

Unconventional Gas:

A review of estimates

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Outline

Project Background

Systematic review

Resource definitions

Estimates of unconventional gas

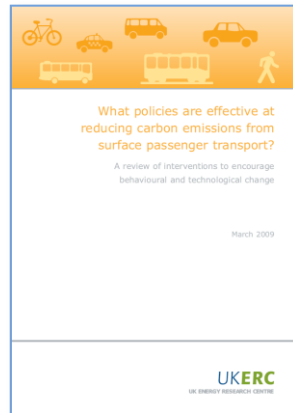
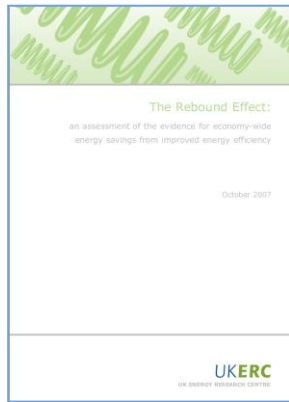
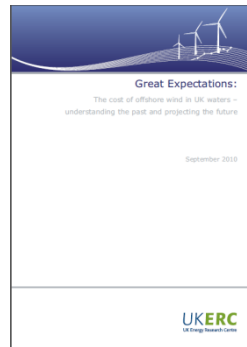
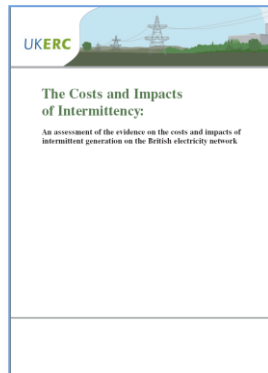
- Shale gas
 - Global, North America, Europe, China
- Other unconventional gas: Tight Gas and Coal Bed Methane (CBM)

Estimates in context

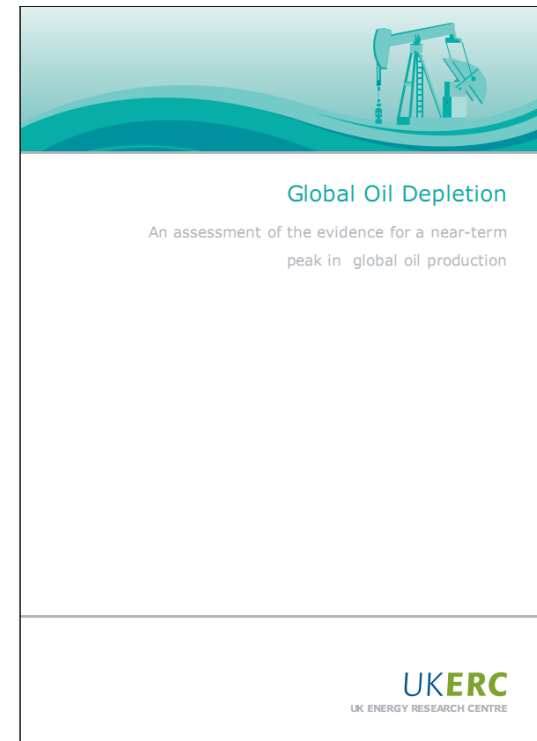
Conclusions

Project Background

Technology and Policy Assessment



Global Oil Depletion



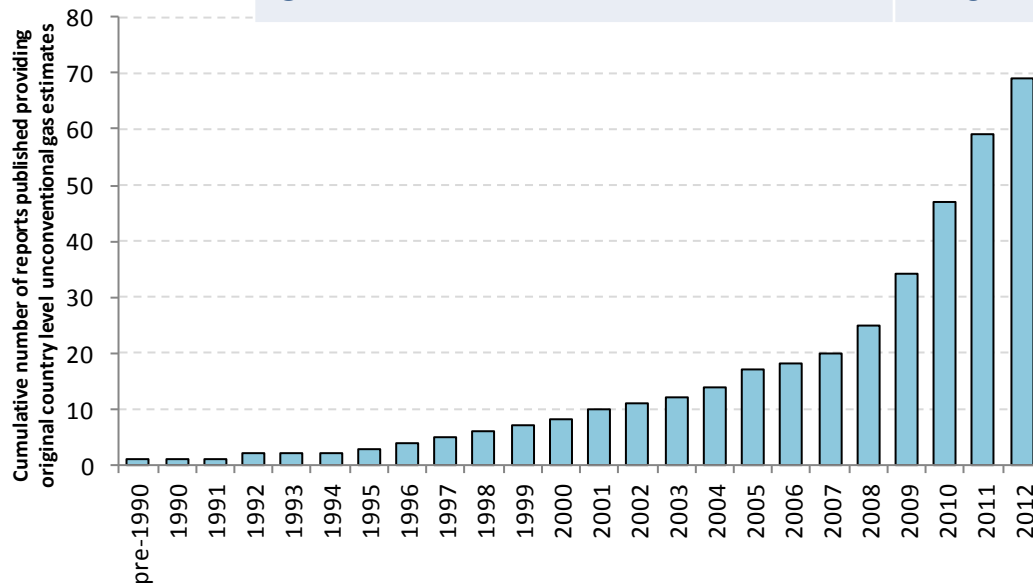
Project background (cont.)



