

## When Pipelines Become Targets: Costing the Consequences

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Good afternoon. I am Jurgen Brauer, professor of economics in Augusta, Georgia, in the United States. I am co-founder and co-editor of *The Economics of Peace and Security Journal*,<sup>1</sup> and it is in **that** capacity - not as an environmental or energy economist or Eurasian specialist - that I have been asked to say a few words about [**slide #1**] “When Pipelines Become Targets: Costing the Consequences.”<sup>2</sup>

I will outline two sets of thoughts, one concerning **various types of costs**, the other concerning some observations regarding pipeline attacks and defense.

One consequence of attacks on oil and natural gas pipelines that one can compute, at least to within an order of magnitude, regards production and therefore **revenue losses**. [**slide #2**] For example, the United States government recently estimated that **Iraq** has lost about \$16 billion worth of oil revenue between January 2004 and March 2006, or about \$7.1 billion on an annualized basis.<sup>3</sup> To take another case, Africa’s biggest oil exporter - **Nigeria** - normally exports around 2.6 million barrels per day (bpd), but “attacks on oil installations in the

Niger Delta have cut about a quarter of oil production since the start of this year.”<sup>4</sup> Annualized, this would amount to a loss of about \$11.9 billion.<sup>5</sup> And in a third case, this one from **Colombia**, if one takes 1999 as the base year, computes production losses due to the civil war through 2005, and evaluates this at some average oil export trading price, then the loss computes to roughly \$2.5 billion a year.<sup>6</sup> As an order of magnitude figure we thus arrive at \$20+ billion for these three countries alone in just one year in the early to mid-2000s. Since the global oil market runs at about \$2 trillion/year, this is a relatively small number in percentage terms, but surely a large one in absolute terms.<sup>7</sup>

One important problem with these sorts of calculations, however, is that energy prices compensate for lower production. So, if Colombia sold (roughly) 800,000 bpd in 1999 at \$10/bbl and only 500,000 bpd in 2005 at \$50/bbl, then the production loss is more than compensated by the price increase, so that Colombia actually **gained** revenue from the worldwide unrest in the energy markets. It is for this reason that I put a question mark next to the first item in the slide.<sup>8</sup>

As to the second item - **replacement/displacement cost [slide #2]** - an example is provided by a set of attacks in January this year.<sup>9</sup> Two attacks took place in the North Ossetia region of Georgia on two parallel natural gas pipelines (the North Caucasus-Transcaucasia pipeline, and the nearby Mozdok-Tbilisi pipeline); the third was on the Kavkasioni transmission line in the Karachay-Cherkessia region (Russia). All three

supply energy from Russia to Georgia and Armenia.<sup>10</sup> To deal with the energy shortfall, Georgia contracted with Iran for emergency imports for about a week's time, obviously coming at a cost but this cost is unspecified. For these sorts of **replacement** costs, I find it difficult to come up with reliable cost numbers. As regards **displacement** costs, an example is provided by World Bank estimates that the run-up in oil prices in recent years has put about 500 million (!) urban poor people at risk, namely those who are on the cusp of using oil-derived products such as gasoline and electricity to better their lives. In Guinea in West Africa for instance, fuel-price related riots broke out earlier this year with several people being killed and various structures being destroyed when government increased gasoline prices in order to cope with trade balance issues arising from the run-up in global oil prices. Similar events have been reported in recent years from Nepal, Yemen, Indonesia, and other places. In Egypt, the government this year (2006) increased fuel subsidies to \$7 billion or 15% of its budget and thus had to cut other items in the budget.<sup>11</sup> The point is that while much of the international discussion about oil and gas markets is couched in terms of the developed countries, most of the impact is felt in the less developed economies, further blighting people's lives there.

