

Uncertainty within and beyond the data: approaches to deal with different types of unknowns

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Why do we measure uncertainty?

- Precision does not necessarily reduce uncertainty





PORXOS m. PALLOL
a Repès de l'Ajuntament
muntanyes de gran, any 1752
+quartera - tresquadras

TABLE OF WEIGHTS.

A Table of Weights, obtained by us from the *Secretaries* of the different States, showing the No. of lbs., which their *LAWs* recognize as a *bushel*, of the following articles. [COPY RIGHT SECURED.]

A VALUABLE TABLE

STATES.	Wheat.	Rye.	Corn.	Oats.	Barley.	Buckwheat.	Clover Seed.	Timothy Seed.	Flax Seed.	Hemp Seed.	Blue Grass Seed.	Dried Apples.	Dried Peaches.	Dried Plums.	Coarse Salt.	Fine Salt.	Potatoes.	Peas.	Beans.	Castor Beans.	Onions.	Corn Meal.	Mineral Coal.
	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS	LBS
NEW YORK,	60	56	56	32	48	48	60	45	56	44	15	22	32	00	56	56	60	60	60	46	57	00	00
OHIO,	60	56	56	32	48	..	64	42	56	..	..	25	33	..	50	50	..	..	56	..	..	..	..
PENNSYLVANIA,	60	56	56	32	47	48	..	..	..	..	..	..	..	..	85	62	..	..	..	..	..	..	..
INDIANA,	60	56	56	32	48	50	60	45	56	44	14	25	33	..	50	50	60	..	60	46	57	50	70
WISCONSIN,	60	56	56	32	48	42	60	..	..	..	..	28	28	..	..	..	..	..	..	..	..	..	..
IOWA,	60	56	56	35	48	52	60	45	56	44	14	24	33	..	50	50	60	..	60	46	57	..	..
ILLINOIS,	60	54	56	32	44	40	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
MICHIGAN,	60	56	56	32	48	42	60	m	m	..	..	28	28	..	..	..	..	..	..	..	..	..	..
CONNECTICUT,	56	56	56	28	..	45	..	..	..	..	..	..	..	..	..	..	60	..	..	..	..	..	..
MASSACHUSETTS,	60	56	56	30	46	46	..	m	m	..	..	..	..	..	70	70	60	60	60	..	50	..	..
RHODE ISLAND, .....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	60	..	..	..	50	50	..
KENTUCKY,	60	56	56	33	48	52	60	45	56	..	..	..	..	..	50	50	..	..	60	..	..	..	..
NEW JERSEY,	60	56	56	30	48	50	64	..	55	..	..	..	..	..	..	..	..	..	..	..	..	..	..
VERMONT,	60	56	56	32	46	46	..	..	..	..	..	..	..	..	..	..	60	..	..	..	..	..	..
MISSOURI,	60	56	52	m	m	m	m	m	m	..	..	..	..	..	50	50	..	..	..	..	..	..	..
CANADA, [Custom.]	60	56	56	34	48	48	60	48	56	..	..	22	22	..	56	56	..	60	60	..	..	..	..

All States not included in the Table, as well as the above blanks, are regulated by the United States standard.

DURYEE & FORSYTH.

Agents, **RAYMOND & WARD**, Chicago, Ill.

FOR BUSINESS MEN.

- Standard measures caused a loss of knowledge and created uncertainty

Why do we ~~measure~~ assess uncertainty?

