Implications of the uncertainty of energy resources on CO_2 emission pathways

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BASQUE CENTRE FOR CLIMATE CHANGE
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LOW CARBON PROGRAMME
EUSKAMPUS JRP ON ENERGY AND ENVIRONMENT

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OUTLINE

1- Introduction: assessing fossil fuel resources availability

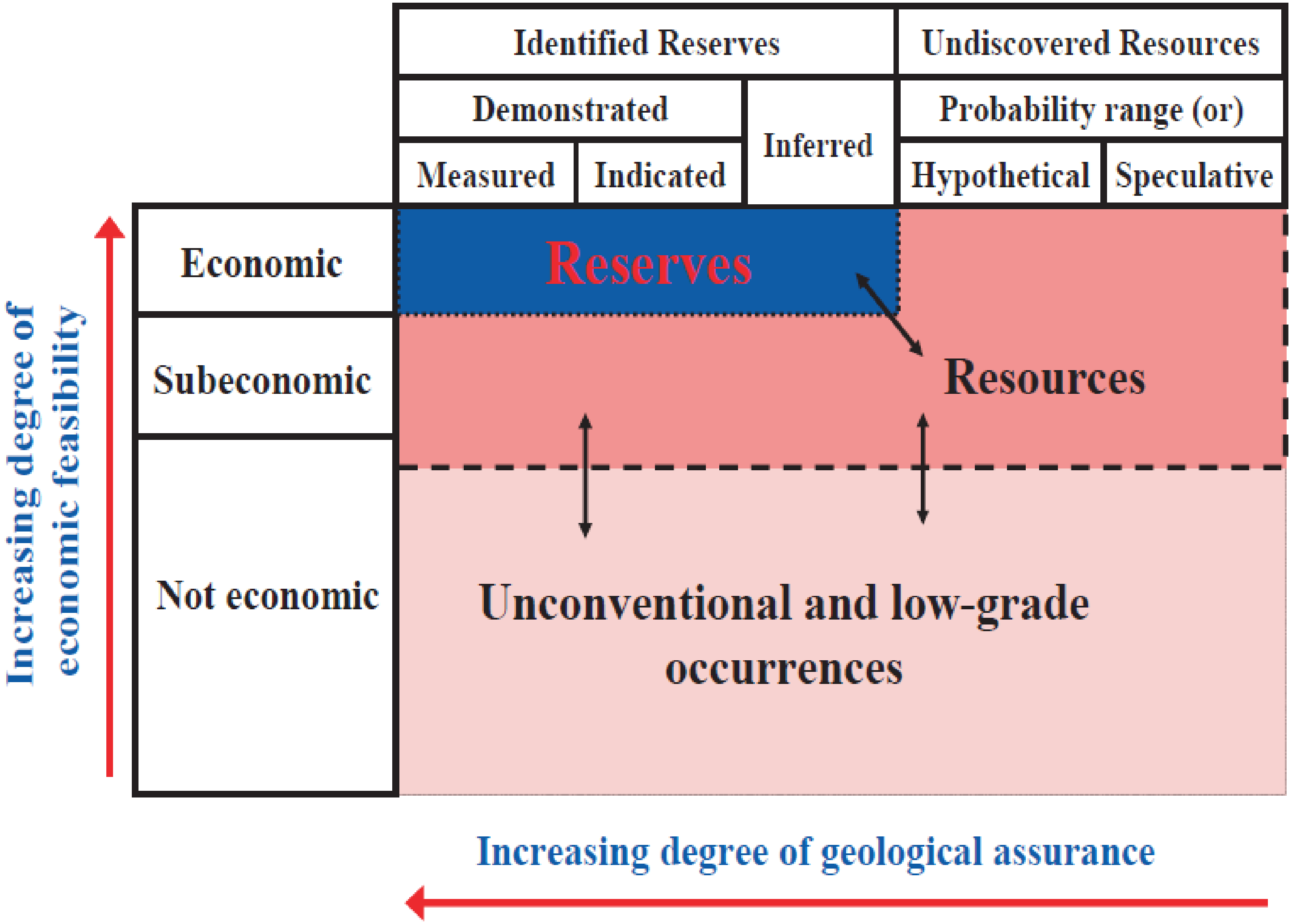
2- Design of the experiment

3- Results

4- Limitations, conclusions & further research

1- Intro: assessing fossil resources availability

1. Uncertainty in fossil fuel resource availability:

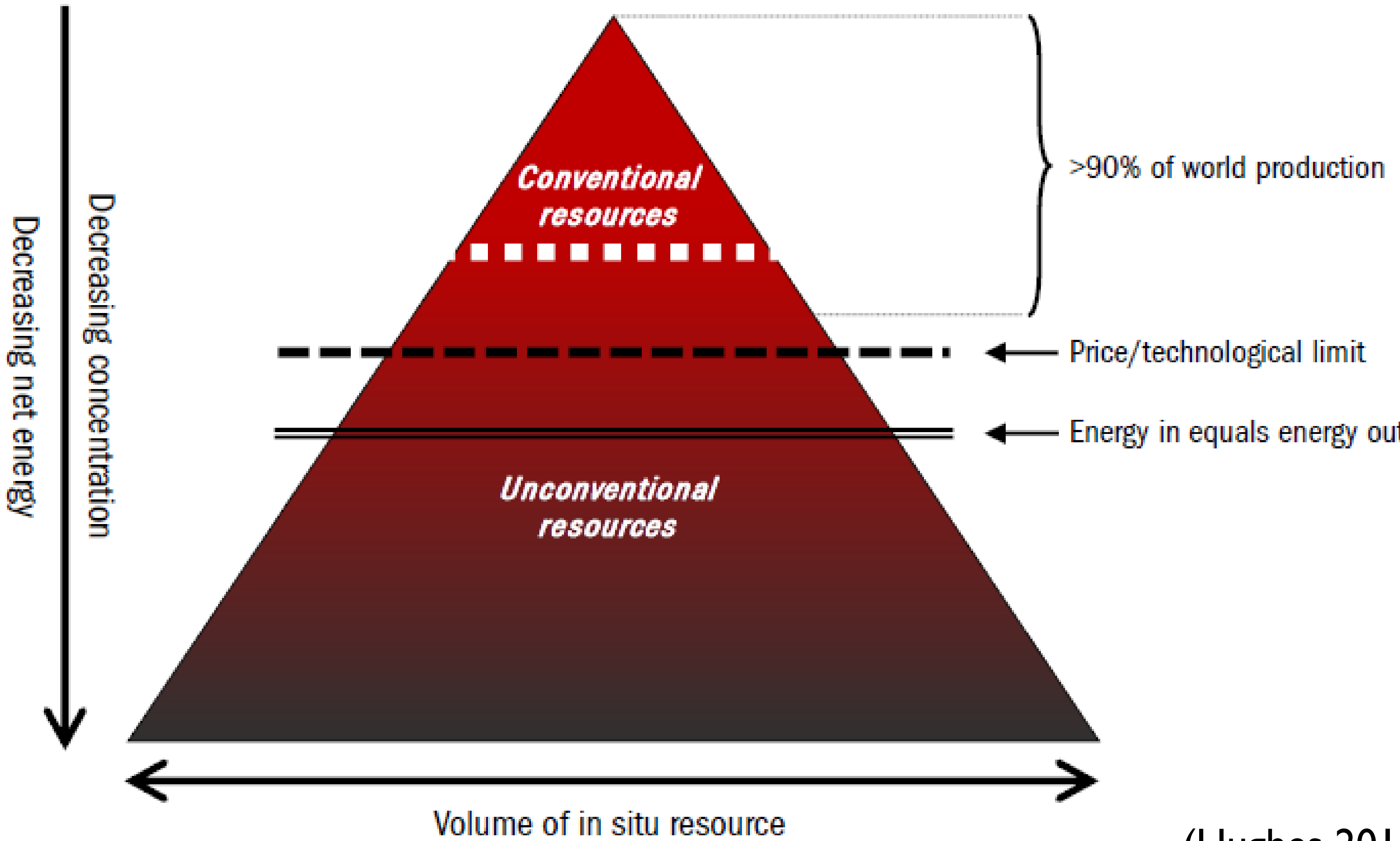


Inherently uncertain estimates!