A third type of cost are **additional security and military costs** to protect and secure facilities [slide #2]. Again, the cases of Iraq, Nigeria, and Colombia are instructive. One serious issue is the extent to which

one believes that the current **Iraq** war is fought, at least in part, over energy sources.<sup>12</sup> One widely reported estimate suggests the long-run costs of the Iraq war to the United States, let alone to others, to be nearly \$2.3 trillion.<sup>13</sup> If the war stopped today, this would annualize to about \$630 billion, a sum so vast that by itself it would fund the remaining years - through 2015 - of the Millennium Development Goals.<sup>14</sup> Another report cites Amy Myers Jaffe of Rice University in Houston, TX, as estimating that the United States since the 1980s has spent about \$20 billion a year in extra military expenditure on securing **Middle East** supply routes.<sup>15</sup> In **Nigeria**, the United States this year (2006) stationed coast guard vessels offshore and provided training to Nigerian armed forces personnel at unspecified cost to fend off insurgents in the delta that have been able to successfully stage offshore attacks with speedboats to force a complete shutdown of Shell's so-called EA oilfield there.<sup>16</sup> In **Colombia**, following significant hesitation by international energy interests to invest due to security concerns, the United States provided, in FY2003, \$99 million to assist pipeline protection in that country. Attacks took place not only on drilling rigs, pumping stations, and pipelines, but on personnel (kidnappings) and on convoys that transport pipeline-related equipment.<sup>17</sup> Another \$147 million was budgeted for FY2004.<sup>18</sup> Colombia itself expends considerable resources of its own to protect its pipelines from rebel attacks.<sup>19</sup>

A further cost of pipeline attacks is that of additional **repair and**

**safeguarding** [slide #2] by which I mean costs primarily borne by energy companies and their customers rather than by states and their taxpayers. Security and repair budgets of private firms are not in the public domain so it is difficult to come up with reasonable numbers. But by way of example consider that in August 2006 for instance BP announced that it estimates a repair bill of around \$170 million for a 16-mile stretch of the Prudhoe Bay pipeline,<sup>20</sup> and it might be possible to use this sort of fragmentary information to come up with estimates of repair bills for the numerous pipeline attacks taking place all over the globe. (To my knowledge no one has attempted to do this work yet.) But in the case of Iraq, clearly the monetary cost is borne mostly by U.S. taxpayers as much of the reconstruction effort depends on successful reestablishment of the country's pipelines. By the end of the third quarter of 2006 - two months ago, that is - not quite \$3 billion of the Iraq reconstruction funds either had been expended or obligated by the United States alone for Iraq's oil and natural gas sector.<sup>21</sup>

**Environmental losses** are widely reported but virtually never costed [slide #2]. For example, in March 2003, in testimony before Congress, a U.S. General mentions a total of three million gallons spilled in Colombia due to pipeline attacks.<sup>22</sup> (At 42 gallons/barrel, that's over 70,000 barrels of crude.) Spillage reports like these can readily be found on the Internet from various corners of the world (e.g., Nigeria, Papua New Guinea, Peru, Mexico, Russia, etc.). But reliable cost information –

containment, remediation, restoration, damage compensation for lost economic activity, and so on – is simply not available. This is so in part because the environmental effects of an oil spill depend not so much on the size of the spill but primarily on the precise nature of the terrain, the environment, and the ecosystem within which the event occurs. Factors such as location, oil type, cleanup strategy, response time, cost of local labor, loss of local economic activity, and so on, all play a role and can lead to dramatic variations in per-unit response costs. So, it is probably smart of me NOT to attach a number to the environmental cost item on the slide. Let's just say that for **commercial** spills that have been costed, the numbers run anywhere from a few dollars to hundreds of dollars per gallon of cleanup, and the total sum for larger spills can go into the billions of dollars.<sup>23</sup>

**Avoidance and substitution costs** likewise are difficult to estimate [slide #2]. Again by way of example, China is diversifying its energy sources (Russia, Kazakhstan, Middle East, West Africa, etc.), but it is also vastly expanding its fleet of state-owned tankers. By 2020, it hopes to carry 60-70% of its seaborne oil imports in state-owned vessels.<sup>24</sup> So by “avoidance” I mean redundancies and excess capacities beyond what would normally be deemed prudent and sufficient.<sup>25</sup> *The Wall Street Journal* earlier this year cited a study by the International Energy Agency according to which insulating newly-to-be-built oil infrastructure from security risks will cost around \$3 trillion over the

