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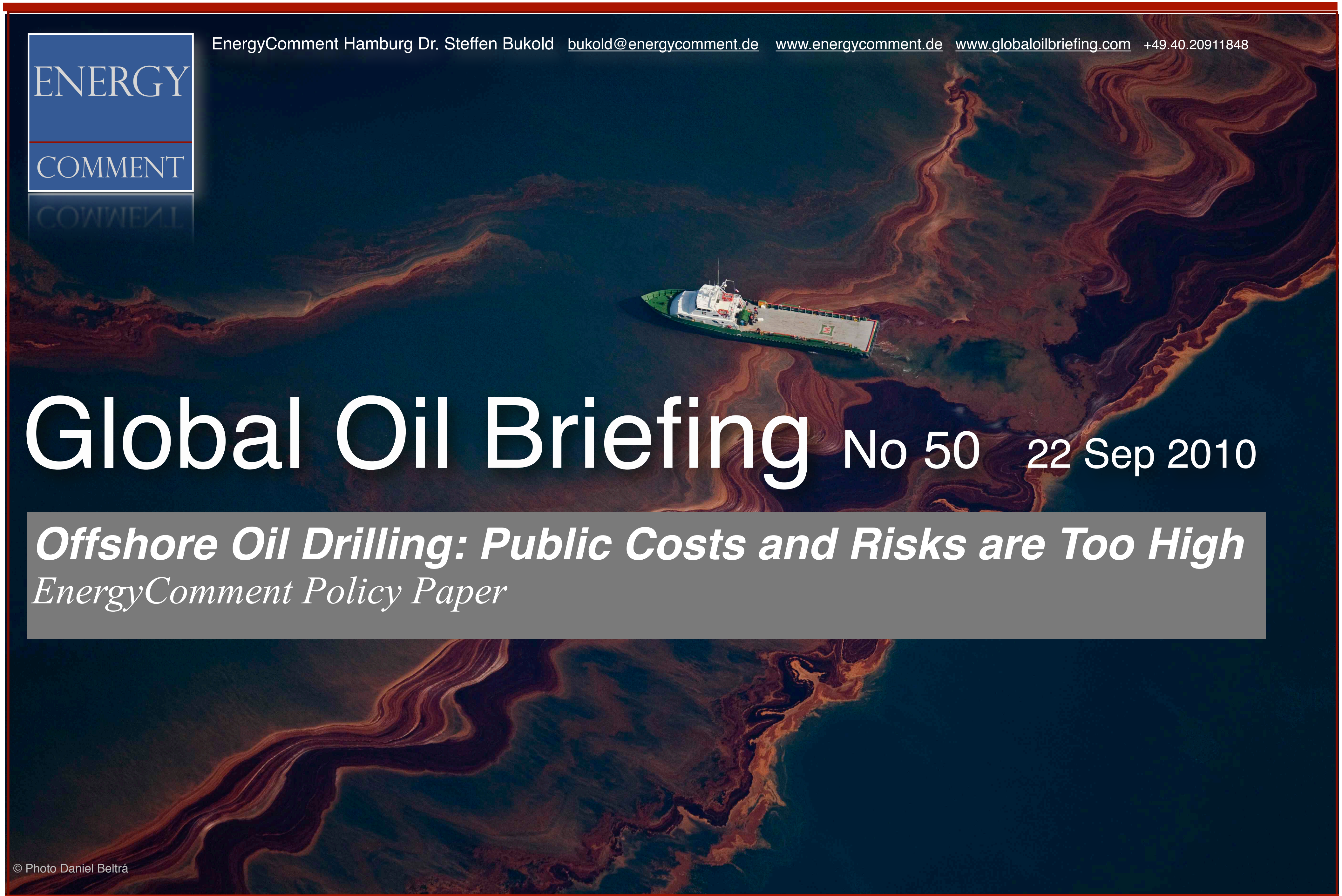

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Offshore Oil Drilling: Public Costs and Risks are Too High

EnergyComment Policy Paper

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An EnergyComment Policy Paper

by Dr Steffen Bukold, Director

1. Introduction

As the 20 April 2010 blowout at the Macondo well in the Gulf of Mexico (Deepwater Horizon) illustrated, with 11 workers killed, 17 others injured, and an oil spill of approximately 5 million barrels of oil, the public risks of offshore oil are not justifiable.

The "Macondo Incident" represents the largest environmental disaster in U.S. history and, globally, the most severe since Chernobyl. In relatively close proximity to, arguably, some of the world's most advanced technical offshore oil resources, safe control of the well was achieved only five months later, after experimenting with various procedures and processes for the first time in these circumstances.

The reality is that even with close access to the best resources in the industry the public risks of offshore oil are fundamentally unsupportable. That the fundamental risks of offshore oil eclipse lower risk opportunities to secure energy security and sustainable economic renewal via investing in climate responsible, non-nuclear, renewables.

The U.S. government placed a 6 month ban on new deepwater drilling after the Deepwater Horizon explosion,[1] while other governments are debating similar steps as deepwater oil drilling is on the rise in many regions of the world, including the North Sea and North Atlantic, without a comprehensive, transparent analysis of the inherent risks.[2]

[1] The definition of "deepwater" varies between studies and over time; it is commonly applied to water depths below 200m or to water depths below 400 to 600m. IHS Cera used the 600 feet (approx.180m) threshold to define global deepwater discoveries and the 2000 feet mark (approx. 600m) for deepwater production. IHS Cera 2010. The Role of Deepwater Production in Global Oil Supply, Cambridge (Mass.). Press Release 30th June 2010.

The Macondo tragedy set off a worldwide discussion about offshore oil and deepwater oil in particular. What are the costs and benefits in terms of environmental risks, climate change, economics and energy security?

An integrated examination, including externalized costs, supports better environmental, economic, security and climate responsible alternative energy paths via responsible renewables. To prevent a misallocation of enormous amounts of capital into new offshore oil, investment decisions need to be initiated now for the long-term benefits.

Offshore oil is inherently risky, with increasing risks of technical and procedural failures in complex deepwater operating environments and the industry's inability to effectively control oil spills. An integrated approach needs to include:

- Hostile operating environments amplifying risks of technical failures
- Climate change costs due to the combustion of fossil oil must be internalized
- Opportunity costs of higher job creation in renewable energy industries
- Higher long-term energy costs as fossil fuel prices are rising and clean energy prices are falling
- The strategic cost of fossil oil exploration reaches an impasse in the face of peak oil and depleted "cheap oil"
- Long-term energy security unattainable due to unpredictable offshore oil supply disruptions

This brief concludes that a ban on <u>all</u> new offshore oil drilling is justified as the risks are too high relative to the rewards.

[2] To name only a few recent activities and events in the North Sea and North Atlantic: The Cladhan oil find in 498m water depth, exploratory drilling in the Norwegian Sea (Dalsnuten in 1450m water depth) and off Greenland´s west coast (Baffin Bay exploratory drilling); recent drilling in the Orphan Basin off Newfoundland took place in water depth of 2600m, 1000m deeper than BP´s ill-fated Macondo well.