- Draft project proposal cited GOD
- Systematic review of resource estimates
- Contribute to wider piece

Systematic review

Number of Papers	
Original Estimates Total	69
Since 2007	49
US and Canada	56
Shale Gas	62
Tight gas	~30
CBM	~40



Resource Definitions

Important to define resource classifications :

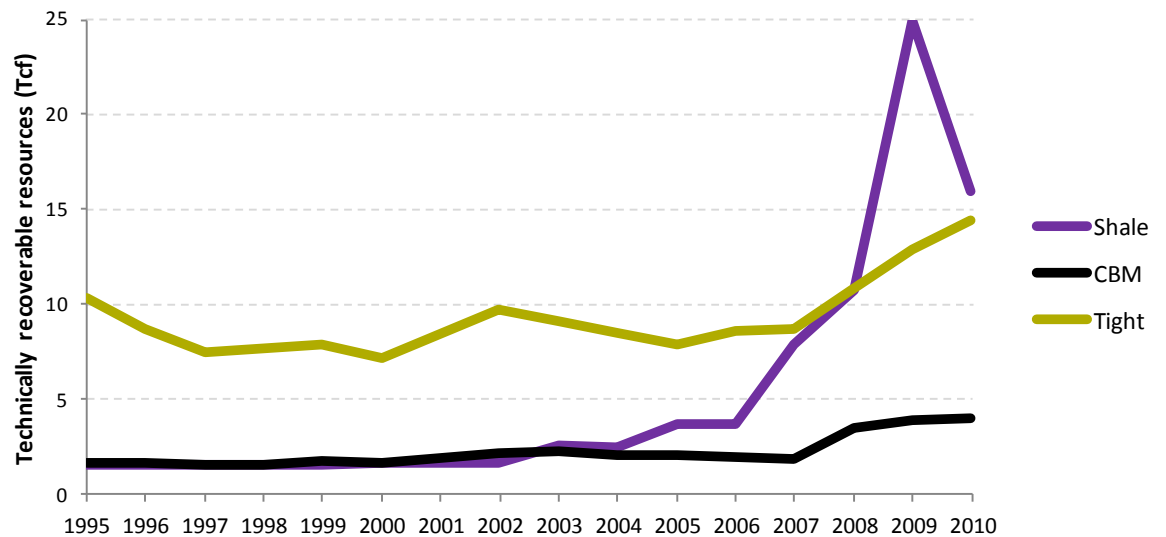
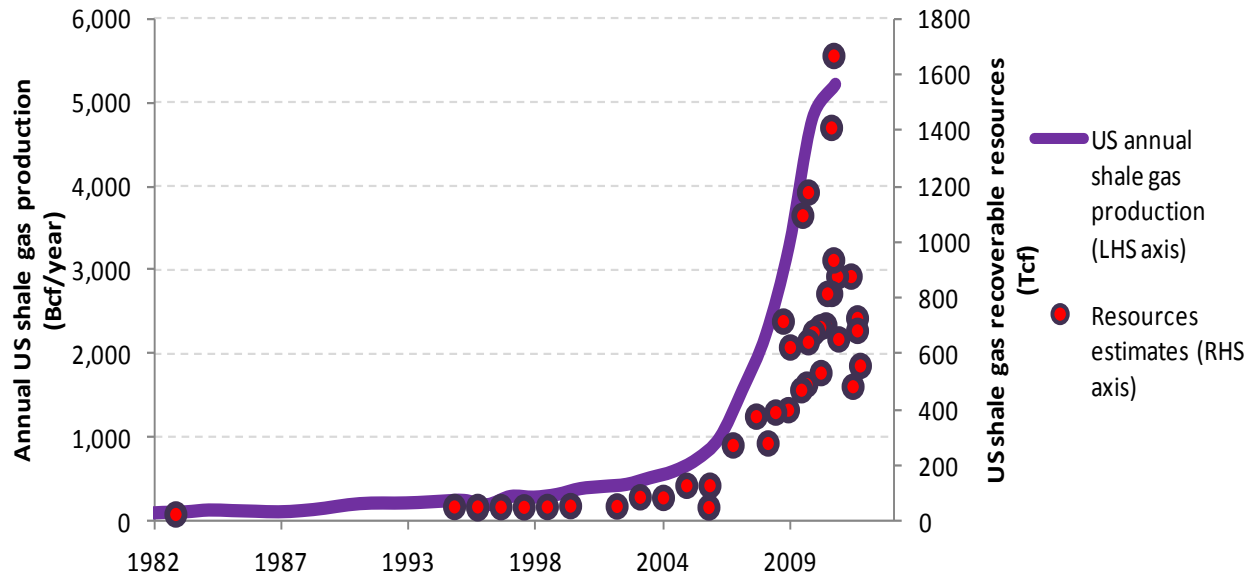
- To avoid comparing apples and oranges
- To provide context of relative certainty of production

