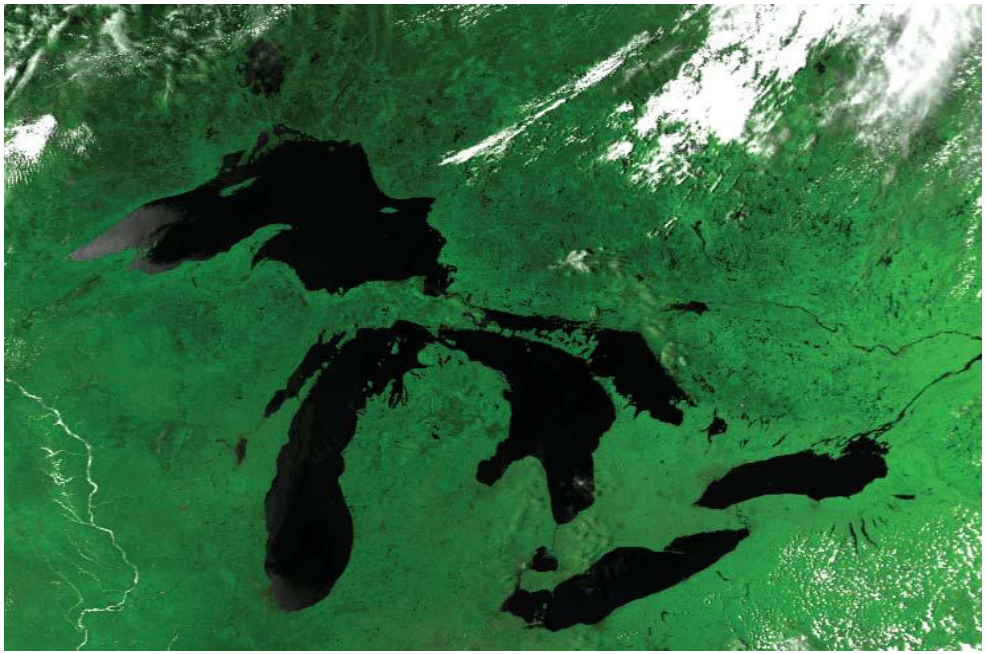
Incorporation of Bio-Energy Systems into the Great Lakes Economy



Source: U.S. Army Corps of Engineers

Conference on *Biomass and Energy for the Great Lakes Economy*
Queen's University, Kingston Ontario Canada
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Presentation by Dr. Geoff Whitfield

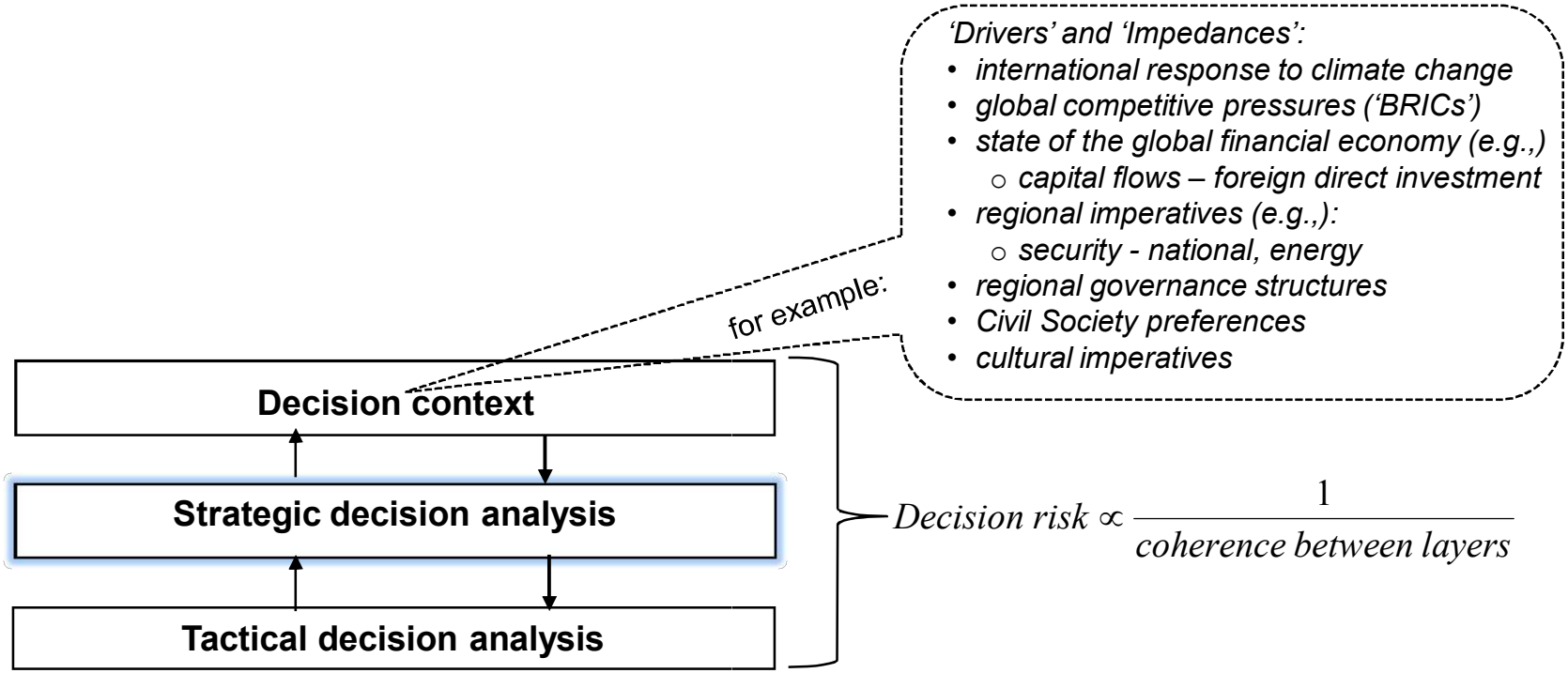
The satellite view is reproduced from the *Great Lakes St. Lawrence Seaway Study* (Fall 2007), Transport Canada and the U.S. Department of Transportation, in collaboration with the U.S. Army Corps of Engineers, St. Lawrence Seaway Management Corporation, Saint Lawrence Seaway Development Corporation, Environment Canada, and the U.S. Fish and Wildlife Service