(Rogner et al 2012)

1- Intro: assessing fossil resources availability

1. Uncertainty in fossil fuel resource availability:



(Hughes 2013)

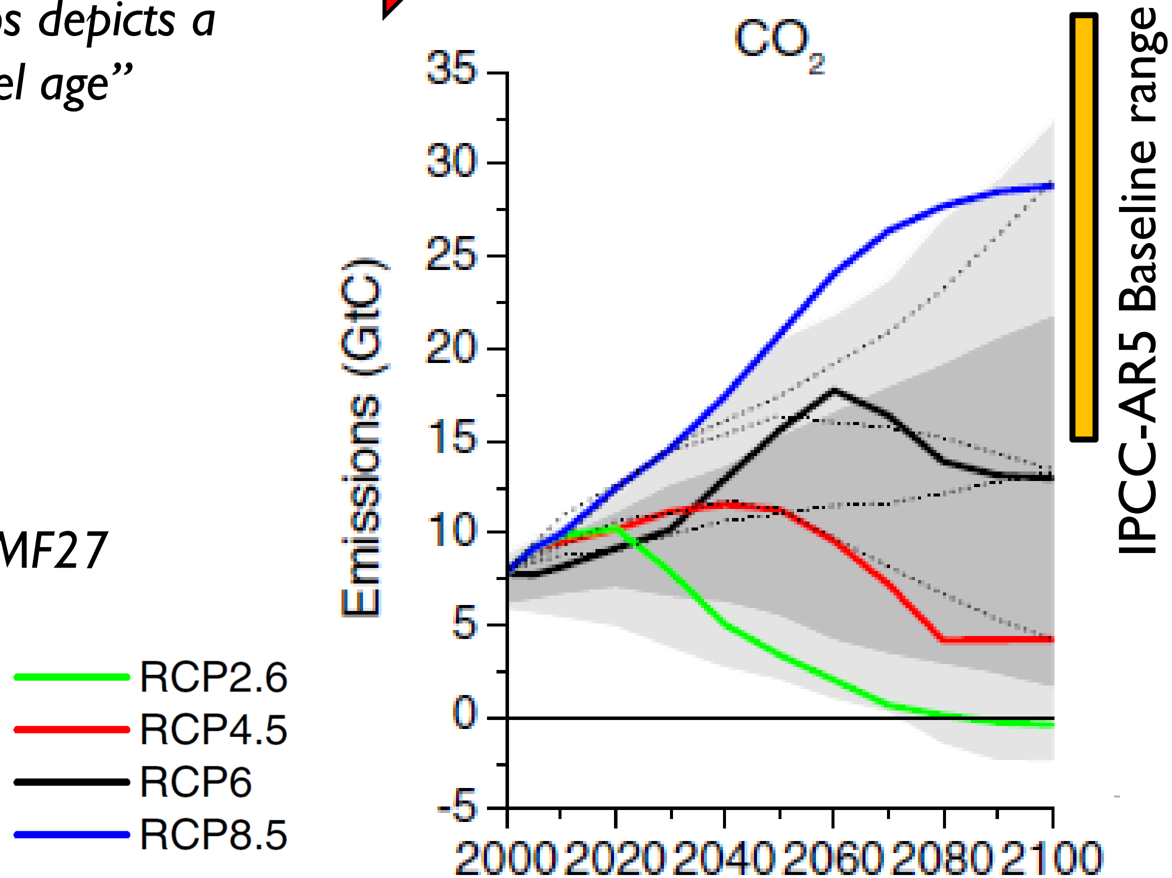
1- Intro: assessing fossil resources availability

2. Climate IAM: hypothesis of abundance of fossil fuel resources

"It is evident that, in the absence of climate policies, none of the SRES scenarios depicts a premature end to the fossil fuel age"
(***SRES 2000***)