			Ultimately recoverable resources				
			Discovered			Undiscovered	
Feasible with current technology	Commercial	Cumulative production					
			Proved	Probable	Possible		
			Reserves				
Sub-commercial			Economically recoverable resources				
			Technically recoverable resources				
Infeasible with current technology							
Infeasible with current technology							

Resource Definitions (cont.)

Name	Short description	Includes gas in undiscovered formations	Includes gas not economically recoverable with current technology	Includes gas that is not recoverable with current technology	Includes gas that is not expected to become recoverable
Original gas in place	Total volume present	✓	✓	✓	✓
Ultimately recoverable resources	Total volume recoverable over all time	✓	✓	✓	
Technically recoverable resources	Recoverable with current technology	✓	✓		
Economically recoverable resources	Economically recoverable with current technology	✓			
1P/2P/3P reserves	Specific probability of being produced				

Resource Estimates



Global Shale Gas

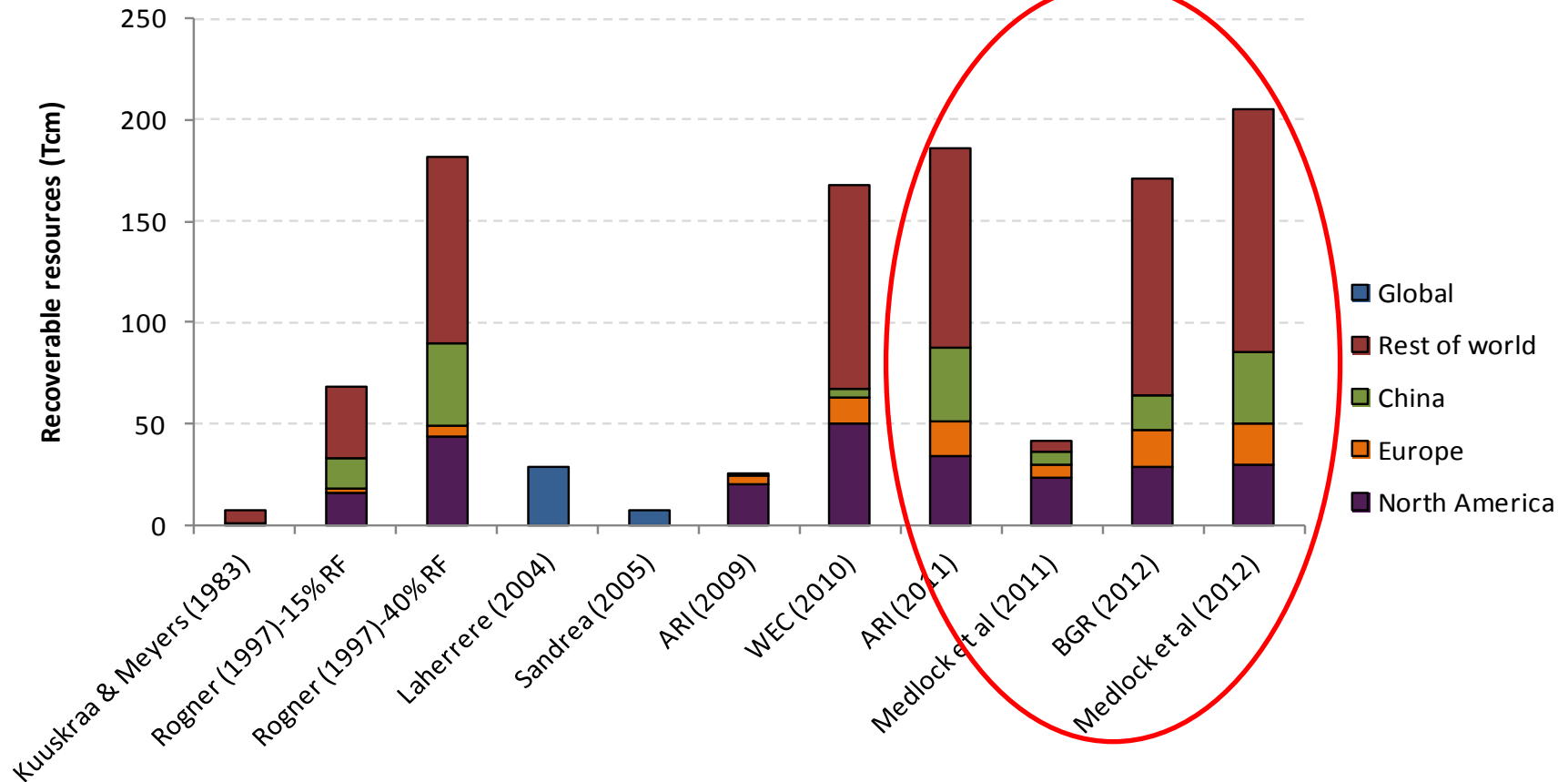
Rogner (1997)

