BULLETIN

Corpus Christi Geological Society

and

Coastal Bend Geophysical Society

September 2021
ISSN 0739 5620

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P.O. BOX 1068* C.C.TX. 78403
2021-2022
www.ccgeo.org

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P.O. BOX 2741*C.C. TX. 78403
2021-2022

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Visit the geological web site at www.ccgeo.org

CCGS/CBGS JOINT MEETING SCHEDULE 2021-2022

September 2021

S	M	T	W	Th	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

October 2021

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24	25	26	27	28	29	30
31						

November 2021

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21	22	23	24	25	26	27
28	29	30				

2021-22 Membership Kickoff—Nueces Brewing Co. Downtown
Thursday, Sept., 9, 2021
5:30p.m.-til

Oct. 20th meeting at Crawdaddy's Downtown. Presenter: Barry J Rava- Exploration consultant to international companies. "Subtle Prospects in the 21st Century: Are They Relevant?"

December 2021

S	M	T	W	Th	F	S
			1	2	3	4
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26	27	28	29	30	31	

January 2022

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23	24	25	26	27	28	29
30	31					

February 2022

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13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28					

CCGS/CBGS Joint Meeting Schedule 2021-2022

March 2022						
S	M	T	W	Th	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

April 2022						
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10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

May 2022						
S	M	T	W	Th	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

Calendar of Meetings and Events Meetings and Events

Calendar of Area Monthly Meetings

Corpus Christi Geological/Geophysical Society…… Third Wed.—11:30a.m.
SIPES Corpus Christi Luncheons…… Last Tues.—11:30a.m.
South Texas Geological Society Luncheons…… Second Wed—noon San Antonio
San Antonio Geophysical Society Meetings…… Fourth Tuesday
Austin Geological Society…… First Monday
Houston Geological Society Luncheons…… Last Wednesday
Central Texas Section of Society of Mining, Metalllurgy & Exp…… 2nd Tues every other month in San Antonio

From the President's Desk

Rick Paige

A Truly New Season

Welcome to the first Bulletin issue of the Corpus Christi Geological Society's 2021-22 season! I hope last season's unprecedented pandemic-induced upheavals didn't impact you too severely. It appears now the worst is over and, while some localized reversals of the infection downtrend are inevitable, the arc of this disease across the U.S. is in overall decline. It's a new season – in more ways than one.

A large component of the new season is the return to live, in-person, monthly technical luncheon meetings! And we have a new venue, Crawdaddys Downtown restaurant. Our last venue, the upstairs meeting room at Water Street Restaurant, is remodeling and unavailable, so Dawn Bissell and I embarked on a search for our new location. The last place we checked out, almost on a whim, ended up as our final selection. Turns out Crawdaddys has a private meeting room, with a top-end A/V set up. Who knew? Crawdaddys also offers another surprise, which I won't spoil here. To find out, look for the meeting announcement in this issue or watch for the email.

I can tell you that in October, the first luncheon meeting of the season, our own Barry Rava will be speaking to us on 'Subtle Prospects in the 21st Century', an all-encompassing discussion that will cover the breadth of the energy industry, and the current role of the independent . And again this season,

student attendance at the meetings is free due to the generous sponsorship of Brent Hopkins at Viper Exploration, Ltd; Austin Nye at Nye Exploration; and Frank Cornish at Imagine Resources. Thank you all for continuing to support our local college students.

In another return to normal, our Society is again engaging in social events. First up was the 11th annual CCGS Fishing Tournament, held July 29th-30th. Once more Leighton Devine and Patrick McCollough put on a wonderful event. Despite cancelling the year before due to the pandemic (or perhaps because of), turnout was strong. The Captain's party, and competition day were fun, and the tournament was able to raise over $2500 for the CCGS college scholarship fund. Thanks Leighton and Patrick for getting us back on the path to "normal" in such a fun and rewarding way!

Next up is the annual Kickoff event, September 9, at the Nueces Brewing Co., from 5:30PM till whenever. We're keeping this year's Kickoff simple, there is no event charge and no RSVP! All we ask is you pay your annual dues, which you can do at the door, or, alternatively, online and, as always, by mail. There will be BBQ available for purchase, and of course, delicious beers brewed onsite. Look for the announcement in this issue and by email.

Following that, the Corpus Christi Oil Man's Tennis Tournament is scheduled for October 23rd -24th at the HEB Tennis Center. While not a CCGS hosted event, it is a fun time that generously donates proceeds to our University Student Scholarship Fund. More information can be found at www.ccott.org.

Last season (2020-21) will be forever remembered as the "Year of Zoom". I'm glad that's behind us, although we're probably not finished with Zoom presentations completely. The "Zoom season" did open our eyes to the wonderful potential of hosting fabulous speakers we couldn't otherwise bring to Corpus Christi. So we will continue to keep our eyes open for suitable material. And that search includes you, dear member. If you run across an impressive presentation, please forward a recommendation to anyone on the board, and we'll see about setting up a Zoom meeting.

Speaking of this season's board, I'm pleased to announce that most members from last season, including me, have agreed to serve another term. My deep thanks to Sebastian Wiedmann, Treasurer; Emily Olson, Secretary; Frank Cornish, Counselor 1; and B.J. Thompson, Counselor 2. I also want to thank our committee chairs for their dedication to the Society. People, without these organizers, we have no CCGS! My deep gratitude to all.

You may have noticed the office of Vice President is vacant. The main duty of V.P. is to find luncheon speakers, and this year's calendar is already partly filled, so much of the work is already done! If you would like to have the ultimate say in selecting the presentations we get to hear, this is the job for you! And it may help to know you only have to confirm the speaker's appearance. Wes Gisler and Will Graham, our arrangement chairs, and Sebastian Wiedmann, our treasurer, take care of the RSVPs and venue. At the risk of repeating myself, without volunteer help from within our membership, we don't have a Society. Please contact me for more information.

Enough with the "new normal"! This season will be more of the "old normal", but only when you get involved and participate. It'll be fun, enlightening, and rewarding. It's truly a new season!

Corpus Christi Geological Society

2021-22 Membership Kickoff

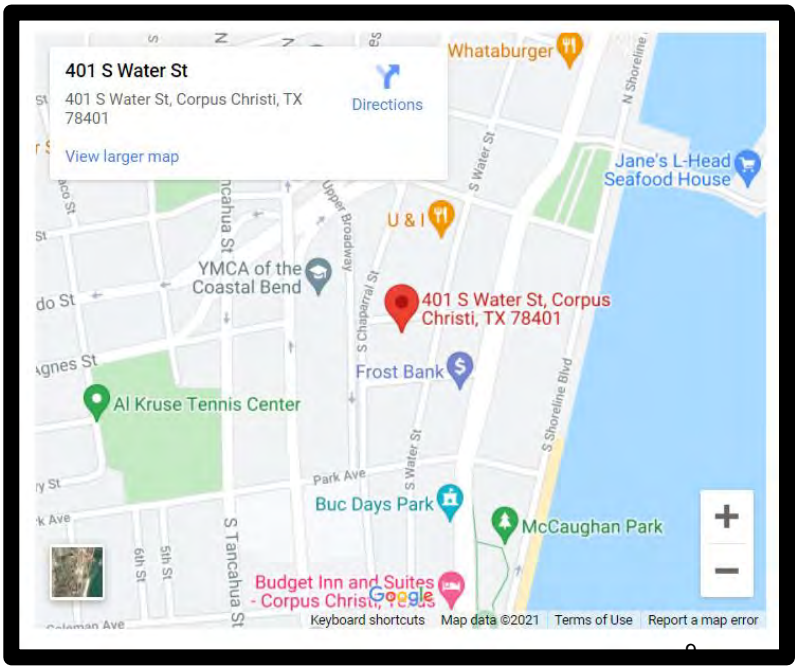
Nueces Brewing Co. Downtown

Thurs. Sept. 9, 2021 – 5:30 pm – 'til

Meet & Greet/Come & Go

No RSVPs, BBQ and snacks available

Please pay dues (still just $25) online or at this event.



www.ccgeo.org

CORPUS CHRISTI GEOLOGICAL SOCIETY
1936
"ALONG THE GOLDEN CRESCENT"

The Return of Luncheon Meetings

Welcome back to in-person lunch meetings! We have a new venue this season:

317 Mesquite St

Crawdaddy's offers a private meeting room, with a high-end A/V system, and of course, delicious Cajun and Creole Seafood. Oh, and one more thing....

FREE BEER!

This perhaps requires a little explanation. Crawdaddy's does not have a liquor license, nor does it want one. In a quirky twist of liquor laws, you can give away beer for free without a license, you just can't sell it. So, Crawdaddy's gives away a couple of different domestic beers on tap to entice their patrons. You will be limited to two.

Also, because they do not carry a liquor license, patrons are allowed to BYOB. Set-ups are provided at no charge (ok, it's Solo cups. Hey, it's a Cajun thing!). So, if you prefer wine with your meal, bring the bottle of your choice!

Would you like to sponsor a "Bring Your Own Bar"? Contact us at arrangements@ccgeo.org

So, please plan on joining us this season as we return to live, in-person technical luncheon presentations.

Corpus Christi Geological Society &
Coastal Bend Geophysical Society

Attention ALL Current & Former CCGS/CBGS Members,

It is a new day and really a NEW WORLD in 2021!

After enduring the COVID-19 shutdown, our Society looks forward to a wonderful year with in-person meetings, live speakers, and renewed activities.

We hope that you will renewal or re-join if you've let things lapse (no worries, many have!).

Here are a few highlights for the 2021-22 Season.

- **Beer & BBQ Kickoff on September 9 at Nueces Brewing Company Downtown. 5:30 till ?.**
- **Luncheon Meetings, Oct. through May, starting October 20.**
- **Special Speakers and Events.**
- **Pay dues ONLINE* with No FEE!**
- **www.ccgeo.org (click renew tab) - or -**
- **https://corpus-christi-geological-society.square.site**
- **Pay dues at the Kickoff with credit card, cash, or check *(same $25 bargain!)***

The CCGS, CBGS , our industry, businesses, colleges, and community have been through a lot this past year. We look forward to your membership renewal and commitment to our future as a Society.

Dues can also be mailed to CCGS, c/o Headington Energy, 500 N. Shoreline Blvd., Ste. 902 N, Corpus Christi TX 78411

Questions? – Contact Randy at membership@ccgeo.org or 361-885-0110

CBGS President's Letter

CBGS Board 2020-2021

President- Dr. Subbarao Yelisetti
Vice President- Dr. Mohammed Ahmed
Secretary/ Treasurer-Charles Benson

CBGS Scholarships

The Coastal Bend Geophysical Society (CBGS) has donated $10,000 to the Department of Physics and Geosciences, Texas A&M University-Kingsville in support of the multidisciplinary Petrophysics Graduate Program that has been requested. These funds will be used as scholarships in attracting quality graduate students.

The board awarded three scholarships of $2,000 each to undergraduate geophysics majors from Texas A&M University-College Station, University of Houston and Texas A&M University-Kingsville. We will be awarding the scholarships again this year.

Scholarship Requirements

Criteria for awarding the Scholarship from Coastal Bend Geophysical Society of Corpus Christi, Texas:

1. Scholarships are open to undergraduate or graduate students.
2. Must have declared major in Geophysics, or Geology with a concentration in Geophysics or Petrophysics.
3. Preference is given to students attending Coastal Bend schools (TAMU-K, TAMU-CC and Del Mar College), then to Coastal Bend natives attending other universities.
4. Must have a GPA of at least 3.0 and be in good standing with the school.
5. Must make effort to attend a Coastal Bend Geophysical Society Meeting in Corpus Christi Texas after being awarded a scholarship to be recognized by the society.

News

- According to Baker Hughes Co, the oil and gas rig count is 500 in the week of August 13, 2021, which is the highest since April 2020. This also reflects a 105% increase compared to this time last year.
- At the time of writing this report, the U.S. crude futures were trading at ~$68 a barrel.
- The expected decline in crude production is 160,000 bpd in 2021 to 11.12 million bpd, as reported by Scott DiSavino on reuters.com.
- The U.S. crude production is projected to average about 11.8 million bpd in 2022.

CBGS Business

CBGS currently has 43 active members, 4 honorary members, and 40 student members. Raised $1,450 towards student scholarships through membership revenue this past year.

CBGS workshops/talks

CBGS recently co-hosted the Ocean Discovery Lecture entitled "*Hunting the Magnetic Field through Ocean Drilling"* by Dr. Lisa Tauxe on Dec 1, 11 am-12:30 pm.

CBGS recently co-hosted a talk entitled "*Links Between Sediment Properties and Megathrust Slip Behavior – the Cascadia Example*" by Dr. Shuoshuo Han on March 1st at noon.

