



Hydro-economic Model for the Saskatchewan River Basin

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Global Institute for
Water Security
www.usask.ca/water



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Research Themes

THEME A:

Integrated
Earth Systems
Modelling

THEME B:

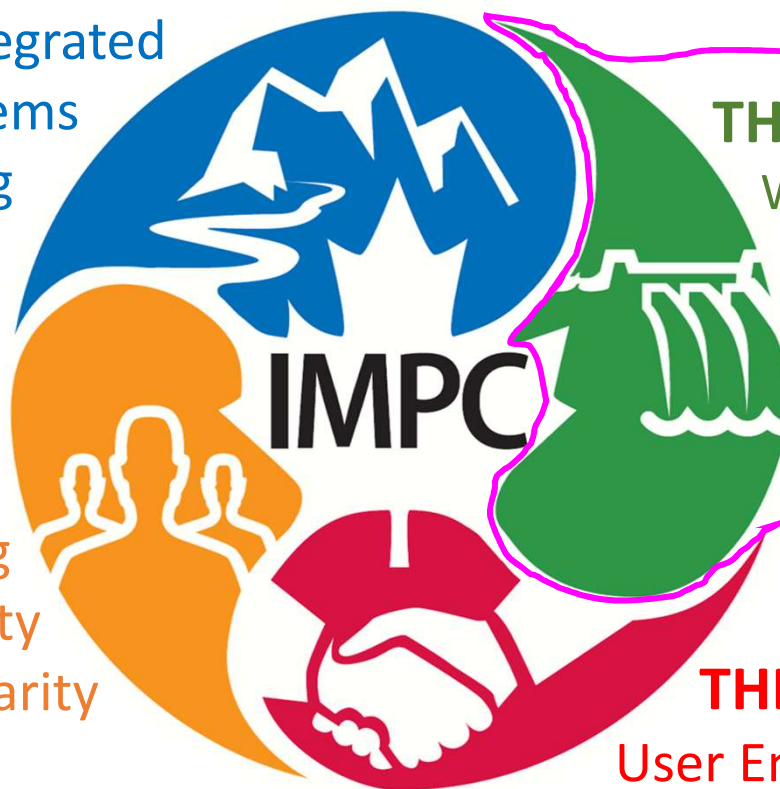
Water Management
Modelling, Coupling
Human-driven and
Natural Systems

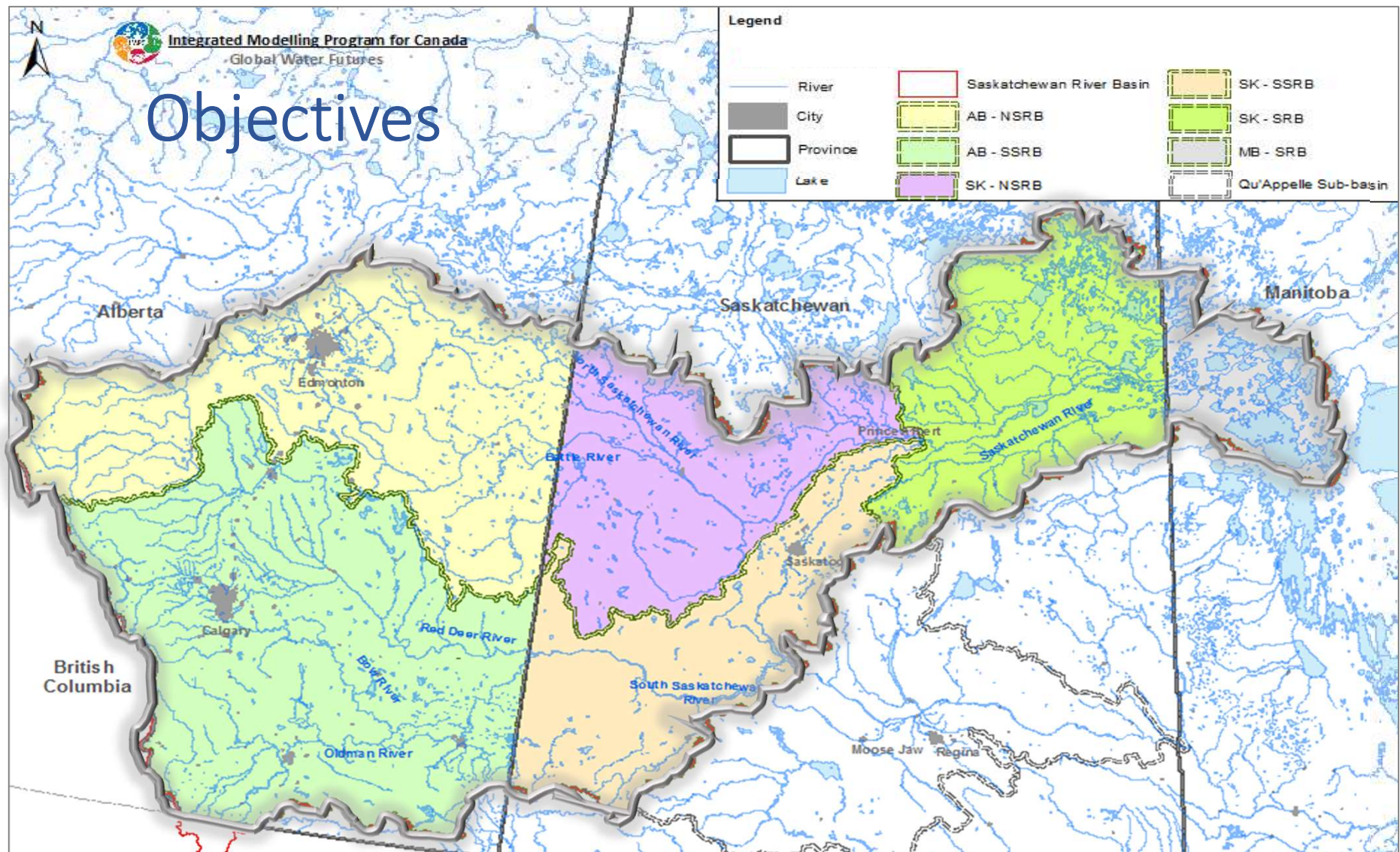
THEME C:

Decision Making
under Uncertainty
and Non-stationarity

THEME D:

User Engagement
and Knowledge Mobilization





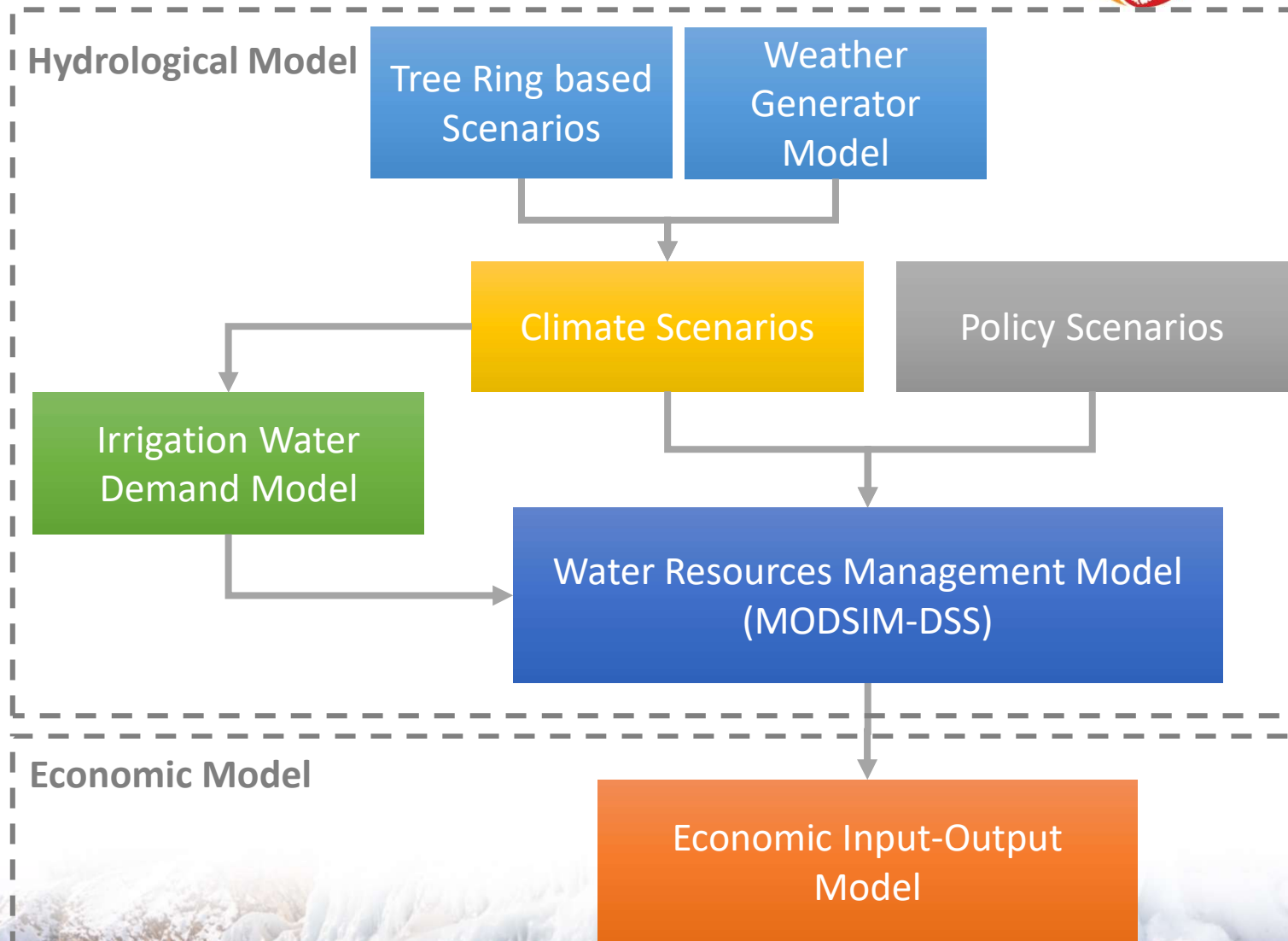
To develop a hydro-economic model that helps:

- Revisit the *water licensing system* in the Saskatchewan River Basin
- Prepare an efficient water management plan for *climate change adaptation* (mainly droughts) in the Saskatchewan River Basin

The Hydro-economic Model Structure



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The Economic Model: An Input-Output Model

Total Final Demand

		Producers as Consumers						Final Demand Y				Total Output
		Agriculture	Mining	Construction	Manufacturing	Utilities	Other Sector	Personal Consumption Expenditures	Private Domestic Investment	Government Purchases of Goods & Services	Net Exports of Goods & Services	
Producers	Agriculture											
	Mining			Inter-industry Transactions (Matrix A)								
	Construction											
	Manufacturing											
	Utilities											
	Other Sector											
Value Added	Employees			Employee Compensation				Gross Domestic Product				
	Business Owner and Capital			Profit-type income and capital consumption allowances								
	Government			Indirect Business Taxes								
Total Input (X)												

$$X = (I - A)^{-1} Y$$

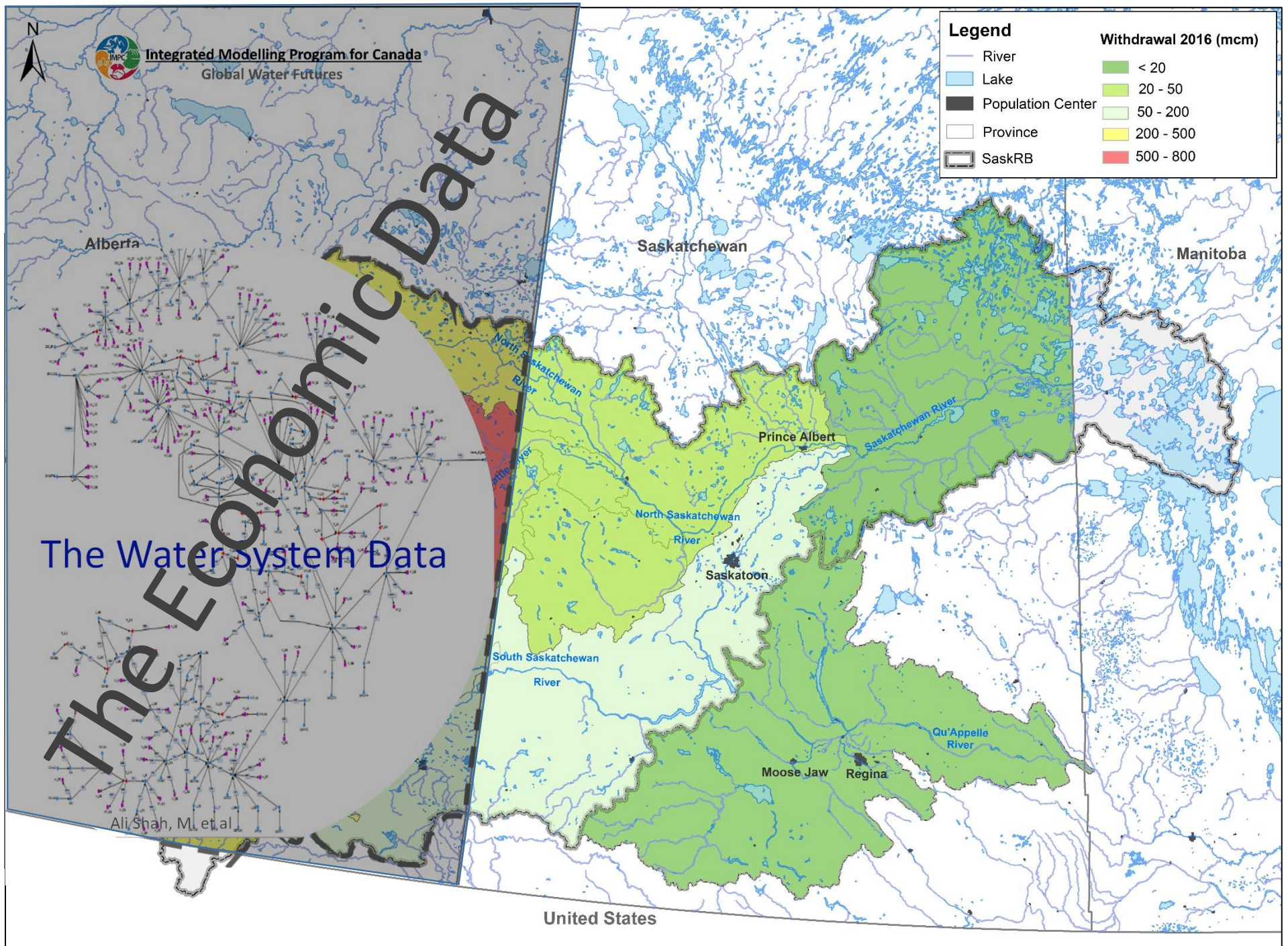
Challenges



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1. Robust Economic Data for the Sub-basins:
 - Different temporal and spatial scales between the Economic and Water Resources System models





Challenges



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1. Robust Economic Data for the Sub-basins:
 - Different temporal and spatial scales between the Economic and Water Resources System models
2. Incompatible water use and economic data:
 - Water use data are in physical units, while economic data are in monetary units
3. Determining Actual Sectoral Water Use:
 - Some of licensees have not been reporting their actual water use properly
 - Several inconsistencies with the data (e.g., different industry classifications, ...)



Challenges



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The Water Security Agency (SK)	Alberta Environment and Parks (AB)
Domestic	Agricultural
Drainage	Commercial
Int Livestock	Crossing
Irrigation	Dewatering
Manufacturing	Disturbance
Mining Other	Government Holdback
Mining Potash	Ground Water Exploration
Multiple	Habitat Enhancement
Municipal	Industrial
Oil & Gas	Irrigation
Oil Byproduct	Management of Fish
Other	Management of Wildlife
Power Gen	Municipal
Recreation	Natural Flow
Water Management	Other Purpose Specified by the Director
	Recreation
	Registration
	Roadway
	Water Act CoP - Hydrostatic Testing
	Water Management
	Water Power
	Wellsite

Challenges



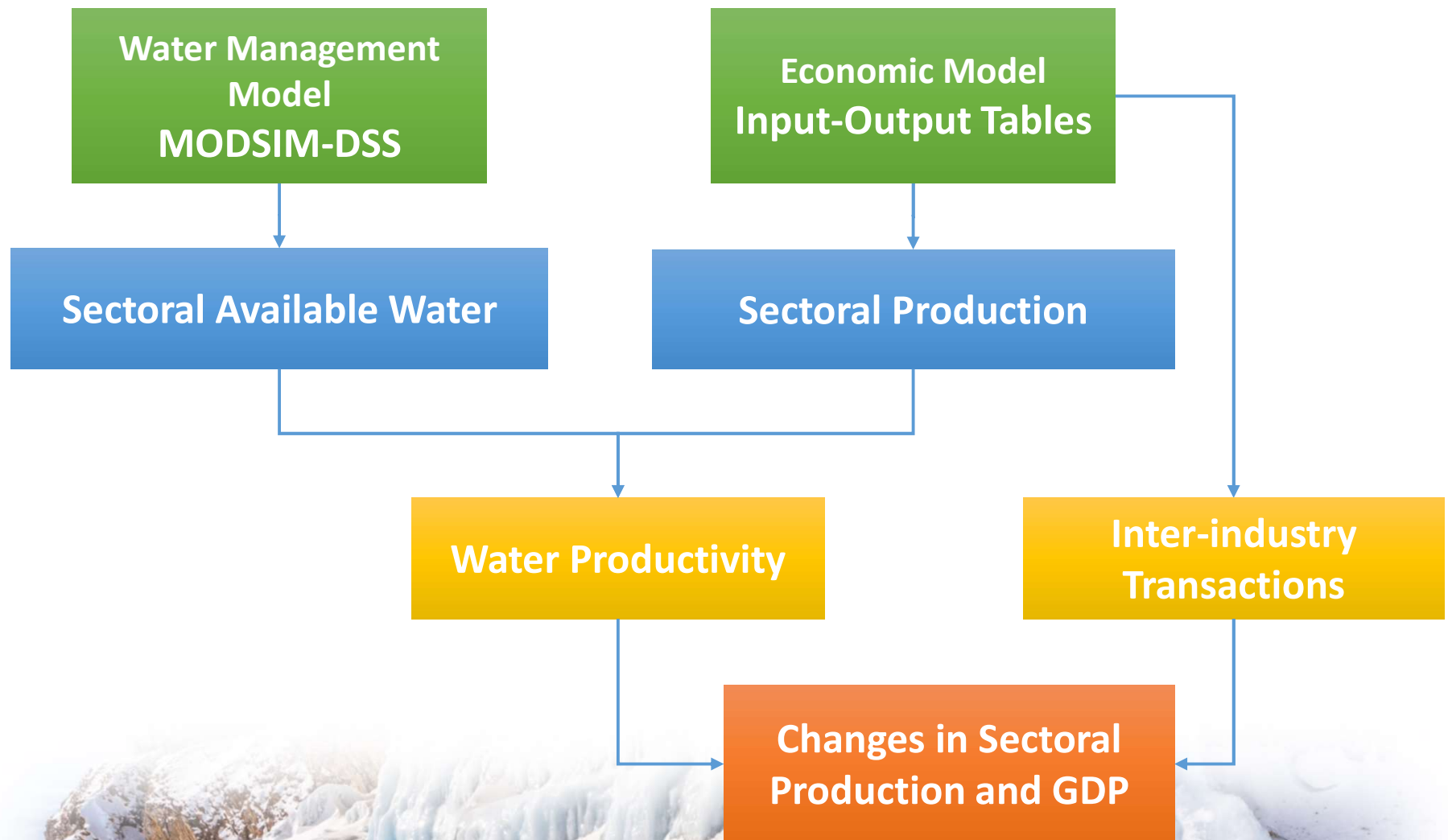
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 - Some of licensees have not been reporting their actual water use properly
 - Several inconsistencies with the data (e.g., different industry classifications, ...)
4. Economic data for Agricultural Production are available without a distinction between Dryland and Irrigated Production.