Summary Table: Offshore oil is increasingly complex and unacceptably risky

RISK FACTOR	INHERENT OFFSHORE OIL RISKS
1. TECHNICAL OPERATING RISKS	
Spill response	The necessary response to effectively control offshore spills exceed the industry's technical capability/capacity, creating an unlimited public liability to balance an unacceptable risk
Rigs / Drillships	Weather and distances to coastal support facilities increase the risks of rig accidents
Blowout preventers (BOP)	Deepwater blowout preventers are not reliable; malfunctions in high-pressure environment create large blowout and spill risks Repairs of BOPs take considerably more time or are not feasible in deepwater Thicker drill pipes in deepwater restrict BOP effectiveness; operational requirements prevent BOP deployment in some drilling/casing phases
Multiple geological issues	High-pressured oil/gas reservoirs and complex geology create higher drilling and casing risks and imply the permanent risk of well con-trol loss Overpressured shallow sediments are prone to uncontrolled gas flows Extreme pressures and pressure differentials as well as extreme temperatures and temperature differentials imply risk of malfunction of drilling and cementing systems Human diving not possible in deepwater, delaying any response to technical failures
Drilling / Mud Circulation	Drilling trade-off between losing (expensive) circulation materials and risking a blowout; narrow margin between pore and frac pres-sures in deepwater; lost circulation during drilling or cement placement affects well control Stability of fluid hydrostatic pressure during drilling more difficult to maintain in deepwater; increased danger of "kicks", i.e. high-pressured gas and oil entering the wellbore and rising towards the seabed High-pressure drilling and fracs may may lead to seafloor instability, resulting in loss of drive pipe, conductor, or the well Increasingly long risers may leak or become disconnected, resulting in a lower hydrostatic pressure Shallow gas flows may destabilize near-wellbore formations and compromise BOP and riser integrity

RISK FACTOR	INHERENT OFFSHORE OIL RISKS
Cementing / Gas Hydrates	Growing temperature and pressure differentials in deepsea increase risk of occurrence or generation of gas hydrates Creation of gas hydrates due to cement hydration; quality of cementing may suffer from shallow saltwater flows Hydrates may become unstable in connection with cement jobs in deepwater environments that contain major hydrate zones. Formation of these hydrates represents a major blowout hazard Formation of gas hydrates may plug blowout preventer
Regulatory and oversight failure	Authorities not adequately trained or equipped to monitor deepwater acitivities; trade-offs between prescriptive and performance-based regulatory approaches in deepwater
Complexity of processes and fast new technology deployment	New mega-platforms for ultra-deepwater notoriously fail to achieve performance targets; production ramp-ups encounter more and more unexpected problems Largely untested technology employed for exploitation of largely unknown deepwater geological structures Time and cost pressures prevent industry standardization and long-term testing or standardization
Human failure in complex environments	Extreme time/cost pressure and high complexity of deepwater drilling requires fast, yet critical decisions with potentially irreversible consequences
Combination of weak elements	BP report of Macondo spill demonstrates that a large number of failures/mistakes can occur at the same time leading to a rapid loss of well integrity (including loss of hydrostatic control, failure of blowout preventer, cement issues).
Weather Risks	Unpredictable severe weather, strong currents send rigs adrift; anchor slippage damages oil and gas pipelines
Arctic drilling	No adequate spill or technical failure response possible in any Arctic water depth; risks of Arctic oil exploration not acceptable
2. CLIMATE RISKS	
GHG budget	Any new offshore oil production undermines GHG objectives. Large capital streams „sink“ in long-term deepwater projects and cement an energy path which is based on GHG-intensive fossil fuels. Remaining fossil options are risky (deepwater, Arctic oil) or dirty (oil sands, extra-heavy oil, oil shale, coal liquefaction). Global warming policies require measures that lead to short-term stabilization and mid-term reduction of oil consumption. In this context, new deepwater drilling is not only too costly but actually dispensable.

RISK FACTOR	INHERENT OFFSHORE OIL RISKS
3. ECONOMIC RISKS	
End of "cheap oil"	Oil exploration and production costs rise; technical challenges produce exponential cost increases and project delays. Opportunity costs climb year by year
Reserves and production potential modest	Deepwater oil reserves and production potential are very limited. Number of promising deepwater oil regions is small. Known deepsea reserves represent just 7-8% of "proved" global oil reserves. Once deepwater fields are developed, very steep decline of production volumes sets on. Deepwater is not a long-term solution to oil scarcity. Global ultra-deepwater wells (>1500m) contribute only about 1% to global oil supplies. Massive oil spare capacities equal total deepwater production (> 600m water depth, approx. 5 mb/d) and exceed ultra-deepwater production (approx. 1 mb/d) by far. Total GoM ultra-deepwater reserves could not even meet U.S. oil demand for one year.
Marginal oil cost	Marginal offshore oil production cost to climb soon beyond the $85-95/b level. In the wake of Deepwater Horizon, cost of deepsea drilling and operation will rise even faster due to insurance costs, more regulation/oversight and higher investor demands.
Opportunity cost	Opportunity costs would mount if society continues to follow the path of deepwater investment. Increased investment in renewable energy or energy efficiency could replace the most expensive fuel by the least expensive. Reduction in oil demand could be achieved in more sustainable and less costly ways such as higher car efficiency or a reduction of crude/fuel oil combustion for power generation.
Job creation	Deepwater drilling is a capital-intensive industry. Replacing it by the build-up of job-intensive regenerative energy industries could provide an additional benefit to economies and societies.
4. ENERGY SECURITY RISKS	
Deepwater oil reduces energy security	U.S. deepwater supplies have been more often and more severely disrupted than U.S. oil imports. Arctic offshore supplies would be even less secure. While responsible renewable energy sources offer long-term energy security.
Peak oil	As climate policies make a non-fossil energy path indispensable, oil scarcity will make it inevitable. Stepping up deepwater investment in the face of climate change, unsolved safety issues and peak oil create unacceptable public risks.

2. Inherent Risk of Failure

As business opportunities in major OPEC countries are limited and as onshore fields in most other countries are exhausted, oil companies have increasingly chosen to focus on high risk deepwater deposits. The public has been left with the high risks of unlimited liability whereas governments and companies have decided to neglect investments in responsible energy sources such as offshore wind parks or geothermal energy.

Outside of OPEC, most of the expected oil discoveries will be made in deeper and deeper waters, requiring ever more complex equipment. The Gulf of Mexico is a case in point. The peak in US onshore production triggered a move of oil exploration into shallow waters, which peaked a few years later in the 1990s. Standard deepwater production has already peaked. Now, ultra deepwater (>1500m water depth) and its even higher risks are rapidly expanding.[3]

The oil industry is now targeting drilling projects in more than 3000m water depth, with untested risk assessments.

The inherent risk[4] of deepwater oil drilling and oil production are illustrated by the BP Macondo (Deepwater Horizon) disaster. It is an obvious lesson of the BP spill that the scope of drilling activities has outstripped powers to remedy system malfunctions. Therefore, granting new drilling licences can not be justified based on the industries capacity/capability to operate safely.

[3] Even before the Deepwater Horizon spill, 532,000 barrels have been spilled in US federal offshore waters. Society of Petroleum Enegineers. 2010. SPE Notes - FAQs on Deepwater Drilling. 6th July 2010.
http://www.spe.org/notes/2010/07/faqs-on-deepwater-drilling-gulf-spill

[4] Earlier studies by MMS (now BOEMRE) show surprisingly high probabilities of oil spills; in the case of the Beaufort Sea, studies concluded a 1:5 probability of major oil spills over the lifetime of drilling leases.
Cheryl M. Anderson C., Johnson W., Marshall C. & Lear, E. (Ed.). U.S. Department of the Interior. Minerals Management Service Environmental Division. Revised Oil-Spill Risk Analysis: Beaufort Sea Outer Continental Shelf Lease Sale 170. OCS Report MMS 97-0039. November 1997.