- The concern of the Conference is the movement from the current system of wealth generation in the Great Lakes region to a more sustainable one

- The specific decision situation with which the Conference is concerned:
  - the fashioning of a bio-economic system
  - based on the large-scale utilization of biomass
  - for the production and exchange of energy commodities
  - making a significant long-range contribution towards sustaining the economy
  - of the Great Lakes region

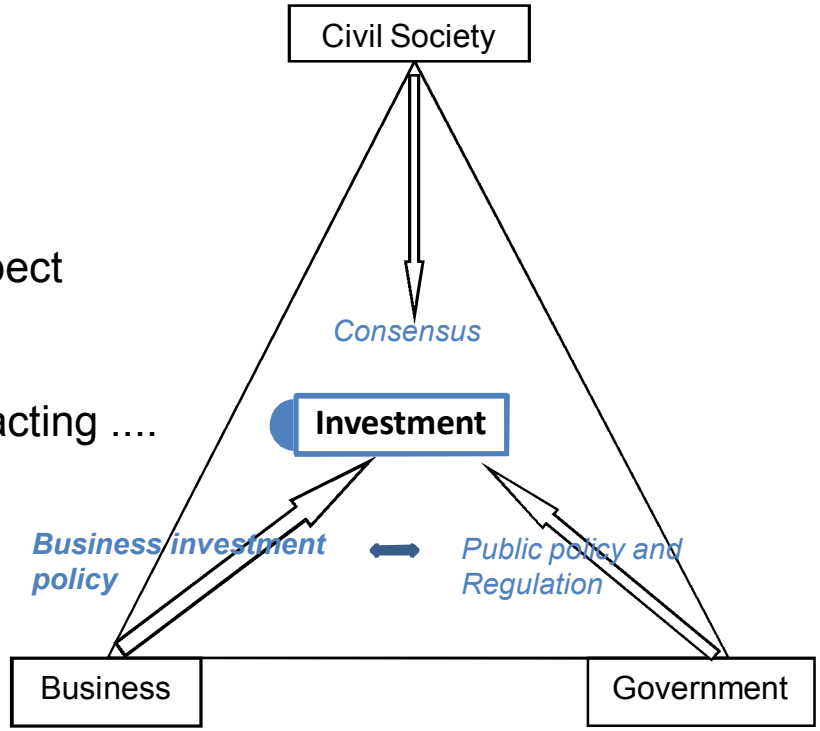
The structure of complex decision situations:

"…strategic decisions and tactics are driven by context" (HBR, October 2006)



- an actionable strategic intent is essential to:
  - the conduct of decision analysis which decision-makers deem to be justifiable and theoretically sound
  - low risk of poor decision outcomes leading to consequences of stranded or impaired assets

- This presentation examines a key strategic aspect of implementing a bio-economic system within the broader 'real' economy of the Great Lakes region: attracting ....