- Only OGIP
- Many authors then apply recovery factor of 15-40%
- Compare with conventional recovery of 70-80%
- Uses single US analogue to calculate all world regions
- Basis of nearly all estimates outside North America till 2009

Region	Original shale gas in place (Tcm)
North America	108.3
Latin America and the Caribbean	59.7
Western Europe	14.4
Central and Eastern Europe	1.1
Former Soviet Union	17.7
Middle East & North Africa	71.8
Sub-Saharan Africa	7.7
Centrally Planned Asia & China	99.4
South Asia	65.2
Other Pacific Asia	8.8
Pacific OECD	0
Total	454.1

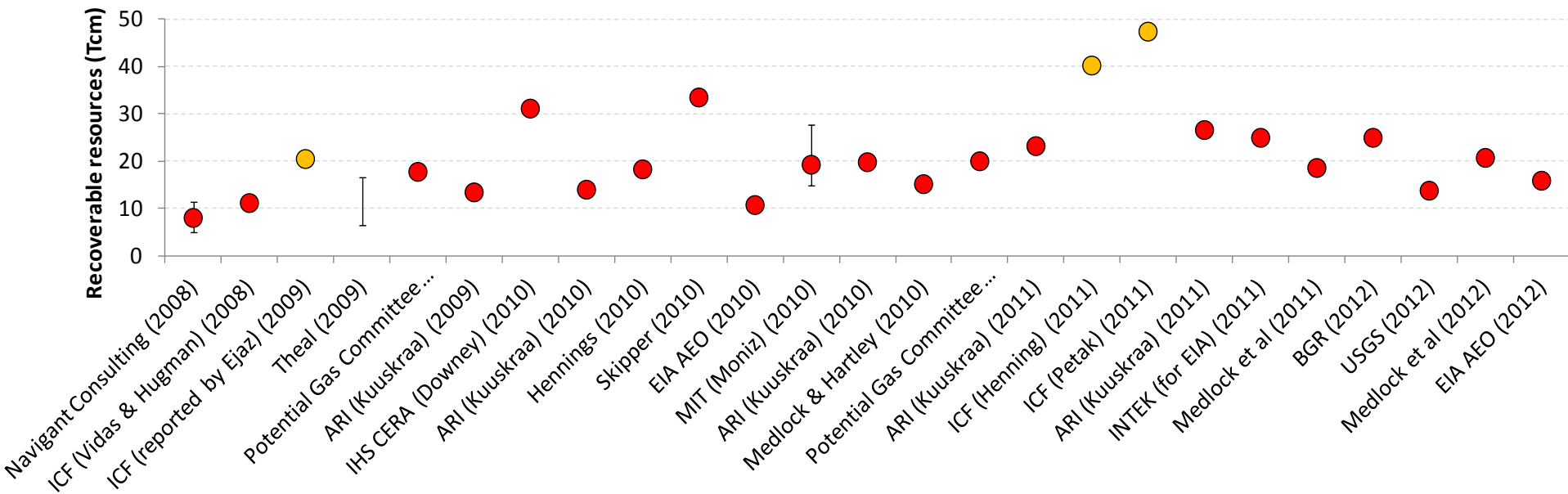
Global Shale Gas (cont.)