Drilling and casing risks

Deepwater drilling is a high risk balancing act of extracting high-pressured gas and oil resources, far below the seafloor, via an increasingly complex drilling system. The challenges that increase with depth, such as pressure and pressure differentials that need to be contained by the technical infrastructure, high temperatures and large temperature differences that may generate gas hydrates and complicate cementing processes, can not be reliably performed at the quality level necessary to avoid all accidents.

The global Society of Petroleum Engineerings warns: *"There are considerable engineering challenges in working in 5,000 feet of water, in the dark, using robotic vehicles. The water at that depth is about 40°F, and the water pressure is enough to crush a submarine. There is a flow of high pressure oil and gas to contend with and extremely high reservoir pressures, which make controlling the flow difficult."*[5] Downhole pressure in the oil-rich Lower Tertiary strata of the GOM may exceed 20,000 psi (138 MPa) and the temperature will exceed 200°C. As it is difficult to meet both pressure and temperature requirements at the same time, equipment needs to redesigned.[6]

Uncontrolled flows have led to total well loss in several cases: *"The presence of overpressured shallow sediments in the deep-water GoM has led to numerous drilling and cementing problems. These overpressured zones are prone to uncontrolled flows of massive amounts of saltwater or gas, especially after cementing operations. Uncontrolled flows from such sands have led to total loss of the well in several cases. Cold temperatures at these depths have an adverse effect on fluid viscosity and setting time for cement, and increase the tendency of gas hydrates to be created as a result of cement hydration and the presence of shallow gas. A narrow margin also exists between pore and frac pressures, resulting in lost returns during cement operations."..."Cementing operations take longer in deep water, and rig time represents a significant expense....Many of the required hydraulic*

[5] Society of Petroleum Enegineers 2010. SPE Notes - FAQs on Deepwater Drilling. 6th July 2010.
http://www.spe.org/notes/2010/07/faqs-on-deepwater-drilling-gulf-spill

[6] Kulkarni, P. 2010. Lower Tertiary play: Is it Gulf of Mexico's final frontier? Offshore (offshore-mag.com), 1st Jan 2010
http://www.offshore-mag.com/index/article-display/7102345141/articles/offshore/volume-70/issue-1/gulf-of_mexico/lower-tertiary_play.html

and mechanical properties are very difficult to achieve under such conditions. ...Geohazards – shallow saltwater flow and gas hydrates – present the greatest challenge in the deepwater cementing equation...Shallow flow can cause safety and environmental concerns, flow during drilling or cementing that can jeopardize template stability, and lost circulation during drilling or cement placement which affects well control. It can also cause excessive hole washouts that make mud removal difficult, destabilization of near-wellbore formations that compromises the integrity of the BOP and riser, and breakthrough of the seafloor, resulting in loss of drive pipe, conductor, or the well....."[7]

Gas hydrates, solids physically resembling ice and consisting of water and gases, are particularly dangerous. Hydrates may become unstable in connection with cement jobs in deepwater environments that contain major hydrate zones. Any gas release is a challenge for safety: *"One unit of gas hydrate is the equivalent of 170 units of gas, and the formation of these hydrates represents a major blowout hazard. In the GoM, they exist near the seabed where destabilization is an issue, and shallow gas can form in the well and in the pipes. Gas hydrates can destabilize as a result of heat generated from the drill fluid or during cement hydration. During cementation, contributing factors to the creation of gas hydrates include the total heat released during the hydration process, heat flow, and dissipation flow. Formation of gas hydrates plugs of the BOP choke and kill lines, dehydrates drill fluids or cement, and overloads of gas separation equipment."*[8]

In summary, the inherent risks associated with all offshore oil production grow ever greater as water depth increases and new, largely untested and unproven technology are employed for the exploitation of largely unknown geological structures including, in some cases, unstable, fluid salt layers and gas hydrate layers, which may compromise the cementing processes or affect well control (e.g. Deepwater Horizon).

[7] Kolstad, E. (Anadarko Petroleum), Mozill, G. & Flores J. (Schlumberger) 2004. Deepwater isolation, shallow-water flow hazards test cement in Marco Polo. Offshore, January 2004, p.76.
[8] Kolstad, E. (Anadarko Petroleum), Mozill, G. & Flores J. (Schlumberger) 2004. Deepwater isolation, shallow-water flow hazards test cement in Marco Polo. Offshore, January 2004, p.78.

Also, ever deeper reservoirs often feature very low safety margins in the drilling process due to the small difference between pore pressure and fracture pressure gradients resulting in lost returns during cement operations. *"Drillers must walk a virtual tightrope between losing circulation and risking a blowout." "With total well depths approaching 40,000 ft (12,192 m), the challenges of ultra-high hydrostatic pressure loom. These conditions stress logging instruments to their limit."*[9]

The stability of the fluid hydrostatic pressure during drilling is a critical issue as it is the primary safety barrier. If it drops below that of the formation, a "kick" occurs, i.e, gas and oil enter the wellbore and rise towards the seabed. The geological properties of deep- und ultradeepwater regions make these events more likely. Circulation losses occur more often and less predictably and mud densities may fluctuate. Additionally, extremely long risers may leak or become disconnected, resulting in a lower hydrostatic pressure that can prevent the flow of formation fluids any longer.[10]

It was this combination of specific deepwater conditions that contributed to the Deepwater Horizon blowout. As BP stated in its Investigation Report[11], well integrity collapsed due to a loss of hydrostatic control, followed by the failure of the blowout preventer. The day before, cement had been pumped down the production casing to prevent oil and gas from entering the wellbore from the reservoir. BP assumes that there were weaknesses in cement design and testing. The cement experienced nitrogen breakout and migration, allowing hydrocarbons to enter the wellbore annulus.

[9] Riding, M. (Schlumberger) 2010. Deep in the heart of offshore. Offshore (offshore-mag.com) 1st May 2010. http://www.offshore-mag.com/index/article-display/7865878534/articles/offshore/volume-70/issue-50/departments/beyond-the_horizon/deep-in_the_heart.html
[10] Tahmourpour, F. (Halliburton) 2009. Deepwater Cementing Consideration to Prevent Hydrates Destabilization, AADE Chapter Meeting, Houston.http://www.slideshare.net/firedoglake/halliburton-deepwater-cementing-presentation
[11] BP 2010. Deepwater Horizon Accident Investigation Report. 8th September 2010. http://www.bp.com/sectiongenericarticle.do?categoryId=9034902&contentId=7064891

Each deepwater area can pose specific problems: Complex and uneven salt layers, high-pressure areas, extreme downhole tool pressure etc. pose particular problems in GOM deepwater drilling. Off Brazil, drillers encounter very complex drilling processes, high-viscosity oil, and high circulating temperatures. Development of some large Brazilian pre-salt fields may even become too expensive and too demanding to be economically feasible. In both regions well control challenges are enormous when extreme pressure levels and temperatures and, in some cases, high sulfur levels.[12]

