Volume 64 | Issue 1

September 2021

# BULLETIN

HOUSTON GEOLOGICAL SOCIETY

NEW LOOK!

## In this issue:

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AFRICA
E&P CONFERENCE
14 - 15 SEPTEMBER 2021
VIRTUAL EVENT
VIRTUAL PROGRAMME NOW LIVE
View online at:
africa.pesgb.org.uk/virtual-programme
Celebrating 20 years of AFRICA E&P CONFERENCE
Over the past two decades, the Africa E&P conference and exhibition has earned itself an outstanding reputation for excellence, delivering high-quality technical content each year on activities in Africa.
The PESGB/HGS are pleased to announce that the 20th Africa E&P Conference 2021 will be an online event, making it more accessible to a wider audience across the African continent and beyond!
TAKE A LOOK AT OUR VIRTUAL PROGRAMME
We have 2 days of expectional technical presentations covering E&P across the diverse regions of Africa, including the latest activities in prospecting, and new data on field and reservoir geosciences. Listen to representations from companies such as Equinor Research, Total Energies, and ExxonMobil; as well as collaborations with universities including the University of Manchester and Université de Toulouse. The 2021 format will also consider what the 'energy transition' may look like for the continent.
So join us for the 20th anniversary celebration of Africa E&P - you won't want to miss it!
Book your ticket now!
africa.pesgb.org.uk
HOUSTON GEOLOGICAL SOCIETY
1923

# FROM THE PRESIDENT *"Serve the Science"*

**MIKE ERPENBECK**

This is the first Bulletin of the present fiscal year (we give it a rest for the summer along with most of our monthly events and larger social events).

As incoming President I welcome back all the Society's members, and sincerely express my gratitude to the new Board members. This is the first Bulletin that is being published in our office by our Website Content Manager, Alyssa Cushing. We thank Alyssa for taking on this task and also our longtime publisher, Lisa Kreuger, for over a decade of fine layout.

Serve the Science. 'What a strange theme from a new President', many may be asking. Surely a more relevant tag line would point to issues of the day, like pandemic, future of the Society, future of the energy industry, and social and political issues that geologists get themselves involved in. However, as members of HGS, as caretakers of our beloved science, we have a special goal to promote geology. We have to remind ourselves what comes first, at least when we are wearing our HGS hats. We serve the science.

I confess to having a great love for the science of geology. I don't remember where I got the initial spark, but growing up in coastal southern California surely enhanced it. The beauty of it was revealed in the oceanside cliffs alternating with the beaches and estuaries, sedimentary marine terraces further inland, igneous and metamorphic batholithic mountains to the east, and beyond that , a vast desert - all within a 90 minute drive of each other. And if this wasn't enough, I was reminded continuously of the power and constantly changing nature of the earth- from feeling the regular earthquakes, and witnessing the frequent landslides and flash floods.

And then, as a youngster, watching a TV special featuring a geologist doing field work on the side of a volcano, dirty and dangerous work, sulfurous gases swirling around. I couldn't imagine being so fortunate as to actually land an exciting job like that -getting paid- for being able to camp and hike around outdoors- I would have done it unpaid. (Of course the down-and-dirty aspects of a career in geology were tempered somewhat after an entire summer doing dusty and sweaty field work in the San Juan Basin for the USGS. Perhaps laboring in an air-conditioned office in Houston might provide all the adventure I really wanted.) The upshot of all this: my life path was first a love of the science, then the career opportunity it offered.

I recognize that the path has been different for many other Society members, who may have grown up in the oil patch, with perhaps less inspiring surface geology. Observing lucrative careers offered to petroleum geologists, their path took a different route. Aiming for the career, then discovering the science in the course of academic career preparation may have led to a different view of the relative importance of science and career. HGS has long offered programs for both, as we know.

The primacy of the science of geology within HGS, however, is set forth in its Constitution:

Section 2. PURPOSE: The objectives of this society are: (1) to stimulate interest and promote advancement in the geosciences; (2) to disseminate and facilitate discussion of geological information; (3) to enhance professional interaction among geoscientists; and (4) to aid and encourage academic training in the geosciences

We serve the science by ensuring that we give as many young persons as we can the opportunity to get that first spark of inspiration that exposure to geology can ignite. We serve the science by offering to share our passion with those who will follow in our footsteps as practitioners and caretakers of the science.

To that end, I would like the Society to continue its robust efforts in its community outreach programs and to increase their scope whenever possible. Many thanks to Steven Johansen who has is now heading up the Educational Outreach committee, continuing the work of Letha Slagle over several years in that committee. Ken Thies has been active in promoting the "Bones in Schools" program in area schools and other civic organizations. We are tasked with letting it be known through direct contact to all school districts throughout the greater Houston area that we can send out our geologists to educate and inspire their school or class. I am hoping Steve and his crew have to issue a large call for volunteers to go out to all these schools who take us up on our offer. I also thank Sharon Choens and Lynn Travis for offering the Earth Science Week every year, Inda Immega and Janet Combs for their programs through the Museum of Natural History, Dorene West for chairing the Science and Engineering Fair committee, and Sue Pritchett and Claudia Ludwig for representing HGS in the Engineering Council of Houston. We especially thank Barbara Hill, the Director overseeing and rationalizing the functions of these outreach committees.

It will take me a year of monthly columns to properly recognize the work of all committee volunteers who serve the science within Houston Geological Society. In the meantime, look throughout the Bulletin and the HGS website for events this month and upcoming.

*"We serve the science by ensuring that we give as many young persons as we can the opportunity to get that first spark of inspiration that exposure to geology can ignite."*

# COVID-19 Policy Statement
## Updated September 1, 2021

The Houston Geological Society continues to maintain a cautious approach to indoor social and educational gatherings. Please check the HGS website on a regular basis for all HGS online event opportunities.

The HGS Board will continue to monitor the situation and governmental directives to determine the pace of opening up the holding of HGS in-person events or whether the situation calls for reversing the trend in some measure.

Please monitor hgs.org and your email for further communication concerning HGS events.

For more information about how you can help to prevent the spread of the virus, visit the CDC website: https://www.cdc.gov/.

