

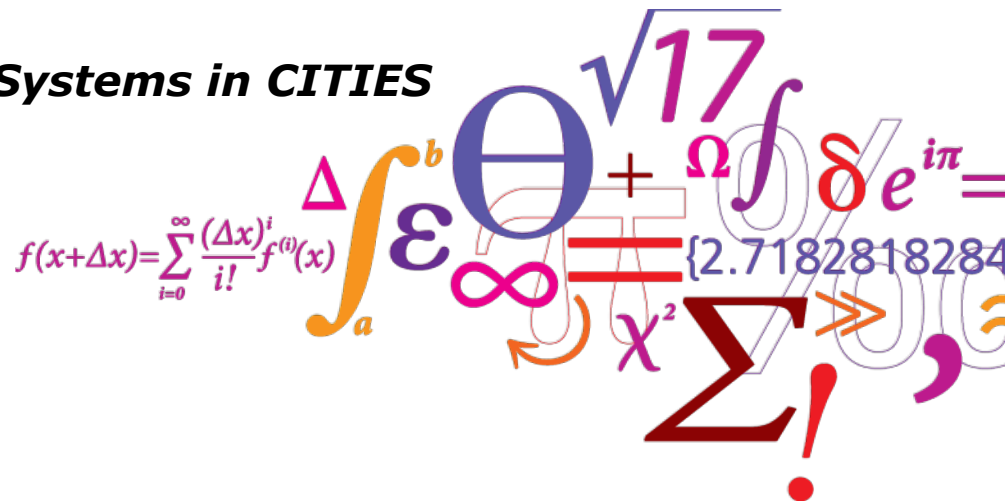
Quantifying the impact - can the design of the study affect the results?

Ivan T. Herrmann

CITIES

Centre for IT-Intelligent Energy Systems in CITIES

May 26, 2014



Agenda

1. The need for a systematic approach to classifying types of studies
2. A proposed taxonomy
3. Systematic classification of types of studies
4. The uncertainty trade-off
5. Discussion and conclusion

The need for a systematic approach to classifying types of studies

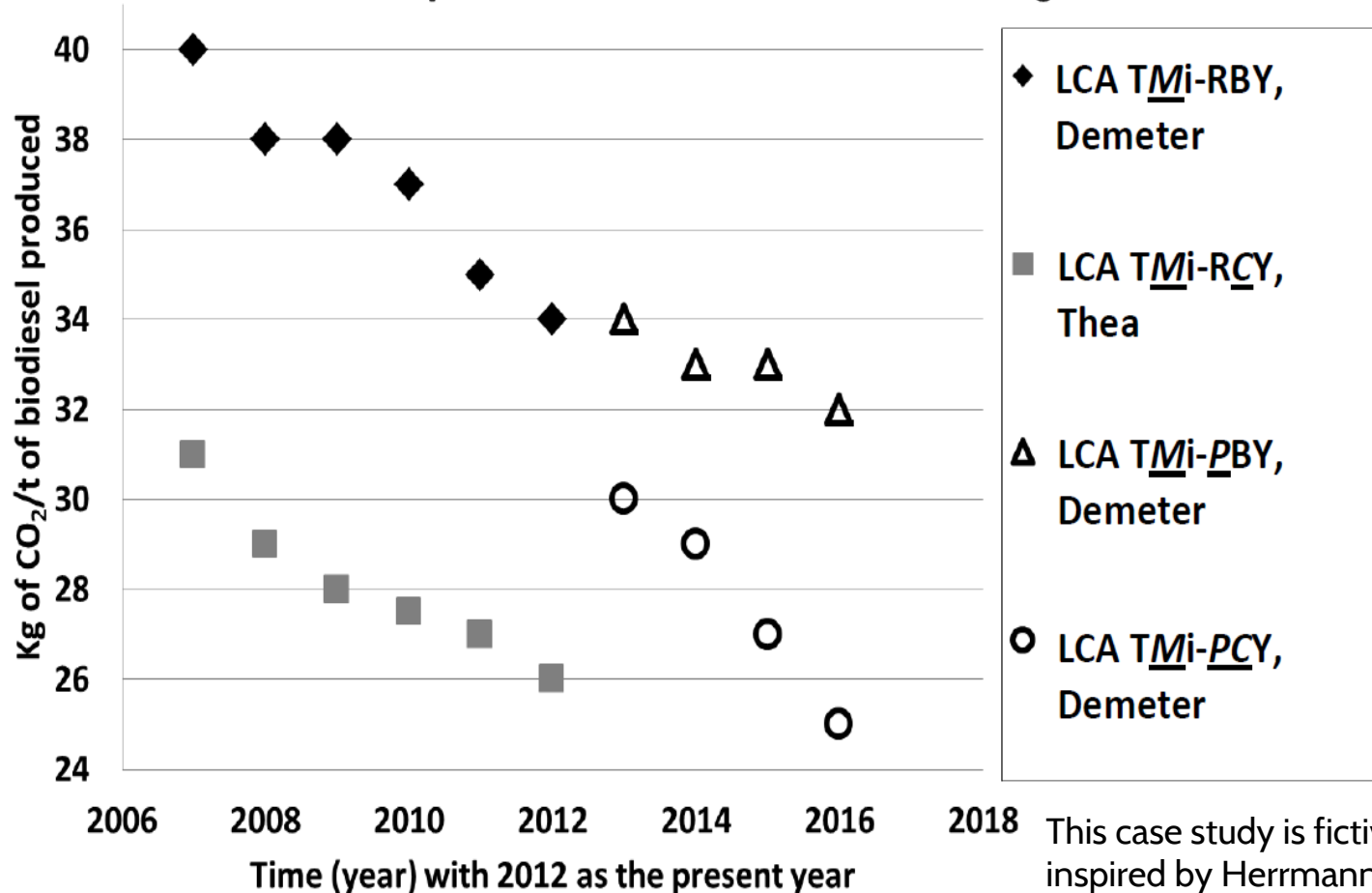
- In the 90'ies and early 00'ies biofuels were believed to be the fuel that could **reduce anthropogenic greenhouse gas emission**.
- In 2008 Searchinger published in **Science** a paper "*Use of US croplands for biofuels increases greenhouse gases through emissions from land-use change*" - which was a game changing study - suddenly biofuel was not that **hot!**
- Since then a countless number of studies has shown one of two options: **biofuel is good** or **biofuel is bad**.