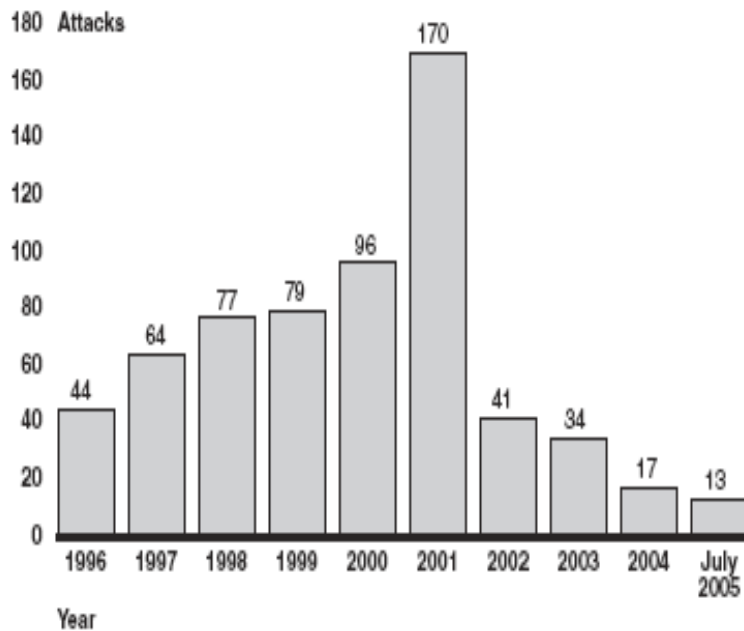
next 25 years (\$120 billion/year).<sup>26</sup> Substitution costs must figure into the overall costing as well. For example, the turmoil in the oil and gas markets certainly has revived the nuclear energy market with its inestimable long-term costs, especially - but not only - of nuclear waste disposal.

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I am not brave (or foolish) enough to try to add up the costs mentioned thus far, except to say that they are significant, certainly in absolute terms. Instead, let me switch emphasis now to make some **observations** regarding pipeline attacks and defense. First, **pipelines are easy targets** (Figure 1) [**slide #3**]. Pipelines are large, static, physical objects, run over considerable distances through multiple jurisdictions, and involve complex geographical domains. They invite attack, and the slide shows the example of attacks on just one pipeline in Colombia over a 10-year period. Note how this differs from offshore installations and seaborne transport. To attack offshore, one needs a somewhat capable armed force with seagoing power, clearly not what most rebel groups, insurrection movements, or terror organizations have at their disposal,<sup>27</sup> although piracy of maritime trade is a growing security problem.<sup>28</sup> However, the unit-cost of seaborne transport is much higher than the unit-cost of pipeline transport, so that the economics of oil and natural

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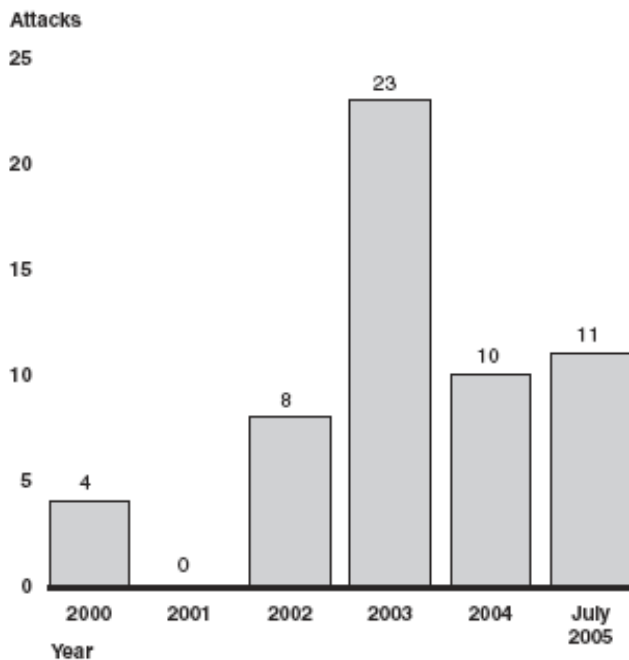
### Caño Limón-Coveñas Oil Pipeline Attacks, 1996–July 2005



Source: Occidental Petroleum Corporation.

