The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Drilling Down: Tainter and Patzek Tell the Energy-Complexity Story

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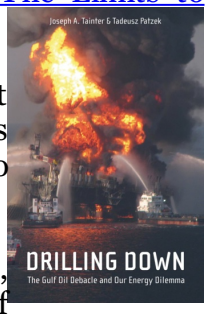
Joseph Tainter and Tadeusz Patzek are authors of a soon-to-be-released book called Drilling Down: The Gulf Oil Debacle and Our Energy Dilemma. This book is part of Charles Hall's *Briefs in Energy* series with the publisher Springer. An earlier book in this series was The Limits to Growth Revisited, by Ugo Bardi.



The new book, Drilling Down, is not simply the story of the Gulf oil spill (although it does tell this story, quite well). Tainter and Patzek use the story of Gulf oil spill as the background for discussing the energy-complexity spiral, and its relationship to this accident.

The energy-complexity spiral occurs because the availability of abundant, inexpensive energy permits increased complexity. Complexity has the advantage of allowing society to solve more problems, but it has the disadvantage of being more costly–that is requiring more energy for its creation. The need for more energy (and the fact that Energy Return on Energy Investment (EROEI) is declining) leads to a need for more complexity to obtain this additional energy, assuring that the cycle continues. With growing complexity, there is an increased risk of accidents that can be expected because of the complex nature of the system, but which are hard for participants to foresee.

Tainter and Patzek add new perspectives to what has been reported elsewhere, such as at The Oil Drum. Joe Tainter is an anthropologist and historian who teaches in the department of Environment and Society at Utah State University. His best-known work is The Collapse of Complex Societies. Tad Patzek has a Ph.D. in Chemical Engineering and teaches at the University of Texas in the Department of Petroleum and Geosystems Engineering. He has testified at congressional hearings on the oil spill.

The book has nine chapters:

1. Introduction
2. The Significance of Oil in the Gulf of Mexico
3. The Energy that Runs the World
4. Offshore Drilling and Production: A Short History
5. The Energy Complexity Spiral
6. The Benefits and Costs of Complexity
7. What Happened at the Macondo Well
8. Why the Gulf Disaster Happened
9. Our Energy and Complexity Dilemma: Prospects for the Future

We have already extracted quite a bit of the easy-to-extract oil. As we move on to more difficult

to extract oil, we find it necessary to use ever more complex, costly and risky technologies, driven by falling EROEI, in an energy-complexity spiral. The energy-complexity spiral in oil production mirrors the larger energy complexity spiral in society as a whole. The introduction describes the purpose of the book as two-fold:

> . . . firstly to explain the Gulf disaster, the energy-complexity spiral, and how they are necessarily connected; and secondly to encourage all consumers of energy to consider whether this spiral is sustainable, and what it will mean for us if it is not.

The two authors bring their perspectives to the situation. Patzek tells the technical story of oil extraction, why we need oil from the Gulf of Mexico, and how oil from the Gulf is found in ever-smaller and deeper reservoirs. He also tells some of the details about the complexity of extraction as more people and companies are involved in the process and as more complex extraction equipment is needed. Tainter brings the overview of how the energy-complexity spiral works. He also provides background on how previous civilizations handled growing complexity, and the difficulty of maintaining adequate energy supply, as marginal returns decline. Together, they tell the specific story of the Deepwater Horizon accident, but also the more general story of our search for greater energy supplies, and the problems involved.

The book describes the Deepwater Horizon as a "normal accident":

> Perrow uses the term "normal accidents" partly as a synonym for "inevitable" accidents, accidents whose likelihood is inherent in a complex technological system. In a highly complex piece of technology with many parts, accidents happen from unpredictable interactions among some of those parts. Complexity makes failures nearly inevitable. Engineers try to avoid failure by adding more complexity, all of which makes the operation of technological systems difficult for human operators to understand.
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> . . .
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> Normal accidents appear as if they are Black Swans, something that cannot happen. In fact, the very nature of complex technologies makes accidents probable. They are a normal byproduct of the operation of systems whose complexity is beyond human understanding.

Part of the reason that accidents are prone to happen is because various tasks are divided among various companies, each trying to earn a profit. Within each company, tasks are further divided among many workers.