***2021-2022 HGS Board***

# FROM THE EDITOR *"Welcome Letter"*

**SCOTT SECHRIST**

Welcome to year 98 of the Houston Geological Society! Our HGS 100th Anniversary is coming up in 2023, and long-term planning volunteers are hard at work maintaining headway towards our Big Celebration in the face of tumultuous change.

The profession of Petroleum Geology is at a crossroads in this second year of the COVID-19 Pandemic.

Now, over a year and a half into the Covid Pandemic, we all are wondering 'what does the future look like'... for HGS members, the Petroleum Geology profession and the world's Petroleum based Energy industry?

Most importantly, our current dues-paid HGS membership has recovered to nearly 2200 members from a low near half that a year ago. As recently as mid 2019, we had nearly 4000 members. Through grass-roots, person -to-person contact, we are bringing HGS members back.

We are also, carefully, bringing back in-person meetings, such as the HGS Shrimp Peel and Crawfish Boil in May 2021. The recent Hybrid UrTec, OTC and NAPE Conventions in Houston were remarkable successes with good in-person and strong virtual attendance, given the Covid-19 Delta variant resurgence. Be sure to look for the HGS Baseball family Sunday Funday October 3rd!

Now our National Professional Societies move to merge and survive in this new world of condensed activity, reduced advertising, shedding office overhead and merging major convention events.

The AAPG and SPE Executive Committees have announced Discussion of a merger of equals. Not a Fait Accompli, but a year's evaluation ahead, at all levels: should we? How and what, where and why? It has been proposed by many for decades, but the challenge is to smoothly merge our friendly but disparate organizations. In the last few days, even the SEG has reached out to their members with a survey to consider the possibility of a three way merger with AAPG and SPE; potentially creating a single upstream Geoscience and Engineering Society. These ideas are in the rough design stage; and nowhere near a "Done Deal".

Our local HGS members can interface thru their local AAPG House of Delegates fellow members. HGS Member concerns and the 'NewOrg' upside opportunities from all aspects are being evaluated and considered. This is still a work in progress... and the HoD needs your input!

One of the KEY points to remember throughout this entire process is that your Houston Geological Society is an INDEPENDENT, Affiliated Society. We are not controlled nor owned by AAPG, even though HGS is the world's Largest Local Geological Society Chapter. Our Undergraduate and Calvert Graduate Scholarship programs remain equally independent; ALL controlled locally, and ONLY by your elected HGS Officers and Board members.

As we face the torrent of change rushing around the world media and extreme weather, we will all benefit from science-based facts and observations. Dr. Jory Pacht leads off our September HGS Bulletin with the latest updates to his Energy 101 presentation. Addressing the latest ESG challenges and changing economic and social positions on the 'Energy Transition', Jory shares his science and fact-based observations of practical responses to a world calling for a wide variety of changes.

Please be sure to share with your family, friends, business associates and your children's teachers. The HGS is dedicated to 'stimulate interest and promote advancement' in geology for the Houston area; and to aid and encourage academic training in the science of geology with proven, science based fact. Visual proof is found in Steve Earle's Grand Canyon Trip Photos; these are must-see classics!

Finally, it is a great honor to serve as your HGS Editor for the 2021-2022 year. I look forward to all article submissions, ideas, suggestions, constructive feedback and, most of all, your questions. All the HGS Officers, Directors and our dedicated HGS Office Staff are working hard to provide Members with the best HGS yet as we rebuild our 'New Normal', preparing for our 100th HGS Anniversary in 2023!

Wishing All great success and the best of health!
**HGS Editor 2021-2022**
**Scott C. Sechrist**

# STUDENT EXPO

Houston Geological Society

STUDENT EXPO

Houston Geological Society

**September 13th & 14th**

## The Basics

The Student Expo's purpose is to get geoscience students face-to-face networking and interviewing opportunities. Each year, the event is held in September which is prime-time recruiting season for energy companies who have been the primary supporters of the event since it's inception in 1999.

## Opportunities

### Exhibitors

The main event is a full day expo that will be held at TGS headquarters in Spring Branch (Houston, TX). Exhibitors (recruiters) come to recruit interns and recent grads through a rapid-fire meet & greet. Interviews are then held on day 2 of the event.

### Speaking

In 2020, the event went fully virtual and primarily consisted of a full day of career seminar talks that focused on different industries geoscience professionals are part of. These included geothermal, oil and gas, environmental, mining, and technology.

### Networking

One of the biggest benefits for students is learning how to network while also building their network. The two opportunites for networking are within the expo itself and the happy hour that will take place after day 1 of the event (Sept. 13th).

**Sponsorship opportunities are available for as little as $250**

**HGS Student Expo**

studentexpo.org

Guided Boats,

Cash Pots,

Trophies

20th Annual Saltwater Fishing Tournament

October 8, 2021

Harborwalk,

Hitchcock, Texas

# HGS VIRTUAL GENERAL DINNER MEETING

**MONDAY, SEPTEMBER 20, 2021**
**6:00PM - 7:00PM**
**HGS MEMBERS $10 NON-MEMBERS $25 STUDENTS $5**
HTTPS://WWW.HGS.ORG/CIVICRM/EVENT/INFO?ID=2299
**EVENT CONTACT: PATTY WALKER | PATTYWALKER1@ICLOUD.COM**

## *Seismic Inversion for Carbon Storage in the South Atlantic Offshore and Anadarko Basin, Oklahoma*

Eighty percent of the world's energy relies on fossil fuels and under increasingly stricter national and international regulations on greenhouse gas emissions, storage of CO2 in geologic repositories is a feasible and vital solution for near- and mid-term reduction of carbon emissions in any climate change mitigation strategy.

To achieve the 2°C climate goal set by the Paris Agreement, projections by the International Energy Agency indicate that around 4,000 million tons of CO2 per year would need to be captured and stored by 2040, growing to around 6,000 million tons per year by 2050. Currently, ~20 large-scale carbon capture and sequestration (CCS) projects are operational around the world with ~30 billion USD investment in comparison to more than 2 trillion USD spent on renewable energy. Therefore, a significant opportunity exists for CCS nationally and globally.

The Southeast Offshore Storage Resource Assessment (SOSRA) and the Southeast Regional CO2 Utilization and Storage Acceleration Partnership (SECARB-USA) research projects were funded by the U.S. Department of Energy with the Southern States Energy Board (SSEB) in the lead.