**Figure 1.** Source: GAO, 2005, highlights page. Note that this captures only attacks on this one pipeline. Wade (2000), citing the Colombian Army Hydrocarbons Office, reports that FARC – one of the rebel groups was responsible for 114 of 169 countrywide pipeline bombings that took place in 1998.

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Source: Occidental Petroleum Corporation.

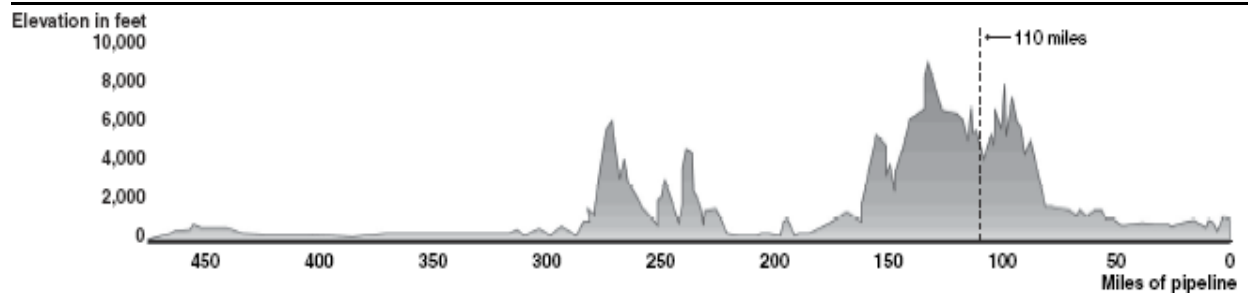
**Figure 2.** Electrical grid system attacks 2000 to July 2005. Source: GAO, 2005, p. 17.

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gas movement actually plays into rebel and terrorist hands.

This would suggest, second, that more should be spent to harden pipelines. But **target hardening induces substitution** to other targets that now, in relative terms, are easier and cheaper to hit [**slide #4**]. A U.S. government

study on Colombia captures this principle with perfection. Soon after U.S. funds kicked in to help secure the initial 110 miles of pipeline, attacks shifted to a substitute target, namely attacks on the electric grid without which the pumping stations do not work (Figure 2).



**Figure 3:** Caño-Limón-Coveñas pipeline, Colombia, elevation. The highest peaks are mostly in the provinces of Boyaca and Norte de Santander, largely unprotected areas. Source: GAO, 2005, p. 6.

Third, since pipelines run over long distances, attackers can **shift the location of attack** [slide #5]. Again, the U.S. government study on Colombia illustrates this shift in strategy to perfection in that post-protection attacks took place at increasing frequency **outside** the 110-mile protected corridor. Another unintended by-product of the protection strategy was that attacks were “pushed” into higher elevations - as the Figure (Figure 3) in the slide shows - which because of the rougher terrain facilitates attacks and complicates repairs (e.g., repair teams face increased exposure to ambush attacks).

In terms of **counter-strategy** [slide #6], let me offer just a couple of thoughts and then conclude - and I’ll also say that this is very much provisional, but it may perhaps stimulate some fruitful discussion at the end of the session. First, it seems to me that companies with facilities under threat need to **minimize the “effective mileage of exposure”** [slide #6]. One needs to design pipelines not just with engineering and geological considerations in mind, but very much with security considerations as well. One wants to minimize the **combined** cost, i.e.,

one wants to **enlarge the set of variables over which one optimizes the system**<sup>29</sup> [slide #6], and maybe there is something to be learned from the computer and information technology industry which in the past also was primarily oriented toward engineering questions but now optimizes over information security-related variables as well, as an article last month in *Science* magazine details.<sup>30</sup> Interestingly, according to a report in the *Oil & Gas Journal*, China - as a net consumer - has already formulated such a strategy which includes source diversification and the aforementioned building of a fleet of state-owned oil tankers.<sup>31</sup>