~40-200Tcm TRR



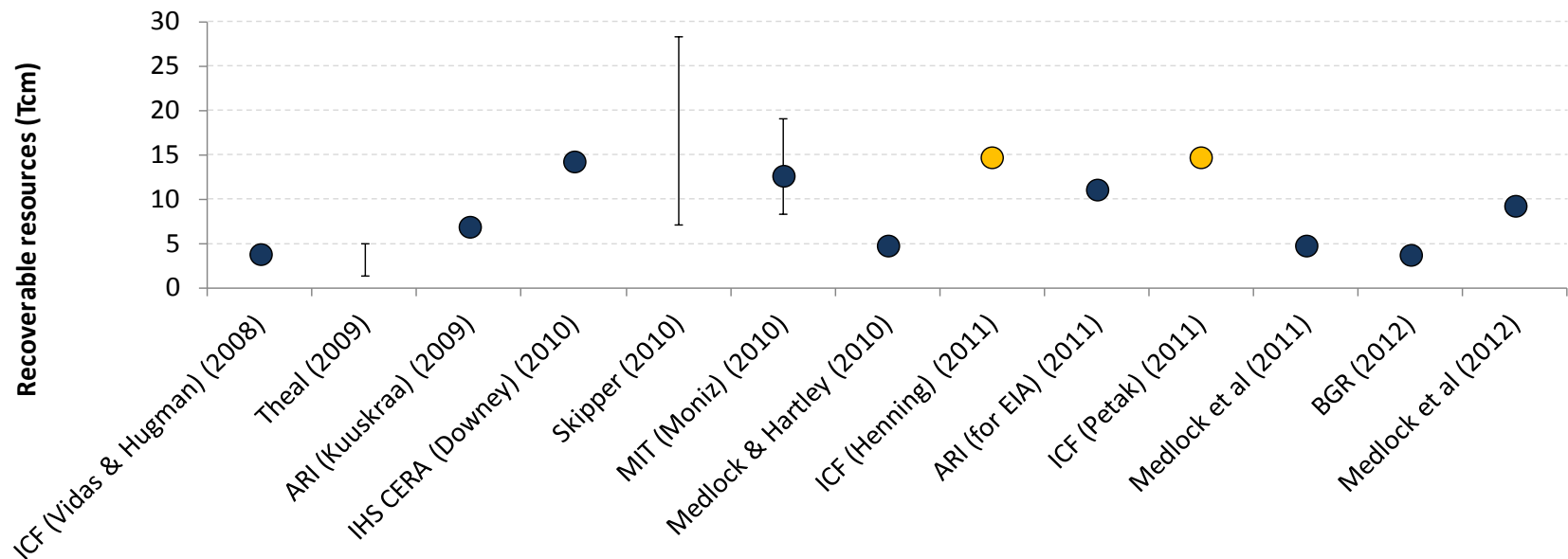
North American Shale Gas (US)

- Intuitively has most evidence (~50%)
- 25 most recent studies
- Very few ranges provided despite uncertainty
- Range ~5-50Tcm
- Yellow dots ERR
- However ICF probably more like TRR (\$14/Mcf)



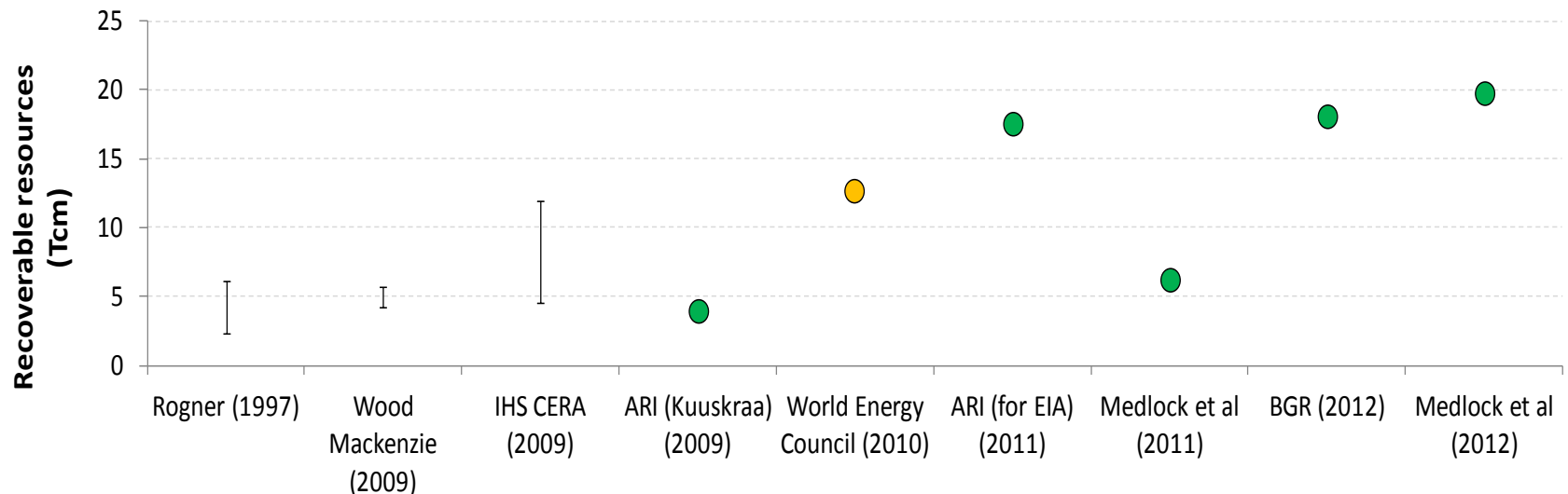
North American Shale Gas (Canada)