Consequently drilling costs increase exponentially. Notwithstanding higher risks, new approaches endeavour to speed up the drilling process. New rig types, drilling techniques, tools, materials and software are being introduced at a fast unproven pace. This time pressure prevents industry standardization and long-term testing. As deepwater environments can be simulated only to a certain extent, the real-world deployment will inevitably be more risky than expected (e.g. behaviour of gas hydrates, mud slides, interaction between several new technical elements, last-minute adaptations etc.). Most state-of-the-art downhole components are produced in very small quantities and used under varying conditions. Consequently, necessary reliability data series are invariably incomplete.[13]

Oil company managers comment: *"Most of the problems we see in deepwater projects are not those you might generally assume, such as deploying new technology or using an inexperienced workforce. Rather, we are still seeing mistakes made by otherwise experienced personnel or quality issues arising in the subcontractor's manufacturing processes. This leads us to ask the question, 'How are these risks being managed by the parties involved?'* "[14]

[12] Schlumberger 2009. Productive Drilling for Deepwater Wells. Company Paper.
[13] Goldsmith, R.: Deepwater wells - high production, high risk. Offshore (www.offshore-mag.com) 1st March 2005. http://www.offshore-mag.com/index/article-display/223825/articles/offshore/volume-65/issue-3/operations-management-information/deepwater-wells-high-production-high-risk.html
[14] Randall Kubota (Chevron) quoted in: Mazerov, K. 2009: Deepwater trend pushes riks management to forefront. Drilling Contractor 30th October 2009. http://drillingcontractor.org/deepwater-trend-pushes-risk-management-to-forefront-1768

"Fail-safe" blowout preventers fail

The blowout preventer (BOP) is the "parachute of oil drillers". Its reliability decides if a well control crisis, or high winds and strong currents that push away the rig from the well, becomes a catastrophic spill or not. Its potential failure puts the entire safety concept of deepwater drilling into question. In addition to valves it has rams available to shear off the pipe and seal the well in emergency cases.

The safety of this "fail-safe" equipment has been repeatedly called into question, even by MMS experts, without triggering appropiate improvements. Norwegian studies recently arrived at a "failure" rate of 45%.[15] Studies give rich evidence of various reliability problems.[16] General issues with BOPs are exacerbated as water depth rises. The breakdown of a small shuttle valve or minor manipulations or operator mistakes may paralyze the entire five-story high equipment.

Moreover, even in standard deepwater operation, some pipe sections are too thick and too strong to be cut by the BOP. In that case, drilling engineers on the rig have to react quickly to "find" a pipe section that can be handled by the BOP before the gas kick reaches the seabed.[17] Also, in normal drilling/casing operations, there are time periods when the BOP needs to be moved or by-passed so that this barrier is ineffective.

[15] Det Norske Veritas found a BOP failure in 5 out of 11 well control loss cases. Barstow, D., Dood, L., Glanz, J., Saul, S. & Urbina, I. 2010. Regulators failed to Address Risks in Oil Rig Fail-Safe Device. New York Times (www.nytimes.com), 20th June 2010. http://www.nytimes.com/2010/06/21/us/21blowout.html
[16] "We need a fundamental redesign of the blowout preventer," then BP CEO Mr. Hayward was quoted. The NYT report provides a detailed overview of the large number of performance deficiences and near-catastrophes caused by BOPs.Barstow, D., Dood, L., Glanz, J., Saul, S. & Urbina, I. 2010. Regulators failed to Address Risks in Oil Rig Fail-Safe Device. New York Times (www.nytimes.com), 20th June 2010. http://www.nytimes.com/2010/06/21/us/21blowout.html
[17] "Deepwater oil drill record excellent: Chevron", CBC News, 15th June 2010.http://www.cbc.ca/canada/newfoundland-labrador/story/2010/06/15/chevron-deepwater-oil-drill-615.html

The BP Investigation Report [18] of the Deepwater Horizon tragedy details the completely unexpected malfunction of the BOP on the seafloor. It is still unclear and debated, why this most critical piece of offshore safety equipment did not work properly.

Weather risks

Extreme weather conditions, e.g. in the Gulf of Mexico, generate additional risks[19] and amplify inherent risks of operation. E.g. The hurricanes Katrina, Rita and Ivan sent 16 rigs adrift with another nine breaking lines or experiencing anchor slippage. In one case, anchors crossed an oil and a gas pipeline of the Mars production platform. The topsides damages of Mars were even heavier.

Earlier, in 1992, Hurricane Andrew sent the semisubmersible drilling rig Zane Barnes on a 48 km trip. The rig toppled one fixed platform, collided with another and dragged its heavy anchors over several pipelines.

Improvements of mooring requirments at least for minor hurricanes are underway but there are is no final solution possible due to inherent tradeoffs such as the extreme weight of safer mooring lines in very deep waters that would produce other risks for rigs.

Risk of Human Error

The previously-mentioned BP Investigation Report also illustrates the time pressure for critical decisions. Apparently, at least half a dozen safety barriers and a number of experts, who were involved in the decision-process, were unable to stop the blowout and the subsequent gas explosion on the rig. Possibly (a final and unbiased incident report is not yet available), the simple misinterpretation of a few data was enough to generate the largest oil spill in history.[20]

Technical Progress? Not sufficiently safe then, not sufficiently safe now.

It is perplexing to read the story of the other major blowout in the GoM, Ixtoc I, 31 years before the Deepwater Horizon disaster. It occurred in much shallower water, but the major issues (loss of drilling mud circulation, ineffective) and the subsequent solution (drilling relief wells) show up striking similarities to the BP Macondo well blowout. Apparently, the problems and the difficulties to solve them have remained unchanged despite new technologies and new regulation:

"*On June 3, 1979, the 2 mile deep exploratory well, IXTOC I, blew out in the Bahia de Campeche, 600 miles south of Texas in the Gulf of Mexico. The water depth at the wellhead site is about 50 m (164 feet). The IXTOC I was being drilled by the SEDCO 135, a semi-submersible platform on lease to Petroleos Mexicanos (PEMEX). A loss of drilling mud circulation caused the blowout to occur. The oil and gas blowing out of the well ignited, causing the platform to catch fire. The burning platform collapsed into the wellhead area hindering any immediate attempts to control the blowout. PEMEX hired blowout control experts and other spill control experts including Red Adair, Martech International of Houston, and the Mexican diving company, Daivaz. The Martech response included 50 personnel on site, the remotely operated vehicle TREC, and the submersible Pioneer I. The TREC attempted to find a safe approach to the Blowout Preventer (BOP). The approach was complicated by poor visibility and debris on the seafloor including derrick wreckage and 3000 meters of drilling pipe. Divers were eventually able to reach and activate the BOP, but the pressure of the oil and gas*

[18] BP 2010. Deepwater Horizon Accident Investigation Report. 8th September 2010.http://www.bp.com/sectiongenericarticle.do?categoryId=9034902&contentId=7064891

[19] "Making MODUs safer in hurricanes", Offshore (www.offshore-mag.com), 1st May 2009.. http://www.offshore-mag.com/index/article-display/361025/articles/offshore/volume-69/issue-5/drilling-completion/making-modus-safer-in-hurricanes.html
Day, H., Springett C. 2002. Drillship or Semi? The choice is not always clear. Offshore (www.offshore-mag.com), 1st April 2002. http://www.offshore-mag.com/index/article-display/144107/articles/offshore/volume-62/issue-4/news/drillship-or-semibrthe-choice-is-not-always-clear.html