CBGS is looking forward to offer workshops/talks in the future. Topic/speaker suggestions are welcome. Email your suggestions to Subbarao.Yelisetti@tamuk.edu

New Degree Tracks at TAMUK and Graduate Scholarships

- Texas A&M University-Kingsville (TAMUK) started its first cohort of MS Petrophysics program in Fall 2018. If you are interested in joining this program in Spring 2022, please contact the graduate coordinator for MS in Petrophysics, Dr. Subbarao Yelisetti at Subbarao.Yelisetti@tamuk.edu.
- The Department of Physics and Geosciences at TAMUK is offering competitive scholarships for MS Petrophysics students. For additional details about the program and scholarships, please visit the website:

  https://www.tamuk.edu/artsci/departments/phge/phys/academics/gp.html
- **BS degree in Geophysics, Minor in Geophysics and Certification in Geophysics** offered at Texas A&M University-Kingsville since Fall 2017. Interested students can contact Dr. Subbarao Yelisetti (Subbarao.Yelisetti@tamuk.edu) for additional information.

Education/Events

-SEG

SEG 2021 annual meeting will be held in Denver, CO from 26th Sep- 1st Oct. See https://seg.org/AM/ for additional details.

See https://seg.org/Education/Lectures/Distinguished-Lectures for information about upcoming SEG distinguished lecture in Houston and other locations.

See https://seg.org/Education/Lectures/Honorary-Lectures for SEG honorary lecture locations in Texas.

-AGU

2021 Fall AGU annual meeting will be held in New Orleans, LA from December 13-17th, 2021. https://www.agu.org/Fall-Meeting

Monthly Saying

Need for oil pioneers ... "The pioneering spirit should now lead American capital and American engineering to seek new sources of petroleum supplies in foreign fields for the benefit of the America of tomorrow. Nor can this be done without popular support inspired by general appreciation of oil as our servant, a servant that works 24 hours a day and 7 days a week" -From National Geolgraphic Article February 1920.

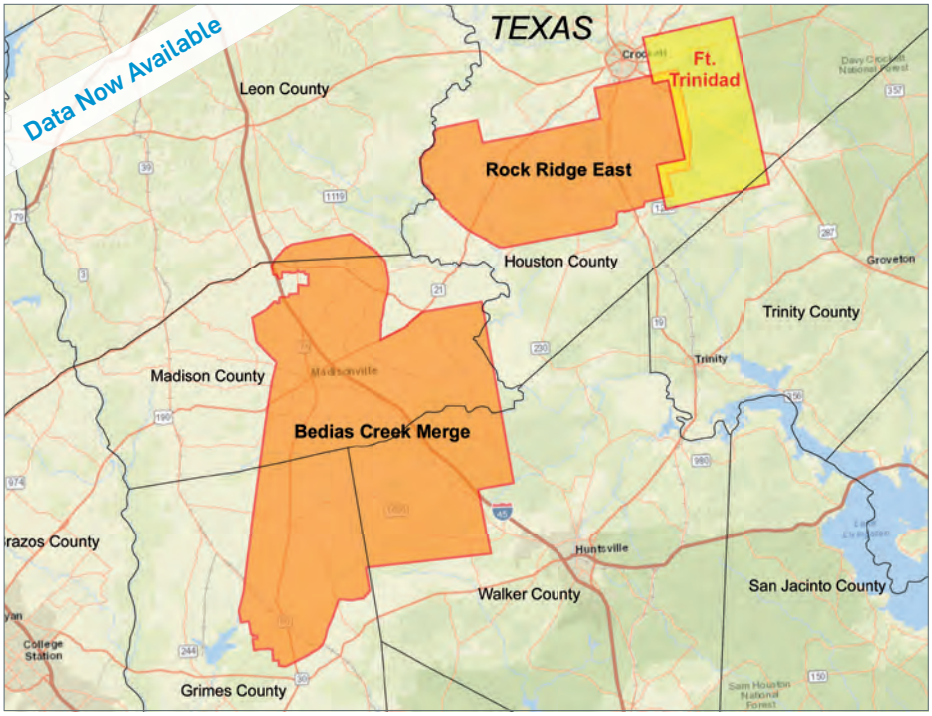
Monthly Summary

Texas Oil and Gas Info	Current Month	Last Month	Difference	
Texas Production	**MMBO/BCF**	**MMBO/BCF**	**MMBO/BCF**	
Oil	136.3	143.3	-7.0	April
Condensate	19.9	20.6	-0.7	April
Gas	848.3	864.4	-16.1	April
	Current Month	**Yr to date - 2021**	**Yr to date - 2020**	
Texas Drilling Permits	779	4793	6374	July
Oil wells	172	1144	1564	July
Gas wells	65	369	439	July
Oil and Gas wells	508	3095	3998	July
Other	7	51	125	July
Total Completions	1161	7567	20149	July
Oil Completions	836	5529	15838	July
Gas Completions	325	2038	4311	July
New Field Discoveries	0	9	17	July
Other	427	2768	7933	July

Subbarao Yelisetti
President, CBGS

YOU'VE ARRIVED

New Ft. Trinidad 3D Survey
Houston and Trinity Counties, TX



CGG continues to expand its East Texas footprint with high-quality 3D projects while illuminating the stacked pay formations.

Data is already available from our Bedias Creek Merge and Rock Ridge East projects. Orthorhombic PSTM from our newest project Ft. Trinidad is also now available.

The right data, in the right place, at the right time

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CGG
Passion for Geoscience

SCHOLARSHIP AWARDS APRIL 2021

The Corpus Christi Geological Society awarded $6,350 in scholarships to 8 local students from TAMU-CC and TAMU-K in April 2021. These scholarships are to be used for the Summer and Fall 2021 semesters. Congratulations to:

TAMU-K
Tahiry Andriamiharisoa, BS Geoscience
Hailey Smith, MS Petrophysics

TAMUCC
Meghan Bygate, BS Geology
Travis Chudej, BS Geology
Skylar Meehan, BS Geology
Katilyn Parker, BS Environmental Science
Michael Haley, MS Environmental Science
Derry Xu, MS Marine Geology

Normally, awards would be presented during the regularly scheduled April meeting. Since the April and May meetings were cancelled, we did not have the honor of meeting these students in person. However, one of our past scholarship recipients, Ryan Turner, gave the technical presentation in April; **"Investigating fault control on reservoir and spatial distribution of hydrocarbons using 3D seismic data and well logging data: A case study from the Oligocene Vicksburg Formation, Brooks County, Texas"**

The CCGS Scholarship fund receives donations from member contributions during the dues renewal in the Fall, the CCGS Fishing Tournament, and the Corpus Christi Oilman's Tennis Tournament. We always appreciate the hard work of the organizers – Leighton Devine for the fishing tournament, and Brent Hopkins for CCOTT. In the past, proceeds from the CCGS Golf Tournament (organized by Fermin Munoz) and the CCGS Pub Crawl (organized by BJ Thompson) benefitted the scholarship fund. Hopefully, we will be able to host these events again in the near future. All donations are vital to allow for the funding of scholarships for our local students. Every donation is very much appreciated. Thank you for your support.

The Scholarship Committee members are:
Brent Hopkins, Treasurer; Rick Paige, CCGS President
Casey Mibb, Lou Lambiotte, and Breanna Wells, Members

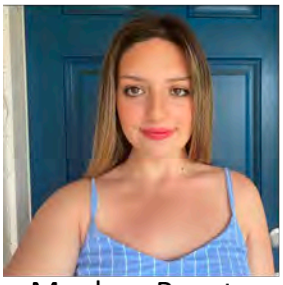
Dawn S. Bissell
Scholarship Committee

TEXAS A&M UNIVERSITY
KINGSVILLE

Tahiry Andriamiharisoa

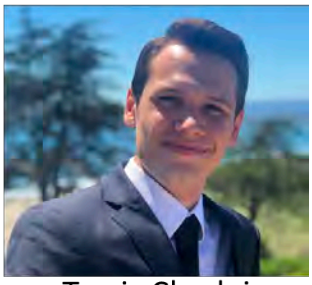
Hailey Smith

TEXAS A&M UNIVERSITY
CORPUS CHRISTI

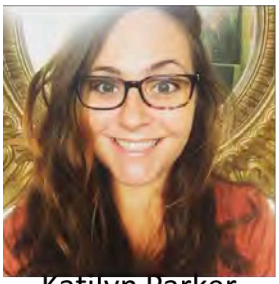


Meghan Bygate

Skylar Meehan



Travis Chudej



Katilyn Parker

Derry Xu

Michael Haley

CORPUS CHRISTI GEOLOGICAL SOCIETY
COASTAL BEND GEOPHYSICAL SOCIETY

LUNCHEON MEETING ANNOUNCEMENT

October 20, 2021

Location:	**Crawdaddy's Downtown, 317 Mesquite St. CC, TX 78401**
Student Sponsor:	**Viper Exploration, Nye Exploration, Imagine Resources**
BYOB Bar Sponsor:	**Available**
Time:	**11:30 AM Bar, Lunch follows at 11:45 AM, Speaker at 12:00 PM**
Cost:	**$30.00 (additional $10.00 surcharge without reservation: NO SHOW may be billed.); FREE for students WITH reservation (subsidized by our generous sponsors!).**
Reservations:	**Please RSVP by 4PM on Friday Oct. 15th before the meeting!**
	Email: arrangements@ccgeo.org

Please note that luncheon RSVPs are a commitment to Crawdaddy's Downtown and must be paid even if you can't attend the luncheon.

SPONSORSHIP OPPORTUNITIES ARE AVAILABLE! IF YOU WOULD LIKE TO SPONSOR, PLEASE CONTACT US AT:

arrangements@ccgeo.org

NYE
802 N. Carancahua, Suite 1840
Frost Bank Plaza
Corpus Christi, TX 78401
www.nyexp.us

Imagine Resources, LLC

VIPER EXPLORATION, LTD

CCGS Luncheon Presentation – Wednesday, October 20, 2021
Crawdaddy's Downtown

Subtle Prospects in the 21st Century: Are They Relevant?

Barry J Rava

Texas Professional Geophysicist 2515 & Texas Professional Geologist 2516
SIPES 3198

Abstract:

This paper briefly discusses a wide array of topics: the state of the energy industry, the demand for hydrocarbons, macroeconomics, the exploration cycle and prospect flow for a small shop, and the development, economics, and sale and drilling of a subtle trap in the 21st century. The origination of the prospect will be viewed from geological and geophysical perspectives. Sales efforts and anecdotal evidence from other prospectors' experiences will be discussed. Economic comparisons to other types of prospects and finding costs will be reviewed. Drilling-timing, Up-front, seismic, drilling, completion and hookup costs will also be discussed for several recent structural prospects.

Biography:

Barry J. Rava has over 40 years oil and gas industry experience. He has a BS, cum laude with high honors in Geology from Hofstra University, and a MS in Planetary Geology and Geophysics from the University of Pittsburgh. He is an exploration consultant to international companies and the independent community, a licensed geologist and geophysicist in Texas and President and founder, in 1996, of Icarus Oil and Gas, Inc. He has also founded 3 other companies that operate based on the relative risk and geographic location of various projects. He has held various board positions with SIPES (past President, Houston chapter and national), Coastal Bend Geophysical Society (past president), Geophysical Society of Houston (past treasurer), Corpus Christi Geological Library (past Treasurer) and Gulf Coast Geological Library (past president). He has authored and co-authored articles in planetary geophysics and given guest lectures on the oil and gas industry. He has memberships in: SIPES, SEG, AAPG, IPAA, CCGS, CBGS, HGS and GSH.

