OMVS
ORGANISATION POUR LA MISE EN VALEUR DU FLEUVE SÉNÉGAL

UNIVERSITÉ LAVAL
Faculté des sciences et de génie
Département de génie civil
et de génie des eaux

AgWA

Setting the scene: how can hydro-economic models help policy making?

Hydro-economic modelling for transboundary river basin management

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Saskatoon, 15 August 2018

CONTEXT: THE PROBLEM

- Conflicts related to use of water:
  - Agriculture
  - Industries and mines
  - Energy generation
  - Domestic water use
  - Environmental concerns and pollution
- Non-coordinated planning of agriculture and hydropower developments
- Political motivation driving the management of water resources

Competition, present or future, for the available water resources

HYDRO-ECONOMIC MODELS

WHAT?

- Address the interconnectedness between water supply and economic use of the resource at river basin scale
- Tools to guide policymakers based on clear understanding of trade-offs arising from conflicting stakeholders' objectives

KEY ASPECTS

- Network representation of the physical basin
- Consistent accounting of flows, water storages, diversions etc.
- Representation of requirements for water and economic benefits from its use, considering both in-stream and off-stream uses
- Incorporation of institutional rules and policies
- Can be optimization or simulation based

MODEL DESIGN, LIGHT AND SHADOW

Design	Pros	Cons
	Simulation vs Optimization	
Optimization	Optimal solutions can recommend system improvements; reveals what areas of decision space promising for detailed simulation	Economic objectives require economic valuation of water uses; ideal solutions often assume perfect knowledge, central planning or complete institutional flexibility
Simulation	Conceptually simple; existing simulation models can be used, reproduces complexity and rules of real systems	Model only investigates simulated scenarios, requires trial and error to search for the best solution over wide feasibility region
	Time	
Deterministic	Conceptually simple: easy to compare with time series of historical data or simulated results	Inputs may not represent future conditions; limited representation of hydrologic uncertainty (just for a single sequence of events)
Stochastic	Accounts for stochasticity inherent in real systems	Probability distributions must be estimated, synthetic time series generated; presentation of results more difficult; difficulties reproducing persistence and non-stationarity of time series
Dynamic	Considers time varying aspect of value; helps address sustainability issues	Requires optimal control or dynamic programming
	Sub-model integration	
Off line	Easier to develop, calibrate and solve individual models	Each model must be updated and run separately; difficult to connect models with different scales
In line	Easier to represent causal relationships and interdependencies and scenario analyses	Must solve all models at once; increased complexity of holistic model requires simpler model components

A LTTTLE QUIZ: WHICH ONE DO YOU WANT?

$1

$1

ECONOMIC EFFICIENCY: INDIVIDUAL OBJECTIVES

Farmers | **Hydropower** | **Cities** | **Navigation** | **Environment** | **Industries**

The standard objective of **maximizing net benefits** implies that each user:

$$\text{Max}\ \ p_y\, f(w, x \ldots \sum^{n} \ldots p_i x_i$$

For every user!

P… PRICE*QUANTITY … WATER … HER COSTS

NET BENEFITS

"Whereas maximizing net benefits is compelling for the decision of individual agents, extending it to social decision making constitutes a moral leap of faith"