This talk is focused on the development of (1) offshore prospective storage resource assessment of the Upper and Lower Cretaceous as well as Upper Jurassic sections within the Southeast Georgia Embayment (SGE) and (2) onshore potential reservoirs in the Cleveland and Skinner formations of the Anadarko Basin, Oklahoma.

This work includes a replicable workflow of model-based inversion that provides the tools to discriminate lithology and predict porosity and permeability necessary for CCS. These analyses have included integration of seismic surveys with core samples and geophysical well logs leading to a detailed stratigraphic, structural, petrophysical, and injection simulation model showing the heterogeneity and highly complex tectonic evolution of the target reservoirs of the Eastern North American Margin and the Anadarko Basin

### *Biographical Sketch*

**Dr. Cameila Knapp** is a Professor of Geophysics and serves as the V. Brown Monnett Chair of Petroleum Geology and Head of the Boone Pickens School of Geology at Oklahoma State University (OSU). She received a Ph.D. in Geophysics from Cornell University and a B.S. degree in Geophysical Engineering from the University of Bucharest, Romania. She was also a Fulbright fellow at Cornell University.

In the early years, she worked with the Romanian State Oil Company and the Romanian National Institute for Earth Physics. She spent 18 years at the University of South Carolina were she was a Professor and the Director of the Earth Sciences and Resources Institute.

Dr. Knapp's research interests include: (1) the application of seismology to the structure, composition, and physical properties of the Earth, (2) environmental and hydro-geophysics, (3) gas hydrates, and (4) carbon sequestration. She has served on national and international committees and scientific panels including the U. S. National Science Foundation and has advised many PhD and MS students most of whom having entered the oil and gas industry.

Dr. Knapp is married to Dr. James Knapp, a Professor and the Boone Pickens Distinguished Chair of Geoscience in the Boone Pickens School of Geology at Oklahoma State University. They have two young daughters who enjoy the outdoors and their Junior Ranger status for many national parks in the U.S.

# SUNDAY FUNDAY AT THE BALL PARK

October 3, 2021

Constellation Field, Sugarland, TX • Game starts at 2 PM

## SUGARLAND SKEETERS VS. ROUND ROCK EXPRESS

Triple-A Affiliate of the Houston Astros VS. Triple-A Affiliate of the Texas Rangers

Family-Friendly Event

REGISTER AT WWW.HGS.ORG

Calling all baseball fans, young and young at heart, to join fellow HGS members, family (including those grandkids) and friends for a Sunday Funday watching the **SUGARLAND SKEETERS** take on the **Round Rock Express** at beautiful Constellation Field. Game time is 2:05 pm, the ballpark is located at 1 Stadium Drive in Sugarland, TX.

Your ticket includes:

- **Insperity Club:** A spacious indoor lounge area with pool tables and large screen televisions
- Premium padded seats located directly outside of the climate-controlled Insperity Club on the second level of Constellation Field (directly behind home plate)
- Gourmet buffet dining with non-alcoholic drinks
- Alcoholic drinks can be purchased at the Insperity Club bar in the indoor lounge

This is a family friendly event, so bring the kids to meet Swatson, enjoy the splashpad and playground area, and run the bases after the game. Come and meet the all-stars of the future and cheer on our Astros Triple-A affiliate in their last game of the MiLB season.
https://www.milb.com/sugar-land/ballpark/stadium-map

**Cost**
**Insperity Club Ticket HGS Group Rate - $55/pp**
Children 3 and under do not need a ticket to enter with a paying adult. There is limited ticket availability for the Insperity Club Level. To guarantee a ticket with the group, you must pre-register on the HGS website and pay with a credit card. **Online registration closes Sunday, Sept 12 at 10:00 p.m. After registration closes there will be no refunds. An electronic ticket link will be provided to attendees after registration closes.**

**Mask Policy**
Masks are not required for fans who have been fully vaccinated. Fans who are not fully vaccinated are encouraged to continue to wear masks. (Full vaccination is defined as having received a final vaccination dose at least two weeks prior to game date (i.e., second dose of Pfizer/Moderna or single dose of Johnson & Johnson).

**Social Distancing**
Physical distancing is required when moving throughout the ballpark. We encourage a 6' distance between you and other parties. To ensure proper hygiene, hand sanitizer dispensers have been positioned around the stadium.

**Parking**
Please visit the HGS website for more information. https://www.hgs.org/civicrm/event/info?id=2331

**Sponsorship**
Main Sponsor $5500 - *4 complimentary tickets*
Gold Sponsor $2500 - *2 complimentary tickets*
Silver Sponsor $1500 - *1 complimentary ticket*
Bronze Sponsor $500

For sponsorship, please contact Andrea Peoples at 713-463-9476 or office@hgs.org.

**REGISTER BEFORE SEPTEMBER 12TH AT WWW.HGS.ORG**


**REGISTER BEFORE SEPTEMBER 12TH AT WWW.HGS.ORG**

# HGS ENVIRONMENTAL & ENGINEERING MEETING

**WEDNESDAY, SEPTEMBER 8, 2021 | 5:30-9:00PM**
**CRAFT REPUBLIC HOUSTON | 11470 WESTHEIMER RD**
**HGS MEMBERS $35 NON-MEMBERS & WALK-UPS $40 EMRITUS/HONORARY LIFE $15 STUDENTS $5**
**HTTPS://WWW.HGS.ORG/CIVICRM/EVENT/INFO?ID=2329**
**EVENT CONTACT: MATTHEW COWAN | MRCOWAN1@HAL-PC.ORG**

## *Drones - Aerial Data Collection Platforms for the Environmental & Engineering Geology Professional*

The use of UAVs, unmanned aerial vehicles or drones, as they are more commonly referred to, is rapidly growing in many industries. The first drones were used for military purposes. Today, the top industries and sectors using drones for commercial purposes include agriculture, chemicals, conservation, construction, delivery, filmmaking, mining, insurance, oil and gas, power generation, public safety, and sewer maintenance. According to the FAA, there are currently 869,428 drones registered (Commercial and Recreational) in the United States.