e.g. *McCollum et al. (2014), EMF27*

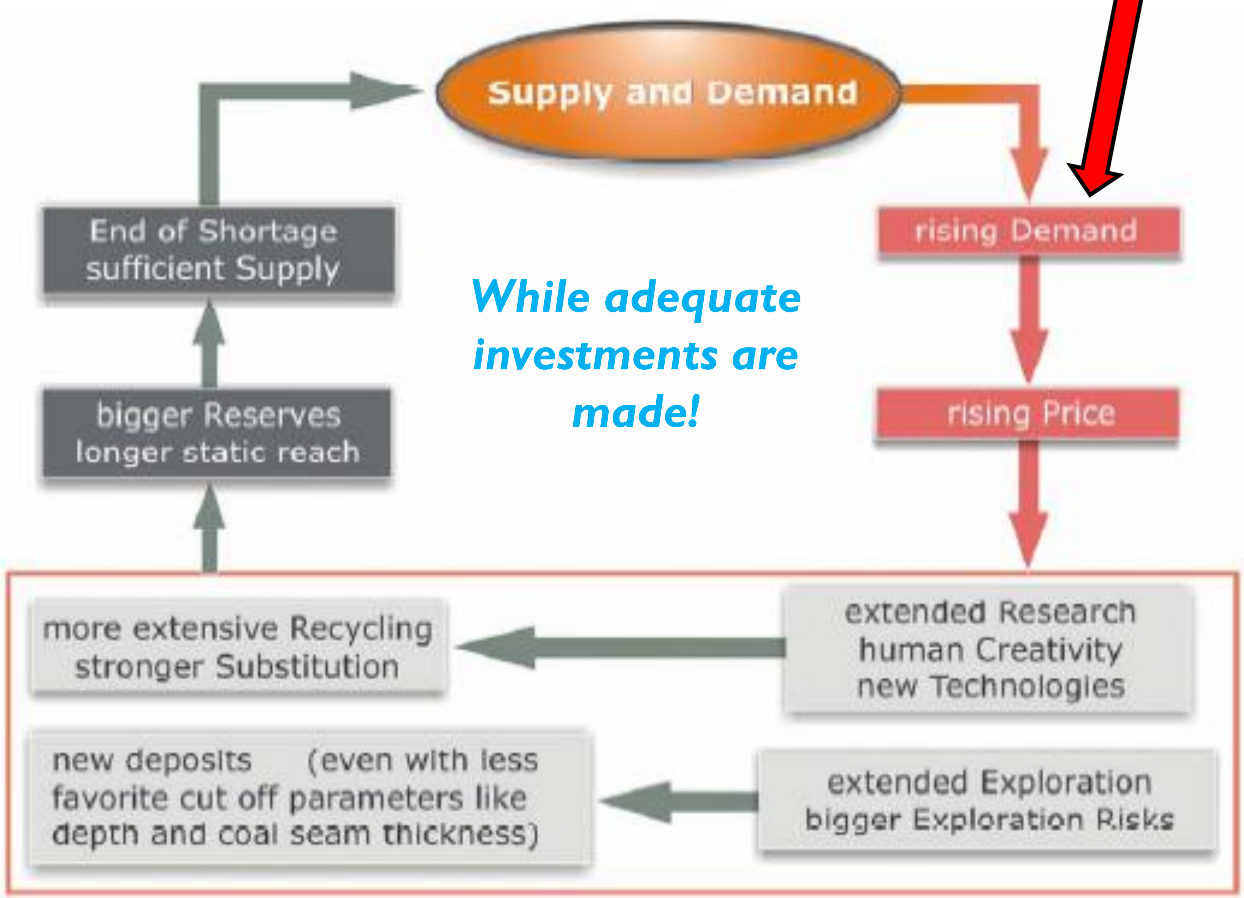
RCPs (van Vuuren et al 2011)



1- Intro: assessing fossil resources availability

2. Climate IAM: hypothesis of abundance of fossil fuel resources

Socio-economic scenarios assuming demand-driven energy availability



Conventional resource economics aproach

(Thieleman et al 2012)

1- Intro: assessing fossil resources availability

3. Resource/reserve estimates are subject to critical limitations for long-term planning due to:

1.1 Dynamic definition,
1.2 No "available" quantities (recoverability factors!)
1.3 Subject to ***critical*** errors and uncertainties.

(1)	Lack of methodological standarization	**→ Data non-updated, non-reliable or non-existant** **→ Confusion in global aggregates** **LOW QUALITY DATA**
(2)	Lack of transparency in many countries (OPEC, Russia, China, etc.)	
(3)	Confusion between different types of resources (conv. vs unconv.)	