Second, since costs of successful attacks reverberate throughout the entire distribution system, a counter-intuitive strategy is to **multiply the targets** [slide #6]! The more outgoing and incoming supply routes there are, the less valuable each one of them becomes in terms of disrupting the entirety of the system. One increases one's cost but decreases the benefit to the attacker.<sup>32</sup> This is one reason, by the way, why I do not believe that pipelines are particularly attractive targets for groups with *global* ambitions such as al Qaeda. Any pipeline or distribution target attacked by al Qaeda is easily substituted for by rerouting shipments over the already existing worldwide network (although I realize this holds more for oil than for natural gas whose markets tend to be more regional than global). Al Qaeda therefore cannot hope to successfully disrupt the *global* flow of crude oil; it can only hope to cause an environmental disaster at some localized point. If this were done for

instance in Central Asia – with its large Muslim-oriented population – that would be fairly pointless. So, it would have to be an environmentally disruptive attack in a “western” country, and since infrastructure there tends to be well protected, it is probably cheaper for al Qaeda to use its limited resources to attack less conspicuous targets.

Finally, work harder to **convert local groups into allies, not enemies** [slide #6]. If I stick once more with my three primary examples - Iraq, Nigeria, and Colombia - evidently energy companies and states have not been especially successful in this regard. Contrast the large number of pipeline attacks in these countries with the small number of pipeline attacks in corresponding counterparts, say, Iraq vs. Iran, Nigeria vs. Angola, and Colombia vs. Venezuela. Compared to the alternative - pipeline attacks on account for some social unrest - maybe we should not be so unhappy about the recent political changes in Bolivia, where the situation reminds me of the “fair coffee” trade or “ecotourism” markets: one wants the local population to benefit and thereby induce it to help protect the resources from which their income might flow. But if there is no benefit sharing, or only insufficiently so, then locals really don’t have much to lose, even if attacks end up literally spoiling their own soil. Numerous experiments in the emerging field of behavioral and neuroeconomics have shown that if I fail to see you being “fair” in a trading situation, I will - up to a point - try to punish you even if that punishment is detrimental to me. So, what I see is various actors

engaging in cost-shifting behavior - in which they try to “free ride” on each other - instead of taking common responsibility for pipeline security and negotiating appropriate cost and benefit-sharing agreements. The very lack of this makes it easier for disaffected groups to arise, step in, exploit the situation, and cause disruption and damage.

Thank you for your attention. I now turn the podium back over to the chair of the session.

## Notes

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1. See [www.epsjournal.org.uk](http://www.epsjournal.org.uk).

2. The PowerPoint slides accompanying the talk are available at <http://www.aug.edu/~sbajmb/paper-Columbia-pipelines.ppt>.

3. SIGIR (2006); Snow (2006). Since the Iraq war began in 2003, there have been numerous attacks on pipelines, facilities managers, and public officials connected to the oil and gas sector. For example, in mid-June 2004, the *Oil & Gas Journal*, a prominent trade publication, carried a series of news stories and reports on continuing pipeline attacks in northern and southern Iraq. For example, attacks in May 2004 reduced output by 11 percent relative to April of that year. This immediately put upward pressure on prices but also discomfited other OPEC producers as supply disruptions anywhere carry production, maintenance, and revenue implications for them. Iraq's northern pipelines to Turkey were reopened 15 August 2003 for the first time since the major phase of the war ended in March 2003. However, one day later sabotage stopped the flow. Estimates suggested 10-14 days of repairs, with revenue losses of \$7 million per day. But the line stayed in fact shut until at least 26 January 2004 and was not expected to reopen before March 2005.

4. Watkins (9 October 2006).

5. That's 237 million barrels, evaluated at \$50/bbl. On 19 January 2006, *Business Day* reported expected 2006 oil revenue for Nigeria of \$52.7 billion. <http://www.businessdayonline.com/?c=45&a=4112> [accessed 20 November 2006]. A loss of 25 percent of that would be \$13.2 billion, close to the number reported in the text.