SPONSORS

Energy 101: A Rational Approach Towards Our Energy Future

J.A. Pacht

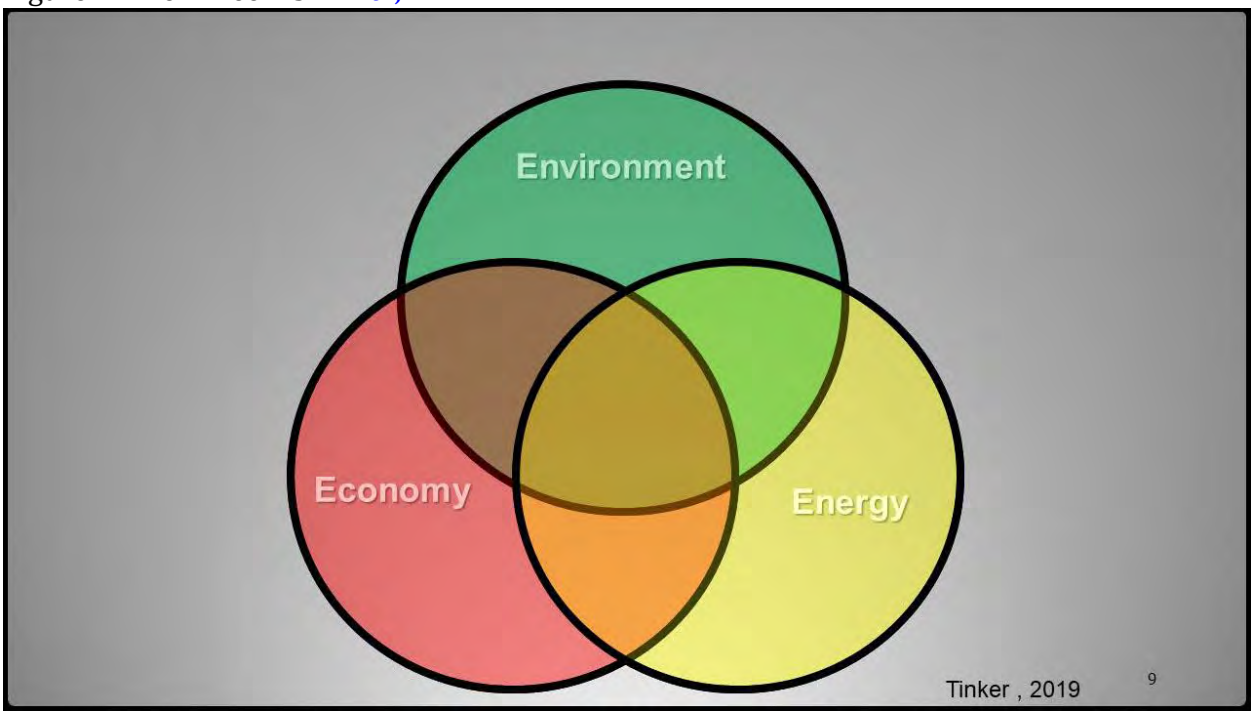
Introduction

How much energy, in watt-hours, does every man, woman and child in the U.S. use in a year? This is probably not a question you've thought about. So, let's think about it! You can use the LED light bulb above your head as a guide. It likely consumes seven watts per hour. What is your answer? 100,000, 1,000,000, 10,000,000? If your answer was any of these numbers, you are wrong. Every man, woman and child in the United States uses over 100,000,000 watt-hours of energy every year. Don't feel bad if you didn't get the answer correct. I have posed this question to numerous energy professionals over the past two years, and few get it right.

So why is the number so big? Energy is in everything we do. For example, food for a family of four for a week takes the energy equivalent of 22 gallons of gasoline to grow, transport, and sell. A single pair of blue jeans takes the energy equivalent of three gallons of gas to create the raw materials, manufacture, transport, sell, and wash (Tinker, 2012). When we think about energy, we might think about filling up our cars with gasoline. But we don't think about how much energy was used to build the car or build and maintain the roads we drive it on. If energy is in everything we do, then the **COST** of energy is in everything we do. Most decisions made regarding energy worldwide are made based on cost. Increases in the cost of energy affect every part of the economy and those increases hit the poor the hardest.

When we talk about energy, we must talk about what Tinker (2019) calls .The Three E' s These are energy, the environment, and the economy. The E's are inextricably linked (Fig. 1). We cannot modify one E.', without affecting the other two.

Figure 1: The Three E's *Tinker, 2019*



Most of the discussion regarding energy, the first 'E.', focuses on fossil fuel sources vs. wind and solar. But nuclear will have an important role to play in our energy future. Discussion regarding the environment, the second 'E.' has focused on CO2. However, we also need to talk about land use, habitat reduction and the effects of mining in ecologically fragile areas. Finally, we come to the economy, the third and most important .'E .'. Energy poverty is a huge problem, not only worldwide but even in developed countries such as the U.S. In the United States, 20 percent of our population has had to choose between energy, and food or medicine (EIA, 2018;NPR, 2018). Most countries will not compromise their economies to reduce carbon emissions. Our decision to do so will increase energy poverty in the United States.

The effect of the shale boom on the economy of the U.S has been nothing short of spectacular. From June 2009 to June 2019, the net fixed investment in oil and gas extraction represented more than two-thirds of total U.S. industrial development and accounted for 40 percent of the growth in U.S industrial production. It has resulted in the creation of 2.8 million jobs and will result in approximately 1.6 trillion dollars in Federal and state revenue from 2012 to 2025 (Yergin, 2021). But we live in a competitive world. If we walk away from those gains and elect to increase the price of energy by moving to more expensive renewables, we damage our economy. We decrease our ability to compete with countries such as China and India that intend to continue to burn coal. We cannot talk about energy as if it is the only .'E .'. Neither can we talk about the environment as if it is the only 'E.'. We must deal with all three of them.

Energy Types

Today the world runs on fossil fuels. As of 2019, 89% of the world's energy came from fossil fuels. Only 4.5% came from renewables (Fig. 2). To understand energy, we must first ask ourselves: What does an energy source need to be? There is no perfect energy source. We need

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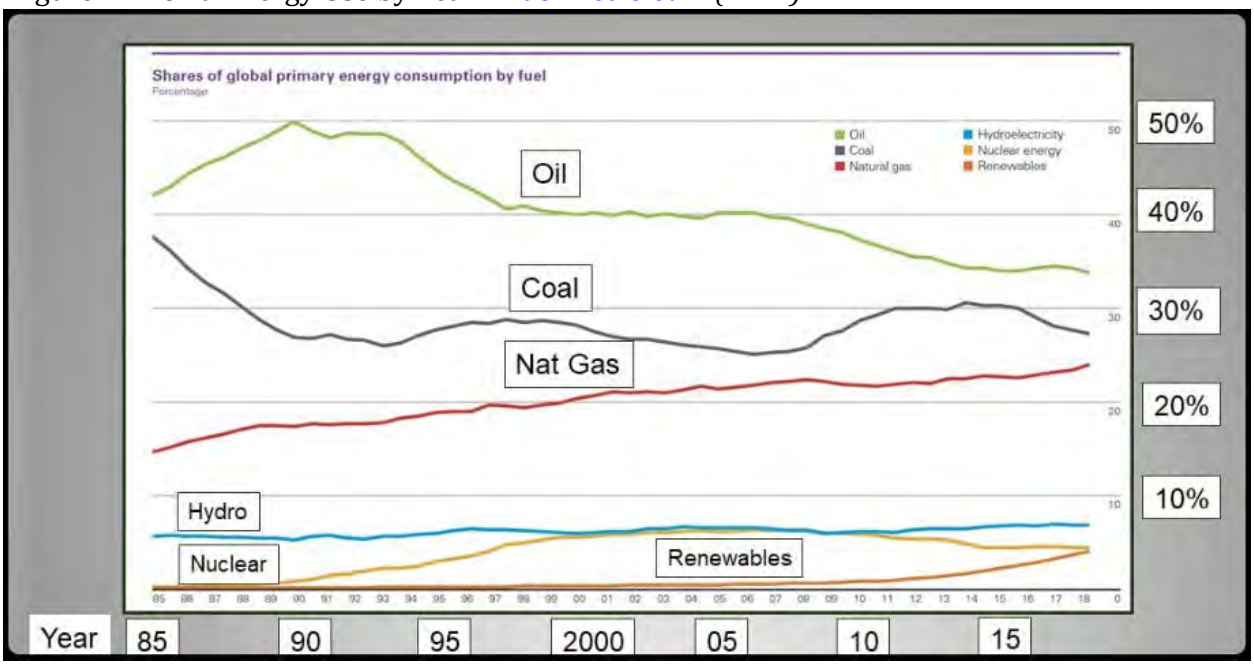
to understand how different energy sources are used and the advantages and disadvantages of different energy sources.

1. An energy source needs to be affordable. Energy that is not affordable is not sustainable. Government subsidies can make an energy source appear more affordable, but they cannot be sustained forever.
2. An energy source needs to be available. Fossil fuel sources are easily transportable. Other sources have greater challenges.
3. An energy source needs to be reliable. Solar and wind are intermittent sources of energy. The sun does not always shine, and the wind does not always blow. Grid storage batteries deplete in approximately four hours and can only address short-term fluctuations. Large batteries are also expensive and the costs for those batteries will be passed on to consumer.
4. All energy sources affect the environment in some way. This includes, but is not limited to, CO2. (Tinker 2012).

With these factors in mind, we can look at the various energy sources we currently use.

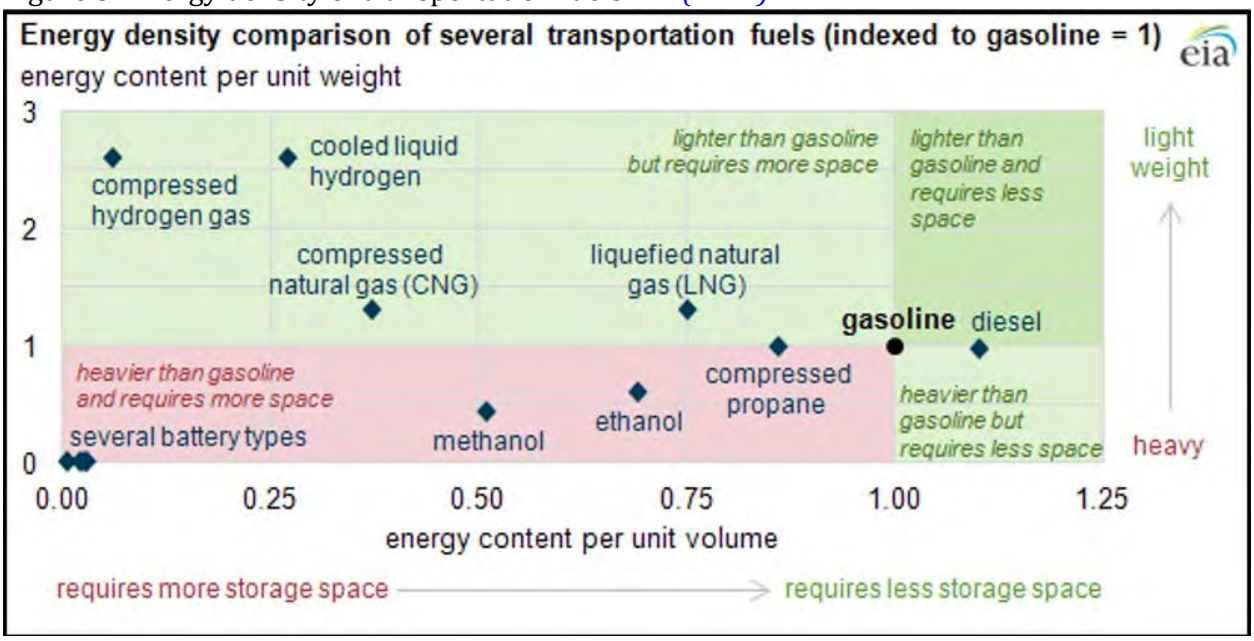
Figure 2: World Energy Use by Year *British Petroleum (2019)*



Transportation - Oil

Oil is dominantly used as a transportation fuel. We use it because it works. Figure 3 shows the energy density of various types of transportation fuels. Batteries are very heavy relative to the amount of energy that they produce. Combustible gases are light but produce small amounts of energy per unit volume. Gasoline and diesel are in the 'sweet spot.'. A single gallon of gasoline can transport four people, in comfort, for 58 miles at 60 mph (Toyota Prius Specifications, 2021).