Can this path of more or less random outcomes of the many different studies of biofuels be explained?

A taxonomy for classifying different studies

<p>Tangibility Tangible (T) vs. Intangible (I)</p>	<p>Tangible things can be touched and seen in the corporeal world. In contrast, intangible things are ideas or concepts. Only hypothesis and indirect evidence can be offered for intangibles.</p>
<p>Repetitivity Single-period (S) vs. Multi-period (M)</p>	<p>Single-period is, for example, the CO₂ emission from a given factory in only 2011. Multi-period information would be for more than one year—say, 2011, 2012, and 2013.</p>
<p>Scale Micro (i) vs. Macro (a)</p>	<p>This is a relative size scale. Micro is small compared to macro, but the absolute scale depends on relevance for the studied function or service. If a project is considered to be on a macro scale, then structural changes should be considered.</p>
<p>Time Retrospective (R) vs. Prospective (P)</p>	<p>Retrospective studies deal with what happened in the past, while prospective studies involve an estimation of future events.</p>
<p>Change Baseline (B) vs. Change (C)</p>	<p>The baseline is business as usual, while a change is anything different from the baseline.</p>
<p>Value Physical (Y) vs. Value (V)</p>	<p>A physical quality is an actual location and quantity of matter and energy in time and space. Value refers instead to the value relative worth placed on that same physical entity by one or more DMs.</p>

Illustration of the dimensions: "prospective vs. retrospective" and "baseline vs. change"



This case study is fictive, but inspired by Herrmann et. al (2012)

Systematic classifying types of studies

			Tangible (T)				(Tangible +) Intangible (I)			
			Single-period (S)		Multi-period (M)		Single-period (S)		Multi-period (M)	
			Micro (i)	Macro (a)	Micro (i)	Macro (a)	Micro (i)	Macro (a)	Micro (i)	Macro (a)
Retrospective (R)	Baseline (B)	Physical (Y)	TSi-RBY	TSa-RBY	TMi-RBY	TMa-RBY	ISi-RBY	ISa-RBY	IMi-RBY	IMa-RBY
		Value (L)	TSi-RBV	TSa-RBV	TMi-RBV	TMa-RBV	ISi-RBV	ISa-RBV	IMi-RBV	IMa-RBV
	Change (C)	Physical (Y)	TSi-RCY	TSa-RCY	TMi-RCY	TMa-RCY	ISi-RCY	ISa-RCY	IMi-RCY	IMa-RCY
		Value (L)	TSi-RCV	TSa-RCV	TMi-RCV	TMa-RCV	ISi-RCV	ISa-RCV	IMi-RCV	IMa-RCV
Prospective (P)	Baseline (B)	Physical (Y)	TSi-PBY	TSa-PBY	TMi-PBY	TMa-PBY	ISi-PBY	ISa-PBY	IMi-PBY	IMa-PBY
		Value (L)	TSi-PBV	TSa-PBV	TMi-PBV	TMa-PBV	ISi-PBV	ISa-PBV	IMi-PBV	IMa-PBV
	Change (C)	Physical (Y)	TSi-PCY	TSa-PCY	TMi-PCY	TMa-PCY	ISi-PCY	ISa-PCY	IMi-PCY	IMa-PCY
		Value (L)	TSi-PCV	TSa-PCV	TMi-PCV	TMa-PCV	ISi-PCV	ISa-PCV	IMi-PCV	IMa-PCV

Red arrow illustrates an increased scope of the study as you move from the upper left corner towards the lower right corner.

How does the scope of the study affect the uncertainty of the study?

$$f(A,B,C) = E(U)$$

- $E(U)$ is the expected inherent uncertainty of a study
- A is the budget constraints for the AN
- B is the size of the study (given by the classification matrix)*
- C is the capability of the AN

An increase or decrease in any of the three variables A , B , or C will lead to an increase or decrease in the expected uncertainty of the given study.

*When moving in any direction from the upper-left corner cell (TSi-RBY), in general the expected inherent uncertainty of the study will increase. The more cells that are indicated with italics and an underline, the more all-embracing the study—but more uncertainty is also expected, *ceteris paribus*. Not including a higher level of the classification matrix means that the AN refrains from making statements about these more all-embracing types of study.

Conclusion and discussion

The design of the study can affect both the result of the study and the expected inherent uncertainty of the result of the study. It is important to have a consistent framework that can clarify and classify different types of studies.

This framework does not present any guidelines on what we ought to do. That is, the presentation does not suggest what we ought to do if we have few resources available (say just a few months with one student) should we try to make an “all-embracing” study in the lower-right corner of the classification matrix, and then accept the increased uncertainty? Or, would it be better to perform a more restricted study with lower uncertainty?

Also, this presentation does not present any recommendation for what level of uncertainty that the DM should accept. Normally the accepted uncertainty level would be the decision makers own choice.