[20] The awareness of unacceptable risks has equally spread to large investor groups. Epicos.com, "Investors Managing $2.5 Trillion Press Energy Companies to Better Disclose Spill Prevention and Response Plans For Deepwater Wells Worldwide. Investors Send Letters to 27 Oil/Gas Companies and 26 Insurance Companies; Seek Responses by Nov. 1. http://www.epicos.com/Portal/Main/Home/Pages/ItemDetails.aspx?wIaopCxX2Y%2BZVNFoJACxA7DMp1qkif5CVSZzO8wUcyNF8V7vLcRsfg%3D%3D

caused the valves to begin rupturing. The BOP was reopened to prevent destroying it. Two relief wells were drilled to relieve pressure from the well to allow response personnel to cap it. Norwegian experts were contracted to bring in skimming equipment and containment booms, and to begin cleanup of the spilled oil. The IXTOC I well continued to spill oil at a rate of 10,000 - 30,000 barrels per day until it was finally capped on March 23, 1980."[21]

And lately, in August 2009, the blowout at the Montara oil rig (Timor Sea) could be plugged only 74 days later and caused a major spill. The size of this oil spill, which took place in only 72m (240 feet) water depth, is considerable. Estimates vary between 28.000 and 200.000 barrels of oil. Four attempts to cap the well failed. Finally, a relief well had to be drilled.[22]

Trends towards complexity

Larger and more expensive mega-platforms notoriously fail to achieve production targets. Production ramp-ups encounter more and more unexpected problems which lead to year-long delays (e.g. Thunderhorse, Mars projects).

Deepwater drilling has become an exceedingly complex enterprise. And the more complex an operation in untested (technical) waters is, the greater the risks.[23] They rise as exploration and production rigs become larger and their locations more remote. Hurrican-related damages, underwater currents or mudslides and natural gas hydrates can damage critical rig infrastructure or the vast subsea industrial facilities.

Economic pressure is high when drilling and production cost rise to several billion dollars and rig costs (6th generation) are close to one billion dollars. And the industry is under permanent pressure to develop new, but unproven, technologies. There is no time for long-term testing although the facilities may stay on the seafloor for decades. Ultradeep platforms like Perdido in the Gulf of Mexico will eventually pump oil simultaneously from 35 wells over the next two decades, all located in deeper water than BP´s Macondo well. The Perdido platform could produce up to 130.000 barrels of oil per day. The deepest well in production in the Gulf — Perdido's Tobago well — lies in 2.900m water depth. One can imagine that oil spills that could not be halted at „routine“ water depths of 1500 meters will be even less controllable at 2900m.

If we add a questionable BOP reliability and rising problems with casing/cementing to this equation, as well as the use of hardly tested new software and hardware components, lax oversight and profit-oriented time pressure, the risks are unacceptable.

2.1 Adequate, large-scale response systems are non-existent

The lack of adequate response measures after the Macondo (Deepwater Horizon) blowout has exposed that the oil industry is not prepared to prevent or contain major spills. Moreover, deepwater spill response systems amplify an already unacceptable risk level via considerably more complex and demanding operating enviroments.[24]

The development of a new response system for the GOM, as announced by four oil majors, would require at least 18 months, but critically, this new response system will be as unproven as the previous system which the industry and government regulators insisted was "sufficient" prior to the Deepwater Horizon disaster . Similar systems for other regions such as Alaska are also unproven and would take even more time as the challenges there are even bigger.[25]

[21] NOAA Emergency Response Division. IXTOC I - 1979-June-03. http://www.incidentnews.gov/incident/6250

[22] Australian Government - Department of Sustainability, Environment, Water, Population and Communities. 2009. Montara Oil Spill. http://www.environment.gov.au/coasts/oilspill.html
Bradsher, K. 2010. Relief Well Was Used to Halt Australian Spill. New York Times (nytimes.com), 2nd May 2010.
http://www.nytimes.com/2010/05/03/us/03montara.html

[23] "Our ability to manage risks hasn't caught up with our ability to explore and produce in deep water," said Edward C. Chow, a former industry executive who is now a senior fellow at the Center for Strategic and International Studies. Mouawad, J., Meier, B. 2010. More Sophisticated Rigs Drill Deeper Still for Oil. New York Times (nytimes.com), 20th August 2010.
http://www.nytimes.com/2010/08/30/business/energy-environment/30deep.html

[24] Reed, M. et al. 2008. Deepwater Blowouts. SINTEF Trondheim (Norway).

[25] IOSC 2008. Assessment of Oil Spill Response Capabilities. A Proposed International Guide for Oil Spill Response Planning and Readiness Assessments. International Oil Spill Conference 2008.

About 3000 ships were involved in fighting the impact of the Gulf of Mexico oil spill. In more remote regions of the world, crisis management would have been even much slower. Response systems for deepwater activities off West Africa are not considered adequate to fight any major oil spill.[26]

In the North Sea/North Atlantic regions, systems have been improved in the wake of the Piper Alpha rig explosion[27], but these systems remain unproven, while risk conditions in new deepwater leases such as West of Shetlands, are amplified via extreme weather conditions and deeper waters. Offshore oil activities constitute an increasingly unacceptable threat to marine ecology as well as fishery and tourism industries of all littoral states.

As the potential spill size increases in GOM deepwater drilling, today´s development approaches amplify the scale of accident outcomes[28] as they permit higher production rates than in the past, reaching as much as 15-20,000 b/d of oil, or an "open flow potential" of 100,000 b/d in the case of well control loss. In that case, a relief well that takes many months or, in extreme ultra-deepwater, more than a year, is the only reliable spill response measure.

2.2. Regulation and oversight failure

The Macondo blowout (Deepwater Horizon) and oil spill have prompted a worldwide review of industry practices and regulatory structures. The incident revealed major problems in oversight and regulation. As a consequence, the Obama Administration has halted drilling in waters deeper than 150m. Reports by the U.S. Interior Department and others demonstrated the hair-raising deficiencies of regulative bodies responsible for the U.S. Gulf of Mexico oil industry.[29] Regulators appeared overworked, undertrained and had too close ties to the oil industry. In June 2010, Interior's acting inspector general, Mary Kendall, explained before Congress that the bureau had only 60 inspectors for the Gulf region to cover nearly 4,000 facilities. The 30-day time limit established under the 2005 U.S. Energy Policy Act for responding to drilling permit applications is clearly not a responsible way to deal with deepwater drilling risks.

Regulators appeared unable to understand the risks of deepwater operations due to the lack of training and information. They relied heavily on the oil and gas industry's standards and information for their own regulations. These deficiencies, which may be even more serious in other deepwater areas of the world, require a top-to-bottom review of offshore procedures, from operations to emergency response systems. Critically, the high reliance on massive oil revenues in some regions of the world results in an inherently imbalanced regulatory environment that underweights environmental and safety priorities.

Moreover, the fast pace of deepwater frontier activites puts further all oversight approaches into question:[30]

The US regulatory approach uses "prescriptive regulations" specifying the lowest acceptable safety standard, leaving regulatory agencies to confirm compliance and set specific rules. This implies a shared responsibility between authorities and operators. This approach has clearly failed as the GOM spill demonstrates.