- 13 most recent studies
- Again few ranges
- Range 4 Tcm – 28 Tcm
- Again yellow indicates TRR
- Again we consider ICF to be equivalent to TRR



European Shale Gas

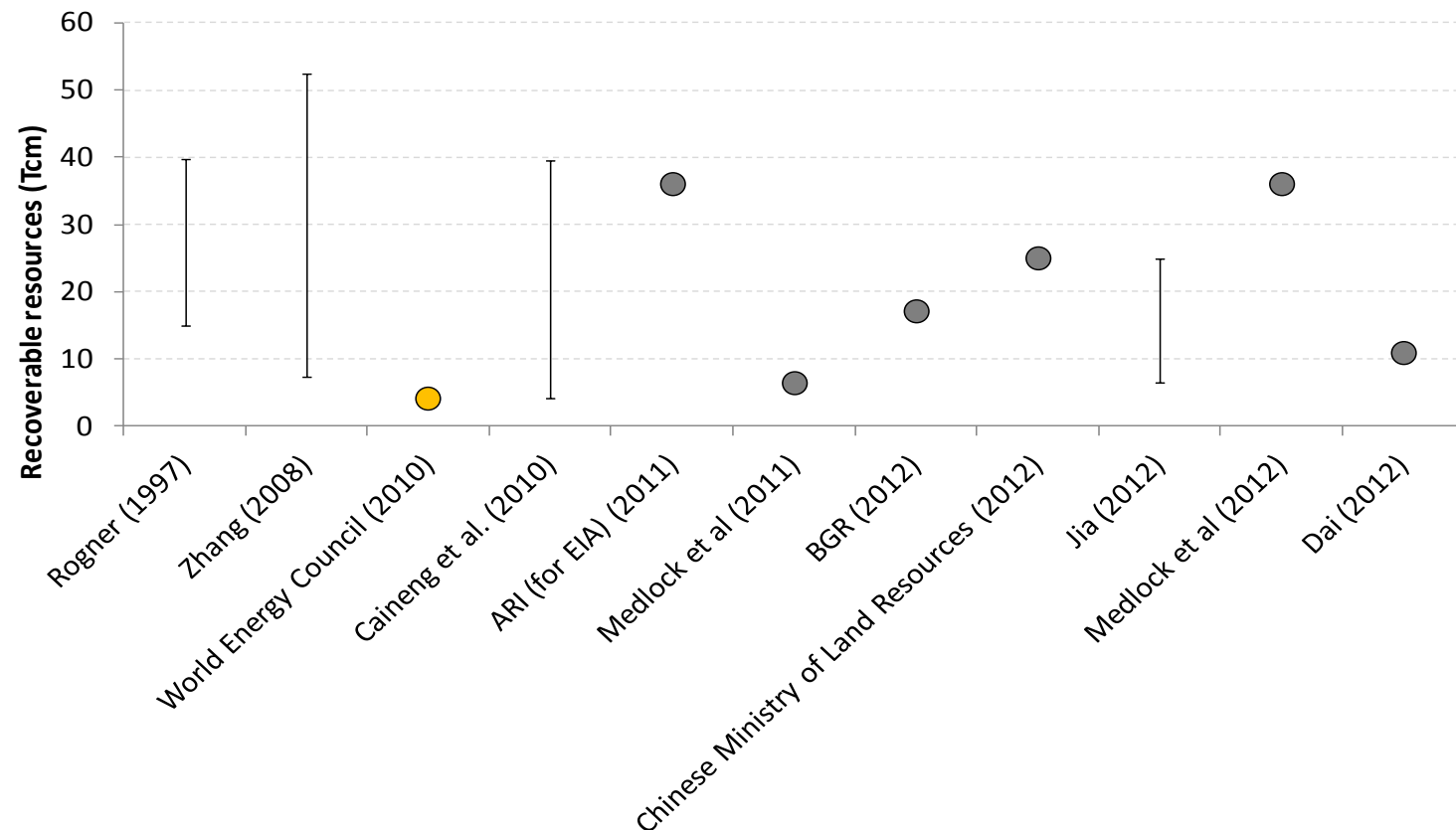
- Fewer studies than for North America
- Range of estimates ~2- 20Tcm
- Mean 10.6Tcm



Note: The range for Rogner's estimate is derived using a 15 – 40% recovery factor within Western and Eastern Europe. Values for Wood Mackenzie and IHS CERA come from Weijermars et al.