- Assessing uncertainty as acknowledging the knowledge that is lost through measurements

Types of uncertainty

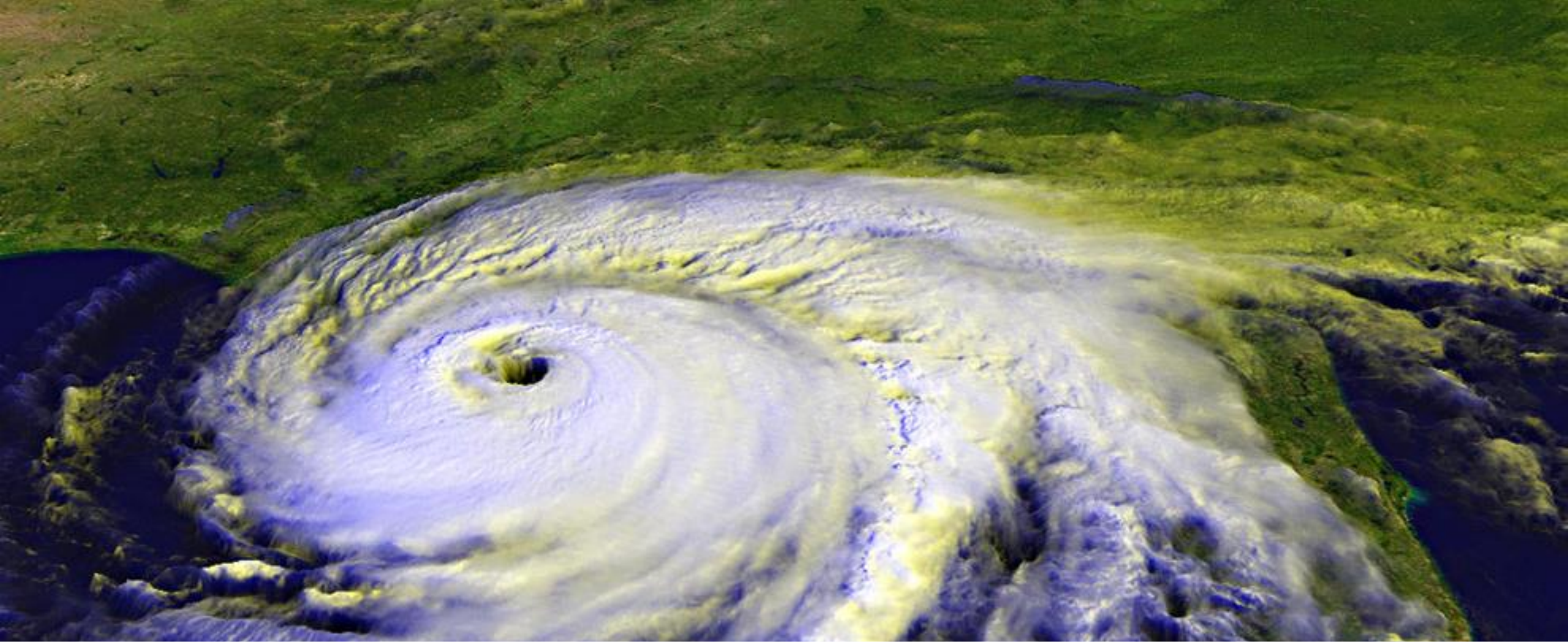
- Risk (known outcomes and known probabilities)



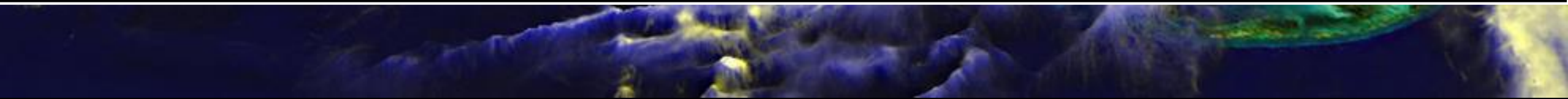
RISK

Types of uncertainty

- Risk (known outcomes and known probabilities)
- Strict uncertainty (known outcomes and unknown probabilities)



STRICT UNCERTAINTY



Types of uncertainty

- Risk (known outcomes and known probabilities)
- Strict uncertainty (known outcomes and unknown probabilities)
- Ignorance (unknown outcomes – we don't know what we don't know)



IGNORANCE



Types of uncertainty

- Risk (known outcomes and known probabilities)
- Strict uncertainty (known outcomes and unknown probabilities)
- Ignorance (unknown outcomes – we don't know what we don't know)
- Indeterminacy (causal chains are open)