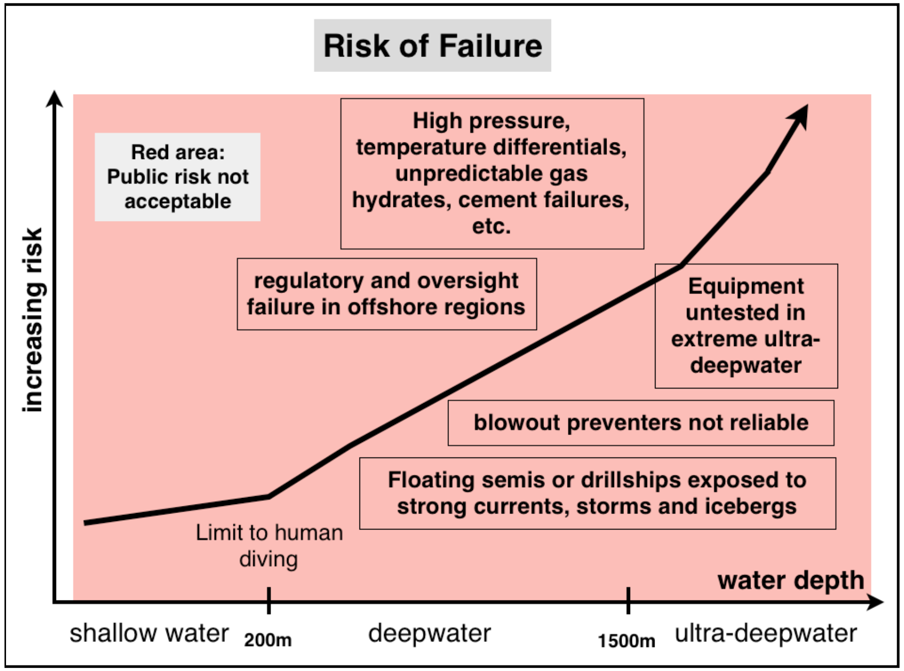
The Norwegian and U.K. approach is based on reviews of safety cases for individual projects. Regulations are performance-based, shifting the choice of how to ensure the best safety approach to operators. This risk-based

[26] Salt, D. 2008. Response Requirements for the West African Region - A New Paradigm? Technical Papers, IOSC 2008.
[27] In 1988, 167 men died in the explosion of that offshore rig. Paté-Cornell, M. 1993. Learning from the Piper Alpha Accident. Risk Analysis Vol.13 No.2 1993, pp. 215-232.
[28] Riding, M. (Schlumberger) 2010. Deep in the heart of offshore. Offshore (offshore-mag.com) 1st May 2010. http://www.offshore-mag.com/index/article-display/7865878534/articles/offshore/volume-70/issue-50/departments/beyond-the_horizon/deep-in_the_heart.html

[29] Lewis, W., Kendall, M., Suh, R. 2010. U.S. Department of the Interior. Outer Continental Shelf Safety Oversight Board. Report to Secretary of the Interior Ken Salazar. 1st September 2010.
[30] Dittrick, P. 2010. Principles of safety policy under review after oil spill. Oil & Gas Journal, 20th September 2010. The Norwegian (DNV) position paper that compares U.S. and Norwegian approaches:Andreassen, E., Bjerager, P., Pitblado, R., Tørstad, E. 2010. An effective US offshore safety regime. DNV Norway.

approach may be more demanding for operators, who cannot hide behind outdated legal minimum requirements, but its individual approach puts even higher burden on the quality and training of oversight staff. Also, it is ultimately prone to a private-sector definition of "acceptable risk". Here, again, the issue of public risk and unlimited public liability of major oil spills remains unsolved and unacceptable.

The lack of effective oversight amplifys the risk that operators/contractors will repeatedly take unacceptable chances. In that case, it is just a matter of time until „Black Swan"-events occur. A halt to deepwater drilling would give governments time to determine what must be done to ensure acceptable risk levels and, subsequently, best practices across the industry.



2.3 Arctic Drilling

Deepwater and Arctic regions are the two frontier regions of oil exploration. The combination of deep water and remote Arctic locations lamplifies environmental risk to unprecedented levels.

Drifting icebergs, extremely hostile weather, long-distance logistics and limited seasonal windows for major activities produce a nightmare for any large-scale spill, fire or blowout response. Small icebergs may be towed out of the way but in the case of larger ones approaching, the rigs themselves need to be moved. Global warming makes the situation even less predictable. In some Arctic regions large-scale operations can only take place between July and October, i.e. most of the year oil leaks would gusher unhindered as ship operation is blocked by thick ice. Additionally, there are no large-scale methods to recover oil trapped underneath ice.

The Arctic ecology is especially fragile and already under pressure from warming seas. Low temperatures and lack of sunlight aggravate the impact of oil spills and delay oil degradation. There are still major ecological damages due to the Exxon Valdez tanker accident which occurred more than 20 years ago.[31]

Under these circumstances, a halt to all offshore oil drilling in the region appears imperative.

2.4 Energy Security Risks

Offshore oil is not a solution to energy security. Indeed, new investments in offshore oil can only delay long-term solutions to energy security via responsible, non-nuclear, renewables.

[31] As to the impact of oil spills on the Arctic ecology: Mosbech, A. (ed.) 2002. National Environmental Research Institute. Ministry of the Environment Denmark. Potential environmental impacts of oil spills in Greenland - An assessment of information status and research needs. NERI Technical Report No. 415.

3. Climate Change

Climate policies require the reduction of GHG emissions by 80% before 2050. To limit the extent of global warming, all countries need to allocate their remaining GHG budgets in the most effective way. This effort demands the optimum employment of capital and a swift re-orientation of energy supplies.[32] The cost of transition, from the old energy paradigm of fossil fuels to the opportunities of economic renewal of responsible renewables, increase over time, as climate change will not wait for political indecision.

High-cost, high-risk oil exploration is clearly not the best way to achieve this objective. Large capital streams „sink“ in long-term offshore oil projects and cement an energy path which is based on GHG-intensive fossil fuels. As the era of „cheap oil“ is definitely over, the remaining fossil options are risky (deepwater, Arctic oil) or dirty (oil sands, extra-heavy oil, oil shale, coal liquefaction).

An ever-expanding fossil fuel consumption produced in ever more hazardous ways is not the answer to future energy supply challenges. It would be more advisable to redirect the capital into clean energy supplies or energy efficiency projects. The sooner the re-orientation, the smoother the transition to sustainable energy systems. Demand sectors need signals as early as possible in order to adapt to new supply systems. Every dollar, pound or euro we spend on high risk/high cost offshore oil would reduce investments in renewable energy and jeopardize agreed GHG emissions targets.

The IEA (International Energy Agency) and other institutions predict an ever-increasing demand for fossil fuels if energy policies remain unchanged. This would imply a vast number of additional deepwater and ultra-deepwater drillings. Yet the resulting GHG emissions would only accelerate global warming and make subsequent adaptation processes more costly. The threshold of two degrees of global warming requires measures that lead to a short-term stabilization and mid-term reduction of oil consumption. In this context, any new offshore drilling may not only be costly but dispensable.

[32] Greenpeace International, European Renewable Energy Council 2010: Energy (R)evolution. A Sustainable World Energy Outlook. ISBN 978-90-73361-90-4.

