CARBON CAPTURE AND STORAGE

International Energy Agency

The role of CO_2-EOR in ongoing and future IEA analysis

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Outcomes of CO_2-EOR analysis

1. A clear understanding of the global potential for CO_2-EOR to contribute to emissions reductions
2. Identification of unique considerations that need to be addressed to achieve emissions reductions
3. Identification and understanding of gaps and barriers that prevent development of projects
4. Sound recommendations for member countries to enable CO_2-EOR as climate policy option

This is work in progress. Your thoughts and suggestions are welcome.

Emissions from CO_2-EOR by parts

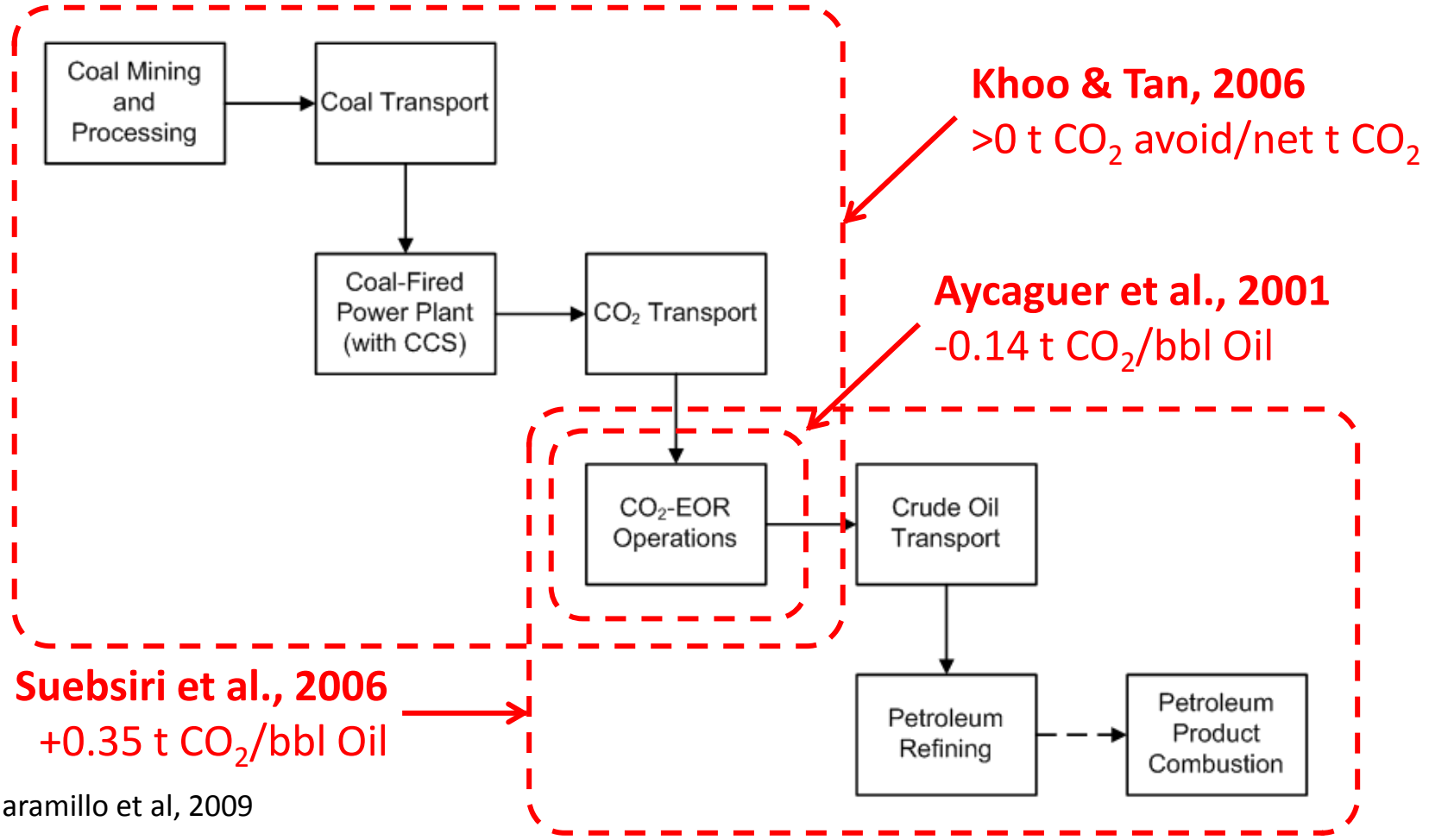
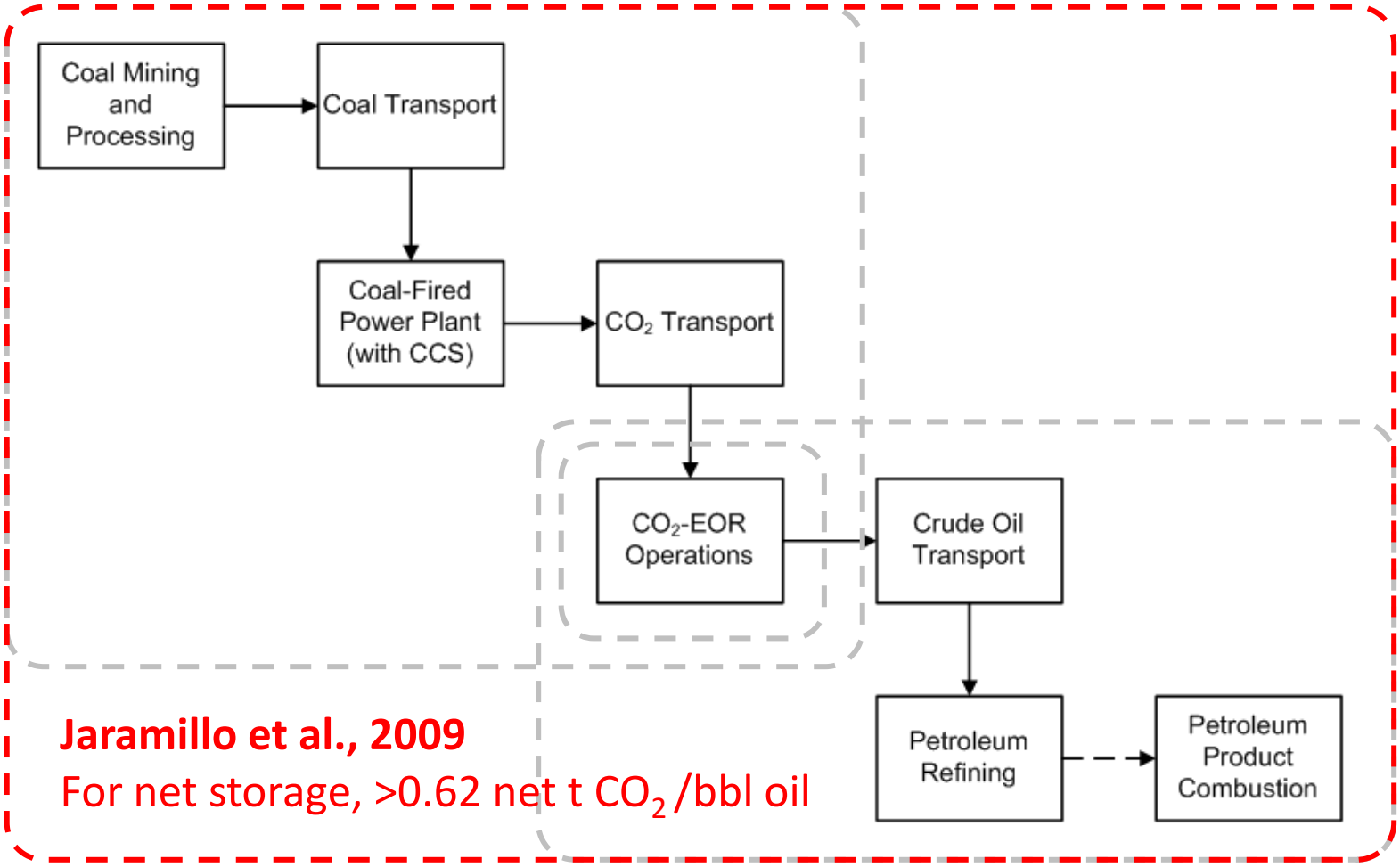