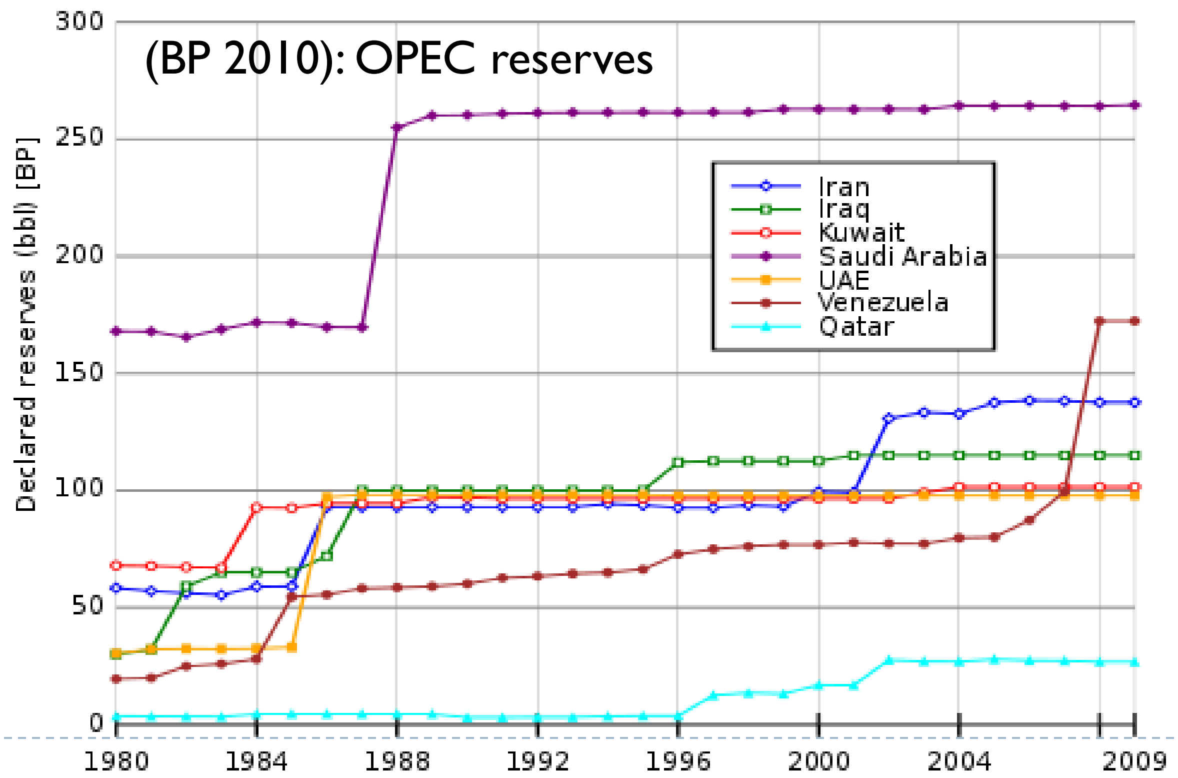
1- Intro: assessing fossil resources availability

3. Resource/reserve estimates are subject to critical limitations for long-term planning:

… with an historical tendency towards overestimation:

Examples:

1. Crude oil



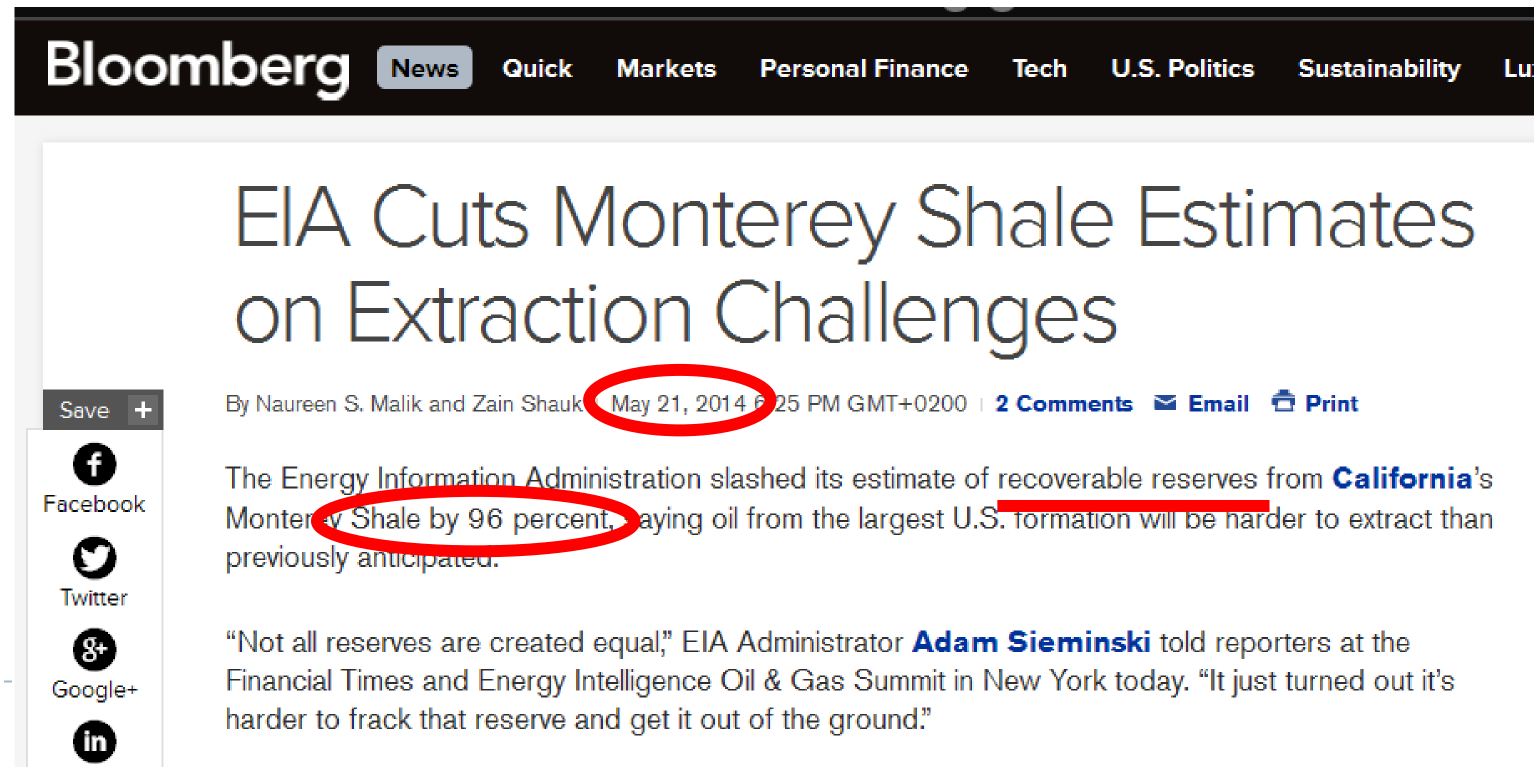
1- Intro: assessing fossil resources availability

3. Resource/reserve estimates are subject to critical limitations for long-term planning:

… with an historical tendency towards overestimation:

Examples:

1. Crude oil
2. Unconv. oil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EIA Cuts Monterey Shale Estimates on Extraction Challenges

By Naureen S. Malik and Zain Shauk May 21, 2014 6:25 PM GMT+0200 | 2 Comments Email Print

The Energy Information Administration slashed its estimate of recoverable reserves from California's Monterey Shale by 96 percent, saying oil from the largest U.S. formation will be harder to extract than previously anticipated.

"Not all reserves are created equal," EIA Administrator Adam Sieminski told reporters at the Financial Times and Energy Intelligence Oil & Gas Summit in New York today. "It just turned out it's harder to frack that reserve and get it out of the ground."

1- Intro: assessing fossil resources availability

3. Resource/reserve estimates are subject to critical limitations for long-term planning:

… with an historical tendency towards overestimation:

Examples:

1. Crude oil
2. Unconv. oil
3. Coal

Estimates from rough and outdated methods (1970s):

When estimates are revised, strong downgrade:

Russia: -40% (Malyshev 2000)
South-africa: -40 % (BP 2008)
USA: -80% (USGS 2009)
…

4. Need of a different approach: **ultimately recoverable resources (URR)**

Estimate of the amount of resources that could ever be recovered:

- explicitly addressing these **uncertainties,**

- aiming at providing robust estimates in the light of the **best available and transparent data,**

- combining a **set of methodological tools** (geology, statistics, etc.).