4. Economic Risk-Reward Unbalanced

4.1 Limited deepwater oil potential not worth the risk

In contrast to its large environmental risks, the oil potential of deepwater and ultra-deepwater drilling is limited. Once the fields are developed, a steep decline of production volumes sets on, in the range of 6-7% for offshore fields in general, and >10% per year for many deepwater fields.[33]

Moreover, the number of promising deepwater oil regions is small: The „golden triangle“ including the GOM, West Africa and Brazil; some smaller deposits off China, in the North Sea/Norwegian Sea and Southeast Asia.

As for the Gulf of Mexico, shallow water (< 305m/1000 feet) oil production has been shrinking since 1998, deepwater volumes (305m-1525m) since 2004. Ultra-deepwater output today represents about one third of GOM volumes, but even assuming further large finds, its total reserves could not even meet U.S. oil demand just for one year. A drilling stop would hardly alter the U.S. oil supply balance.

Globally, known deepsea reserves are in the range of 100-120 bn barrels. This represents just 7-8% of so-called "proved" global oil reserves.[34]

Deepwater fields (> 457m/1500 feet water depth) currently produce about 8 mb/d, which is 10% of global oil supplies. Using a 610 meter (2000 feet) limit, it is estimated at just 5 mb/d although there are 14.000 deepwater wells. Ultra-deepwater wells at more than 1500m water depth contribute only about 1% to global oil production, i.e. just 20% of unused spare capacities.[35]

[33] IEA 2008. World Energy Outlook. Paris.

[34] BP 2010: Statistical Review of World Energy, June. Many experts assume lower reserve numbers; cf. a technical overview of this discussion in Bukold, S. 2009. Öl im 21. Jahrhundert (Oil in the 21st century). Vol.1. Munich, pp.87-215.

[35] EnergyComment 2010. Global Oil Briefing No.42. Hamburg, 6th June 2010; IHS Cera 2010. The Role of Deepwater Production in Global Oil Supply, Cambridge (Mass.). Press Release 30th June 2010.

4.2 High Costs will increase far beyond responsible energy solutions

Deepwater oil and Canadian oil sands are the global „marginal cost" suppliers, i.e. they have the highest production costs and limit the downside of crude prices.

They illustrate the trend of oil companies to avoid political risks (with internalized profit risk) in some oil-rich countries and replace it by higher technical risks (with externalized public risk) in areas they perceive as politically more stable. As Goldman Sachs [36] put it a few months before the Macondo spill when outlining 280 major future oil and gas projects: "We believe that from 2010E, the Top 280 investment profile will increasingly focus on areas with lower political risk...While we see political risk declining, technical risk is likely to step up from 2011, as companies move into frontier areas to look for resources in politically safe countries that are more technically challenging to develop. This step-up in technological risk is likely to lead to an increase in development times, delays and cost overruns...caused by three main factors: 1) a change in production mix: more traditional and easily monetized oil and gas fields are replaced by fields with higher technological complexity and higher capital intensity (i.e. deepwater, LNG, GTL and heavy oil); 2) the increased depth of prospects and greater proportion of pre-salt or sub-salt fields in the deepwater win zone; and 3) the tackling of more geologically complex, HPHT (high-ressure, high-temperature, S.B.) and high sulfur reservoirs."[37]

Goldman expected marginal oil production cost to climb towards the $85-95/b level within a few years. Today, in the wake of Deepwater Horizon, future costs of deepsea drilling and operation will probably rise even further:[38]

a) Higher insurance cost: The total insured loss of all affected parties from the Deepwater Horizon rig explosion and spill could reach $3.5 billion, which is about 50% more than the $2.2-2.5 bn in annual insurance premiums worldwide for oil and gas exploration. As a consequence of the Macondo desaster, deepwater rig insurances are likely to rise by up to 50%.[39]

If the federal cap on economic liability for oil spills is increased from $75m to $10bn, the cost of obtaining insurance coverage will become prohibitively expensive - if the insurance industry offers the coverage at all, what is still unclear. The adequate pricing of deepwater drilling risks may shrink the insurance market, as medium-sized companies cannot afford the coverage and leave the drilling markt, and as insurance companies cannot model their risk. Operators may want to transfer the risk to contractors who cannot not afford the coverage either. In the end, there is a risk that spill damages and fines will not be covered as there is no insurance available. The true cost of oil drilling would be externalised to the society. Oil prices would need to much higher levels to make the industry attractive to investors.

b) Costs will rise due to new regulatory requirements, closer oversight and stricter requirements.

c) Costs will rise due to longer drilling times once the new requirements are adopted.

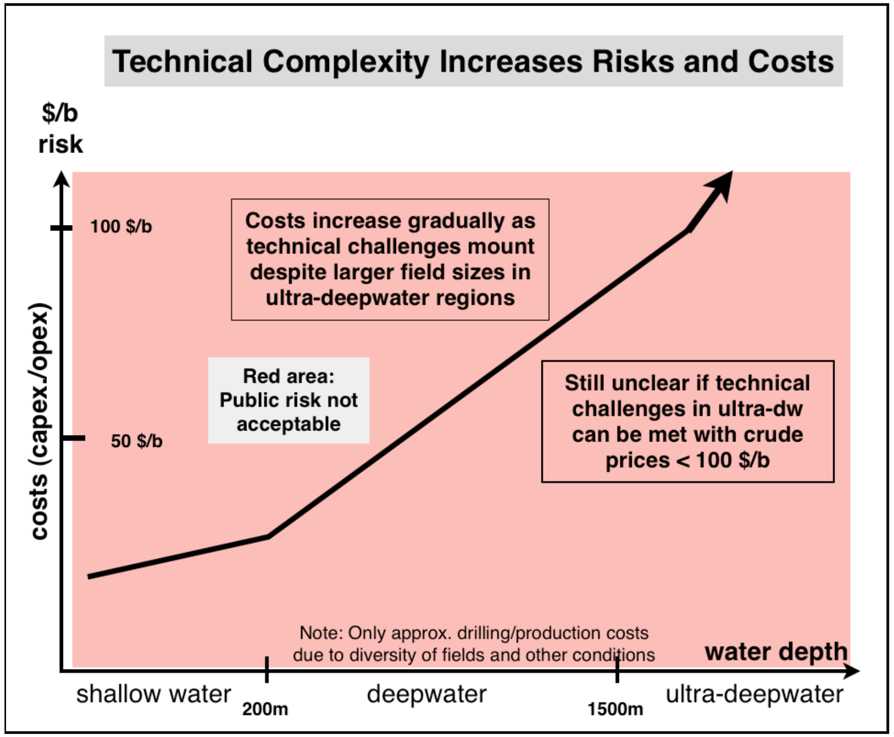
d) Costs will rise due to higher cost of capital as investors and creditors will demand higher returns due to the perceived higher level of risk.[40]

[36] Goldman Sachs 2010. Global Energy - 280 Projects to Change the World, 15th January 2010.
[37] Goldman Sachs 2010. op.cit.
[38] Grant Thornton 2010: The Implications of the April 2010 Oil Spill on Deepwater Exploration and Production, Summer 2010.http://www.grantthornton.com/portal/site/gtcom/menuitem.550794734a67d883a5f2ba40633841ca/?vgnextoid=b21322847909a210VgnVCM1000003a8314acRCRD&vgnextchannel=ff8f2cfeadc16210VgnVCM1000003a8314acRCRD

