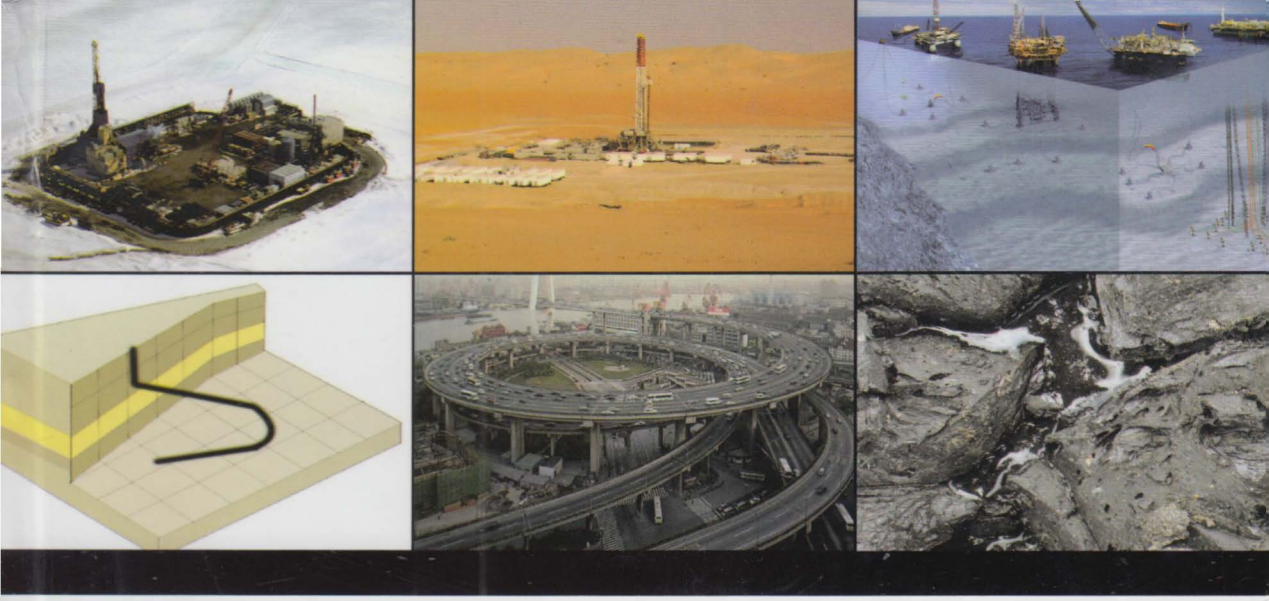
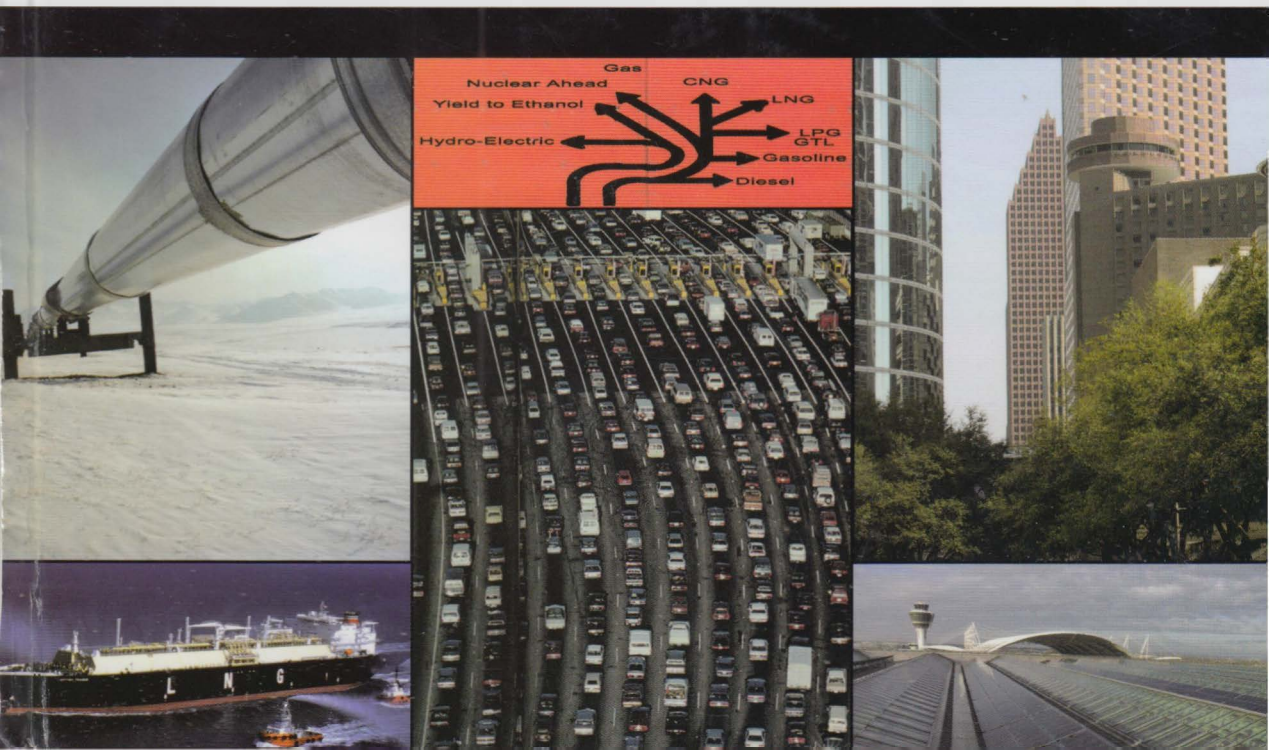