Griffin, 2006

ECONOMIC EFFICIENCY: INDIVIDUAL OBJECTIVES

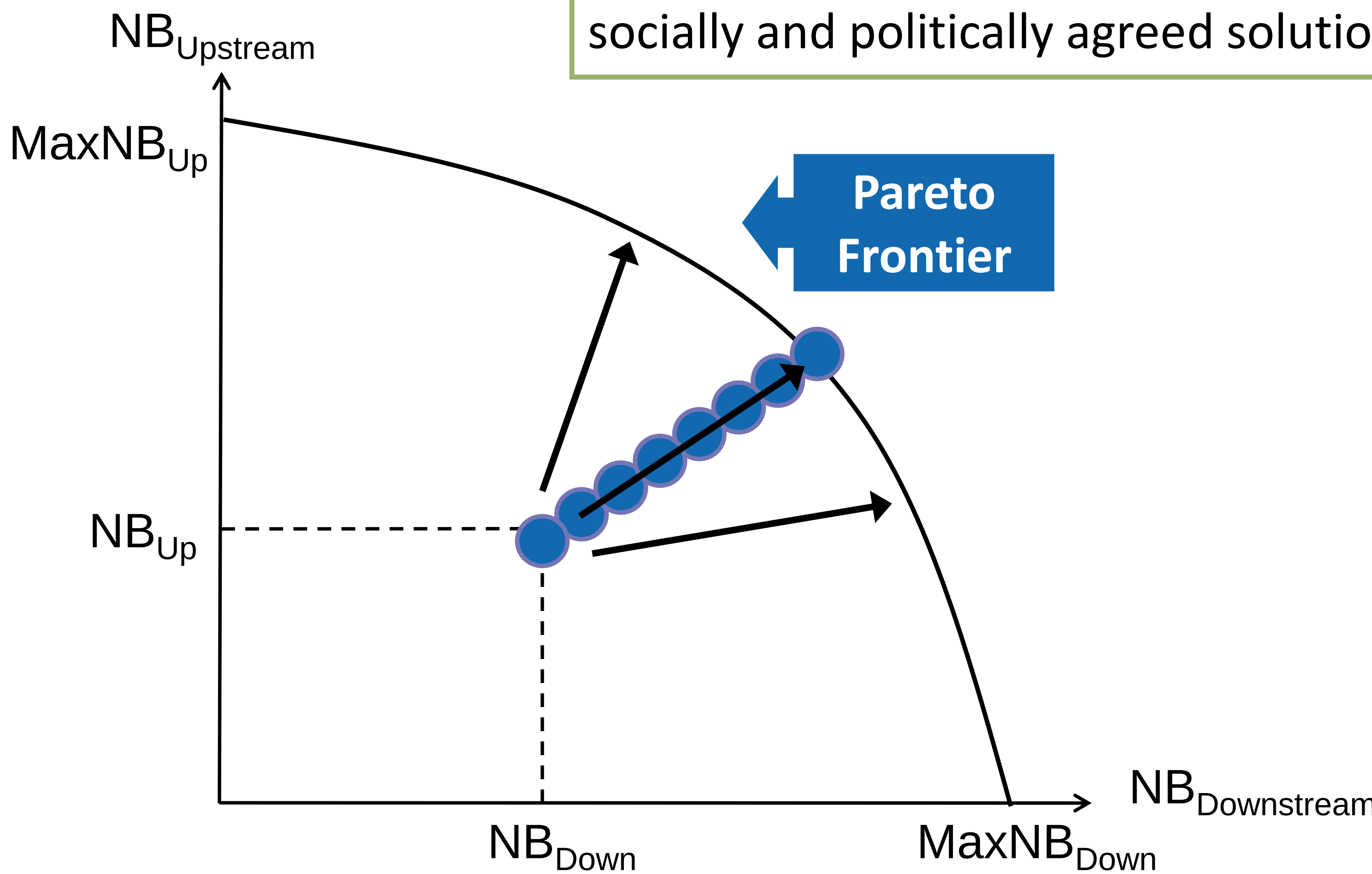
NB maximization of one user might decrease the NB of other users

Given the tradeoffs between multiple conflicting objectives, there exist multiple **Pareto optimal solutions**, i.e., solutions for which it is not possible to improve on the attainment of one objective without making at least one of the others worse.