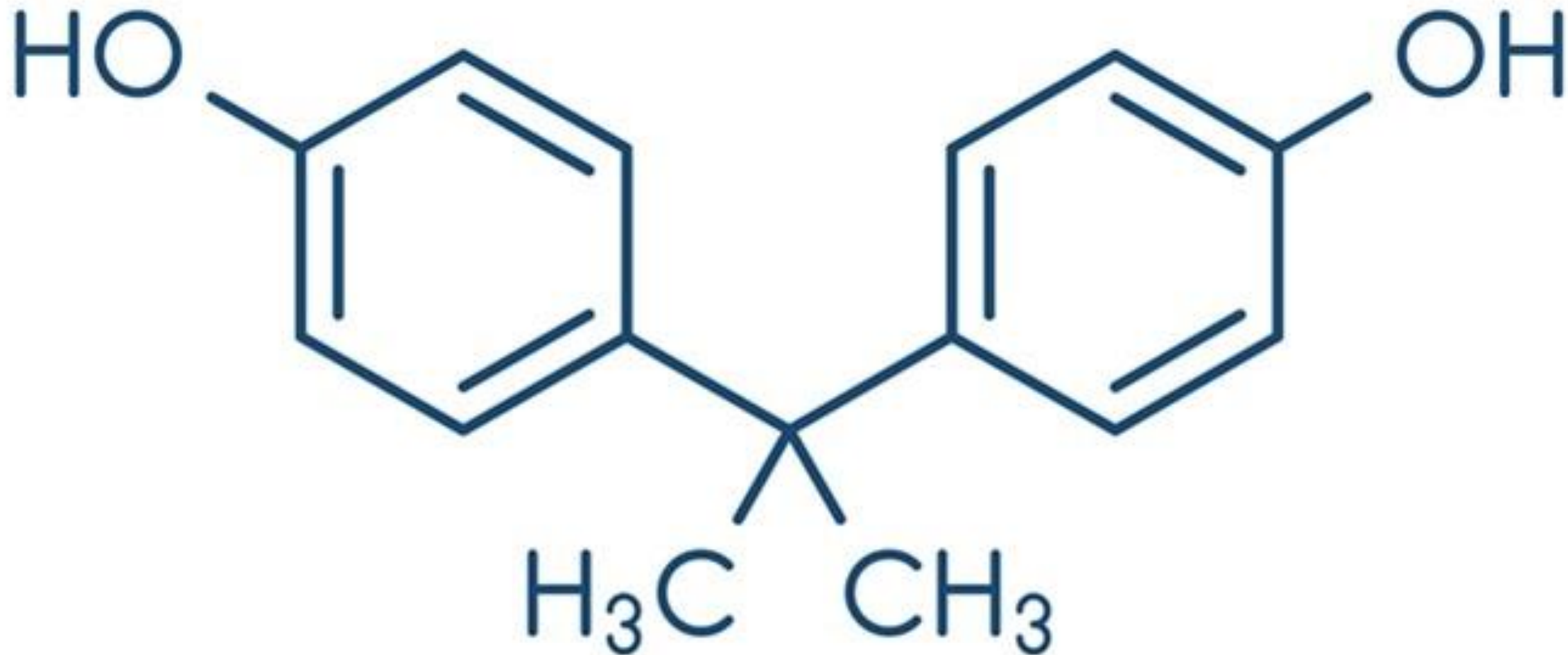


INDETERMINACY



Types of uncertainty

- Risk (known outcomes and known probabilities)
- Strict uncertainty (known outcomes and unknown probabilities)
- Ignorance (unknown outcomes – we don't know what we don't know)
- Indeterminacy (causal chains are open)
- Ambiguity (unknown outcomes and known probabilities)



AMBIGUITY

bisphenol A

Types of uncertainty

- Risk (known outcomes and known probabilities)
- Strict uncertainty (known outcomes and unknown probabilities)
- Ignorance (unknown outcomes – we don't know what we don't know)
- Indeterminacy (causal chains are open)
- Ambiguity (unknown outcomes and known probabilities)