Figure 3: Energy density of transportation fuels *EIA (2013)*



Today there is a strong push to transition from internal combustion (IC) engines to electric cars. Some states in the U.S. and countries are limiting future sales of cars powered by IC engines. What are the effects of this going to be? Many who live in single-family dwellings and who only use a car for commuting will adjust quite easily. A Tesla Model 3 can be fully charged in six to thirty hours using a 220v outlet. The variations are dependent on the amount of amperage. However, it takes four days to fully charge the same Tesla Model 3 using 110v power. This makes recharging at home challenging for those who live in apartments and who may have to park several hundred feet away from their apartment doors. It is simply not practical to run a several hundred-foot extension cord from their apartments to their cars for a period of days. Commercial superchargers are few and far between in many states and countries and they take around 45 minutes to fully recharge an electric car. If there are cars ahead of you it is going to be a long wait**.**

Electricity

All the other sources of energy I discuss are used largely to generate electricity. Electricity is unique. It is the only commodity that is consumed the moment it is created. Today most of the energy used for electricity in the world comes from fossil fuels. 38.2% comes from coal and 23.2% comes from natural gas. Renewables make up 8.4% and solar is less than 2% (Fig. 4)

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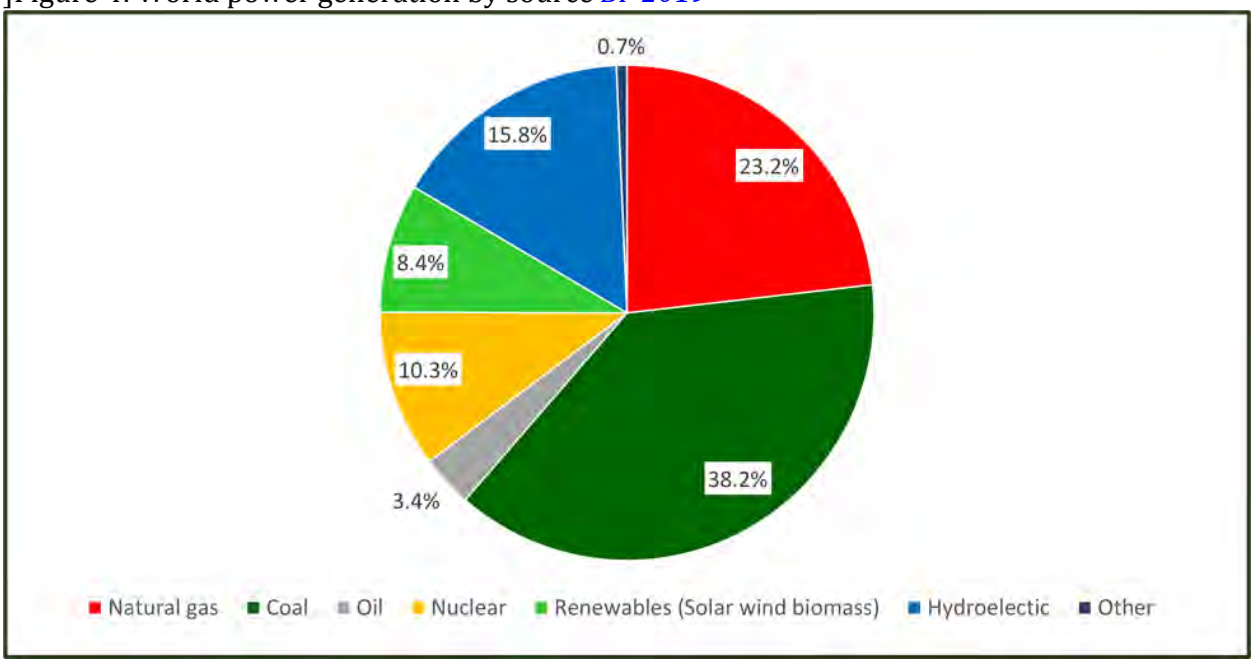
]Figure 4: World power generation by source *BP 2019*



Let's look at the pros and cons of each of these sources:

Coal

Coal is available, affordable, and reliable. It is the most abundant and cheapest energy source in the world and is the easiest to mine and process. Therefore, coal is the dominant energy choice of developing countries and Asia. The amount of coal consumed for energy has increased over 5X in Asia during the past 30 years. In fact, over 50% of the coal used for electricity is consumed in China. China currently has 993 gigawatt-hours (GwH) of coal power capacity and is currently building over 300 new coal plants which will generate an additional 259 GwH (BBC, 2018). The U.S. currently has 244 GwH of coal fired capacity, down from 317 GwH in 2011. Europe also shows decreasing use of coal. Coal produces 2.08 pounds of CO2 per kilowatt hour (KwH), making it a major contributor to greenhouse gases.

Natural Gas

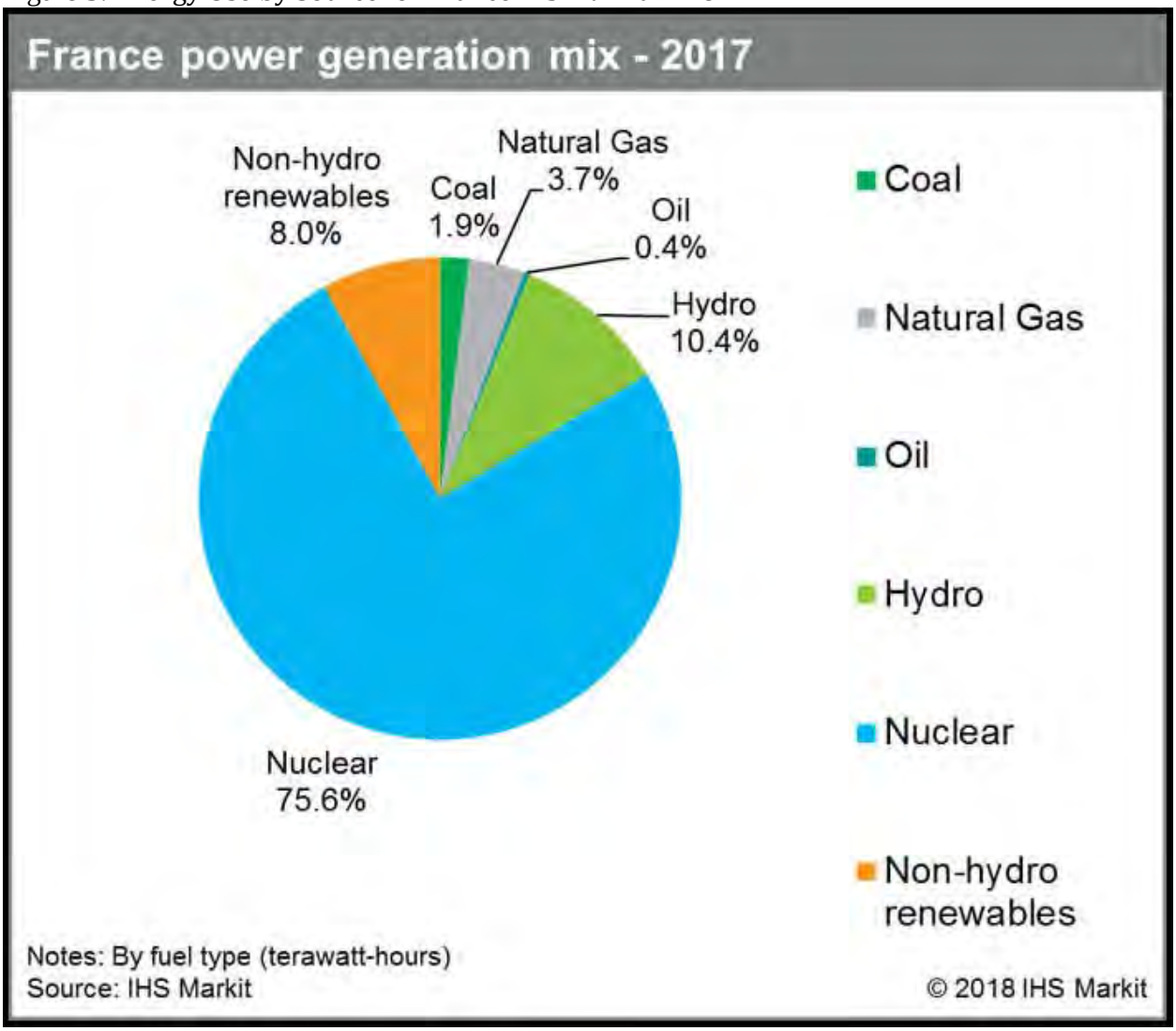
Natural gas is also abundant, affordable, and reliable. The United States has a network of pipelines to easily transport it from the well to the consumer. Natural gas is also relatively clean. It emits 58% of the CO2 that coal emits (1.12 pounds. CO2 per KwH). There has been much discussion in the press about methane emissions, but methane is only resident in the atmosphere for 10-12 years. In addition, methane emissions have decreased by 24% as gas production has increased by 19% and oil production by 65% from 2011 to 2017 (EIA 2018, EPA, 2018). Methane is a more powerful greenhouse gas than CO2, but the volumes released by anthropogenic processes are very small relative to CO2. Therefore, its impact on global warming is minimal relative to CO2. The U.S has greatly reduced its own CO2 emissions by switching from coal to gas. Conversion of coal-fired power plants to natural gas-fired plants has led to a 14% reduction in CO2 emissions since 2005 in the U.S. (EIA, 2020). New technologies

are also being developed to sequester CO2 emitted from natural gas power plants in a cost-efficient manner.

Nuclear Power

Nuclear power is available, affordable, reliable, and clean. Nuclear has it all. There is zero pollution of any sort. France gets 75.6% of their electricity from nuclear power and it is the largest electricity exporter in the world. They have solved the storage problem and they recycle 96% of fissionable material. France will be the first major country to produce all their electricity without using any fossil fuels. As of 2017, only 5.6% of their electricity was derived from coal and natural gas (Fig. 5).

Figure 5: Energy Use by Source for France *IHS Markit 201*8



Sadly, it has been politically very difficult to build new nuclear plants in the United States. Punitive regulations have made it very difficult to build reactors that can supply electricity at a reasonable rate. Two plants have recently added reactors and one small new plant is working

its way through the process. However, many reactors are reaching the end of their service life and are being shut down. The average age of nuclear power plants in the U.S. is over 40 years. Many plants are being decommissioned and the energy created by nuclear reactors in the U.S. has declined. Reactors in France are newer, safer, and far better. We are also beginning to see major new innovations in reactor design. These include small modular reactors and thorium reactors.

Biomass

Biomass is the dirtiest fuel available. It puts 9% more CO2 into the atmosphere than coal along with other many other pollutants. It is a major cause of respiratory diseases in the undeveloped world, where it is commonly used for cooking. Biomass is sold as a 'green fuel.' using highly flawed logic. We are told that a tree absorbs CO2 during its lifetime so when it is burned the there is no net CO2 added to the atmosphere. What no one asks is: What if the tree is not burned? When plants decay naturally much of the carbon is not oxidized and turned to CO2. Instead, it is reabsorbed into the ecosystem due to consumption by organisms such as bacteria, insects, and fungus. Good soil is filled with organic material derived from decay of older plants. Carbon is also stored in wood that is harvested and used to build homes and furniture.

Hydro Power

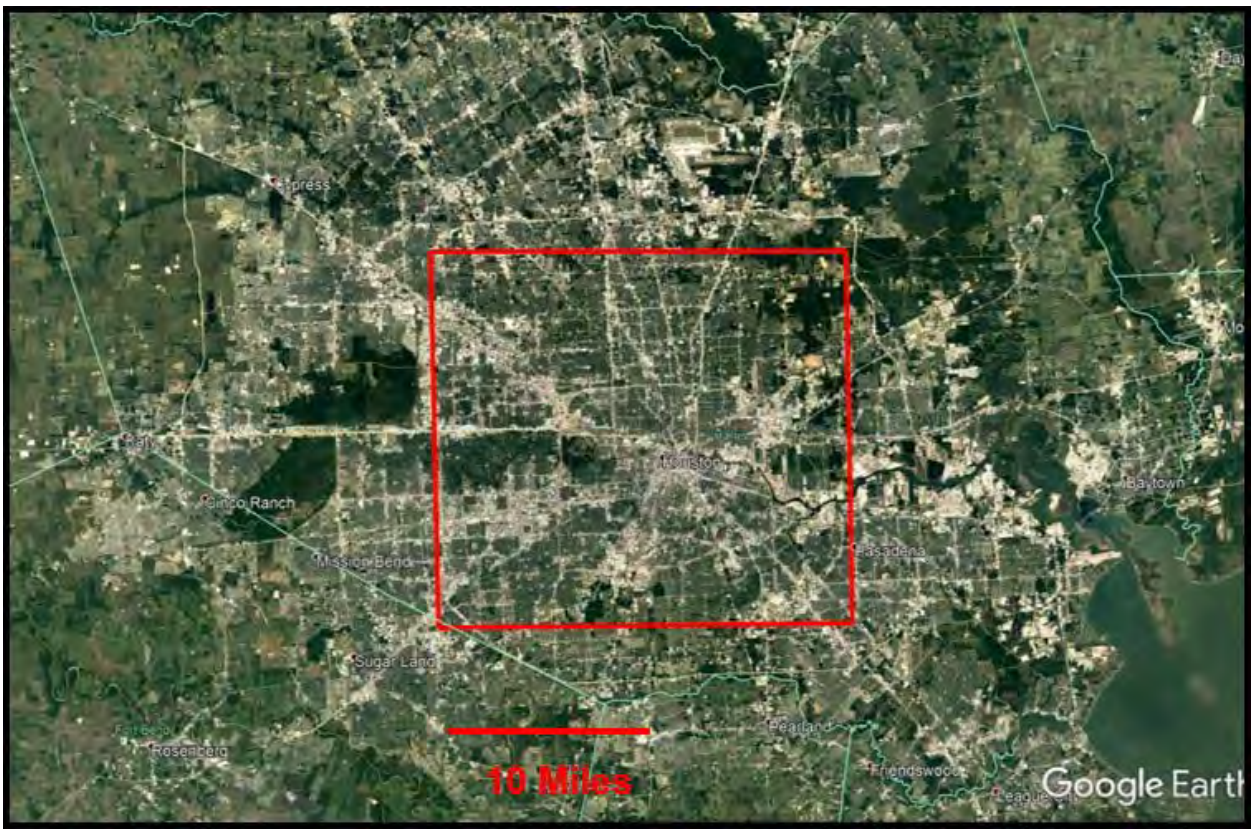
Hydro power is great where you can have it. It is clean, affordable, and reliable. However, you need proximity to large rivers with steep gradients and lots of rain. The state of Oregon, for example, has these assets and gets 43% of its electricity from hydro power. However, many areas in the world do not have the proper topography or climate. In addition, dams may interfere with commerce and cause environmental damage.