The Hydrocarbon Highway

By Wajid Rasheed



The Hydrocarbon Highway

By Wajid Rasheed

www.hydrocarbonhighway.com

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For Mum and Dad

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Preface and Acknowledgements

Why write a book on oil? Does oil matter?

Advocates argue that petroleum promotes progress; put simply, it is the 'black blessing'. Cynics argue that it is a sunset industry; 'fossil fuel' sums it up. Environmentalists state that it is a polluting fuel; 'crude oil' says it all. Yet, when all is said and done, oil matters because it touches the life of almost every human on the planet. Due to the invention of the combustion engine and the ability to motorise, transport and mechanise tools, the utility and importance of oil has become indisputable. Along with the wheel, penicillin or aviation, oil ranks as one of mankind's greatest discoveries.

Make no mistake, this book is clearly an insider's perspective but it is not an apology for oil. Having worked for more than a decade in oilfield operations and publishing, it seemed increasingly important to me to dispel myths and present facts regarding oil and energy. Does this imply a bias to oil? Think again. If you were sick, whose opinion would you value—someone without knowledge of medicine or an experienced medical practitioner?

Oil is by far the most convenient and best bang-for-buck fuel that mankind has found. That is why it flows through hundreds of countries and trillions of transactions worldwide, generating mobility, power and countless products along the way.

Global economic growth depends on it and questions regarding its supply penetrate deep into the heart of geopolitics and resource nationalism.

Paradoxically, it is not even the oil or gas we want. It's all about the 'lifestyle'. We want the freedom of driving our cars or of flying around. We want the climate-comfort that comes from heating or cooling our homes, our workplaces and malls. We want a host of derivatives such as plastics, deodorants and cosmetics. No other commodity touches us so completely.

That's fine. But what about our legacy to future generations? What about carbon emissions and global warming? What about the 'Oil Curtain' and access to oil? Do we want to leave a tainted world whose energy sources are entangled in environmental damage? Such tiny questions render complex answers that yield vast consequences.

Practically speaking can we *change* out the oil? Can we alter our dependence on oil? Imagine reconfiguring every gas station in your home town or city to supply another fuel, then doing this in every state, country and continent in the world. Behind the retail outlets are the networks of distribution and storage, which will need to be changed, and this involves dealing with thousands of different suppliers. Yet, this completes just half of the equation. The other half—demand—resides in the world-wide fleet of automated machines—cars, trucks and buses. Imagine reconfiguring all those engines. Now, repeat the exercise for aviation, maritime and trains. That's demand inelasticity.

Considering the scale, vastness and complexity of a single application, i.e. transportation, it is clear to see how embedded oil is. To appreciate the magnitude of oil dependence, imagine reconfiguring two-thirds of the world's power generation plants and industrial and manufacturing processes.

That's just the theoretical part because we don't have a replacement for oil, yet.

Any eventual exit from oil and gas dependence must start by refocusing the issues through this lens of practicality. Oil cannot be wished away; it is a building block of modernity that fuels growth; connecting cities and lives. As modernity spreads globally, lifestyles that are based on the heavy consumption of oil and energy are increasingly found up and down social classes across the world.

Once it is accepted that oil plays a profound role in the energy equation and our future, we need to know, can it ultimately be replaced? I believe so. We are not facing a doomsday scenario, but complacency is a danger. We need to know how much oil is left, where it is and how long it will last. We need to know how carbon emissions and global warming can be effectively reduced. This means all eyes to the oil, which will increase in importance and relevance. It is certainly not a sunset industry, just yet.

Given the far-reaching effect this has on all of us, as well as the environment, the debate has rightly moved outside the oil company office and the university campus and into mainstream media. Yet, very few accounts are available that outline the real energy challenges that face us and the generations to come.

This book is about those challenges and practical solutions. It is about the 'Hydrocarbon Highway'—what it is and where it is going. Incredibly, this highway has been built without an exit. The purpose of this book is to tell this story and make it known to the general audience so that society is better informed about oil and energy. In doing so, this book offers pragmatic views of oil, gas and what the energy of the future looks like considering economics, geopolitics and technology.

No single book can cover a subject in its entirety or address every type of reader. Consequently, I have aimed this book at three types of readers and it can be read either selectively or cover-to-cover according to the reader type, knowledge level and available time.