- Some types of uncertainty cannot be meaningfully quantified, or cannot be quantified at all
- Identify the knowledge that is lost

Qualitative methods of uncertainty analysis

- Dealing with qualitative aspects
 - Knowledge Quality Assessment (integrity, responsibility, rigour, transparency, reproducibility); problem framing; involvement of stakeholders; selection of indicators; mapping uncertainty; **NUSAP**; sensitivity auditing; social multicriteria evaluation (weighting of evidence and aggregation of social preferences) - (van der Sluijs 2007, Strand & Oughton 2009; Saltelli et al. ; Munda 2005)
- Typologies of uncertainty
 - Nature of uncertainty (knowledge related & variability); risk, strict uncertainty, ignorance and indeterminacy (Wynne 1992); risk, uncertainty, ignorance and ambiguity (Stirling 2003); technical, **methodological and epistemological uncertainty** (Funtowicz & Ravetz 1990); location of uncertainty, level of uncertainty, quality of knowledge base, value-ladenness of choices (van der Sluijs 2006)

Uncertainty analysis
Approach (i)
Dealing with qualitative
aspects

- NUSAP (Funtowicz & Ravetz;
van der Sluijs)
 - Numeral (the quantity)
 - Unit (the type of measure)
 - Spread (the statistical error)
 - Assessment (the quality of the
information)
 - Pedigree (the quality of the
process of producing the
information)

	Numeral	Unit	Spread	Assessment	Pedigree
Value of compensations	1 E2	\$/litre	±5	0.5	(3, 4, 3)

Score	Quality of model	Quality of data	Degree of acceptance
4	Established model	Empirical data	High
3	Theoretical model	Historical data	Medium
2	Experimental model	Educated guess	Low
1	Statistical processing	Uneducated guess	None

Figure 3. Example of Numeral, Unit, Spread, Assessment, Pedigree. *Source:* Adapted from Funtowicz and Ravetz (1990).

Example Pedigree matrix parameter strength

Code	Proxy	Empirical	Theoretical basis	Method	Validation
4	Exact measure	Large sample direct mmts	Well established theory	Best available practice	Compared with indep. mmts of same variable
3	Good fit or measure	Small sample direct mmts	Accepted theory partial in nature	Reliable method commonly accepted	Compared with indep. mmts of closely related variable
2	Well correlated	Modeled/derived data	Partial theory limited consensus on reliability	Acceptable method limited consensus on reliability	Compared with mmts not independent
1	Weak correlation	Educated guesses / rule of thumb est	Preliminary theory	Preliminary methods unknown reliability	Weak / indirect validation
0	Not clearly related	Crude speculation	Crude speculation	No discernible rigour	No validation

Uncertainty analysis
Approach (ii)
Typologies of
uncertainty

- Analysis of the sources of uncertainty (Funtowicz & Ravetz 1990)
 - Technical uncertainty
 - Methodological uncertainty
 - Epistemological uncertainty



Enkanini

Energy needs

The community asked for connection to “Eskom”, the national electric utility



iShack project

- Solar panels installed on roof tops
- 64% of households in Enkanini had solar panels in 2015