Wind and Solar

Wind and solar both have the same advantages and the same disadvantages. They are both clean energy sources. But they are more expensive that other sources, even with today's government subsidies. Both are intermittent energy sources. Wind power only works when the wind blows. Solar power only works when the sun shines. Therefore, they are not reliable. Wind and solar are also both 'low density.' energy sources, so centralized solar plants and wind farms require a large footprint. They require low value real estate in remote areas. Finally, a massive infrastructure investment in high tension lines and power substations is necessary to get power from these plants to population centers.

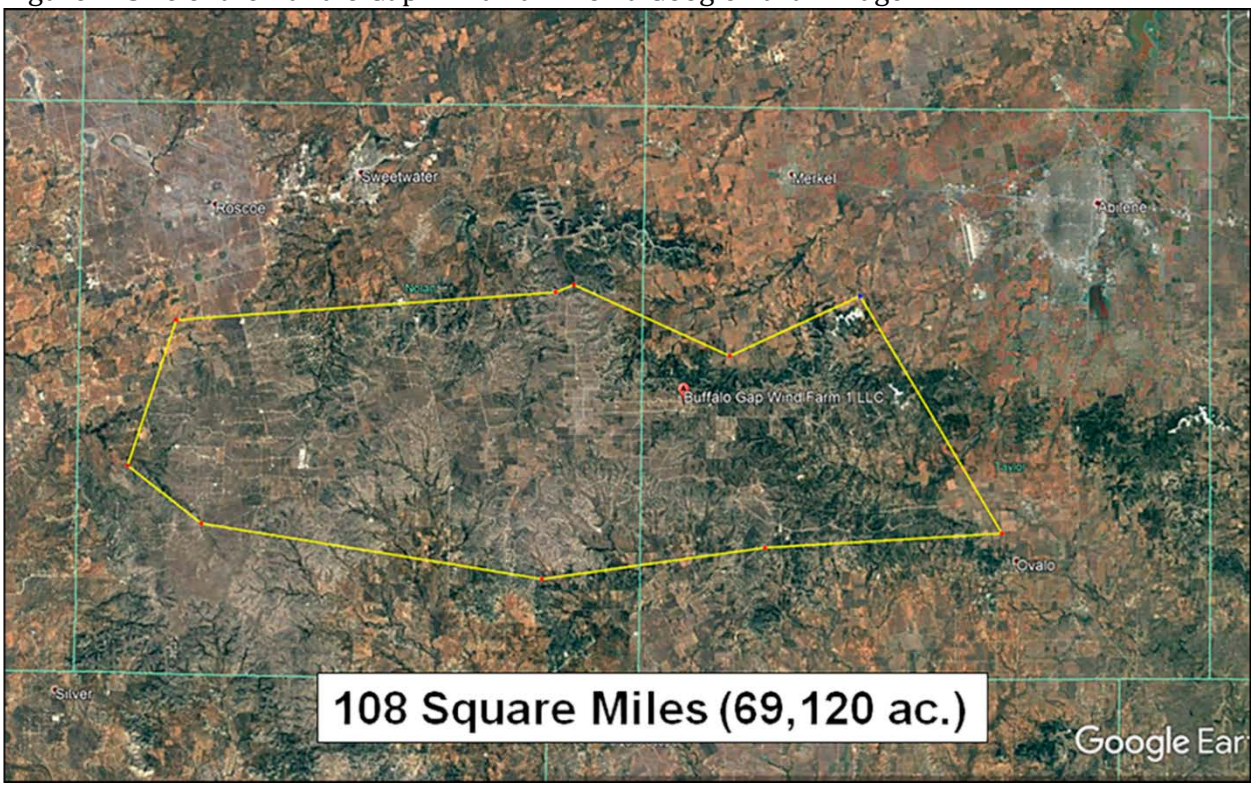
Wind and Solar footprint: *How much real estate do these energy sources require?* Using the Ivanpah Solar plant in the Mojave Desert as a guide, I calculated how big a solar facility would have to be to power Greater Houston. The Ivanpah Solar Plant is 3,600 acres in size and supplies electricity to 140,000 households. Greater Houston has 2,324,758 households and a lesser amount of solar radiation. The solar radiation at Ivanpah is 7.4 kW h/m day. In Houston, it averages 4.5 kW h/m day. I also had to consider the fact that residential use of electricity is only 38% of total use. Therefore, a centralized solar plant big enough to power Houston would have to be 257,996 acres or 403.12 sq. miles in size. That is nearly the size of Houston itself (Fig. 6).

Figure 6: Red square shows the size of a solar power plant that could power Greater Houston. The square (403.12 square miles in size) is overlain on a Google Earth image of Greater Houston.



Wind requires even more acreage. The Buffalo Gap Wind Farm is one of the largest wind farms in Texas. It has a nameplate capacity of 523.3 megawatts (MW). However, that number is misleading as nameplate capacity is only reached when all turbines are operating at maximum efficiency. The average electrical output is 33.3% of that (174.3 MW). The Buffalo Gap Wind Farm provides electricity for 175,422 households at maximum capacity but on average it can only supply electricity to 58,415 households. Wind intermittency also creates issues in Texas. Wind power generation generally decreases during late summer in Texas when demand in Texas is highest. Spot energy prices in Texas spiked from $20 -$30 MwH to over $9,000 MwH in the August 2019 during a major heat wave. There was worry about a similar problem in June 2021. Wind velocity was low and electricity demand was very high.

Figure 7: Size of the Buffalo Gap Wind Farm on a Google Earth Image



Wind turbines have also created issues for those who live nearby them. WHO has documented negative health effects for humans living near wind farms due to low frequency noise. Local communities are strongly protesting the installation of nearby wind turbines. Since 2015, about 300 government entities from Vermont to Hawaii have rejected or restricted wind projects. In California, wind turbines are so difficult to site that most developers have simply given up trying to build new projects in the state. New York State passed legislation to force local communities to accept wind projects against their will (Bryce 2021; Dugstad et al., 2020). That legislation is almost certainly headed to court.

Scientific research shows that wild herbivorous animals avoid windfarms. Hundreds of thousands of birds and bats are killed each year by wind turbines (Lopucki et al 2017). But the biggest issue is the acreage required for a wind farm. The Buffalo Gap wind farm covers 69,120 acres (108 square miles). That means that to power a single household requires over one acre of land dedicated to supplying the power (Fig. 7).

Rooftop Solar: It is not necessary to use the grid to power or partially power a household with solar. Many have elected to put solar panels on their homes. So, I calculated how much it would cost to get 50% of my yearly power from solar energy. There are multiple websites to help you calculate this. The two I used were: Energy Sage Solar Calculator and WholeSolar Calculator. The answer for me was approximately $45,500. The government will give me a check for $10,500, reducing my total expenditure to $35,000. But is that cheaper than getting power from the grid? The answer is: It depends on where you live. I pay $0.097/KwH, which is an average rate for Texas. My average bill is $325/mo. Solar panels last for approximately 20 years. So, I calculated the monthly payment on a 20 year note for $35,000 with 5% interest. My

monthly payment on that loan would be $230.98. Since that only covers 50% of my electricity, my average electricity bill would be that $230.98 + $162.50 or $393.43. That would be $68.43 more than I pay now. I did not include yearly maintenance, which would add $600-$1000 per year.

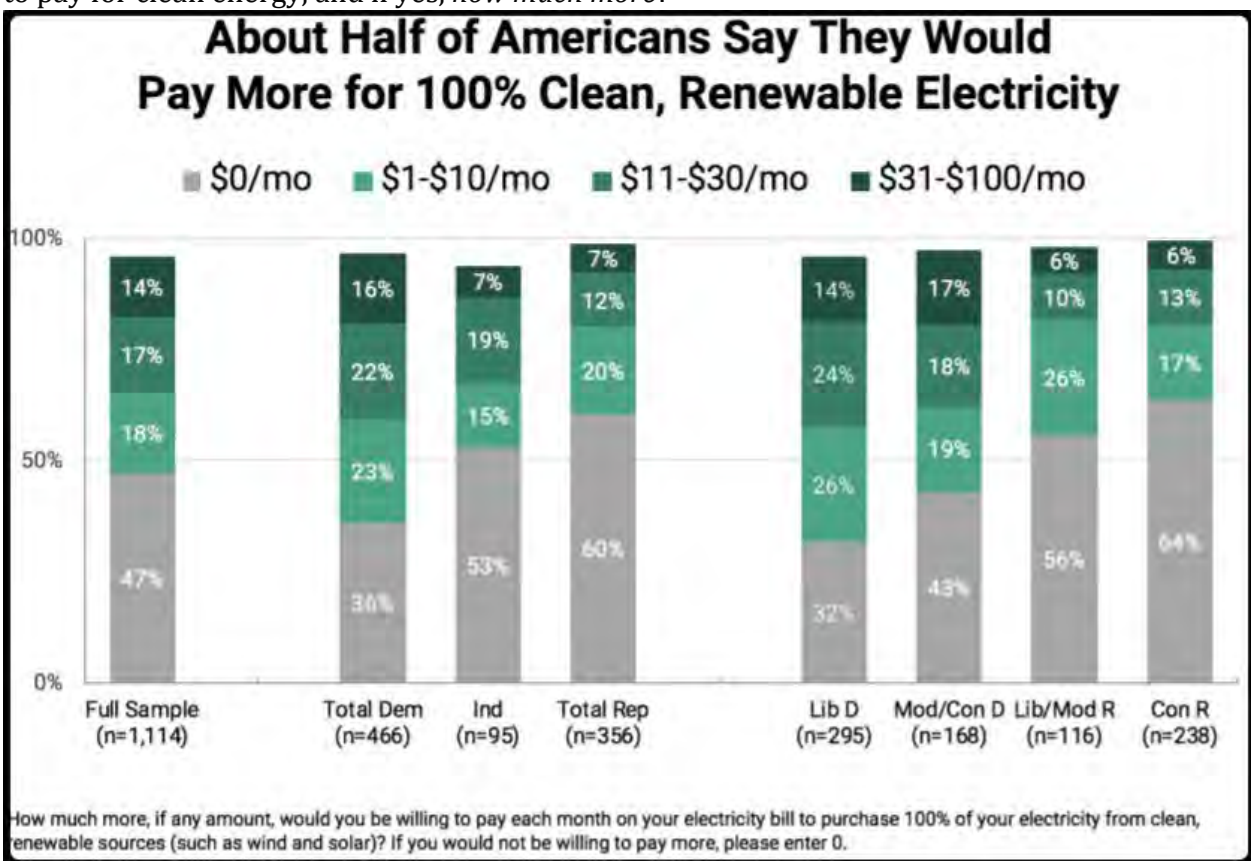
If I lived in Massachusetts, my answer would be different. Instead of paying $0.097/KwH I would be paying $0.226/KwH. Massachusetts has some of the highest electricity rates in the continental U.S due to regulations, prohibition against building pipelines, and a move toward renewable sources. Instead of getting natural gas from the nearby Marcellus gas fields in Pennsylvania, they import liquified natural gas (LNG) from Yemen and Russia, among other countries. That greatly increases the cost of electricity. In Massachusetts, my average bill from the power company would be $649.52/month. By switching to 50% solar I would save $85.78 per month.

The state government of Massachusetts has taken measures against fossil fuel use that have made electricity 2.3 times more expensive than in nearby Pennsylvania, where rates are similar to those in Texas. Are these rate increases to reduce global warming supported by the public? In 2018, Yale researchers asked that question. They asked how much more people were willing to pay to get their energy from 100% clean, renewable sources. They interviewed 48% Democrats 36% Republicans and 16% independents (Fig. 8). Although Democrats were more willing to pay higher prices the numbers are quite conclusive. 47% of all surveyed stated that they we not willing to any more money at all. Only 14% were willing to pay more than $31.00 extra per month (Fig. 8). Those in Massachusetts are currently paying far more than that relative to those in nearby Pennsylvania. These price differentials affect the poor the hardest. It is, therefore, fair to ask if state legislators in Massachusetts are truly looking after the interests of their constituents.

