CHALLENGES IN SHALE GAS DEVELOPMENT IN EUROPE

Yvonne Schavemaker, TNO

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GAS IS FASTEST GROWING ENERGY SOURCE



LARGE PART IS EXPECTED FROM UNCONVENTIONAL HYDROCARBONS



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WHY ARE UNCONVENTIONAL HC IMPORTANT TO THE EU?

- > The European Commission's Energy Roadmap 2050
 - > gas is critical fuel for transition to low-carbon energy system
 - Gas replacing oil and coal can reduce CO2 emissions
 - > Gas has a permanent role in future energy mix besides CCS
- > EU will become more dependent on energy imports in the future
- Europe will be affected by shale gas activities, also when these play a role in the rest of the world



EIA UNCONVENTIONAL GAS IN EUROPE



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RESOURCE ESTIMATES CHALLENGES

- Huge variety in estimates
- Different methodologies
- > Different input parameters
- Large uncertainties
- > GIP vs PGIP

But all resource estimates say there might be <u>considerable</u> <u>amounts</u> of hydrocarbons present.



McGlad et al, 2013



PUBLIC RESISTANCE





SHALE GAS MORATORIA IN EUROPE



Source: The Economist, February 2nd 2013

ARGUMENT MAP SHALE GAS PRODUCTION IN EU MEMBER STATES



their contribution

to legislation

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EU REACTION TO SHALE GAS DEBATE

- > January 2014 EU published:
 - * minimum principles for the exploration and production of hydrocarbons (such as shale gas) using high-volume hydraulic fracturing"
 - Complementary to EU legislation and MS legislation
 - Plan carefully, assess all environmental and community risk thoroughly, inform the public well, ensure best practices
- July 2014 European Science and Technology Network on unconventional hydrocarbon extraction



CHALLENGES ON PUBLIC PERCEPTION OF RISKS

- Risks vs perceived risks
 - Need for clear technical knowledge base
- > Challenges on communication, dissemination, transparency and education
- > Use lessons learned from implementations of other new technologies
- > e.g. CO2 storage
 - Learning history approach resulted in:
 - > Clear and steady leadership
 - No predetermined results
 - No timeconstraint on decision making
 - (decision) process should be transparant and clear





CONCERNS AND CHALLENGES ON HF



Note: The possible environmental hazards discussed in the text are shown with red arrows. Although the figure illustrates a shale gas well with multi-stage hydraulic fracturing, some similar hazards are present with conventional gas wells, and with tight gas developments.



ECONOMIC CHALLENGES

- > Will it still be profitable?
 - > Suffering from a low oil price?
 - Additional research
 - > (Baseline) monitoring
 - > environmental impact studies
 - Longer trajectories licence applications
 - Implement innovative technologies

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COLLABORATIVE RESEARCH

- > European Energy Research Alliance Joint Program Shale Gas
- Horizon 2020
 - Measuring, monitoring, mitigating & managing the environmental impact of shale gas
- > TKI Upstream Gas consortium





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OBJECTIVES EERA JP SHALE GAS

- > Share results of national initiatives on R&D on Shale Gas development
- > Align EU research on shale gas exploration and production
- > Address specific European issues which are different from US experiences
- > Share experimental facilities and numerical tools
- Annual Knowledge sharing meetings
- > Bi-Annual SP meetings



Research inventory of shale gas literature in European countries

H2020 ENVIRONMENTAL IMPACT OF SHALE GAS DEVELOPMENT

To provide scientific recommendations for minimizing the environmental footprint of shale gas exploration and exploitation in Europe.

- > 4 year program coordinated by TNO
- > 18 excellent EU RTO's and Universities
- Independent and transparant
- > External Advisory Board, incl. USGS, NRC, ARI, GERG
- Industry experience in Industry Panel
- > 2,5y program 3M€ funding

SP1: Hydraulic fracturing, induced seismicity and well integrity SP2: Water, soil & well site activities

- SP3: Impact on air & global climate
- SP4: Impact on public & stakeholders

SP5: Integration & dissemination

First deliverable (Dec 2015):

 Report on review of best practices in US and Canada

NAFTY I GAZU

G F 7

Helmholtz-Zentrum

POTSDAM







TKI – UPSTREAM GAS

- National consortium of operators to achieve ambition of Netherlands on hydrocarbon exploration and production
- > ~2 M€/y (50% government)
- Coordination: TNO
- > 2012-ongoing
- Partners from Industry, SME, University and RTO's









E	Mature fields	New Fields	Tough Gas
P			
	Exploration & F	ield Development	
	Production & R	eservoir Management	
	Infrastructure		
	HSE & reliable of	operations	
	Hardware (Sens	ing, Actuation, Comp	ression)
	Societal Impact	and Human Capital	



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TOUGH GAS LINE PROJECTS

- Sweet spot identification & reservoir characterization
- for life GDF JVez ebn wintershall Innovative water management & green fraccing fluids GDF SVez **NO** innovation for life ebn wintershal Clay swelling & fines migration **D** innovation for life ebn wintershal
- Field case for fraccing & optimized tough gas production ATPO
- **NWO MVI public acceptance shale gas**
- Tectonics, stress, fractures and productivity

TUD, TUE, UU



wintersha

Netherlands Organisation for Scientific Rese

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SWEET SPOT DETERMINATION PROJECT

- TOC is governed by out-of-control primary production (flocculent blizzard), rather than intensity of anoxia
- > prospectivity not in deepest of the basin, but in proximal zones adjacent to the paleo-



GOT IA, Perth 2015

coastline



UPFRONT OPTIMIZATION OF WELL PLACEMENT AND FRAC JOBS



Example: Posidonia shale gas play, the Netherlands

 Outcome: Scenarios for optimum gas production and reduction of production costs (less wells/fracs)

Workflow:

- (1) Area selection in gas shale
- (2) Natural fractures and stress field from 3D seismic survey
- (3) Geological model from seismics + well data
- (4) Reservoir characterization from seismic attributes
- (5) Modelling of optimum placement of horizontal wells and frac jobs







ALTERNATIVES TO FRACCING?

- Modelling productivity of innovative configurations of needle or radial wells
 - > Innovation to harder rocks, applicable in coals and limestone
- Conclusions show comparible results with hydraulic fracturing





SUMMARY

- > Gas is a recognized fuel in a low carbon energy system by the EU
- Resource estimates are uncertain but promiss considerable amounts
- Public resistance
 - Need for better communication
 - Learning for other technologies
- R&D efforts
 - International networks EERA/H2020
 - National programs TKI

THANK YOU

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