6. The computation is based on data from the U.S. Energy Information Agency. Taking 1999 with 816,000 bpd production as the base, production fell off – some say due to fall in proven reserves, but really due to investment uncertainties on account of violent conflict – to 526,000 bpd in 2005. Since domestic consumption was roughly constant, all of the fall equals export losses. If one figure an average crude oil price of \$30/bbl over this time period, the loss computes to about \$2.5 billion a year over this 6-year time period. See <http://www.eia.doe.gov/emeu/international/oilprice.html> and <http://www.eia.doe.gov/emeu/cabs/Colombia/Full.html> [accessed 20 November 2006].

7. For comparison, the 2006 estimated cost to help achieve the Millennium Development Goals (MDGs) is around \$70 billion; see [http://www.unmillenniumproject.org/reports/costs\\_benefits2.htm](http://www.unmillenniumproject.org/reports/costs_benefits2.htm) [accessed 28 November 2006].

8. Similarly, Iraq's \$16 billion loss referred to in the text stems entirely from the deviation from target production that U.S. planners had envisioned. Had the target been set higher, the "loss" would have been higher. Had the target been set lower, a "gain" may have resulted. For **non-conflict producer countries**, such as Norway say, there have been revenue gains. As to **consumers**, the loss is essentially an income transfer to producers, hence for example Russia's strengthened economic and therefore geopolitical position. A widely reported number suggests that since 2003, the war in Iraq has led to an increase in the price of globally traded oil of about \$10/barrel.

9. Stratfor (2006).

10. Watkins (2005).

11. Cummins (2006a). And earlier this month, Russia announced that it will triple domestic natural gas prices to stifle demand, in part so that it can fulfill its export obligations (White, 2006). Much more than half of Russian state-monopoly OAO Gazprom's natural-gas sales by volume are for domestic consumption. It remains to be seen how this plays with Russia's not exactly well-off population.

12. Personally, I am not comfortable with the "blood-for-oil" thesis but U.S. President Bush himself in his January 2006 State of the Union address famously remarked on America's "addiction to oil," implying that the United States might not have expended military resources there where it not for the region's energy resources.

13. Bilmes and Stiglitz (2006).

14. See, e.g., <http://www.un.org/millenniumgoals/>, <http://www.undp.org/mdg/>, <http://www.earth.columbia.edu/>, or <http://www.unmillenniumproject.org/> [all accessed 28 November 2006].

15. Cummins (2006b).

16. Cummins (2006b). The same article reports that Royal Dutch Shell PLC and other oil companies in **Nigeria** used to subsidize Nigeria's security forces and funded numerous avenues by which to manage unrest in the Niger delta. Shell stopped these activities in 2003 but began funding about \$25 million worth of "development projects" in the region. Oil companies are generally tight-lipped about security-related topics, so that one cannot possibly estimate the overall amount of money doled out this way.

17. Wade (2000).

18. The funds are to "train, equip, and assist" two Colombian battalions of "up to 800 soldiers" to help secure the first 110 miles of the 477 mile long Caño-Limón-Coveñas pipeline from Arauca province to the port of Coveñas (GAO, 2005). This is intended to recapture about \$500 million in revenue (in 2001) lost to attacks. For the United States, this helps diversify supply lines; for the U.S. private partner in the pipeline, Occidental Petroleum Corporation, there is similarly a profit to be had by shifting costs to taxpayers (OPC and its local partner contribute only about \$8.65 million/year to pipeline security; see GAO, 2005, p. 9).

19. WOLA (2003).

20. BP shares responsibility for this pipeline with Exxon Mobil and ConocoPhillips. See news story at <http://www.foxnews.com/story/0,2933,208006,00.html> [accessed 28 November 2006].

21. See p. 32 of [http://www.sigir.mil/reports/quarterlyreports/Oct06/pdf/Report\\_-\\_October\\_2006.pdf](http://www.sigir.mil/reports/quarterlyreports/Oct06/pdf/Report_-_October_2006.pdf) [accessed 28 November 2006]. This is probably somewhat on the high side, however, because part of these funds are not purely for repair but also for a redesign of the entire sector.