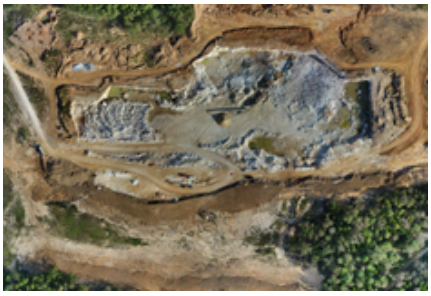
This talk will briefly cover types of drones, how drones work, and how they are being utilized to solve business problems in a more efficient, safer manner, and at a lower cost than traditional methods.Updated FAA, Federal Aviation Administration, requirements, and regulations will also be covered. Actionable data products generated from drone imagery include high-resolution aerial photos and videos, Orthomosaic (photo maps), digital surface elevation models (DSM, DTM), 3D models, detailed measurements, such as area, volume, length, surface profiles, and infrastructure inspections (optical zoom, thermal imaging). Discuss how drone data seamlessly integrates with other applications, such as GIS, geographic information systems. Specific applications in flood control and surface mining will be discussed. Show some examples of types of sensors being used on drones including gas leak detection, air quality, Ground Penetrating Radar (GPR) and other applications.

### *Biographical Sketch*

**Mike Allison** holds a BS and MS in Geology. He has 34 years of experience in the upstream oil & gas industry. Mike's experience and background in both Geoscience and IT make him uniquely qualified to recognize how technical solutions can solve E&P business problems. Much of Mike's experience has been focused on leading IT teams directly supporting key E&P departments including Geosciences, Engineering, Spatial/GIS, Land and SCADA. He has worked for different O&G companies including Majors (Gulf Oil and Chevron), Independents (Devon Energy and Fieldwood Energy) and several Service Companies (Exploration Logging, Landmark Graphics, Geoscience Data Management and Moblize).

After leaving Fieldwood Energy, he founded a drone services company named Raptor Aerial Services LLC (RAS). His company provides aerial mapping surveys, stockpile volumetric calculations, inspections, data collection and marketing to a variety of industries. The company provides solutions focused on increasing sales, reducing costs, saving time and improving safety. RAS is fully insured and FAA Part 107 certified.

Mike is an active member of AAPG and HGS. He has severed as the Treasurer-Elect and Treasurer on the HGS Board. As a member of the HGS Continuing Education committee, he conceived and initiated the recording of HGS presentations now available at https://www.hgs.org/multimedia_overview. Mike has taught an HGS Continuing Education Courses on drones and drone mapping. He has also given a number of presentations on drone technology. A full list of courses and presentations can be found on the RAS website at www.raptoraerialservices.com .



HOUSTON GEOLOGICAL SOCIETY

# ANNUAL GOLF TOURNAMENT

**October 18, 2021**
**Sterling Country Club, Houston, TX**

Format: 4-Man Scramble
Entry Deadline: October 14, 2021

For sonsorships, please call the HGS Office
at 713-463-9476 or email office@hgs.org

**VISIT WWW.HGS.ORG TO REGISTER**

# HGS Golf Tournament

## Monday, October 18, 2021
## Format: 4-Man Scramble


Come join us for golf, food, friends, and fun at the annual HGS Golf Tournament at **Sterling Country Club and Houston National Golf Club** (www.sccathn.com). There will be prizes awarded for closest to the pin and long drive, putting games before we start, as well as many great door prizes for participants.

**Entry Fee**: $175.00/Golfer or $700.00/Team.
**Early Bird Special (Through September 24th)**: $150.00/golfer or $600.00/team
**Entry Deadline: October 14th.**

Individual entries will be grouped with other individual golfers to make a foursome. Entries are limited to and will be accepted on a first-in basis.

**SCHEDULE OF EVENTS**
8:00 – 9:45 a.m. Registration, free use of driving range and mini games.
(Breakfast will be provided by Core Lab and Petro Log International, Inc.)
10:00 a.m. Shotgun start
3:00 p.m. Cash bar, open buffet
3:30 p.m. Door prizes and awards presentation

**Companies or individuals interested in sponsoring the event should contact Andrea Peoples or Alyssa Cushing at office@hgs.org or 713-463-9476. Sponsorship deadline is October 8th.**

**REGISTRATION OPTIONS**
-Online: https://www.hgs.org/civicrm/event/info?id=2298
-Email: office@hgs.org
-Mail: Houston Geological Society, 14811 St. Mary's Lane, Suite 250, Houston, TX 77079

**If paying by check, please make check payable to HGS or Houston Geological Society.**

Team Captain:_____ Phone:_____ Amount Enclosed: $_____

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| Foursome Members ***(Please Print)*** | Company | Phone | Email |
|---|---|---|---|
| 1._____ | _____ | _____ | _____ |
| 2. _____ | _____ | _____ | _____ |
| 3. _____ | _____ | _____ | _____ |
| 4. _____ | _____ | _____ | _____ |

Please provide email addresses for ***all team members***, as all communications will be done via email.

# September 2021

| Sunday | Monday | Tuesday | Wednesday |
|---|---|---|---|
| | | | 1 |
| 5 | 6<br>***HGS Office Closed for Labor Day*** | 7 | 8<br>***HGS Environmental & Engineering Dinner Meeting***<br>"Drones - Aerial Data Collection Platforms for the Environmental & Engineering geology Professional"<br>Page 12 |
| 12 | 13<br>***HGS Student Expo***<br>Page 6<br>***HGS Student Expo Happy Hour***<br>6 p.m. | 14<br>***HGS Student Expo***<br>Page 6<br>***PESGB-HGS Africa Conference***<br>Page 2<br>***HGS Board Meeting***<br>5 p.m. | 15<br>***PESGB-HGS Africa Conference***<br>Page 2 |
| 19 | 20<br>***HGS Virtual General Dinner***<br>"Seismic Inversion for Carbon Storage in the South Atlantic Offshore and Anadarko Basin, Oklahoma"<br>Page 8 | 21 | 22 |
| 26<br>***IMAGE: Joint SEG & AAPG Convention***<br>26 Sept. - 1 Oct. | 27 | 28 | 29 |

# September 2021

| Thursday | Friday | Saturday |
|---|---|---|
| 2 | 3 | 4 |
| 9 | 10 | 11 |
| 16 RESERVE YOUR SPOT ONLINE AT HGS.ORG | 17 | 18 |
| 23 | 24 | 25 |
| 30 | | |