The chance of "normal accidents" can be expected to increase as drilling is started in ever-riskier places, such as off the coast of Greenland and north of the Arctic Circle.

Drilling Down touches on many interesting topics, from details about how extraction is done, to details about what happened at the time of the accident, to overviews of how various civilizations have dealt with rising complexity and reduced energy flows. Tainter brings up the issue of declining marginal return on investment in complexity–and how this seems to be born out, for example, by fewer new patents, even in energy sectors. The book also mentions that more complex solutions–from hybrid gas-electric cars to fancier military airplanes–tend to be more expensive per unit built, and this higher cost limits how many are actually sold.

The book talks about how energy slaves in the form of fossil fuels are a way of paying for increased complexity, at least until they start running short. The book also talks about how things that should be obvious–like our dependence on fossil fuels–are masked by the fact that they are so much a part of our everyday life, and for many years were not a problem. In explaining this, the point is made that a fish wouldn't know that its nose is wet–water is such a part of its everyday environment as not to be noticed.

This is not a book that gives a formula for solving our energy problems. The following is part of the final remarks of the book (actual wording may vary–the manuscript I am working from is not final).

> It is fashionable to think that we will be able to produce renewable energy with gentler technologies, with simpler machines that produce less damage to the earth, the atmosphere, and people. We all hope so, but we must approach such technologies with a dose of realism and a long-term perspective. A geothermal project in Basel, Switzerland, begun in December 2006, had been underway only a few days when there was a small earthquake of magnitude 3.4, frightening people and damaging buildings. More than 100 aftershocks continued into 2007, and the project was abandoned, because people were too scared. Solar and wind power, at a scale great enough to be meaningful, would consume large amounts of land . . . Renewable energy that gives the same power per person as we enjoy today would not be free of environmental damage. . . Indeed, in the large land areas that it would require, renewable energy could cause more environmental damage than that caused by our use of fossil fuels. We know that this is not a pleasant observation, but throughout the book we have emphasized the need for realism.
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> It is always important to keep long-term processes in mind, as well as the regularities in how humans behave. As with fossil fuels, we will first exploit sources of renewable energy with the steepest energy gradients, the highest EROEI. Once those no longer satisfy our needs, we will do what we are now doing with petroleum: We will produce renewable energy in places that are more and more unfavorable, and to this we will develop technologies that are complex, costly, and risky. Perhaps in the end the consequences will not be as great as the Gulf spill, although we will not presume to guess how people might weigh the economic and emotional costs of an earthquake against those of an oil spill, or the difference between opening up the Arctic National Wildlife Refuge to oil drilling and taking over a vast desert ecosystem to capture its solar energy. We hope that renewable energy will be more environmentally benign than fossil fuels have been, but we will know only when we push into renewable energy sources that yield declining marginal returns.
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> What are the alternatives? The fiscal crises currently experienced by many governments give us a taste of what would likely be in store for us should our energy sources ever prove inadequate. . . Teachers are being laid off, programs canceled, and school years shortened. Britain is eliminating whole agencies of government, and planning to implement the most drastic curtailment of public services since World War II. All this is happening at a time when energy is still abundant and relatively inexpensive.
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> Our societies cannot postpone a public discussion about future energy. As we stated earlier, this must be an adult discussion, a discussion that is honest, serious, and realistic. It cannot be grounded in punditry, or faith-based economics, or unlimited technological optimism. . . We can anticipate and plan for our future, or we can simply

> allow the future to happen. This is our choice.
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> The era of plentiful petroleum will someday end, hopefully without any more accidents of the magnitude of the Deepwater Horizon blowout. We don't know when this will happen, nor does anyone else. Surely it will happen sooner than we want. Yet we are not without some ability to understand how the future will unfold. We can project the future based on past experience, for we are not the first people to encounter challenges of energy. Always in our discussions it is worthwhile to keep in mind the restatement of Stein's Law: A trend that can't continue, won't.

Drilling Down is now available for pre-order. The book is already available in Europe. I am told the book will be available worldwide the second week in October. The book is well worth its modest price of $13.23, in my opinion. With one detail-oriented author, and one "big picture" author, the book includes something for everyone. No background in oil terminology is required; a glossary is provided.

This post originally appeared on Our Finite World.