Another question needs to be asked: I am an affluent person who has had a very successful career. I do not need the $10,500 that the government is willing to give me to put solar panels on my home. *Should our government be taking money from hard-working middle-class and lower middle-class taxpayers and giving it to those who do not need it? Is it moral for our government to do so?*

Are wind and solar scalable? Our nation, along with many European nations are currently embarking on a hugely expensive program to move from fossil fuel sources of energy to wind and solar. But few have asked if this is even possible. Will our economic rivals, like China, commit to a similar program? What are the implications for our economy and our environment if they do not and instead continue to use cheaper high-carbon sources? Today, increases in wind and solar do not make up for global growth in energy consumption. In the oil and gas business you will hear people talk about the 'Creaming Curve.' It refers to skimming the cream.' meaning that we drill wells in the best areas first. We have done the same for wind and solar. We built solar plants in the Mojave Desert and wind farms in flat, windy, lightly-populated areas in Texas. Additional locations will be suboptimal and therefore more expensive.

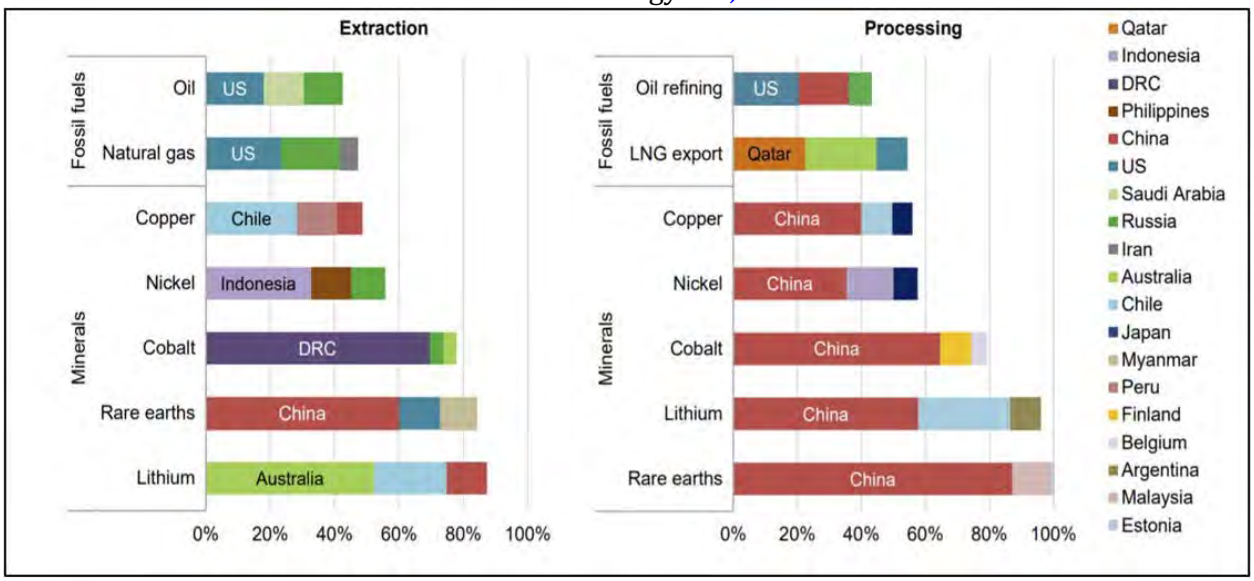
Figure 8: Results from a Yale poll taken in 2018 asking whether respondents would be willing to pay for clean energy, and if yes, *how much more*?



The most important variable that controls our ability to switch from fossil fuels to renewables will likely be the availability of the metals necessary to make this switch. The IEA (2021) stated that to meet world climate goals we must increase lithium use by 40X and graphite, copper, and nickel by 20X- 25X. Where are these metals going to come from? No one knows. It is not clear that some of these metals even exist in sufficient quantities. Today they come largely from China. Figure 9 shows who controls extraction and processing of these minerals. China also controls 80% of the solar photovoltaic (PV) cell market.

Over 50% of the cobalt (an essential component of Li-Ion batteries), comes from a single province in the Congo. All the PV systems currently on the market are reliant on one or more raw materials classed as critical or near critical by the EU or the US Department of Energy because of their natural scarcity or their recovery as minor-by-products of other commodities. They include high purity silicon, indium, tellurium, and gallium. What happens to the cost of energy if the cost of these metals skyrocket, either due to natural scarcity or market manipulation by China? We saw the perils of overreliance on critical goods from China with the Covid-19 pandemic. Do we as a country want to be reliant on China for our energy?

Figure 9: Countries that control extraction and processing of strategic metals necessary for transition from fossil fuels to wind and solar energy *IEA, 2021*



Batteries

There has been quite a bit of talk about battery technology in recent years and how this technology will solve the reliability problems for wind and solar. However, reality is a bit more sobering. Grid storage batteries deplete in around four hours. To store the electricity the U.S. uses in one day would take the entire output of the Tesla Gigafactory for 500 years (Mills, 2020). In addition, it costs $15-$18 per barrel to purchase an oil storage tank. To store an amount of electricity equal to the energy in one barrel of oil (1,700 kWh), it would cost $510,000 based on the $300 per kWh cost of the Tesla Megapack (JP Morgan, 2021).

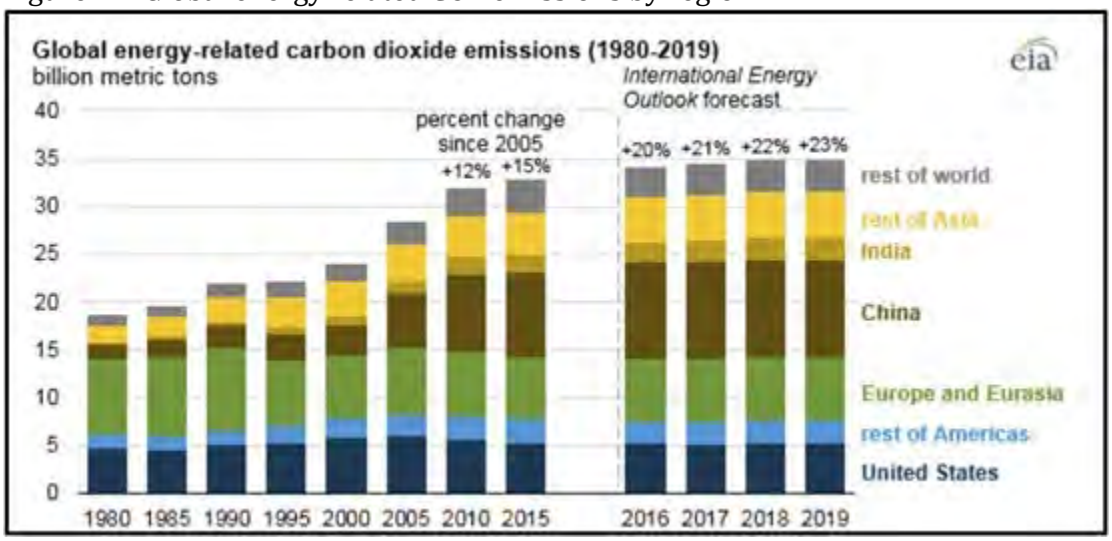
In 2019, Herrington did a study in which he observed that to convert all the cars in the UK to electricity by 2050 would require the entire world's production of neodymium, three quarters of the world's lithium production, and at least half of the world's cobalt production. I took his figures and extrapolated them to the U.S. To convert all our cars would require 1.7X the world cobalt production, 3.4X the world neodymium production and 2.6X global lithium production. And even if we converted every IC car in the world to electricity, global CO2 would only drop by around 5% (Yergin, 2021). The electricity to charge these cars still must come from somewhere and that somewhere will be fossil fuels. To produce a single car battery 250 tons of earth needs to be mined, refined, processed, and shipped (Mills, 2020). Mills (oral comm., 2021) also noted that far more energy is used in construction of car batteries and in mining, processing, and extraction of the raw materials than in building the car itself. All of that creates environmental damage. Figure 10 shows a lithium mine in Western Australia. An oil pumpjack has been added to the picture for scale. Which one do you believe creates more environmental disruption?

Figure 10: Photo of a lithium mine in Western Australia. An oil pumpjack (red square) was superimposed for scale (adapted from: *Tinker 2021)*

The Brave New World

Today, the U.S. controls its own energy. We are the largest producer of oil in the world. We have enough natural gas to last several hundred years. We have been the beneficiaries of cheap energy for our entire lives. But we are making the decision to make our energy more expensive and more reliant on foreign sources by moving to renewables. What are the immediate effects of this? The answer is that we subsidize China, not only by buying their strategic metals but also by making our products more expensive as a function of using more expensive energy. U.S. produces ~13% of global CO2 emissions. These emissions have been flat since 1980 and decreased by 14% since 2005. Worldwide, however, CO2 emissions have increased by 23% since 2005. Most of that increase is from China, which produces 29% of world emissions, and India (Fig. 11). China's 300+ new coal plants alone will produce more CO2 than all the coal plants currently in operation in the United States.

Figure 11: Global energy related CO2 emissions by region *EIA 2019*



China imports around 75% of its oil. However, they have vast reserves of coal. Therefore, they see coal as a strategic resource, and they have made it very clear that they do not intend to reduce coal usage anytime soon (Yergin, 2021). During the past 20 years, India has gone from around 33% household electrification to almost 100%. As a result, their per capita GDP has tripled during that same period. They have done this by using coal-fired power plants. The Prime Minister of India, Narendra Modi, has made it very clear that the economy of his country comes first and stated: we are too poor.' to move to renewable sources. EIA predicts a 50% increase in global energy use by 2050. Nearly all that increase will be in Asia (Fig. 12) and much of it will be derived from coal.

So, what exactly must happen in order for the world to go to 98% carbon free by 2040 as many American and European policymakers want to happen? Tinker, 2019, illustrated this with a series of figures. Figure 13 shows where we are at now. It shows our current energy mix. Note that you cannot even see solar on this chart.

Figure 12: Expected global increase in energy use by region *EIA 2018*

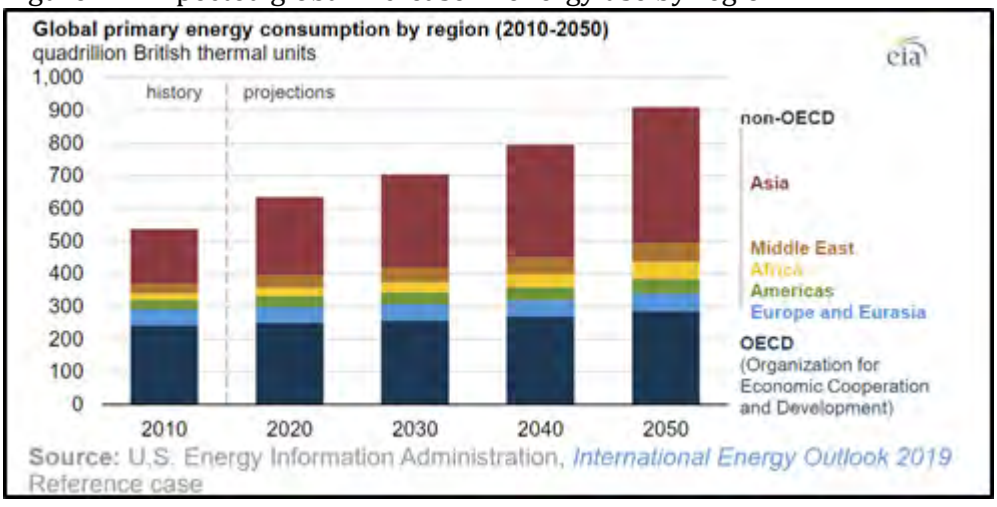
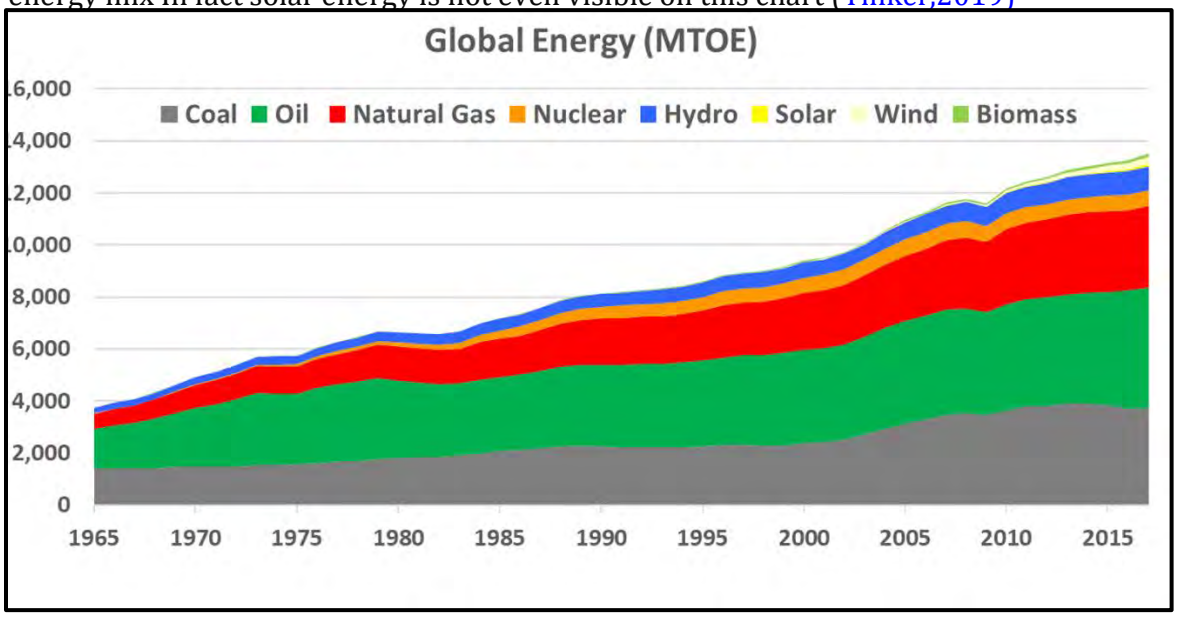


Figure 13: Chart which shows growth in global energy in (Millions of Tons of Oil Equivalent (MTOE) Note that renewable sources (wind and solar) comprise a very small portion of today's energy mix In fact solar energy is not even visible on this chart (Tinker,2019)



Tinker (2019) then superimposed the energy usage chart on another chart which shows population growth (Fig. 14a). As world population grows, energy usage will obviously increase. His final chart Fig. 14b, shows what is necessary to accomplish to get to 98% carbon free energy by 2040. Does this look realistic to anyone?