### *Reservations*

*The HGS prefers that you make your reservations online through the HGS website at www.hgs.org. If you have no internet access, you can email office@hgs.org or call the office at 713-463-9476.* ***Reservations for HGS meetings must be made or cancelled by the date shown on the HGS website calendar, which is normally 24 hours before hand or on the last business day before the event.*** *If you make your reservation on the website or by email, an email confirmation will be sent to you. If you do not receive a confirmation, please contact the Webmaster at webmaster@hg.org. Once the meals are ordered and name tags and lists are prepared, no more reservations can be added even if they are sent.* ***No-shows will still be billed.***

### *Pricing*

**In-Person Meetings**
*HGS Members* **$35**
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### Latin America – An Exploration Overview

**Chairs: Bob Fryklund (IHS) and Daniel Minisini (Shell)**

The Atlantic conjugate margin agglutinate the activity of most offshore operators. Analyzing the geological and non-technical risks at continental scale allows ranking the opportunities within the entire conjugate margin, classifying reliable sites against marginal sites, based on criteria derived from the same group of explorers, and on knowledge transferred from databases geographically far apart. Method, data and mindset behind these analyses will be presented to debate among explorers.

Brazil and Guyana are leading the region and the world in new volumes of discovered hydrocarbons. Mexico is in pursuit, but the next several years of deep-water drilling will be critical. Colombia offshore too is in the proof of concept stage and upcoming wells will be critical in determining if there are enough resources for commerciality. In Argentina, the Vaca Muerta is ramping up.

- Still lots of basins remain under-explored.
- Where will the next discovery be?
- What role will future demand and the call for a reduced carbon footprint have?
- Will Venezuela rejoin the marketplace?

### Frontier Areas; New Plays and Missed Opportunities

**Chairs: Catie Donohue (GeoMark Research) and Mark Olson (Apache)**

The Latin America and Caribbean regions contain about 20% of the global proven oil reserves but the excitement of the area lies in the significantly under explored offshore and unconventional opportunities. Recent exploration work is challenging preconceived models of reservoir presence, source presence, and tectonic development to identify some compelling new petroleum concepts. From new reservoir provenance models in Mexico, updated crustal type models in the Caribbean and new details on the A-C-T source rock along the equatorial margin, these new ideas are driving frontier exploration and regenerating interest in the area.

### Greater Caribbean; Non-Guyana and Suriname

**Chairs: Bryan Ott (Hess) and Sean Romito (University of Houston)**

The Caribbean Region remains a challenging frontier area located between the prolific oil-rich basins of the Gulf of Mexico and northern South America. Despite a number of gas discoveries in recent years, bold explorers continue their search for the elusive oil field, and the region has seen numerous high-impact wildcats drilled in the recent years. This year BPC spud the Perseverance -1 wildcat targeting Jurassic to Cretaceous carbonates in a large fold on the Bahamas Bank. BHP and partners continue exploring in the deep water areas of Trinidad, where a number of gas discoveries have been made. Elsewhere in the Caribbean, Shell has farmed into offshore Colombia, and ongoing farm-outs continue in Jamaica.

### Greater Caribbean; Guyana and Suriname

**Chairs: Shawn Wright (Hess) and Ben Kirkland (CNOOC)**

The Guyana-Suriname basin is often considered one of the last remaining under-explored but highly prospective basins in the world. With exception of the discovery of the onshore Tambaredjo and neighboring heavy oil fields in Suriname in the 1960s, a spotted exploration history dating back to the

1920's had been largely unsuccessful. Exploration interest was renewed when a 2002 report by the USGS estimated ~13.6 Bbbls of oil reserves were left undiscovered. Exploration efforts were soon rewarded with the economic discovery of high-quality oil-bearing Late Cretaceous turbidite sands at Liza-1 in the Stabroek block by an ExxonMobil-led partnership in 2015. Following the Liza discovery, additional operators have found success in the basin with discoveries at Jethro and Joe (Tullow-led), Maka, Sapakara, Kwaskwasi, and Keskesi (Apache-led)and Sloanea (Petronas-led). Since 2015, ~25 commercial discoveries have been made making the Guyana-Suriname basin the most exciting basin on the Atlantic margin. As exploration moves outside of the proven Upper Cretaceous stratigraphic trap play fairway in the SE Stabroek area, the level of technical understanding of the petroleum system is the key to predicting hydrocarbon fluid properties and discovering additional resources. In particular, source rock presence/maturity and reservoir presence/quality are areas of substantial interest. With several high-impact wells in the very near future targeting Paleocene to Jurassic plays, the players in this basin are continually acquiring new information and the future of the Guyana-Suriname basin is bright.

### South Atlantic; Non-Brazil

**Chairs: Katy Sementelli (BHP) and Corey Moss (Murphy)**

Industry activity has recently shifted south to the countries of Argentina and Uruguay with successful bid rounds held in each country in 2018 and 2019. Both countries saw an increase in interest in Frontier Offshore blocks with awards going to supermajor partnerships in Argentina(Shell, XOM, Total) and independents operators in both countries (BPC in Uruguay, for example). Recent seismic acquisition and reprocessing of data have expanded interest in new play ideas, such stratigraphic traps in deep-water reservoirs, and revisiting known plays in new areas (Malvinas Basin). Uruguay has revamped the bid-round process to include an open-round formula for flexible options in generating interest in both offshore and onshore acreage. Argentina has put the 2020 round on hold in light of economic investment concerns related to the COVID19 pandemic. However, activity in the region has not stalled with seismic acquisition associated with work commitments continued in 2020. Optimism in the Southern Atlantic was enhanced with a discovery in 2019 in the Outeniqua basin off South Africa by Total with the Brulpadda well. Further excitement continues with a well of interest; Total'sVenus-1 wildcat targeting a major ultra-deep water prospect in the Orange Basin offshore Namibia which may confirm the Cretaceous source potential in the South Atlantic. Frontier exploration continues in the Southern Atlantic areas.