Figure: Jaramillo et al, 2009

Cradle-to-grave emissions from CO_2-EOR



Emissions reductions through displacement

Marginal Barrel Displaced (kg CO_2e/bbl)	Marginal Generation Displaced (kg CO_2e/MWh)	Emissions Reduction Efficiency			
		Project 1	Project 2	Project 3	Project 4
Current Average Consumption-USA (529)	Current Average Generation-USA (652)	71%	68%	70%	73%
Canadian In-Situ SCO (600)	Uncontrolled IGCC (894)	140%	128%	137%	145%
	NGCC (425)	87%	75%	83%	92%
Saudi Arabian Light (521)	Uncontrolled IGCC (894)	94%	92%	93%	95%
	NGCC (425)	41%	38%	40%	42%
	Carbon-free Electricity (0)	-8%	-10%	-8%	-7%

McCoy et al, 2010

Important observations from past life-cycle assessment research

1. Emissions **depend on boundaries**:
   a) Including emissions from oil production makes business-as-usual (BAU) CO_2-EOR a net emitter
   b) Changes to design and operation of BAU CO_2-EOR could decrease the CO_2 footprint
2. **If** energy-related emissions that **would otherwise be produced** from an equivalent system are displaced, CO_2-EOR reduces emissions
3. Emissions reduction efficiency is **a function of energy displacement and CO_2 utilization**
   a) Displacement of CO_2-intensive power and oil results in a larger emissions reduction than would otherwise occur

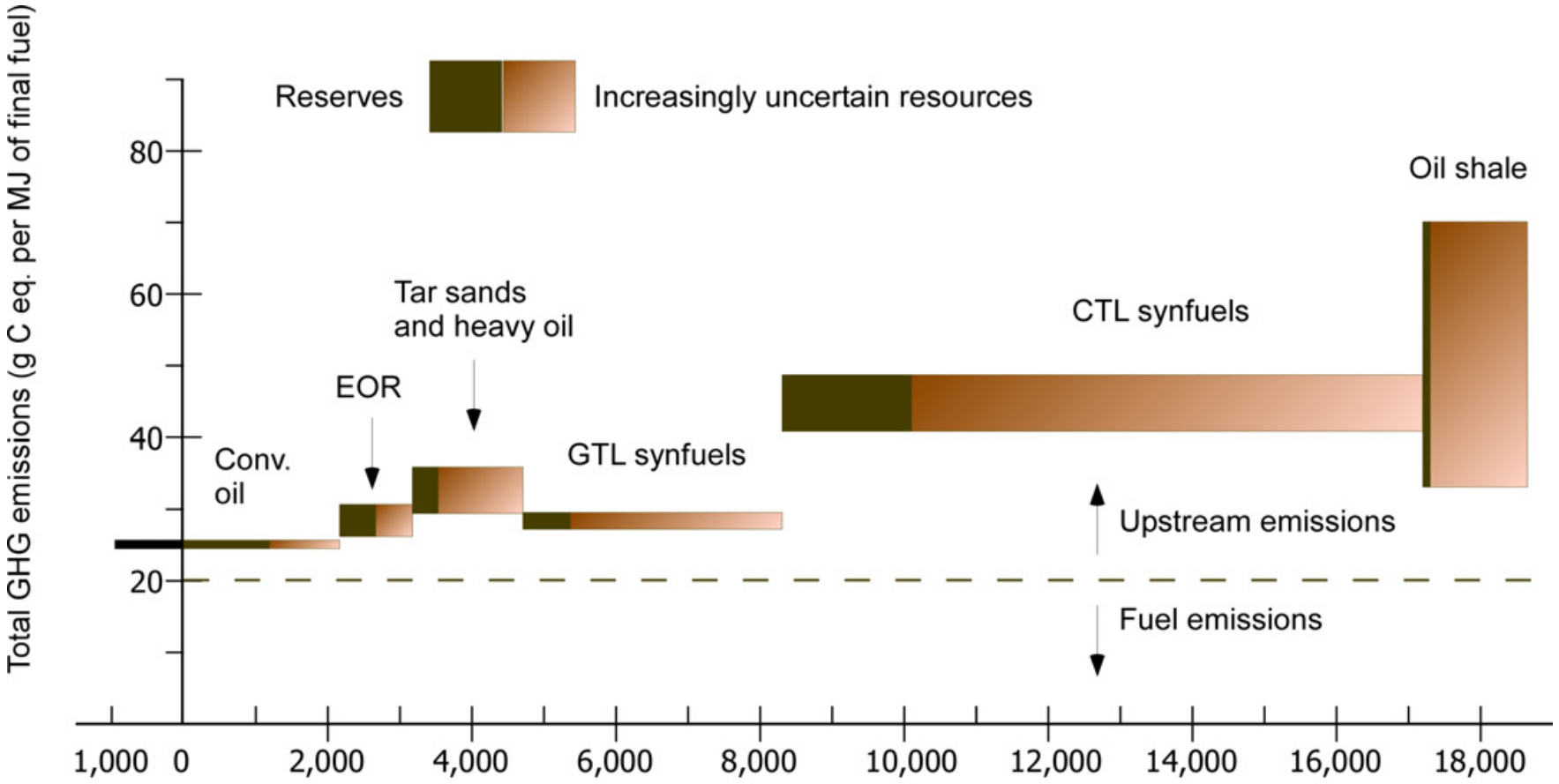
Attributes of CO_2-EOR operations necessary for qualification as storage