The Hydro-economic Model Work Flow



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Preliminary Water Supply Restriction Scenarios



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• The First Scenario:

A uniform reduction in raw water intake and precipitation:

a. North Saskatchewan River Basin:

- 5% raw water intake reduction in all sectors
- 8% precipitation reduction in Rain-fed agriculture

b. South Saskatchewan River Basin:

- 8.5% raw water intake reduction in all sectors
- 11% precipitation reduction in Rain-fed agriculture

• The Second Scenario:

A non-uniform reduction in raw water intake and precipitation:

a. North Saskatchewan River Basin:

5%	Irrigated - Crop and animal production
8%	Rain-fed - Crop and animal production
2.5%	Manufacturing
2.5%	Mining, quarrying, and oil & gas extraction
2.5%	Construction
0%	Utilities

b. South Saskatchewan River Basin:

8.5%	Irrigated - Crop and animal production
11%	Rain-fed - Crop and animal production
4.2%	Manufacturing
4.2%	Mining, quarrying, and oil & gas extraction
4.2%	Construction
0%	Utilities

Preliminary Results



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GDP Drop under Different Scenarios

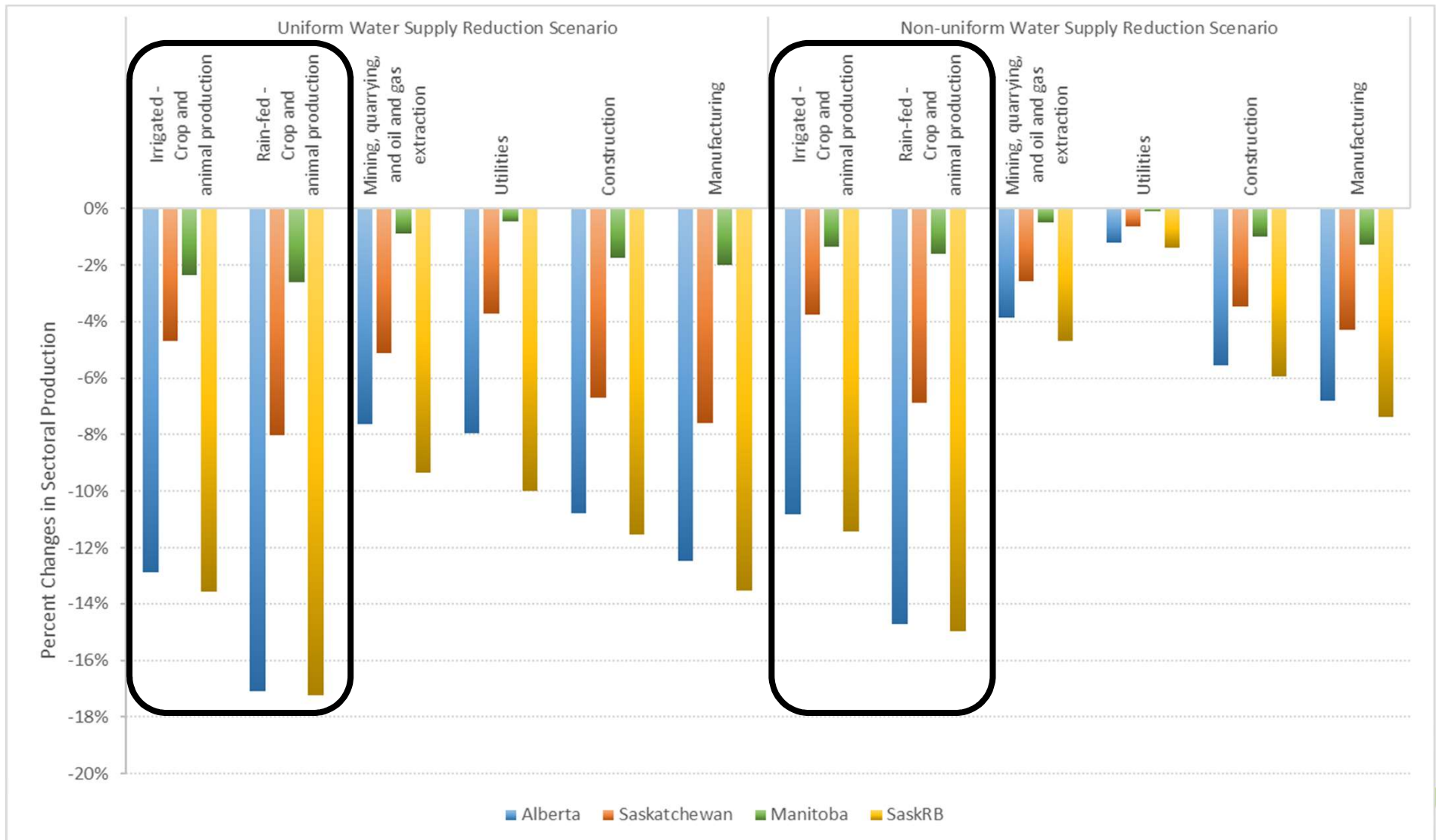
Province/River basin	GDP Reduction			
	Uniform Scenario		Non-uniform Scenario	
	Billion \$	%	Billion \$	%
Alberta	22.1	6.1	11.5	3.1
Saskatchewan	3.2	4.1	1.8	2.4
Manitoba	0.028	0.05	0.013	0.02
SaskRB	25.4	7.0	13.4	3.7