### South Atlantic; Brazil

**Chairs: Bill Dickson(DIGs) and Marcus Zinecker (BP)**

Equatorial Margin - huge region,unclear potential
Vast region with potential for Upper Cretaceous & younger fan plays analogous to Jubilee (offshoreGhana) and Zaedyus(offshore French Giuana).Restrained by lack of infrastructure except Potiguar/Ceara (easternmost basins) where existing onshore and shallow water fields mature. Undeveloped deepwater discoveries at Pecem, Pitu, Tango.

### Southeast Margin - giant and super-giant discoveries & production; unexplored potential

2021 excitement includes:
**Sergipe**: ExxonMobil well on an outboard ultra-deep-water block, perhaps testing two new play types (contourite sands, carbonate buildups on rift-age volcanic features) which could require sourcing from Aptian seaward dipping reflectors interbeds where younger A-C-T marine source is too shallow or absent.
**Campos**: probe ultra-deep-water targets with both post-salt A-C-T marine source pods; and usual syn-rift-sag lacustrine source. Post-salt targets include contourites in lows; pre-saltCO3 targets difficult to image and a really reduced by lack of regional top seal resulting from extensive salt movement.
**Santos**: 3D mapping of present-day pre-salt structuration is excellent; reservoir facies inversions are good; but insufficient. Need better understanding of basin evolution at crustal level to improve models of thermal history, CO2 and volcanic pathways, source facies distributions.

### Pacific Margin; Onshore and Offshore

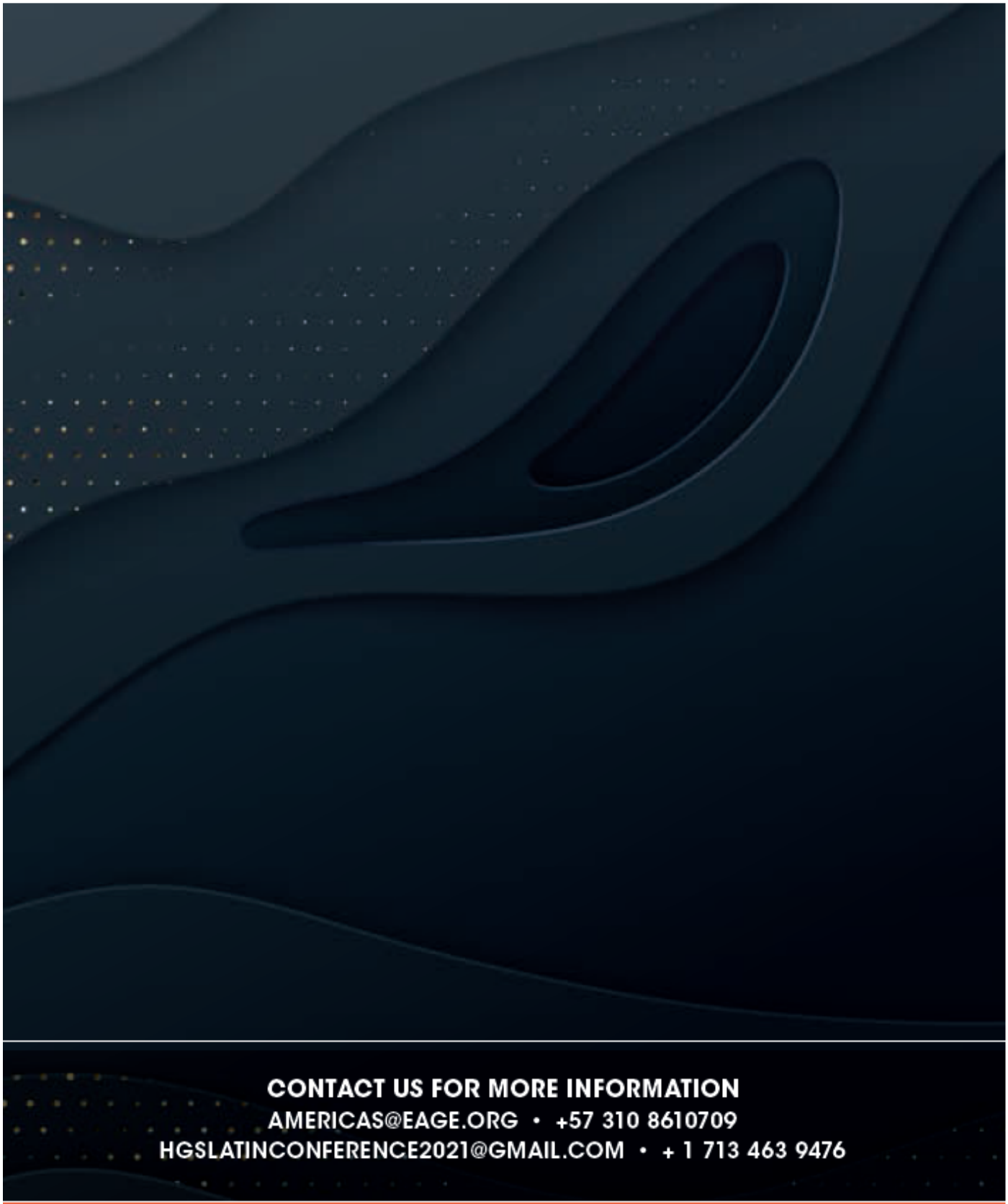
**Chairs: Lucia Torrado and Leo Liu (Chevron)**

The Pacific Margin of Latin America has one of the largest concentrations of oil seeps in the world. With several mature Cretaceous to Cenozoic source rocks, reservoirs like turbidite sandstone, extensive seal rocks and multiple, combined trapping mechanisms, the Latin America's convergent margin is proving to be an attractive area ready to be explored. The increased availability of high-quality data and farm-ins from major O&G companies like Equinor in Nicaragua's Sandino basin, and Tullow Oil, BP and Oxy's in the Peruvian offshore are an encouraging indicator of the value and potential of this margin.