22. See <http://ciponline.org/colombia/03031201.htm> [accessed 28 November 2006]. In November 2001, just one of the 170 attacks that year on just one pipeline in Colombia resulted in approximately 7,000 barrels of oil spilled over a 50 mile stretch, including river ways (GAO, 2005, p. 7)

23. For just two examples, see <http://www.buzzardsbay.org/oilspillcosts.htm> and [http://www.environmental-research.com/erc\\_papers/ERC\\_paper\\_2.pdf](http://www.environmental-research.com/erc_papers/ERC_paper_2.pdf) [both accessed 28 November 2006].

24. Collins (2006).

25. China's massive intended shipbuilding program may, however, adversely affects its blue-water navy ambitions which, in turn, carries geopolitical consequences for instance in relation to India, Taiwan, and the United States.

26. Cummins (2006b). I have not been able to verify this number from materials available on the IEA web site.

27. There are notable exceptions, however. Cummins (2006b) reports on speedboat attacks by Niger delta rebels on Shell offshore platforms. These were sufficiently strong and successful for Shell to close production at the EA field.

28. See, e.g., information available at the International Maritime Organisation: <http://www.imo.org/home.asp> [accessed 28 November 2006].

29. One way to do this is to bury pipelines underground such that an attacking group would need to "unbury" the line to stage an attack. This would raise the cost of attack, probably to a degree that makes such attacks unviable. Burying pipelines is, however, expensive and not usually a feasible option. Another option is to run pipelines as much as possible along existing transportation corridors (roads, railroads, canals) and population centers (villages, towns, cities). This, too, may add to cost. Another option is to relocate well-heads. Depending on geology, well-heads are usually situated on top of the oil or gas source so that one has a straight shot down to the source, minimizing the cost of access and extraction. However, if one enlarges the set over which one optimizes, namely extraction and initial pipeline transport, then it well may be the case that shifting the tap-location, while increasing the cost of extraction, minimizes the overall cost of delivery. One also will want to use pipeline designs that **withstand "nuisance blasts,"** i.e., that increase the threshold requirement for terror groups such that a considerable share of these groups' resources would be needed to acquire or construct and deliver sufficiently high-powered blasts to disrupt pipeline function. In other words, one would not want every village drunk with a grievance to be able to take a successful whack at the local pipeline. Groups with more resources also tend to be more easily tracked.

30. Anderson and Moore (2006).

31. By 2010, they are to carry 40-50% of China's requirements and, by 2020, 60-70%. At the moment, only 10-12% of Chinese oil imports come on Chinese-owned vessels, in contrast to South Korea (30%) and Japan (80%). Geopolitical considerations also enter into the decision in that China apparently does not wish to risk being held hostage by cutoffs at strategic choke-points such as the Strait of Malacca (the U.S., India, Japan, apart from pirates, could conceivably block these sea lanes). These choke-points carry 75% of all Chinese seaborne oil imports (Collins, 2006).

32. One needs to be careful with this, though. Maybe the best thing is to let rebel groups or terrorists blow up a pipeline once in a while for fear of what else they might do if those points of attack are foreclosed.

## References

- Anderson, R. and T. Moore. "The Economics of Information Security." *Science*, 314(5799), pp. 610-613.
- Bilmes, L. and J. Stiglitz. 2006 "Encore." *Milken Institute Review* (Fourth Quarter), pp. 76-83.  
<http://www.epsusa.org/StiglitzBilmes10-06.pdf> [accessed 24 November 2006].
- Collins, G. 2006. "China Seeks Oil Security with New Tanker Fleet." *Oil & Gas Journal* Vol. 104, No. 38. 9 October 2006. [http://www.ogj.com/display\\_article/274229/7/ARCHI/none/none/China\\_seeks\\_oil\\_security\\_with\\_new\\_tanker\\_fleet/](http://www.ogj.com/display_article/274229/7/ARCHI/none/none/China_seeks_oil_security_with_new_tanker_fleet/) [accessed 20 November 2006].