Figure 14a: Figure 13 superimposed on a chart of projected world population growth. *Tinker 2019)* .

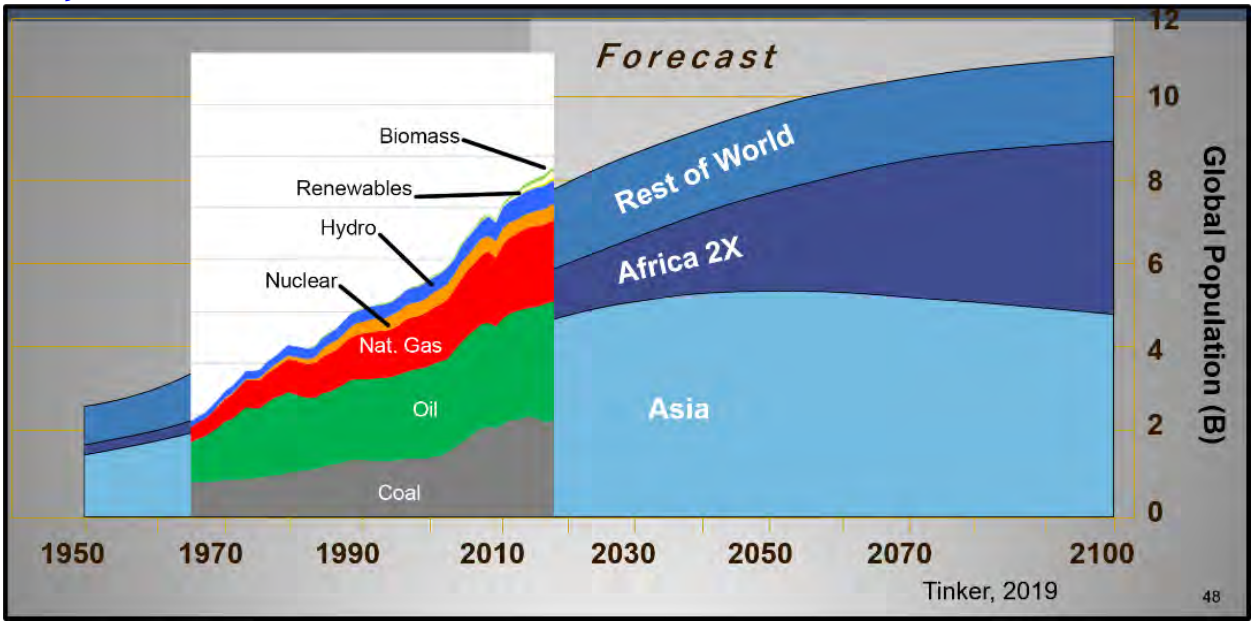
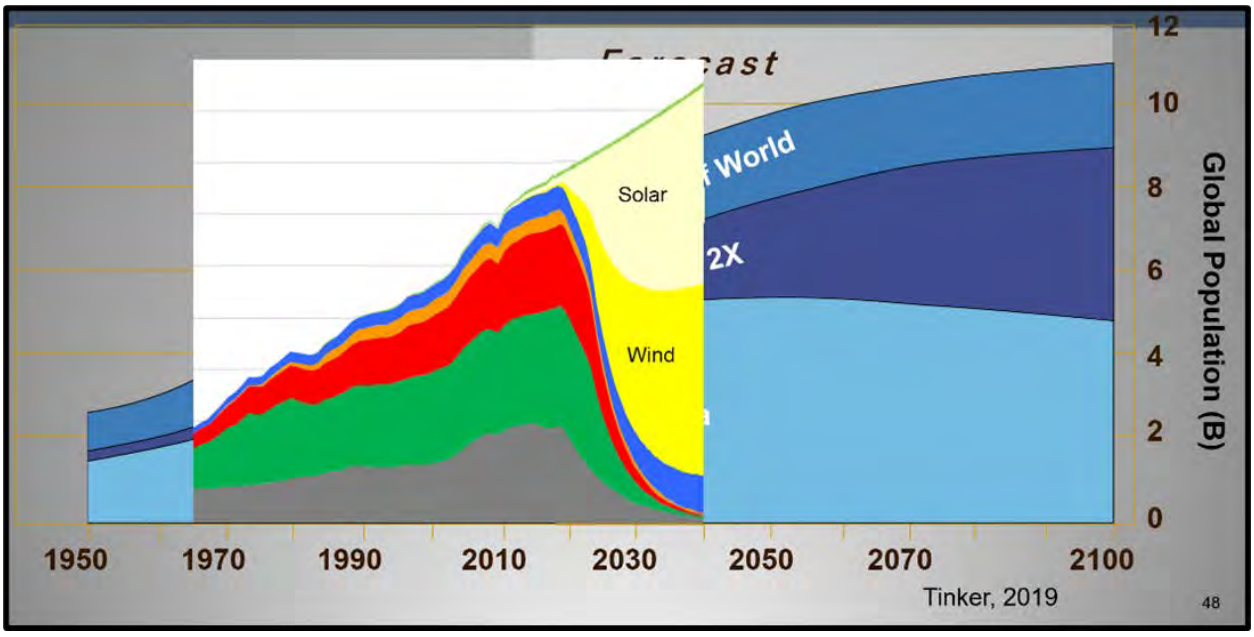


Figure 14b shows world energy consumption by source superimposed on a chart of projected world population growth assuming a move to 98% free carbon sources. Note the huge increases in wind and solar energy which would be necessary. These increases are not possible given global issues with energy distribution and the difficulties of scaling wind and solar *Tinker 2019.*



Inconvenient Truths

This whole discussion started with an 'Inconvenient Truth.'. So, let's list a few more.

- It is not *technically* possible to move to 100% carbon-free energy production in the near future.
- It is not *politically* possible to move to 100% carbon-free energy production in the near future.
- It is not *economically* possible to move to 100% carbon-free energy production in the near future.

- It is inhumane to move to 100% carbon-free energy in countries affected by energy poverty. Many developing countries cannot afford renewables. They need to get out of energy poverty first.
- China, and India will continue to increase CO2 emissions no matter what we do. Global energy consumption will rise by 50% by 2050.

Many in Europe and the United States think that if they, as countries act, the problem will be solved. Other countries will follow suit. But both China and India have made it clear that they are not going to do so. Coal-fired power plants have a 60 to 100-year life. China is not building 300+ of them today to discard them tomorrow. They will, however, be glad to sell us PV cells manufactured using coal. It is not anthropogenic United States warming and it is not anthropogenic European warming. It is anthropogenic global warming. China and India will be

growing, not reducing their own carbon footprints over the next 50 years and we are not going to go to war with China over coal usage.

So, what can we do? Scott Tinker made several suggestions in 2012 that are still relevant today He mentioned that renewables (solar, wind, hydro etc.) are increasing but they cannot increase to a level where a crossover between fossil fuels and renewables occurs in the next 50 years. That crossover can only occur by increasing use of the transitional fuels: nuclear and natural gas along with renewables. Tinker observed that this will require that we double natural gas production, increase nuclear energy by 3X and increase renewables by 5X. We are meeting those goals with natural gas and renewable. However, the United States and other European countries are shutting down nuclear power plants. According to Dan Crenshaw (U.S. Representative, "if you are not serious about nuclear power, you are not serious about climate change.".' Transitioning to nuclear power is the best way by far for developed countries to make a material difference in their CO2 emissions.

We can also work on carbon capture. Today a 50 MW natural gas plant is operating in Laporte Texas that has zero CO2 emissions. It uses a new technology called Allam Cycle, named after its inventor. Instead of using high pressure steam to drive turbines, it uses the CO2 generated during combustion. The process involves heating the waste CO2 to a high enough temperature such that it acts as a supercritical fluid (Fernandes et al.,2019). Supercritical CO2 is a more efficient way to drive the turbines and that increased efficiency makes up for the higher cost of using it. The CO2 not used in the process is sequestered or sold to industry. The technology is cost-competitive with wind and solar at present and a 300 MW plant using this technology is expected to come online in 2022. Occidental Petroleum company is using CO2 scrubbers to remove CO2 from the atmosphere in their large Permian oilfields.

Sadly, these are exceptions. Many legislators have advanced anti-fossil fuel initiatives that not only greatly increase the cost of energy but also increase the amount of CO2 emitted and decrease energy reliability for end users. The most famous of these is the cancelation of the Keystone XL Pipeline. The logic is that somehow if there is no pipeline to the U.S that the oil will stay in the ground. That will not happen. Kinder Morgan is expanding the Trans Canada Pipeline to transport the oil from Alberta to Vancouver. There it will be shipped to Asia and the west coast of the United States. It will also be shipped by rail. More CO2 will be emitted because of these transportation methods and there is a greater chance of a land or oceanic oil spill.

Another example is the effort by New York to outlaw natural gas pipelines. When Governor Andrew Cuomo vetoed construction of new pipelines, the utility companies refused to allow new hook-ups as they could not guarantee supply. Cuomo then stated that the companies had to make the hook-ups anyway. More CO2 will be released as a function of transport of LNG by truck and in a major blizzard, people will freeze as the trucks will be unable to deliver fuel. If we outlawed hydraulic fracturing as many would like to do, we would have to greatly increase coal usage to meet baseload demand for electricity and import far more oil that we do today. Again, these measures serve to increase, not reduce CO2 emissions. They also make energy more expensive. President Biden's ban on oil and gas leasing on Federal lands has already resulted in a significant increase in energy prices.

Conclusion

Politicians figured out a very long time ago that an answer must be simple, not necessarily correct. The press and those on social media universally embrace simple answers. This is true on both sides of the political spectrum. Sun good, oil bad! That is a simple answer. Global warming is a hoax! That is another simple answer. Perhaps the best example of a simple answer was North Face's refusal to make jackets for an oil and gas service company, Innovex. North Face is apparently blissfully and completely unaware that their products are made completely and entirely from petroleum products.

The issue was best defined by H.L. Mencken: He stated:

"For every complex problem there is an answer that is clear, simple, and wrong."

This quote probably best defines the present state of discourse on energy in the United States. Each side is screaming their simple answers at each other, unaware or uncaring that those answers are simply not true. The simple answers make us feel good but they won't work! At best they do nothing. At worst, they make the problems of energy security, energy cost and global warming worse.

Energy affects every facet of our life and yet we take energy for granted. The light switch pretty much always works at my house. As do the plugs. But energy does not come from a light bulb or a plug. It comes from a vast array of different companies linked by a complex supply chain. Our prosperity is a direct function of cheap energy that has come largely from fossil fuels. There is no magic button.' we can press to change us from a world dependent on fossil fuels to one dependent on wind and solar. Every change we make to our energy mix affects both our economy and the environment. Not all the changes to the environment as a result of moving to wind and solar will be positive. Is mining green? Does anyone think that the cobalt mines in the Congo are run to EPA and OSHA standards? Is anyone watching the destruction of the rainforest as a function of mining there? What happens to wildlife when they are displaced from their natural habitat by a multi-thousand acre mine, solar plant, or wind farm?

Moving towards a lower carbon future will require economically viable solutions that may be different for different countries and even different for different areas within each country. It will involve trade-offs in cost and in different types of environmental damage we are willing to tolerate. Different countries will take different pathways. The transition won't happen in 30 or even 100 years and it will not be simple or easy.