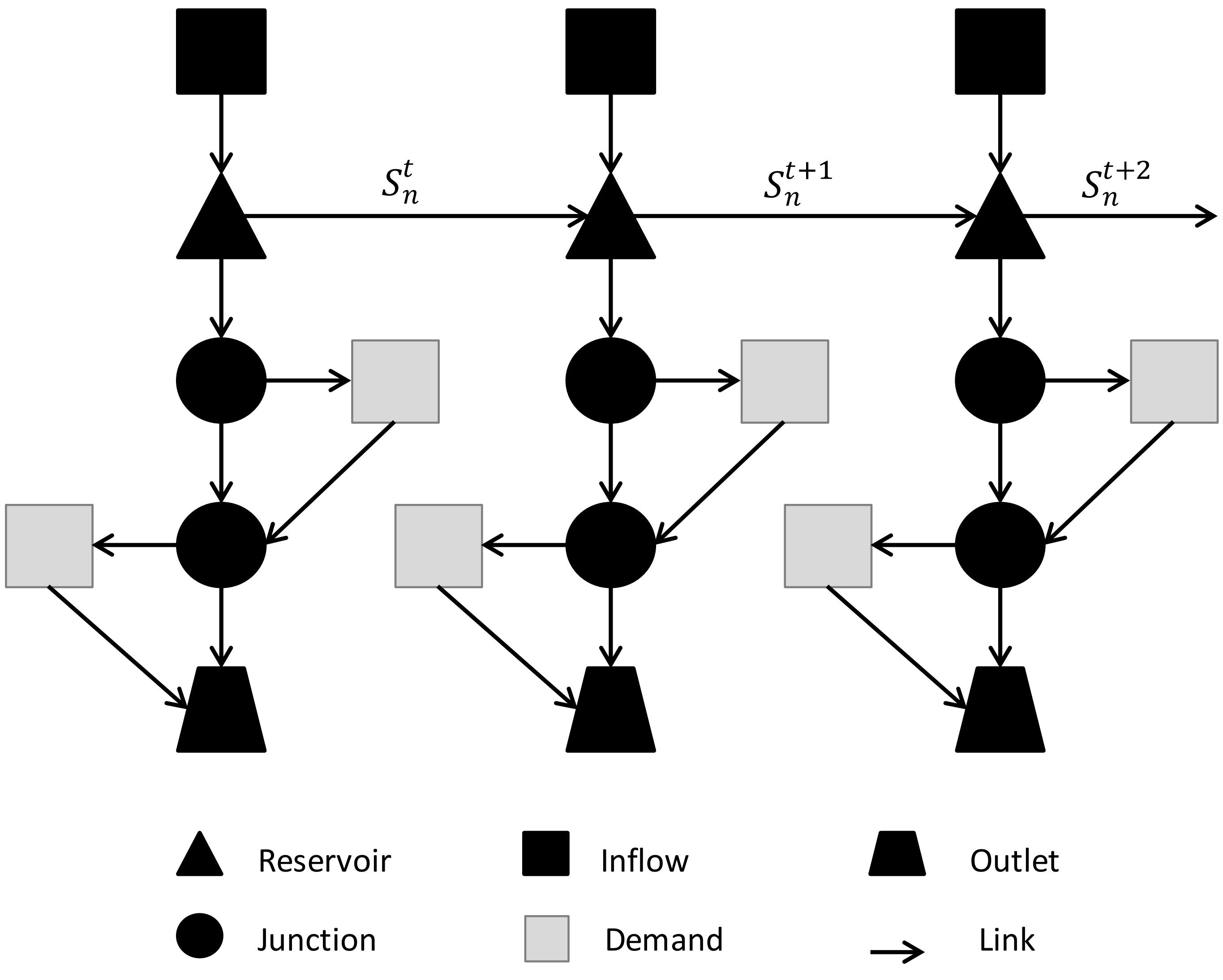
Pareto efficiency is derived by maximizing the net benefits received by one agent subject to available water and to a required level for the benefits of other users.

PARETO FRONTIER

Reach the Pareto Frontier and chose a socially and politically agreed solution



NODE-LINK NETWORKS



WHY POLICYMAKERS SHOULD USE HEMs?

Make a complex system easy to grasp: HEMs show the impact of possible natural, technical, institutional changes on the whole water system

