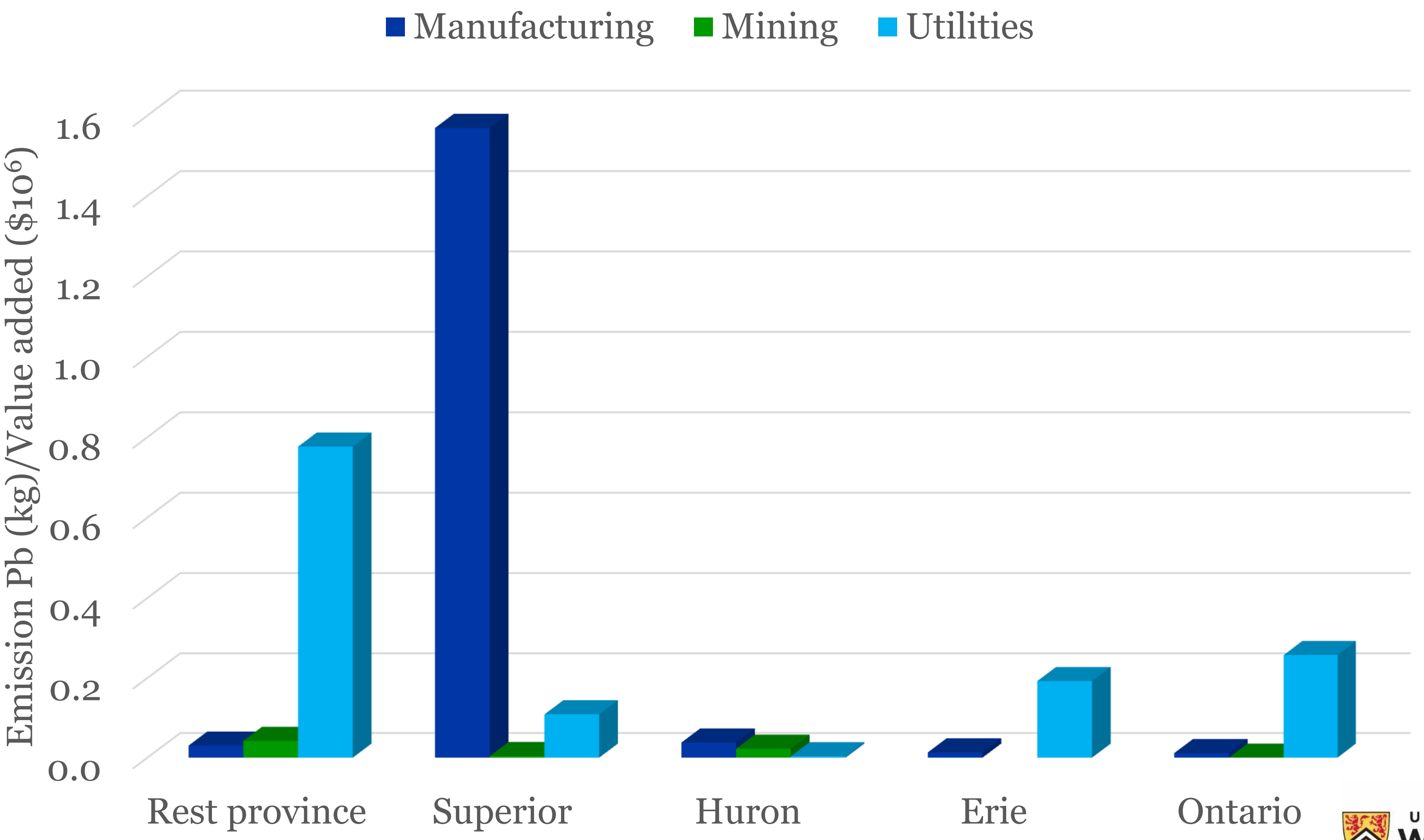
Results

- Similar graphs are available for other pollutant releases to water using both NPRI and ERRIS data