China Shale Gas

- Increasing number of reports in recent times
- Medlock (2011) considers water constraints
- Variation larger than Europe and North America
- From <5 - >50Tcm



Other Unconventional Gas (Tight Gas)

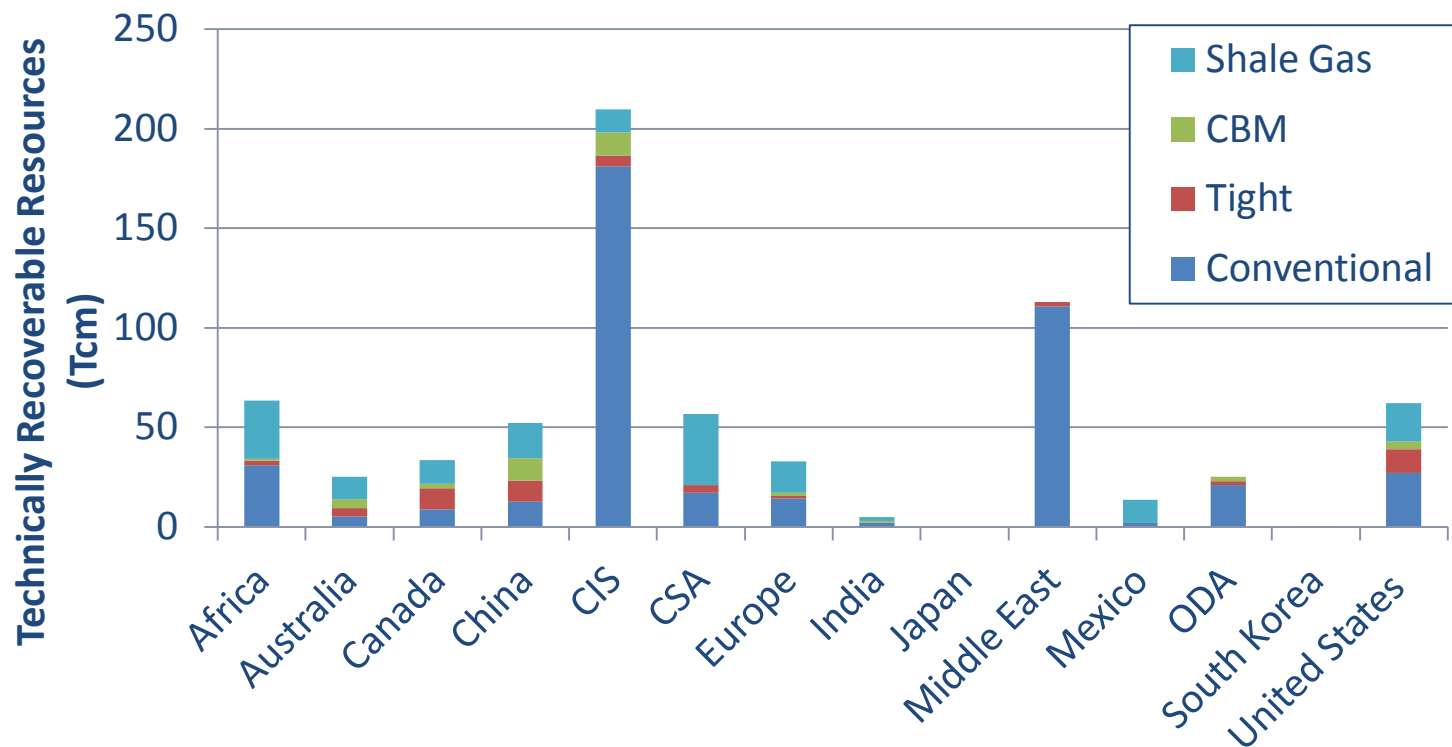
- Is tight gas conventional? Permeability or technology?
- Fewer studies of tight gas
- Assumed recovery factors 6–65%
- Best estimate ~50Tcm TRR

Global tight gas resource estimates		
Report	OGIP (Tcm)	TRR (Tcm)
Rogner (1997)	215	
Kuuskraa & Meyers (1983)	85	
Total (2006)	310 – 510	20 - 50
BGR (2009)		46

Other Unconventional Gas (CBM)