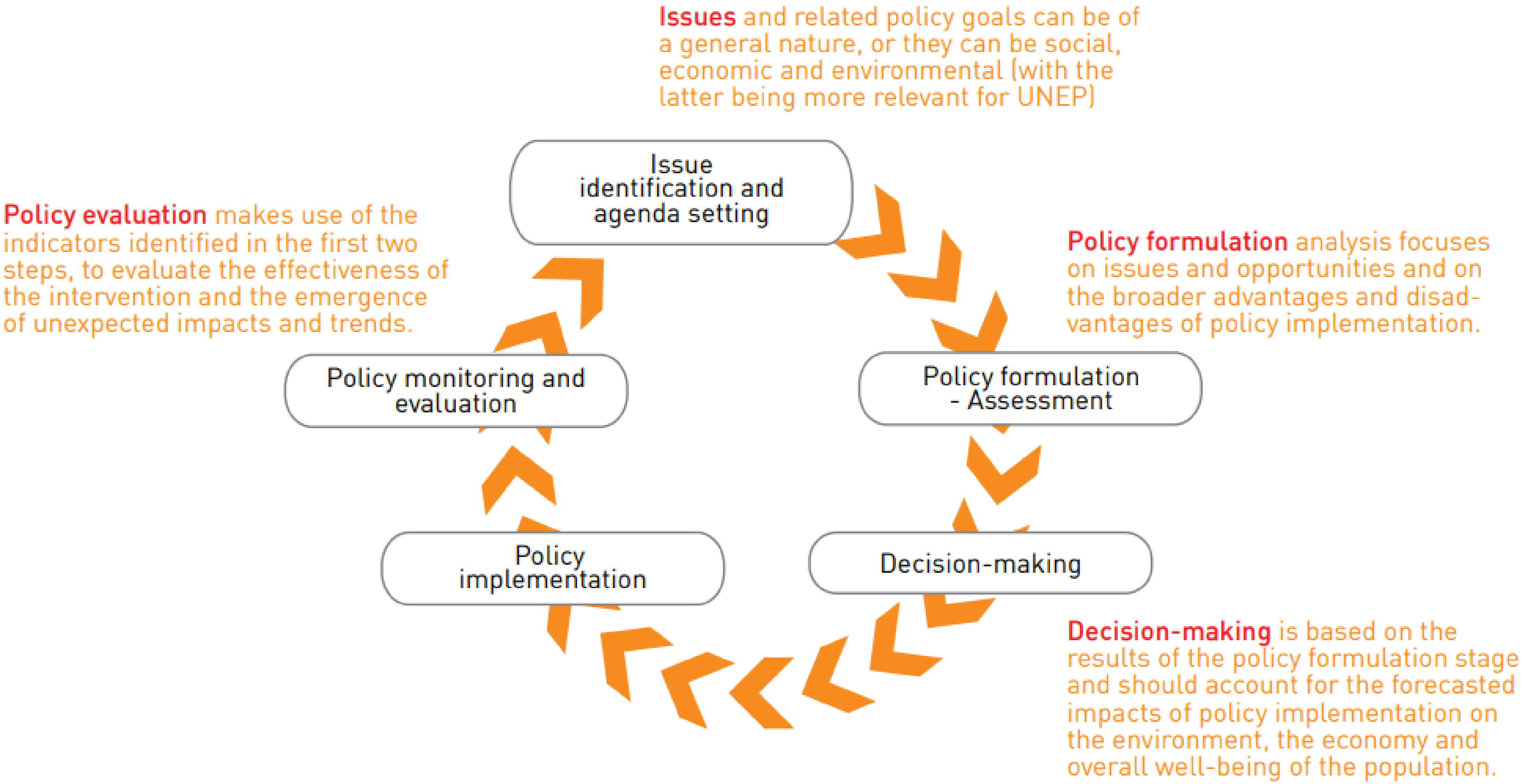
Comprehensive: HEM can include the interests of multiple stakeholders and show trade-offs

Include uncertainties: HEM can show the likelihood of the occurrence of certain outcomes

Policy-driven: If developed with stakeholders, HEM can answer critical policy questions and show the impact of policy changes