Business leaders, investors, analysts, policy-makers, media professionals and opinion formers are the selective readers, and I would recommend they read: *Chapter 4: The Fall of the Oil Curtain*, *Chapter 5: World Oil and Gas Production* and *Chapter 14: Exits From the Hydrocarbon Highway*. Whether you are a cynic or an advocate, I would ask everybody to read this book dispassionately, especially chapters 4 and 14.

Other selective readers are those that have a general interest in energy, oil and gas, business and geopolitics. They should read the chapters above, but should also include *Chapter 6: Properties, Players and Processes*, *Chapter 7: Pregnant Ladies and Fish Bones* and *Chapter 8: Extreme E & P.*

Particularly useful for filling the student-to-professional gap or for a new entrant to the industry as well as researchers, these people should read the book from cover-

to-cover. In this regard, the book should help accelerate learning and will be useful in overcoming 'The Big Crew Change'—a major human resources challenge facing the industry due to a large number of personnel near retirement age compounded by a lack of new entrants.

This book has distilled many years of experience and knowledge from colleagues and other sources and more than a decade of my own experiences. The endnotes provide further information for those that wish to pursue detail.

Setting out on this odyssey many years ago has meant I have 'rolled-up' my sleeves, donned a hard hat and boots to work offshore and in service facilities as well as polished my shoes to work with the executives. All this has meant experiencing 'feast and famine', testing exciting new technology and traveling to more countries than one should given the carbon consequences of air-travel. I owe much to the diverse set of people that I have worked with in service companies, oil companies, universities and research organisations, some of whom were not only solid colleagues but were an inspiration.

These include: Joao Carlos Placido, Antonio Lage, Joao Figueira, Jose Pires, Felipe Rego and Marcelino Guedes at Petrobras; Tariq Al Khalifah at King Abdulaziz City of Science Technology; Jaleel Al Khalifa, Muhammad Saggaf, Mohammad Hattab and Shaohua Zhou at Saudi Aramco; Alberto Valencia at Halliburton; Wayne Spence at the Society of Petroleum Engineers (SPE), Jorge Trujillo, David Jones, Carl Mountford, Kenneth Armagost, Colin Mason and John Thorogood (retired) at BP; Mike Killalea at the International Association of Drilling Contractors (IADC); John Lewis at ASRC Energy Services; Bill Pike at Hart Energy Publishing; Susan Ganz at Schlumberger; Mark Dykstra, Mark Anderson, Les Shale, Mauricio Figueiredo, David Schnell and David Curry at Baker Hughes; Maira Baitureyeva; Brian Moffatt; John Neal, Stuart Masson and Ken Ellis at NOV Andergauge; Stefan Miska at Tulsa University; and, finally, Jose Ignacio Montes at L10 who provided invaluable insight into renewable energy.

It is with sadness that I heard of the death of Chris Lenamond.

Special acknowledgements should be made to Richard G. Ghiselin, P.E., who edited the book; Professor Richard Dawe of the University of West Indies, Trinidad and Tobago, who also provided input on the early drafts; Dr AbdulAziz Al Majed,

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All the mistakes are my own, while much of the credit goes to these people.

We all caught the oil-bug.

Introduction

30 billion barrels annually and 85 million barrels consumed daily. That works out as roughly 90,000 barrels consumed by the time you have read this sentence.

Despite the current downturn total oil demand will grow to 113 million barrels per day in 2030 as illustrated by the reference case of the EIA IEO's World Energy Model.

I do not see alternative fuels playing a substantial role in the medium term; petroleum will continue to play a central part in energy needs. We know that demand for petroleum is increasing; we only need to look at China, India and wealthy Middle Eastern Countries. Meanwhile, consumers in the US and Europe will continue to sustain current levels of demand. Yet, supply has been reduced from key producers in Iraq, Nigeria and Venezuela. Future trading and globalisation have created more market volatility and this is worth considering.

For every physical barrel produced, 18 'paper' barrels are traded. On a daily average basis, the physical markets trade approximately US $7 billion of oil—the ceiling to this trading is physical production. In comparison, paper markets trade approximately US $126 billion daily and there is no ceiling to paper contracts. This is why

isolated incidents that would not have impacted the oil markets previously create an immediate impact on trading. Think hurricanes in Houston. Think Geopolitics.

Tomorrow's reserves holders are National Oil Companies (NOCs) and they are located in the Middle East, Former Soviet Union (FSU), Africa and Latin America. In order to find, access and produce these petroleum supplies we need technology. In certain applications today, the petroleum industry uses space-age technology. The use of this advanced technology is crucial to finding new oil and gas resources and developing them cost-effectively while protecting the environment.

Yet, in others the technology is rudimentary and there is scope for much improvement; for example, an average of 65% of all known oil and gas resources is left in the ground. Additionally, many prospective basins remain unexplored worldwide.

If we are to look beyond oil, we must first turn to technology and to our creative imagination.