In the words of Ernie Moniz, Energy Secretary for Obama:

"It will get hotter. And we will adapt."

Acknowledgements

Many of the ideas in the article came from Dr. Scott Tinker and his colleagues at the Switch Energy Alliance (SEI) https://switchon.org/ This organization is dedicated to energy education and has produced two feature length movies on energy and energy poverty. They have also created a complete high school/college course on energy. SEI is nonpartisan and presents all side of issues on energy. If you are interested in energy, I urge you to visit the SEI site, watch

the movies and consider a donation to the organization. Stephanie Green, J.D. Free and Geary Johansen reviewed earlier versions of this manuscript and made many helpful comments.

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President, Altair Resources LLC

Dr. Pacht began his career at ARCO in the exploration research department in 1980. ARCO recognized his contribution in its 1987 Annual Report where his team was credited with adding $350 million of reserves. His work continued at TGS-NOPEC as a Senior Scientist working in the Gulf of Mexico and offshore Africa. In 1992, he founded Seis-Strat Services, Inc., a geological and geophysical service company employing up to 35 geo-scientists in seven countries. He sold Seis-Strat in 2008. From 2004 to 2016, Dr. Pacht founded (with partners) and sold several oil and gas production companies, one of which was producing over 5600 BOEPD at time of sale. He is currently the president of Altair Resources. Dr. Pacht has won five best paper awards and has published over 80 papers and abstracts. He serves on the Alumni Advisory Board of the School of Earth Sciences at Ohio State, where he received his Ph.D. During the past two years he has given over 20 lectures on energy to professional groups, universities, and business groups worldwide.

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Rockport, West
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Tally Island
Tract 831-G.O.M. (offshore)
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Nomanna
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Boedecker
Cage Ranch
Encintas
ERF
Gyp Hill
Gyp Hill West
Loma Blanca
Mariposa
Mills Bennett
Pita
Tio Ayola
Tres Encinos

CALHOUN COUNTY
Appling
Coloma Creek, North
Heyser
Lavaca Bay
Long Mott
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Olivia
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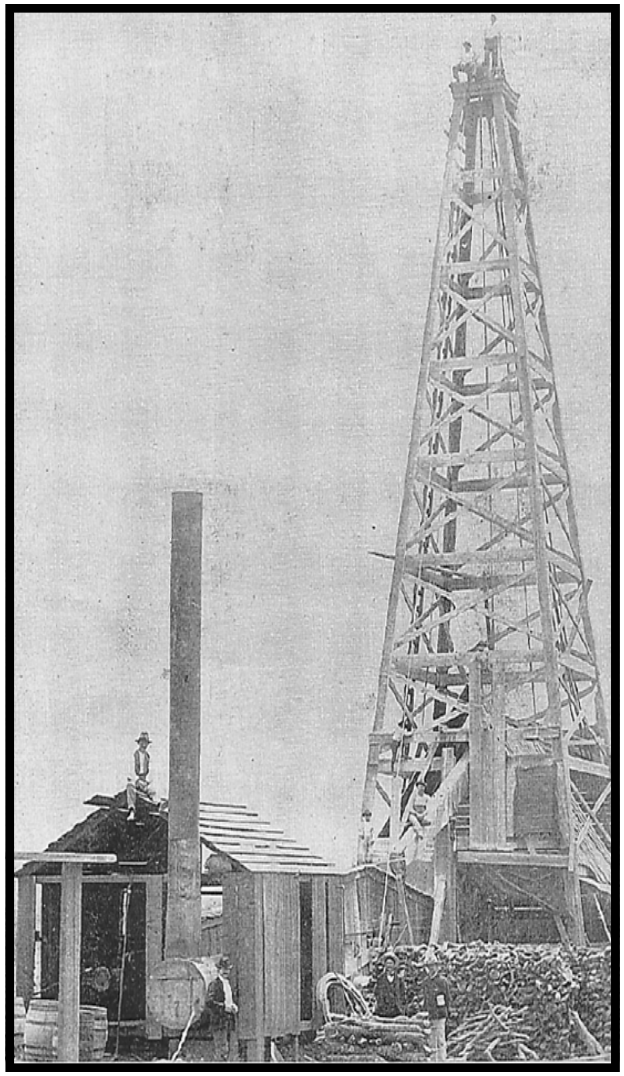

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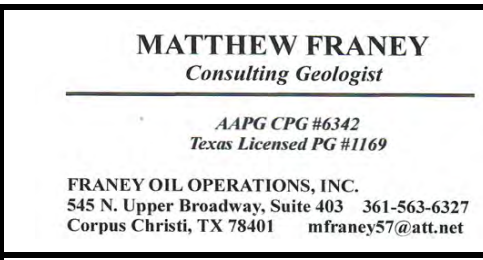

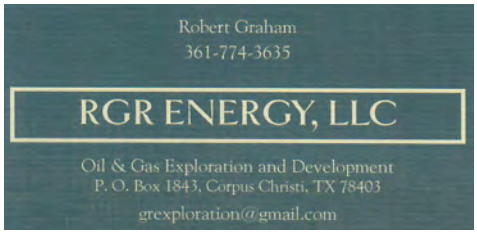

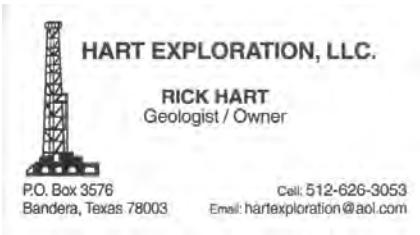

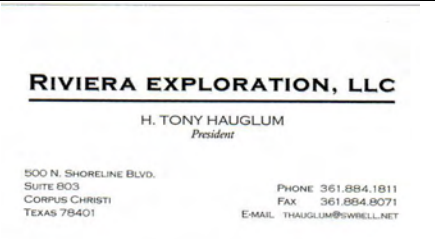

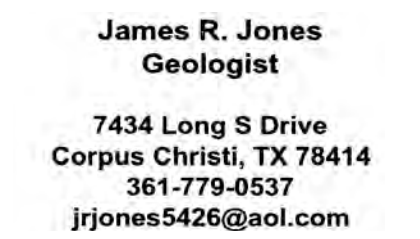

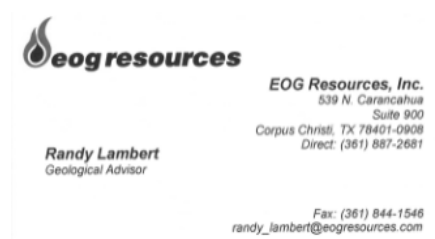

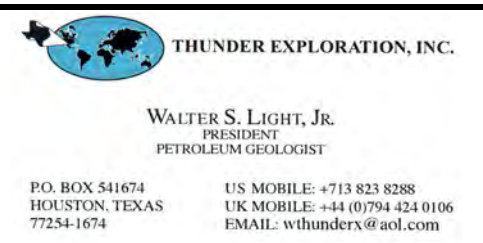

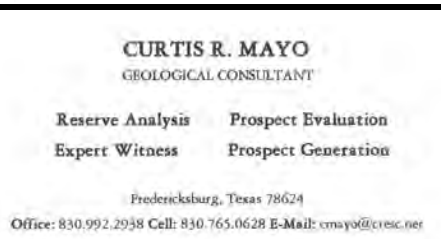

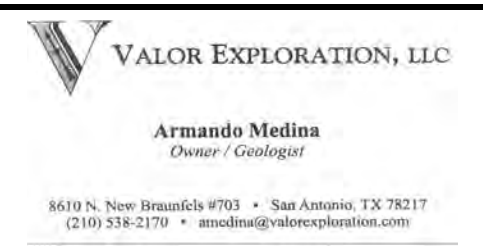

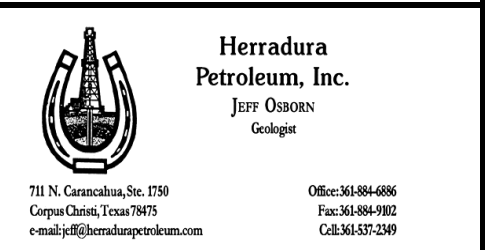

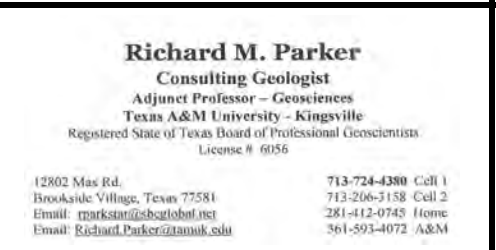

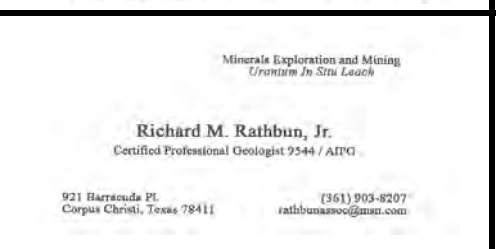

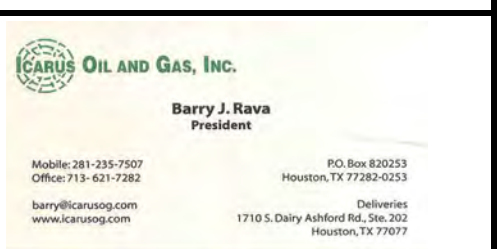

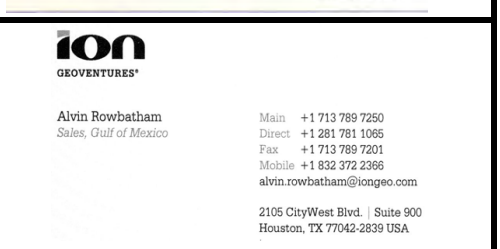

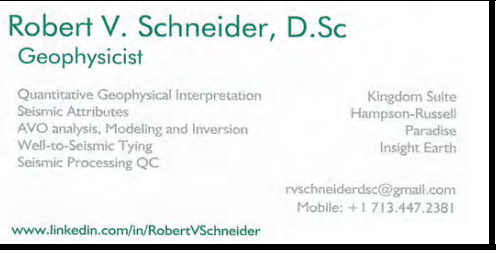

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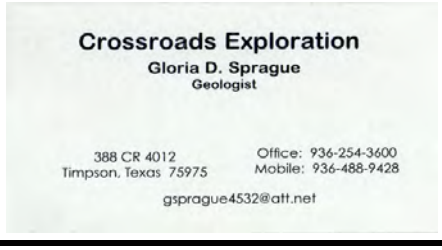

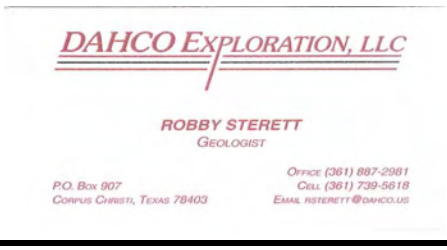

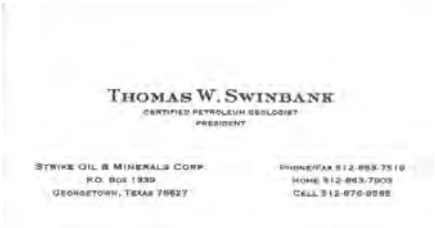

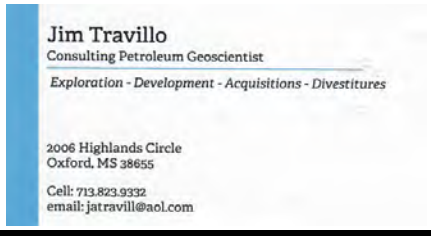

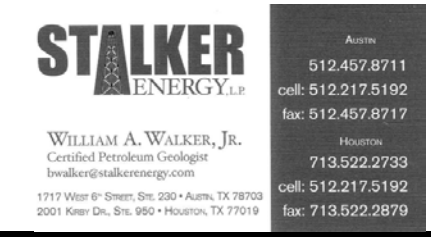

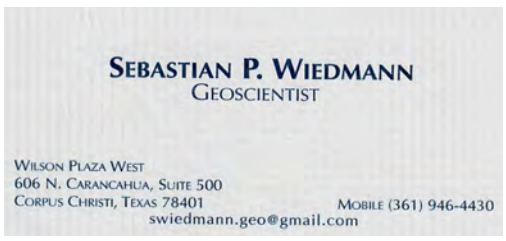

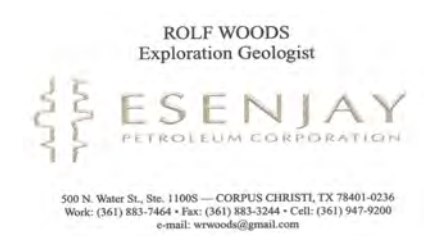

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