2- Design of the experiment

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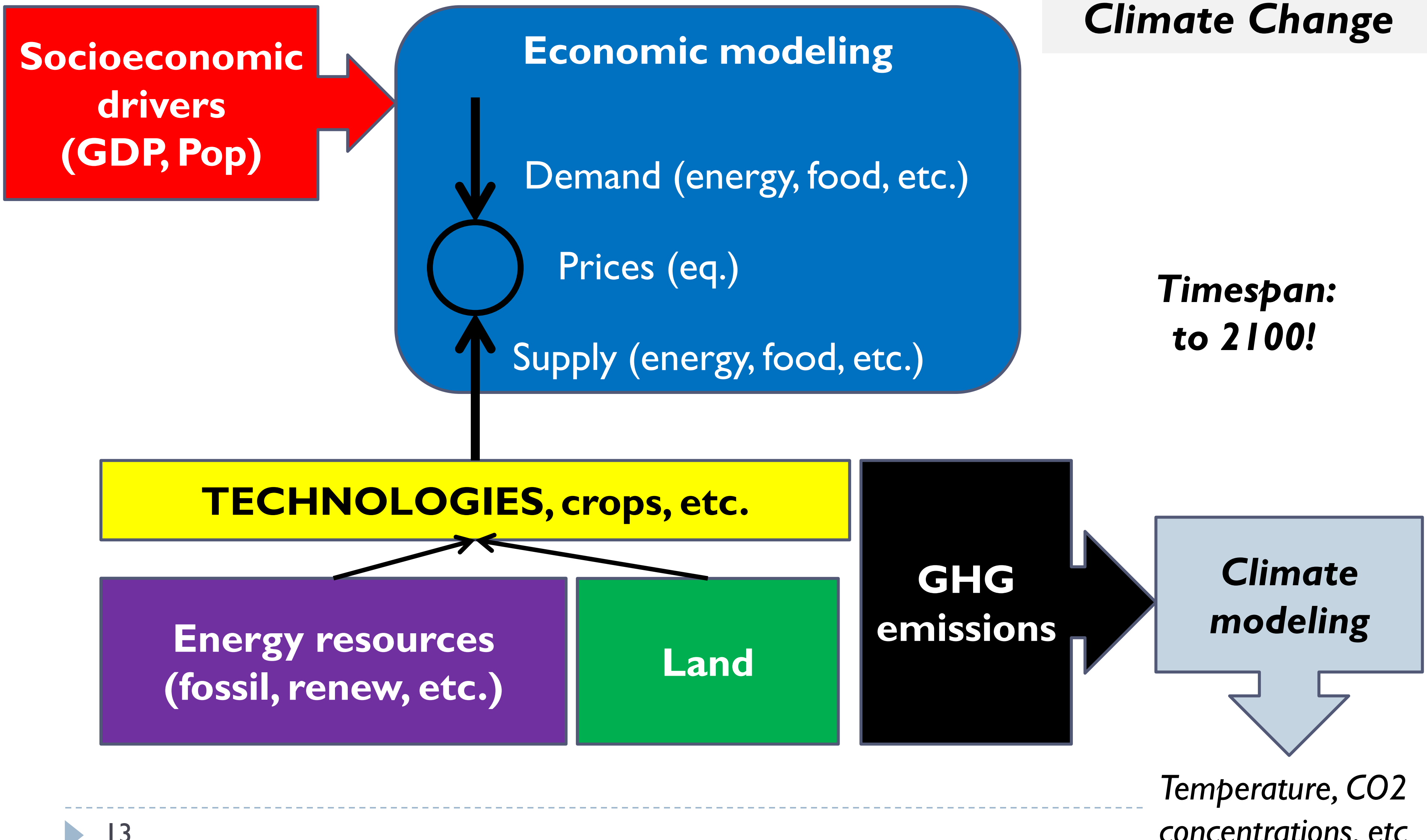
Integrated Assessment Modeling of Climate Change