- from the perspective of the business domain:

Some contextual data and information related to the region

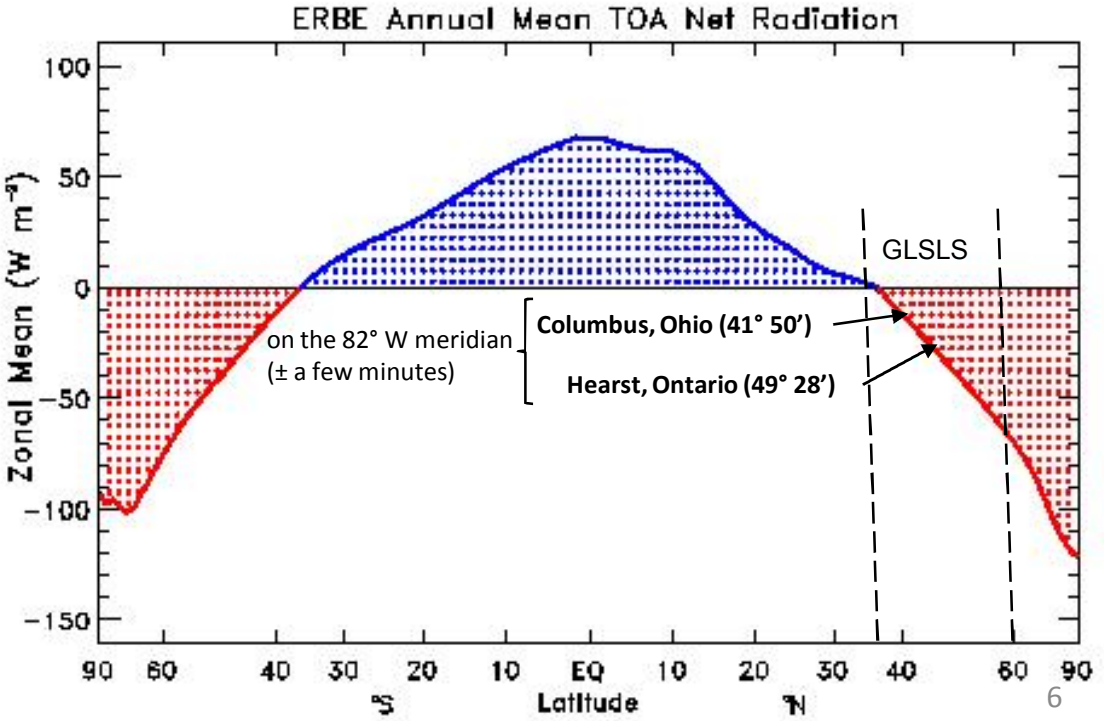
- identify the physical geographical region and position it climatically
- characterize regional demographics and the scale of the economy

Main industrial centres of the GLSLS system's region

Source: the *Great Lakes St. Lawrence Seaway Study* (Fall 2007), Figure 7.1

The physical geographical region - provinces and states adjoining the Great Lakes St. Lawrence Seaway:

- Ontario and Quebec,
- New York,
- Pennsylvania and Ohio,
- Michigan,
- Indian and Illinois,
- Wisconsin and Minnesota



Source: K. E. Trenberth and J. M. Caron (2001)
ERBE ≡ Earth Radiation Budget Experiment
TOA ≡ top-of-the-atmosphere

- Hearst:
  - natural resource-rich sub-region of Ontario
  - strong transportation linkages
  - weakened primary resource industry
  - Bioeconomic activity viewed as a route to revitalization of the local economy
  - collaboration with the Sustainable Bio-economy Centre (SBC) to assess biomass to commodities and products

- Ohio:
  - biomass-rich sub-region of the Great Lakes region
  - weakened primary resource and secondary industry bases
  - strong Small to Medium-sized Enterprise (SME) base in urban centers
  - the Public Utilities Commission of Ohio acts as gatekeeper of biomass projects
  - industry 'pull-through' of bioproduct Research and Business Development (R&BD)
    - cf., Ohio Bioproducts Innovation Center (OBIC)

Regional demographics and the scale of the economy

- 110 million people
  - of the order of 25 million residing in rural and remote communities (?)
- combined regional gross domestic product (GDP) in 2005 ≡ $4.3 trillion
  - in 2006, Ontario and Quebec accounted for 58 percent of Canada's GDP
  - In 2005, the eight states in the region contributed 28.5 percent to U.S. GDP
- substantial global macroeconomic entity:
  - 55 percent of North America's manufacturing and services industries
  - about half of all North American retail sales

Source: a summary of the regional economy, presented in the *Great Lakes St. Lawrence Seaway Study* (ca. 2007)