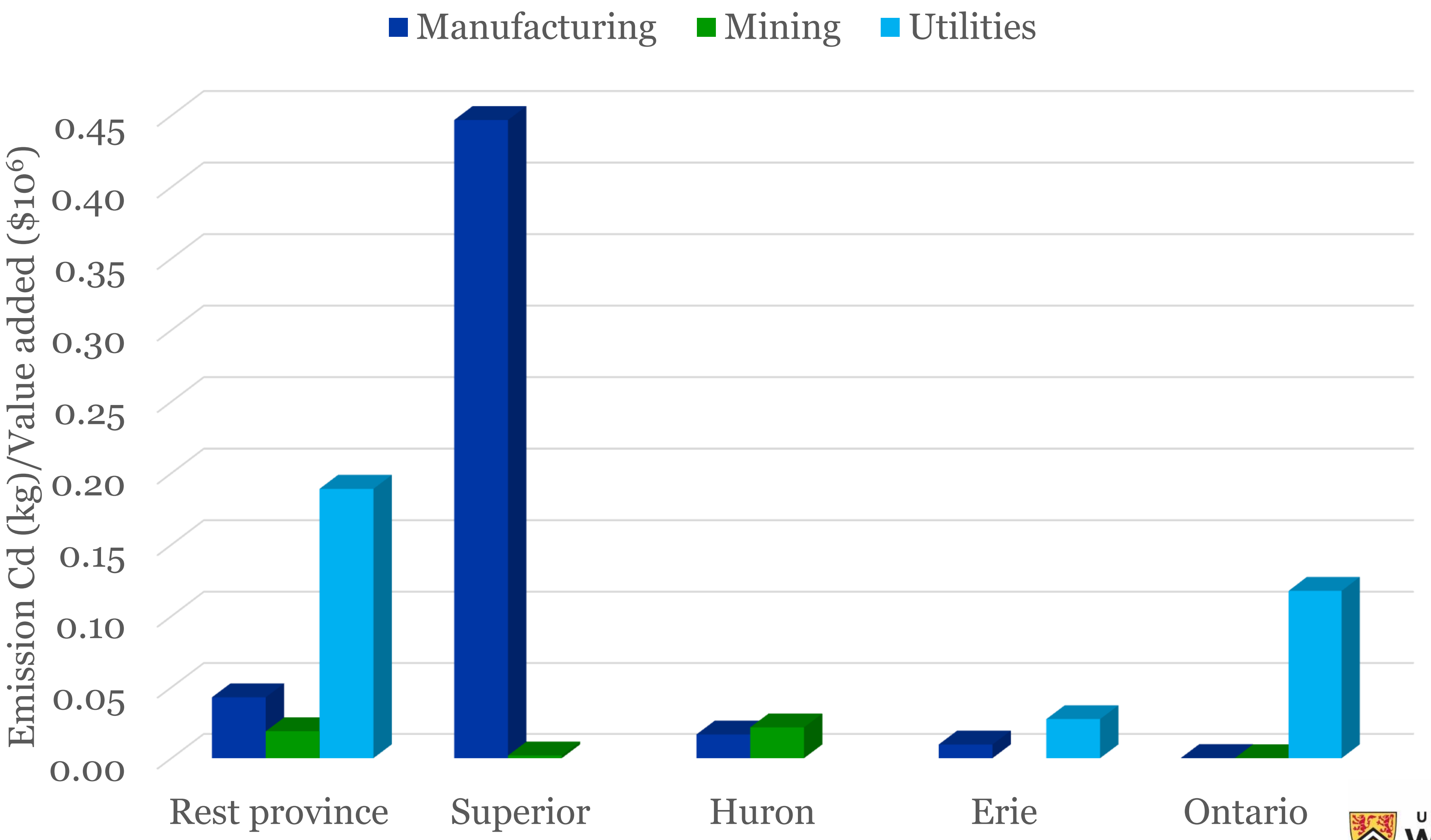
Results

Lead emission intensity economic production across sub-basins



Results

Cadmium emission intensity economic production across sub-basins



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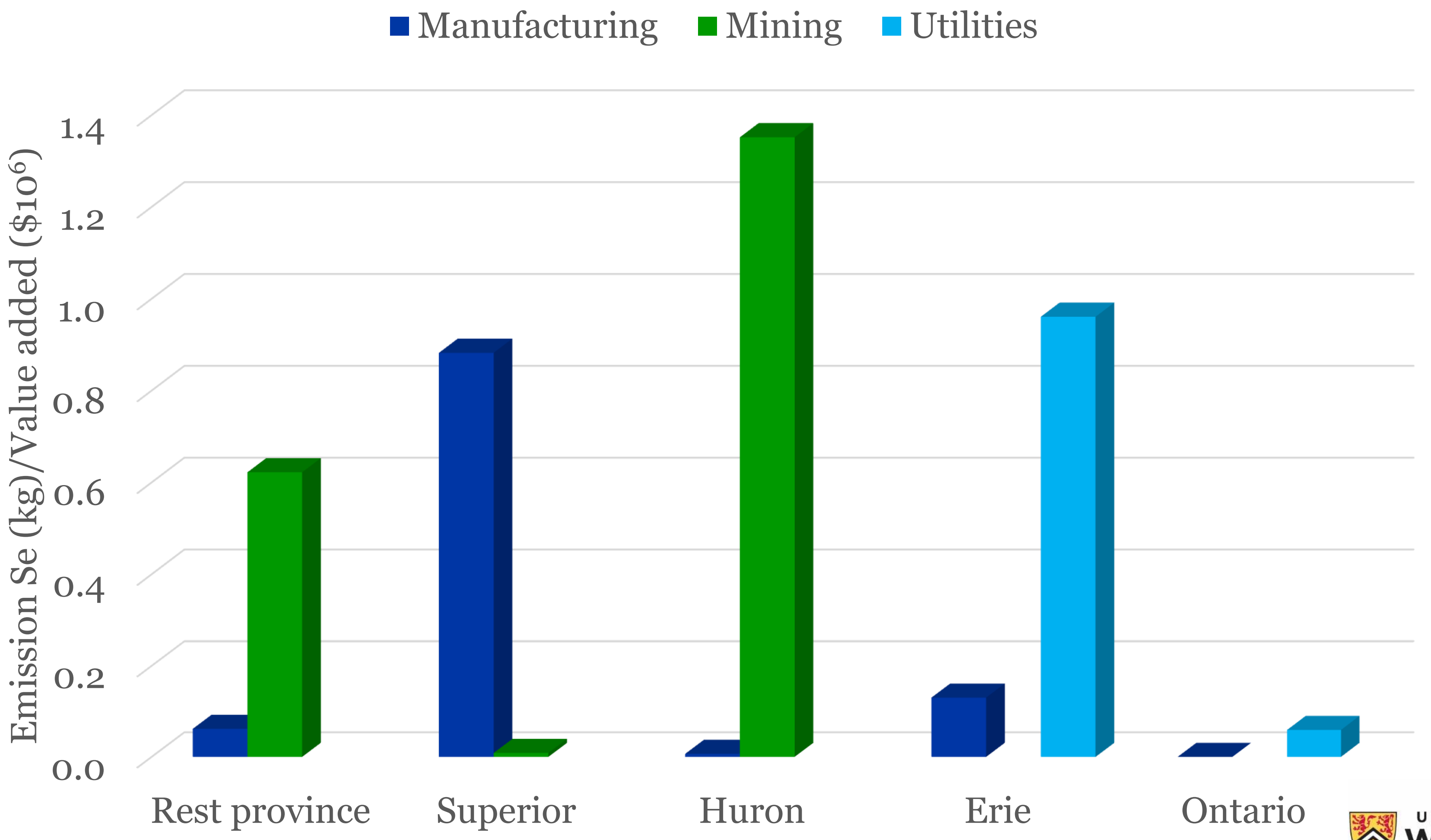
Results