Technical Modifications	Energy Policy	Climate Policy
• Increase net CO_2 utilization through changes to design and operation (?) • Monitoring, measurement, and verification of similar stringency to that applied to saline aquifers • Abandonment to ensure long-term retention of stored CO_2	• Law and regulation to enable CO_2-EOR as a oil recovery process • Regulation to ensure that CO_2-EOR is undertaken safely for humans and the environment	• Measurable emissions reduction goals and accompanying policy • Laws and regulation enabling CO_2-EOR as climate change mitigation option • Accounting rules that accurately award credit for emissions avoided

Unique policy considerations for CO_2-EOR

- Without the right energy and climate policies, displaced emissions may not remain displaced
- Large-scale uptake will link oil and carbon markets in a new way. Could changes in CO_2 supply impact oil prices?
- Under certain combinations of climate policy, CO_2-EOR could shift emissions from power to transport
- Increasing supplies of conventional oil in the near- to medium-term could prevent a move up the carbon supply curve in the long-term

The carbon supply curve and its implications



Farrell & Brandt, 2006

Barriers to private investment in CO_2-EOR

BAU CO2-EOR	CO_2-EOR for Climate Change Mitigation
• Low valued investment option in IOC portfolios • Lack of low cost CO_2 for injection in many places • Competition with other EOR processes • Mismatch in business cases for capture versus injection	• Those for BAU CO_2-EOR, PLUS: • No return on additional cost for storage • Cost for monitoring, measurement, and verification • Cost for ensuring long-term containment

Can incentive policies address these issues?

If so, how?

Funding mechanism for CO_2-EOR as climate change?

- Under the Clean Development Mechanism (CDM) difficult issues have to be addressed relating to life-cycle emissions:
  - Baseline
  - Additionality
  - Project boundaries
- How will EOR figure into post-Kyoto mechanisms: e.g., NAMAs
- Technology specific multilateral funding vehicles: e.g., ADB-World Bank fund.

International Energy Agency

From issues to actions at the IEA: possible next steps