Current global competitiveness of the regional economy

- The region possesses the attributes of an ‘Old economy’
  - product and process proliferation
  - focus on dividends
  - reliance on traditional funding sources
  - centralized command and control
  - strict division of labour between ‘skilled’ and ‘unskilled’
  - rigid hierarchies
  - vertical integration and expanding in-house functions

Source: Keith Reams, Lead Economist, Pacific Rim, Global Transfer Pricing, Deloitte Touche Tohatsu, Sydney, March 5, 2008

The fashioning of a bio-economic system affords an opportunity to employ the ‘New Economy’ model

- highly focused strategy on specific products and processes
- reinvestment of earnings for growth
- use of own stock for funding investment
- distributed decision-making
- highly educated in-house workforce
- highly mobile workforce
- automated routine activities
- automated data and information assembly and sharing
- interoperability

drawn from: Keith Reams, Lead Economist, Pacific Rim, Global Transfer Pricing, Deloitte Touche Tohatsu, Sydney, March 5, 2008

First ‘Gate’ preliminary feasibility assessment of the Bio-economy investment financing case

- establish a time horizon: 2030 (let us say)
- take a ‘first cut’ at estimating:
  - a feasible strategic scale of a bio-economic system within the broader economy of the region
  - asset and infrastructure investment requirements
  - likely magnitude of revenue streams to stakeholders
- estimate life cycle costs associated with some feasible assemblies of supply chains

Sample calculations under a set of heuristics gave these preliminary indications of feasibility:

- a quantum of energy likely to correspond to the order of 10% of regional energy requirements ≡ 200 TWh ≡ 720 PJ
- amount of installed capacity likely to contribute that quantum of energy ≡ 27 GW
- the asset and infrastructure investment requirement is likely to be in the range of $55 billion to $110 billion in today's dollars
- nominal revenue accruing from sale of energy ≡ $10 to $20 billion per annum in today's dollars
- nominal potential revenue accruing from sale of credits ≡ $1.0 to $2.0 billion per annum in today's dollars

(refer to back-up charts for the heuristics employed)

Summary

- There is a need and opportunity for incorporation of a bio-economic system into the broader ‘real’ economy of the Great Lakes region.
- A key need in the design and implementation of a bio-economic system is the formulation of an actionable strategic intent.
- A critical success factor is building a financial model for the operation of the bio-economic system.

Back-up chart #1: ‘First cut’ at estimating a feasible strategic scale

- assume a quantum of energy generated and embedded in biofuels produced and exchanged, equivalent to Ontario’s current annual stationary energy generation
  ≡ 200 TWh ≡ 720 PJ
- assume an average capacity factor (ACF) associated with biomass conversion to energy commodities of the order of that currently experienced in Ontario’s current annual stationary energy generation
  - that is, the biomass conversion capacity installed by 2030, expressed in power generation terms, is equivalent to the current installed power generation capacity in Ontario ≡ 27 GW
- this amount of installed capacity is likely to contribute a quantum of energy to the Great Lakes economy, of the order of 10% of its energy requirements

Back-up chart #2: 'First cut' at estimating asset and infrastructure investment requirements

- assume a nominal fully-loaded asset and infrastructure investment requirement in the range of $2 million/MW to $4 million/MW
- at $3.7 million/MW, $100 billion is required to be invested in assets and infrastructure over the period to 2030, in order to contribute a quantum of energy to the Great Lakes economy of the order of 10% of its energy requirements
    - that is, the asset and infrastructure investment requirement is likely to be in the range of $55 billion to $110 billion, in today's dollars

Back-up chart #3: 'First cut' at estimating likely magnitude of revenue streams to stakeholders

- depending upon the portfolio mix, the revenue stream from sale of a portfolio of energy commodities could amount to between $10 billion per annum to $20 billion per annum

energy sent at an ACF corresponding to 7000 hours per annum	TWh per annum	200	200
nominal energy price in today's dollars	$/MWh	50	100
nominal energy price in today's dollars	$/GJ	14	28
nominal revenue accruing from sale of energy in today's dollars	$billion per annum	10	20

- does the potential exists to create a second revenue stream through becoming a net seller of carbon credits?

nominal CO_2 avoided per MWh	tonnes/MWh	0.5	0.5
energy sent at an ACF corresponding to 7000 hours per annum	TWh per annum	200	200
nominal CO_2 avoided per annum	Mtpa	100	100
nominal cost of carbon	$/tonne CO_2	20	40
nominal proportion on which revenue accrued through sale of credits		0.5	0.5
nominal revenue accruing from sale of credits in today's dollars	$billion per annum	1.0	2.0

- Given an actionable strategic intent against which to work,
  the responsibility of constituencies is to provide an analysis which decision-makers believe to be justifiable and theoretically sound