Preliminary Results



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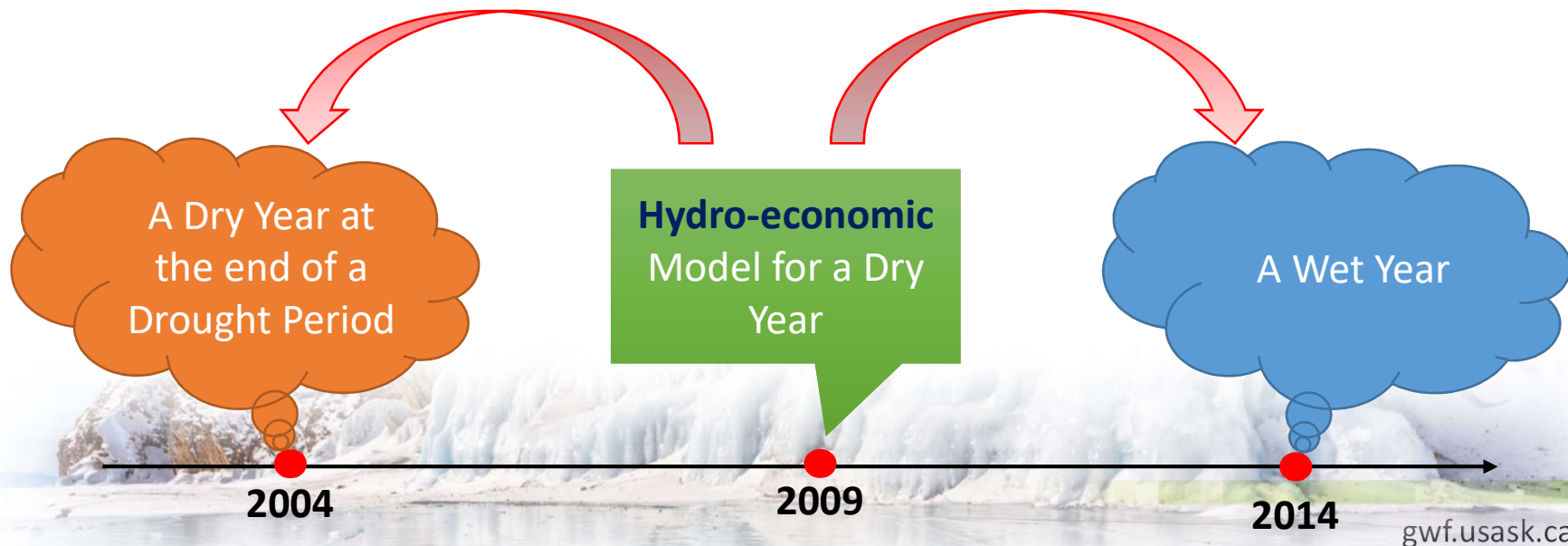
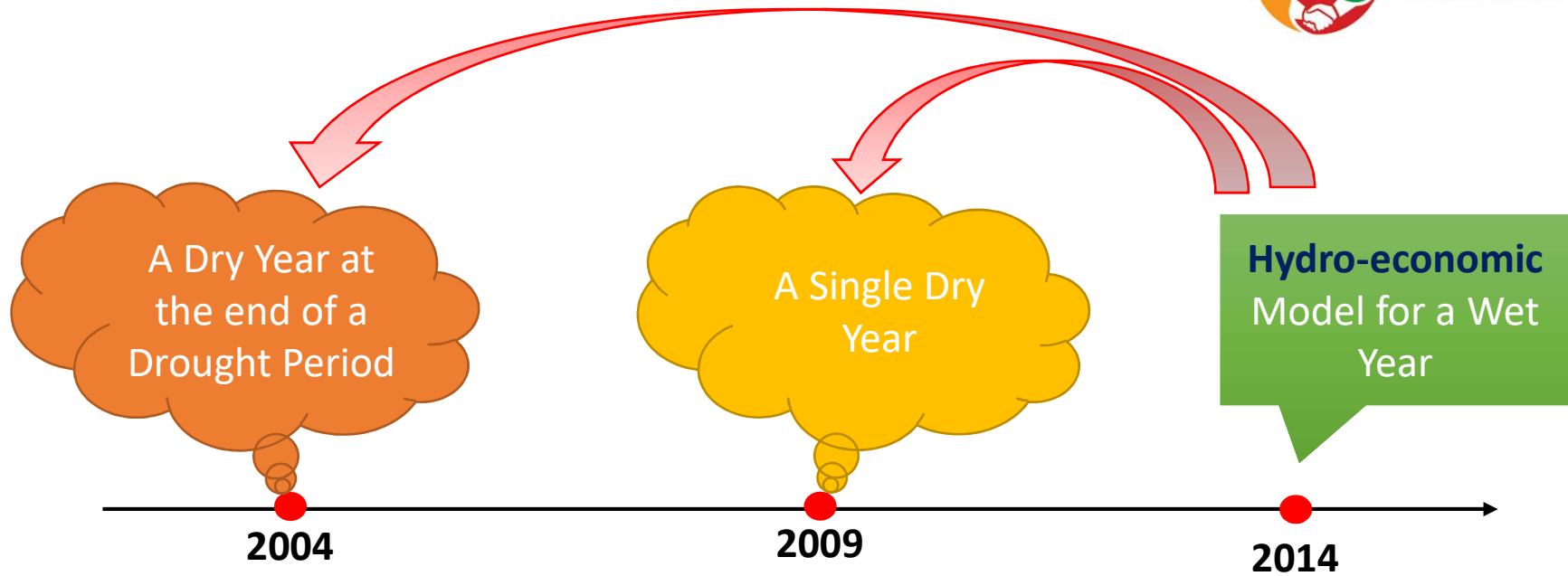
Sectoral Production Reduction in the three provinces and the Saskatchewan River Basin under Uniform and Non-uniform Scenarios