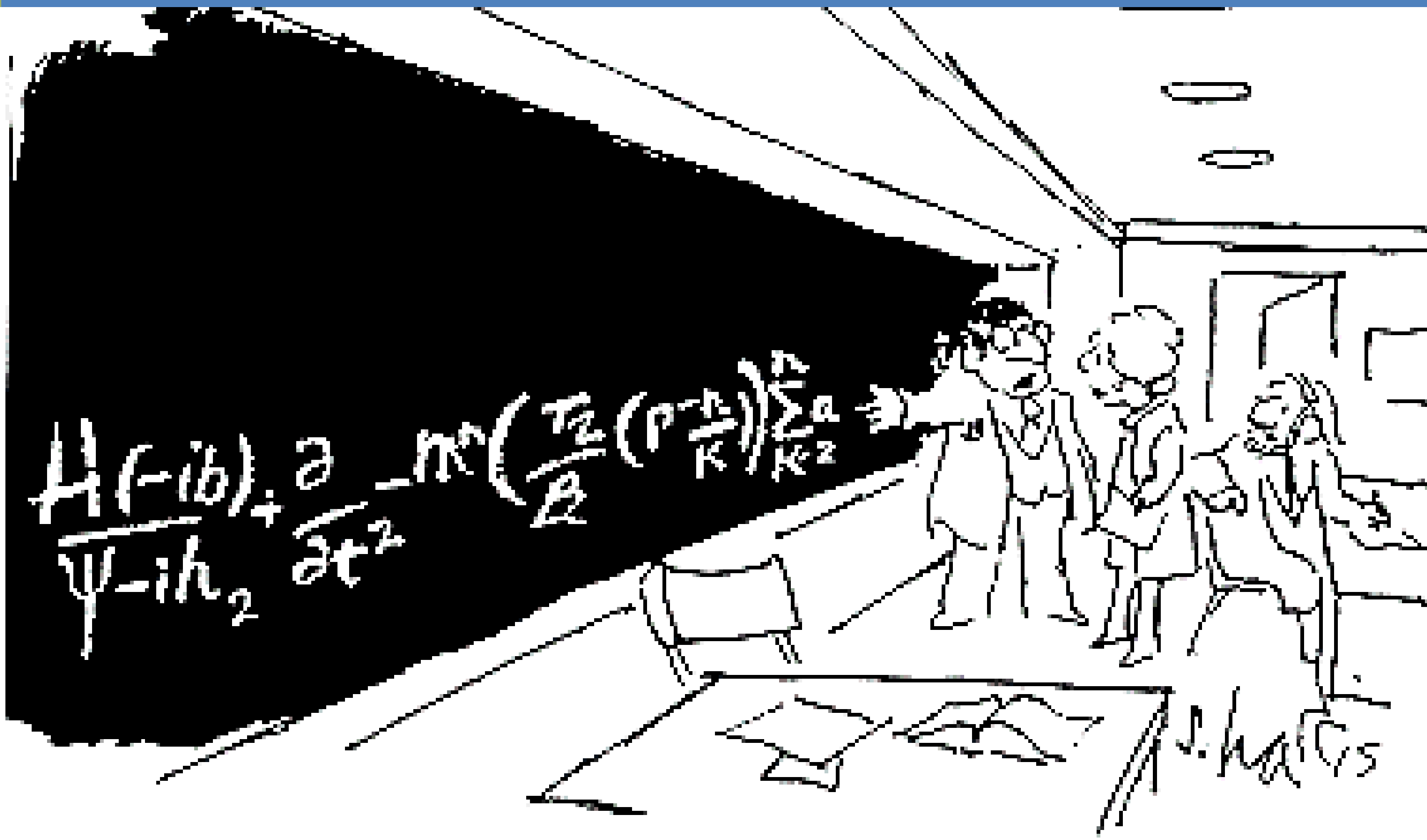
But how can models have the desired policy impact?
How can policy and science be more integrated?

POLICY CYCLE – WHERE RESEARCH FITS



Source: UNEP, 2014. Using models for Green Economy Policymaking.

IT IS NOT THAT EASY…



“But this *is* the simplified version for the general public”

BARRIERS TO SCIENCE – POLICY COMMUNICATION

- **Timeframes**: policy cycles and research agendas may not match
- Different **vocabularies**, meanings and understandings of terms
- Policy makers may not have the **expertise or the time** to consult with experts or access information from academic research
- Science includes **complexity and uncertainty** while policy makers are required to make specific policy legislation
- Different **decision making criteria**: building coalitions and balancing VS problem setting and narrower frame of choices
- **Confusion** among different disciplines and options

BEST PRACTICES

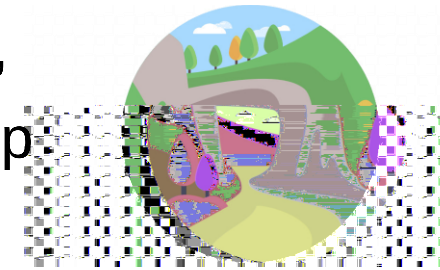
- **Engage since the start**, work on assumptions and scenarios together, communicate frequently
- Overall principle: **transparency**
  - Provide information on data sources
  - Include quality assessment of data sources
  - Show how data was collected
- **Clarity** in presenting:
  - Why the model fits the purpose
  - The model assumptions and structure
  - Results graphically and in an immediate manner
  - Uncertainties around results

It is a marathon, not a sprint

Main source: Sullivan, Wells, Coyle, 2015.

CONCLUSION

- Hydro-economic models representing the physics, constraints and objectives of water systems to help water managers **assess and formulate** policies



- Integrating science and policy is complex and is a process that should start from **issues identification, to policy formulation and its evaluation**

- Beyond best practices, we will **share** practical examples of how HEM can effectively inform policies
- We count on you: today it is time to **learn** and share experiences

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THANK YOU

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