- Cummins, C. 2006a. "As Fuel Prices Soar, A Country Unravels." *The Wall Street Journal*. 18 November 2006.
- Cummins, C. 2006b. "Crude Tactics: As Oil Supplies Are Stretched, Rebels, Terrorists Get New Clout." *The Wall Street Journal*. 10 April 2006.
- [GAO] United States Government Accountability Office. 2005. Security Assistance. Efforts to Secure Colombia's Caño-Limón-Coveñas Oil Pipeline Have Reduced Attacks, but Challenges Remain. Report GAO-05-971 (September). Washington, DC: GAO. <http://www.gao.gov/new.items/d05971.pdf> [accessed 19 November 2006].
- [SIGIR] Office of the Special Inspector General for Iraq Reconstruction. 2006. "Unclassified Summary of SIGIR'S Review of Efforts to Increase Iraq's Capability to Protect Its Energy Infrastructure." SIGIR-06-038 (27 September 2006). Washington, DC: SIGIR.
- Snow, N. 2006. "US Estimates Iraq Lost \$16 Billion in Oil Revenues." *Oil & Gas Journal*, Vol. 104, No. 38. 9 October 2006. See <http://www.sigir.mil/reports/pdf/audits/06-038.pdf> for the original report [accessed 20 November 2006].
- [Stratfor] 2006. "Georgia, Russia: Energy Attacks Escalate Tensions." *Stratfor*. 23 January 2006. [http://www.stratfor.com/products/premium/read\\_article.php?id=261246](http://www.stratfor.com/products/premium/read_article.php?id=261246) [accessed 19 November 2006].
- Wade, J. 2000. "Violence, Crime Continue to Cast Shadow over Future Oil Investment in Colombia." *Oil & Gas Journal*, Vol. 98, No. 3. 17 January 2000. [http://www.ogj.com/articles/article\\_display.cfm?Section=ARCHI&C=Feat&ARTICLE\\_ID=54786&KEYWORDS=%7Bpipeline%20attacks%7D](http://www.ogj.com/articles/article_display.cfm?Section=ARCHI&C=Feat&ARTICLE_ID=54786&KEYWORDS=%7Bpipeline%20attacks%7D) [accessed 20 November 2006].
- Watkins, E. 2006. "Watching the World: Nigerian Oil in Jeopardy." *Oil & Gas Journal*, Vol. 104, No. 38. 9 October 2006. [http://www.ogj.com/display\\_article/274233/7/ARCHI/none/none/WATCHING\\_THE\\_WORLD:\\_Nigerian\\_oil\\_in\\_jeopardy/](http://www.ogj.com/display_article/274233/7/ARCHI/none/none/WATCHING_THE_WORLD:_Nigerian_oil_in_jeopardy/) [accessed 20 November 2006].
- Watkins, E. 2005. "Georgian Section of BTC Pipeline Opens." *Oil & Gas Journal Online*. 18 October 2005. [http://www.ogj.com/articles/article\\_display.cfm?Section=ARCHI&C=RegF&ARTICLE\\_ID=239702&KEYWORDS=%7Bpipeline%20security%7D](http://www.ogj.com/articles/article_display.cfm?Section=ARCHI&C=RegF&ARTICLE_ID=239702&KEYWORDS=%7Bpipeline%20security%7D) [accessed 20 November 2006].
- Watkins, E. 2004. "Iraq Gives Mixed Signals About Northern Field Oil Export Timeframe." *Oil & Gas Journal Online*. 24 January 2004. [http://www.ogj.com/articles/article\\_display.cfm?Section=ARCHI&C=GenIn&ARTICLE\\_ID=197252&KEYWORDS=%7Bpipeline%20attacks%7D](http://www.ogj.com/articles/article_display.cfm?Section=ARCHI&C=GenIn&ARTICLE_ID=197252&KEYWORDS=%7Bpipeline%20attacks%7D) [accessed 20 November 2006].
- White, G.L. 2006. "Russia to Increase Natural-Gas Prices at Home." *The Wall Street Journal*. 22 November 2006, p. A10.
- [WOLA] Washington Office on Latin America. 2003. *Colombia Monitor* (May). [http://www.wola.org/Colombia/monitor\\_may03\\_oil.pdf](http://www.wola.org/Colombia/monitor_may03_oil.pdf) [accessed 19 November 2006].