### Mexico

**Chairs: Stan Ingram (CNOOC) and Mike Durcanin (Murphy)**

Mexico is a major petroleum producing country with numerous proven basins, including the both the Salina del Istmo and Sureste "Super Basin" with ~60 BBOE of recoverable reserves. These offshore basins are characterized by world-class mature source rocks with numerous reservoir – seal pairs proven in several different stratigraphic intervals similar to its northern counterpart. Unlike the US GoM however, initial exploration and development generally focused mainly on both shallow-water Cretaceous and Jurassic carbonates. As such, the deeper water clastic Neogene/Paleogene plays attracted little interest until now. Following the historic energy reform in 2013, five offshore license rounds were held between 2014 – 2018 with participation from 25 companies that bid over 50 exploration wells and numerous seismic acquisition programs across 55 licenses. With the exception of the giant Zama discovery (roughly 700+ mmbo recoverable) within the Upper Miocene play in the Sureste basin and minor successful step outs within this play (i.e. Cholula, Saskeen), exploration results thus far have been disappointing. Recently, the newest discovery, Polok-1, confirmed a commercially viable petroleum system in the Lower Miocene. To date, as over half of the initial commitment wells remain to be drilled, Mexico remains an exciting location for exploration activity in 2021 and beyond.



# Energy 101: A Rational Approach Towards Our Energy Future

BY DR. JORY A. PACHT, PRESIDENT OF ALTAIR RESOURCES LLC

## *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.

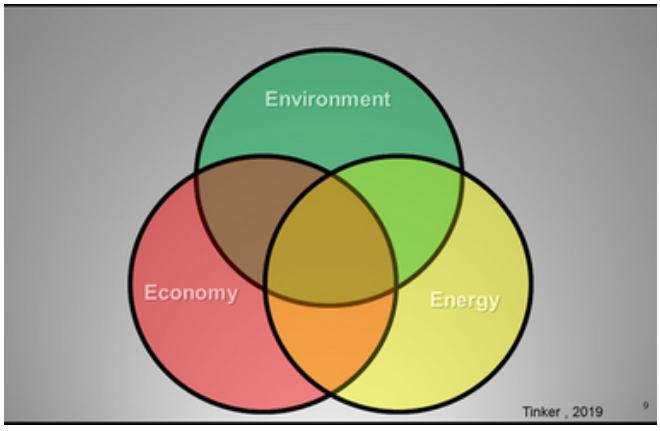



Figure 1: The Three E's ***Tinker, 2019***

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 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.

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.

# Energy 101: A Rational Approach Towards Our Energy Future *...continued*

DR. JORY A. PACHT, PRESIDENT OF ALTAIR RESOURCES LLC

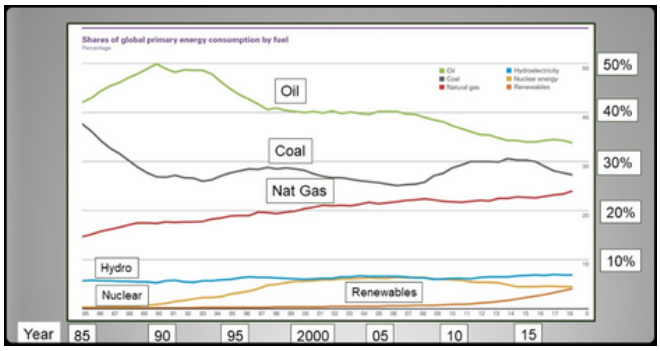



Figure 2: World Energy Use by Year **British Petroleum** (2019)

## *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**).

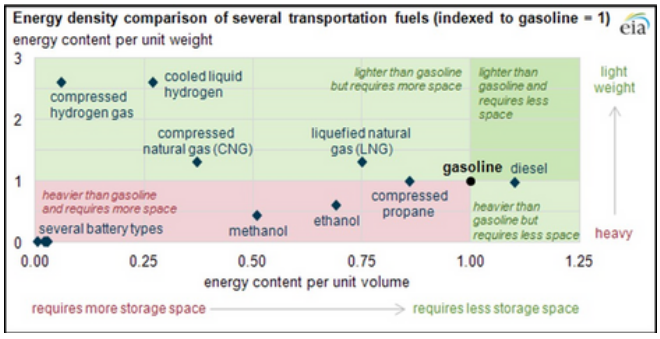



Figure 3: Energy density of transportation fuels **EIA (2013)**

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).

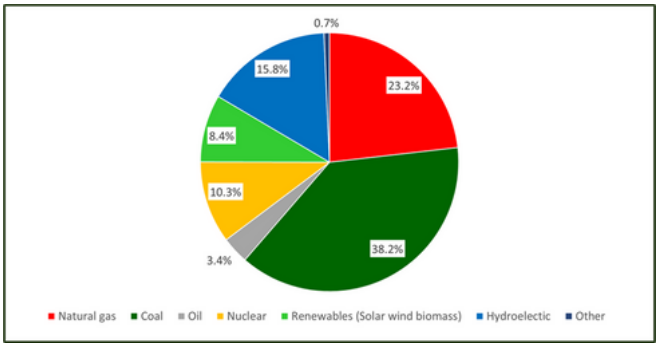



Figure 4: World power generation by source BP **(2019)**

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).

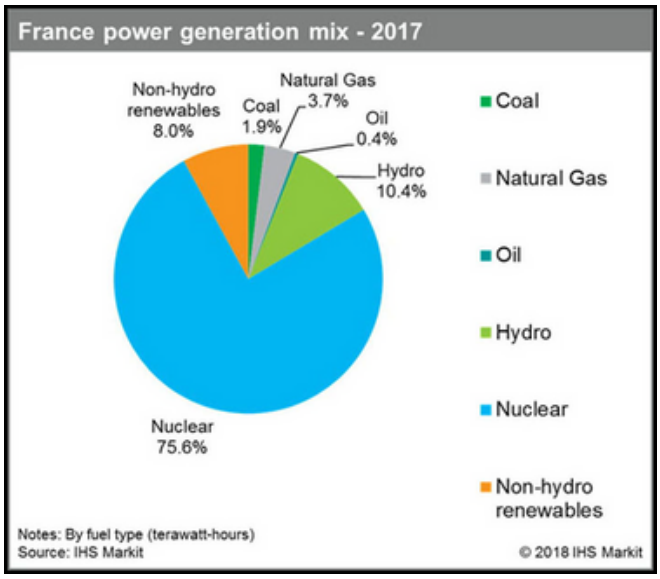



Figure 5: Energy Use by Source for France *IHS Markit* (2018)

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).