2- Design of the experiment

- URR survey:
  - Data from (Dale 2012)'s review for:
    - Conventional oil (200 estimations)
    - Conventional gas (70 estimations)
    - Conventional coal (40 estimations)

(probabilities implicit in the sample)

  - Data from (Mohr & Evans 2015) for:
    - Unconventional oil (low, best guess, high)
    - Unconventional gas (low, best guess, high)

  (critical literature review)

(Probabilities assigned by "expert guess")

  - Data from (NEA 2012) for uranium

2- Design of the experiment

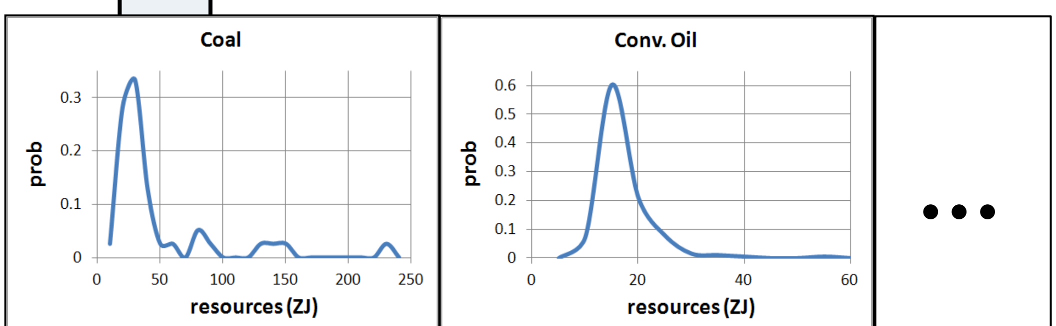
Baseline scenarios (no additional climate policies!)

GCAM model
(Human activities)

emissions

Uncertainty +
global sensitivity analysis

n= 1,000 scenarios (Montecarlo simulation)
9 uncertain inputs



Fossil URR probability distributions

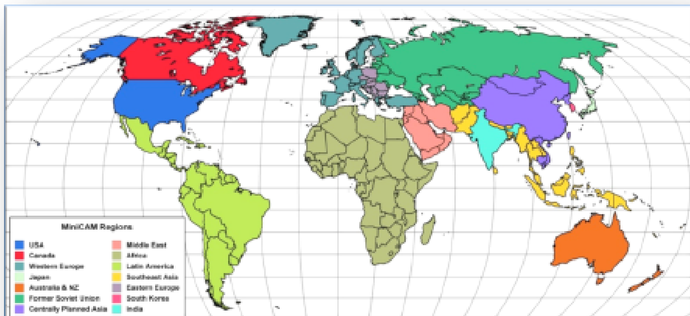
2- Design of the experiment

The Global Change Assessment Model

Pacific Northwest NATIONAL LABORATORY

Proudly Operated by **Battelle** *Since 1965*

14 Region Energy/Economy Model



- GCAM is a **global integrated assessment model**
- GCAM links **Economic**, **Energy**, **Land-use**, and **Climate** systems
- Typically used to examine the effect of technology and policy on the economy, energy system, agriculture and land-use, and climate
- Technology-rich model
- Emissions of 16 greenhouse gases and short-lived species: CO_2, CH_4, N_2O, halocarbons, carbonaceous aerosols, reactive gases, sulfur dioxide.
- Runs through **2095** in **5-year time-steps.**
- Documentation available at: **wiki.umd.edu/gcam**

• Participation on all IPCC reports from 1990 to 2014

• Freely available

http://www.globalchange.umd.edu/models/gcam/download/

3- Results

4- Limitations, conclusions & further research

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• **Main limitation**: Very bad data for some resources (coal and unconventional fuels). On the light on the "best" current information:

• Confirmation of the **need of urgent global action** *(> carbon-budget)*
• **Current baseline scenarios from IPCC assessments might be incompatible with resource constraints**
• **Coal uncertainty** dominates
• Likely **transition to renewable energies before the end of the century** even without climate/promotion policies
• **Policy implications**:
  • Need to increase resources to assess the availability of fossil fuels?
  • Less pressure to keep in the ground the "unburnable" fossil fuels?
  • Prioritize R&D for renewables?

• **Further research**: climate uncertainties & policy scenarios.

Thank you -

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