The Next Step



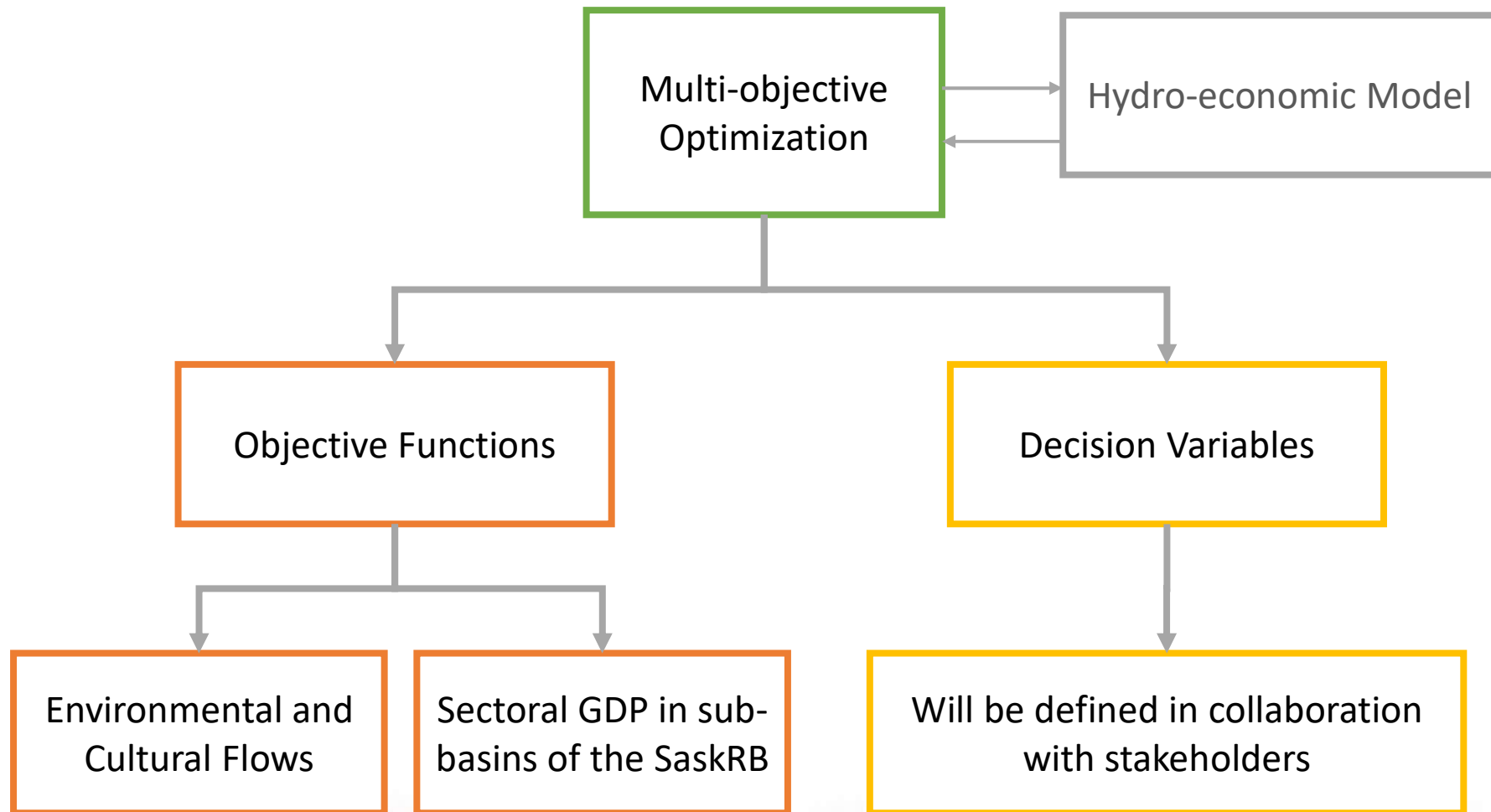
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The Next Step



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10:15-10:45 Coffee break
10:45-11:15 Awards
11:15-12:15 Plenary session



3. The Economic Impacts of Water Supply Restrictions due to Climate and Policy Change: an Inter-regional Supply-side Input-Output Analysis at Transboundary River Basin Scale

Leila Eamen, Roy Brouwer, Saman Razavi

16:15-18:00

Water Scarcity

Room : Room 3.205

Chair: Roy Brouwer, The Water Institute / University of Waterloo

1. Virtual Water Trade: The Implications of Capital Scarcity

Hamed Ghoddusi, Mohamad Afkhami, **Thomas Bassetti**, Filippo Pavesi

Discussant: Hao Zhao

2. Surface Water Trading and Groundwater Depletion in California

Hao Zhao

Discussant: Leila Eamen

3. The Economic Impacts of Water Supply Restrictions due to Climate and Policy Change: an Inter-regional Supply-side Input-Output Analysis at Transboundary River Basin Scale

Leila Eamen, Roy Brouwer, Saman Razavi

Discussant: Jorge Garcia

4. Assessing the Economic Impacts of Water Scarcity on the Great Lakes Basin using a Supply-Side Input-Output Model

Jorge Garcia, Roy Brouwer, Rute Pinto

Discussant: Thomas Bassetti

Conclusions



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Conclusions



The Inter-regional Hydro-economic model of the SaskRB can capture *interrelationships* between different economic sectors and evaluate the *direct and indirect economic impacts* of different climate and policy scenarios.



Interconnections between various sectors and inter-regional trade flows *dampen* the **impact** of water supply restriction on the more water dependent sectors.



By *adopting appropriate policy options* in the face of climate change induced water shortage the **economic losses** could be *reduced* by almost **50** percent.



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Thank You!