Solar panels conflict

Dear iShack Clients,

***The Hub is closed
until further notice.***

URGENT problems only call Hotline: 071 837 1370

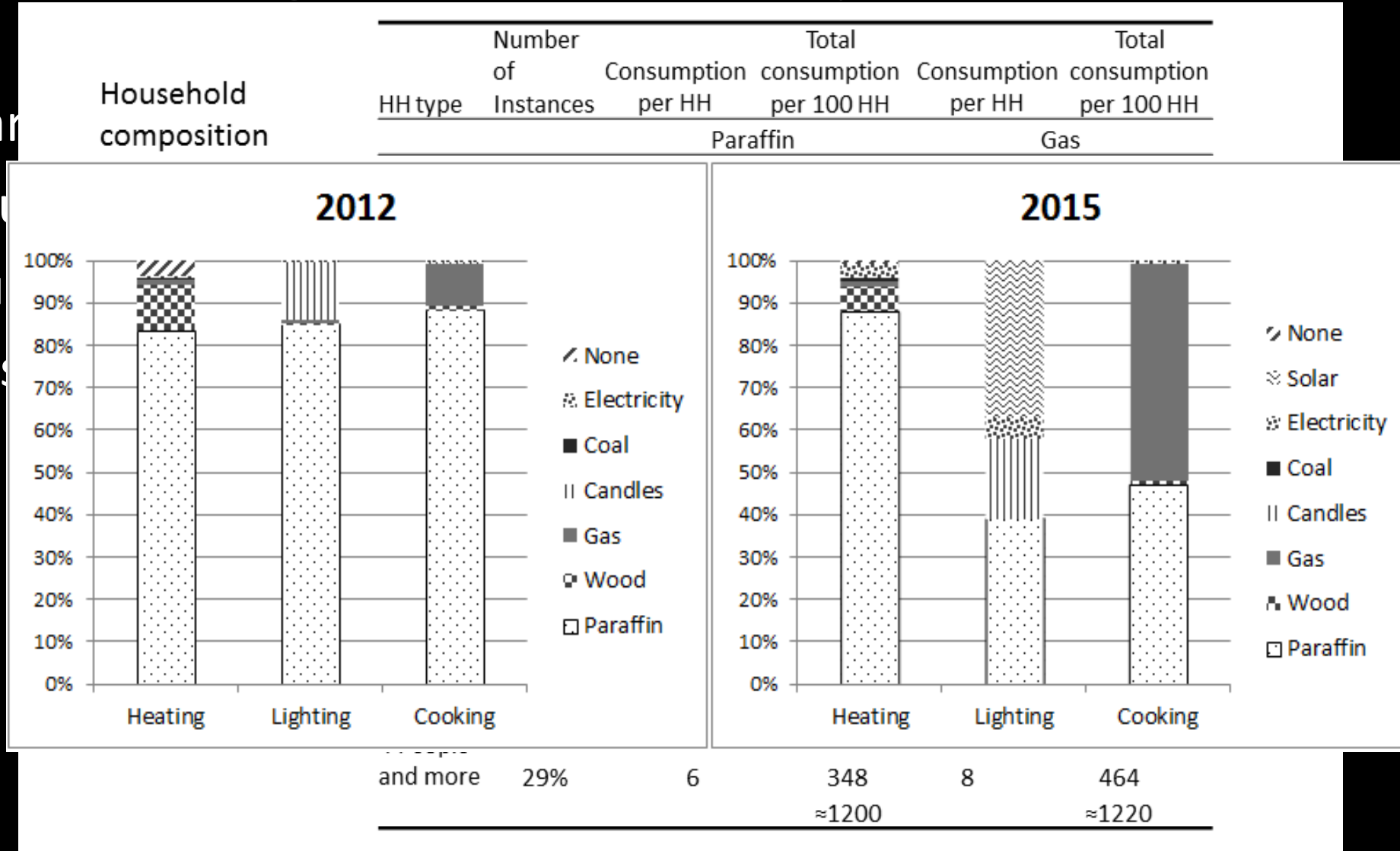


Technical uncertainty

How to provide electricity

Methodological uncertainty

- Solar
- Pop
- Hou
- Cons



Epistemological uncertainty

- Enkanini residents want the formal recognition of the settlement
- Municipality: Politically difficult to recognize the informal settlement

Typologies of
uncertainty:
BPA

- Analysis of the sources of uncertainty (Funtowicz & Ravetz 1990)
 - Technical uncertainty
 - Methodological uncertainty
 - Epistemological uncertainty

Take-home thoughts

- Uncertainty analysis requires a critical reflection about the limits of knowledge
- Analyzing uncertainty does not tame the uncertainty



Thank you for your
attention!

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