[39] "Moody´s Reports 50% Rise in Insurance". Newswires Upstream (upstreamonline.com), 3rd June 2010. http://www.upstreamonline.com/live/article216597.ece
[40] "The Deepwater Horizon disaster was a game-changer for shareholders," said Pennsylvania State Treasurer Rob McCord. "It demonstrated the catastrophic consequences that can result when firms fail to provide essential risk assessment.... "Would I invest in an offshore drilling company if its disclosure statement revealed that its 'rapid response' to a catastrophic oil spill involved the unproven technique of stuffing golf balls, hair clippings and shredded tires down a well? Probably not," McCord added. Epicos.com. "Investors Managing $2.5 Trillion Press Energy Companies to Better Disclose Spill Prevention and Response Plans For Deepwater Wells Worldwide. Investors Send Letters to 27 Oil/Gas Companies and 26 Insurance Companies; Seek Responses by Nov. 1." http://www.epicos.com/Portal/Main/Home/Pages/ItemDetails.aspx?wIaopCxX2Y%2BZVNFoJACxA7DMp1qkif5CVSZzO8wUcyNF8V7vLcRsfg%3D%3D

In sum, continuing deepwater exploration would further increase the marginal cost of oil production and, most probably, oil prices. High-cost ultra-deepwater projects will approach the $100 per barrel threshold to be profitable[41]. The public risk remains unacceptable.

Opportunity costs would mount if society continues to follow this path of investment. A halt to deepwater oil drilling accompanied by increased investment in renewable energy and energy efficiency would replace the most expensive fuel by the least expensive.



41 Marginal cost of production including commercial hurdle rates is in the $85-95 area, with areas such as ultra-deepwater West Africa and lower tertiary GOM topping the price scale. Goldman Sachs 2010. Global Energy - 280 Projects to Change the World, 15th January 2010. See also: EnergyComment 2010. Global Oil Briefing No.36. Hamburg, 11th April 2010.

4.3 Job Creation

Offshore oil drilling is a capital-intensive industry. Also, about 50% of the oil industry´s profits tend not to be re-invested but distributed as dividends or used for share buy-backs. Replacing potential oil supplies by the build-up of job-intensive responsible renewable energy industries would provide an additional benefit to economies and societies.[42]

4.4 Smoother transformation into the post Peak Oil era

More and more experts expect a steep fall in oil supplies in this decade or the next due to geological reasons. As climate policies make a non-fossil energy path indispensable, oil scarcity will make it inevitable. The steepness of the decline and the time to prepare for this event are crucial cost variables as they determine the speed of the adaptation process (e.g. for car fleet turnover). A stop to any new offshore oil drilling would smoothen this transformation process since the adaptation to smaller fossil fuel supplies would start earlier without actually consuming the resources which may be difficult to replace in specific applications, e.g. in particular segments of the chemical industry, planes or ships.

The oil age will end anyway. But we can still decide how disruptive and costly the transition will be. Stepping up deepwater investment in the face of peak oil and climate change would be like accelerating in a dead-end street.

4.5 Phase-out of offshore oil is feasible without supply disruptions

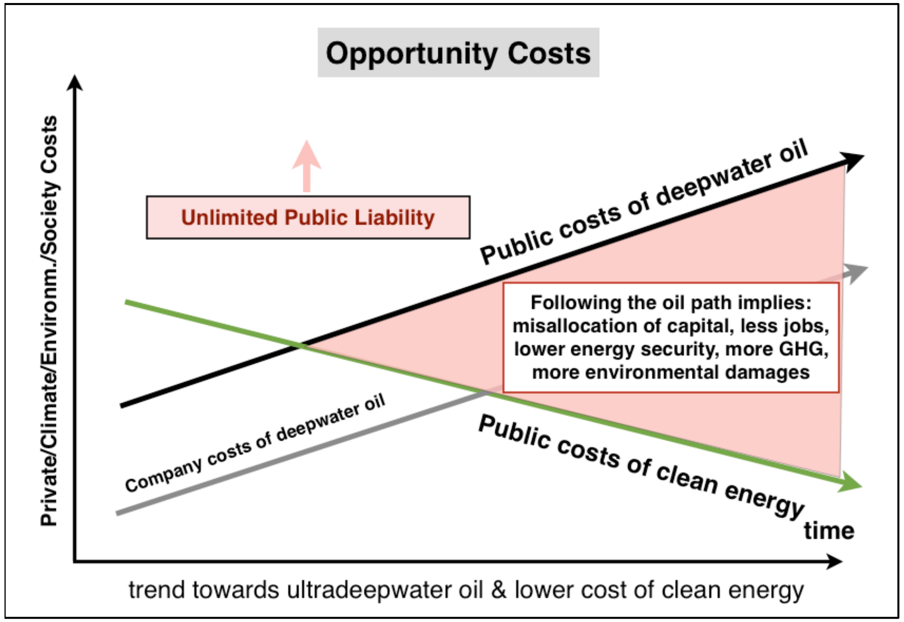
A ban on any new offshore oil drilling would gradually reduce available oil supplies as developed fields enter the decline phase without being replaced by new fields. But the reduced volumes would not jeopardize the economy.

The International Energy Agency (IEA) estimates that an extended global moratorium on new deepsea drilling would cut the world oil output by 0.9

42 Greenpeace International, European Renewable Energy Council 2010: Energy (R)evolution. A Sustainable World Energy Outlook. ISBN 978-90-73361-90-4.

mb/d in 2015. Earlier studies arrive at similar numbers.[43] As free global production capacities (mostly onshore in Saudi Arabia) are in the region of 5 mb/d[44], even an oil-dependent world economy could afford to stop further deepwater drilling. This also explains why global oil prices did not rise after the BP oil spill and the U.S. drilling ban.

Moreover, as outlined above, an equal reduction in oil demand could be achieved in more sustainable and less costly ways such as higher car efficiency or a reduction of crude/fuel oil combustion for power generation.



[43] Fatih Birol, Chief Economist at International Energy Agency. Platts (platts.com). 22nd June 2010. http://www.platts.com/RSSFeedDetailedNews/RSSFeed/HeadlineNews/Oil/8835513

[44] U.S. Energy Information Administration 2010. Short-term Energy Outlook. Online Edition.http://www.eia.doe.gov/emeu/steo/pub/gifs/Fig11.gif.

5. Conclusion

All offshore oil production is inherently risky with deepwater and ultra-deepwater oil drilling especially high-risk. The hostile and remote environments such as the Arctic can not safely tolerate any offshore oil production.

Unfortunately it is only a matter of time until the next offshore oil disaster takes place. The economics of ever deeper offshore oil drilling are only made viable by the oil industry being capable of transferring liability to governments and avoiding the internalization of costs related to economic opportunity cost, energy security and climate change.

Offshore oil is not a solution to energy security. Indeed, new investments in offshore oil can only delay investments in responsible, non-nuclear, long-term renewable energy solutions. Extreme environmental risks, additional climate change costs, reduced energy supply security, opportunity costs of lower job creation and higher energy costs support a ban on any new offshore oil drilling. The choice is clear that governments can no longer continue to delay an accelerated transition to more environmentally and economically sustainable investments in responsible, non-nuclear renewable energy technologies.

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