Selenium emission intensity economic production across sub-basins

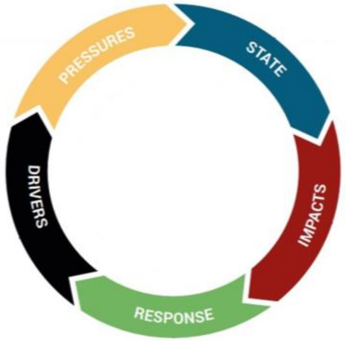


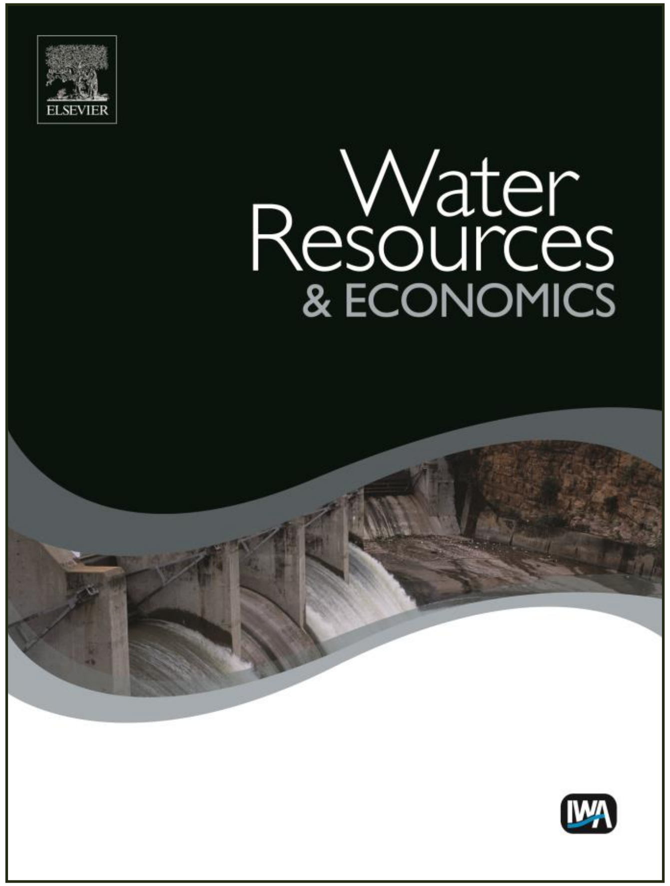
Next steps

- Time series analysis 2012-2016 (Supply and Use Tables)

- Two papers under review on integrated hydro-economic modelling
  - Garcia, J. and Brouwer, R. (under revision). A multiregional Input-Output optimization model to assess the economic impacts of water supply disruptions in the Great Lakes Basin. Economic Systems Research.
  - Garcia, J., Brouwer, R., Pinto, R. (under review). Estimating the total direct and indirect costs to the Canadian economy of Phosphorus emission reduction policies in the Great Lakes Basin using a multi-regional Input-Output model. Annual conference EAERE, June 2020, Berlin.

- From pressures to impacts: inclusion of water quality monitoring data





Thank you for your attention

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