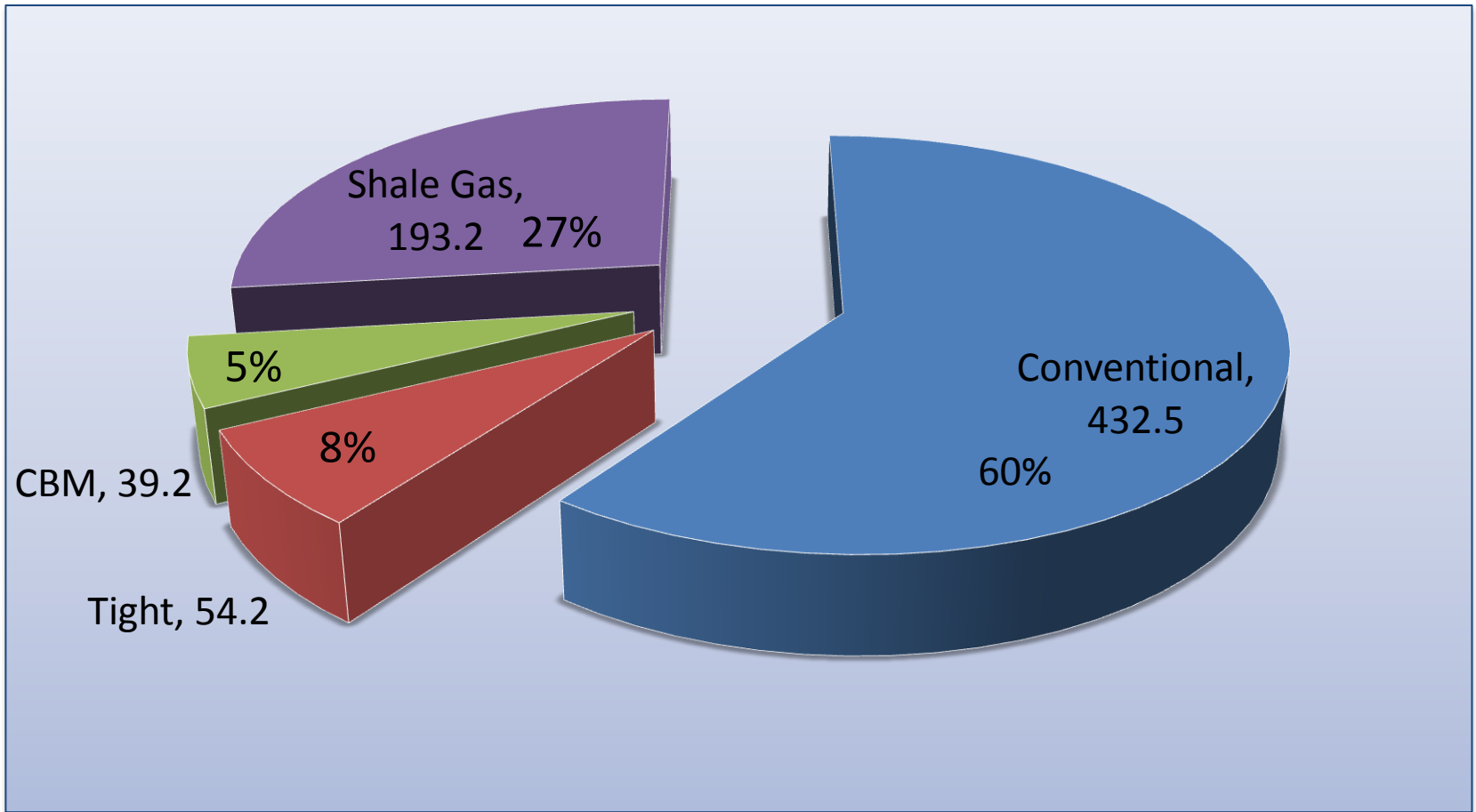
- Also small and incomplete evidence for CBM
- CBM usually considered unconventional
- Resource estimates relatively consistent over time
- Best estimate ~40Tm
- Majority in China and CIS

Estimates in Context



Notes: CSA = Central and South America, CIS = Commonwealth of Independent States, ODA = Other Developing Asia

Estimates in Context (cont.)



Conclusions

Uncertainty

- Some regions not studied
- Use of inaccurate analogues

Best Evidence for US

- But still uncertain with wide ranges

CBM and Tight Gas need more study

- Both have very poor evidence base

Unconventional might be 40% of global gas resource

Future work

- Paper based on JRC work looking at methods
- Submission to DECC consultation on the impacts of shale gas for the UK
- Potential paper looking at tight gas estimates in more detail

Thank You!

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