# Energy 101: A Rational Approach Towards Our Energy Future *...continued*

DR. JORY A. PACHT, PRESIDENT OF ALTAIR RESOURCES LLC

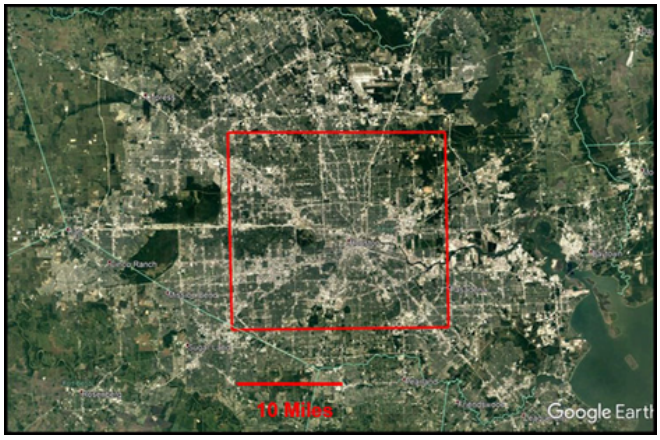



Figure 6: Red square shows the size of a solar power plant that could power Greater Houston. The square (403.12 square miles in size) is overlain on a Google Earth image of Greater Houston.

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.

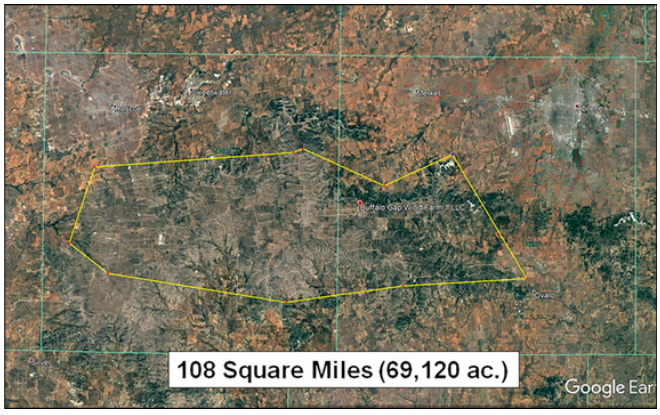



Figure 7: Size of the Buffalo Gap Wind Farm on a Google Earth Image.

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.

# Energy 101: A Rational Approach Towards Our Energy Future *...continued*

DR. JORY A. PACHT, PRESIDENT OF ALTAIR RESOURCES LLC

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 those 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.

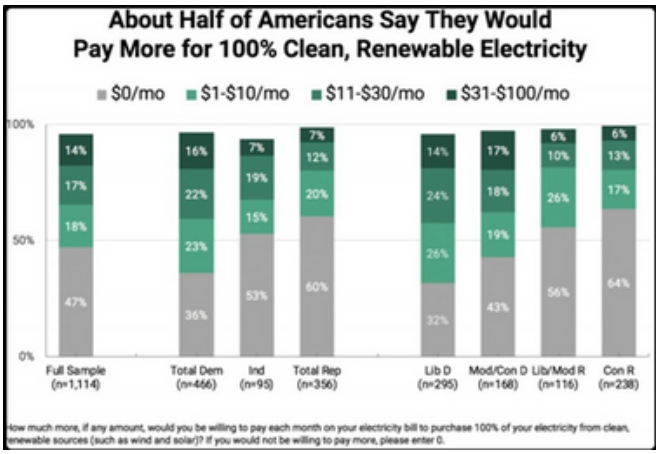



Figure 8: Results from a **Yale poll** taken in 2018 asking whether respondents would be willing to pay for clean energy, and if yes, *how much more?*

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.

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?

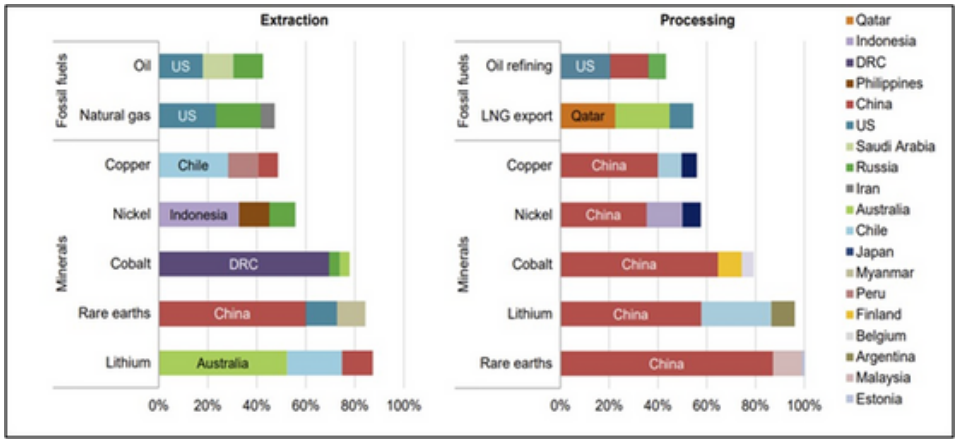



*Figure 9: Countries that control extraction and processing of strategic metals necessary for transition from fossil fuels to wind and solar energy* **IEA, 2021**

# Energy 101: A Rational Approach Towards Our Energy Future *...continued*

DR. JORY A. PACHT, PRESIDENT OF ALTAIR RESOURCES LLC

### *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?

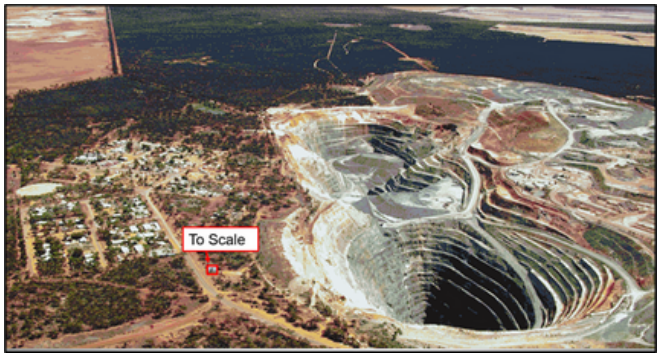



*Figure 10: Photo of a lithium mine in Western Australia. An oil pumpjack (red square) was superimposed for scale (adapted from: **Tinker 2021**).*

### *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.

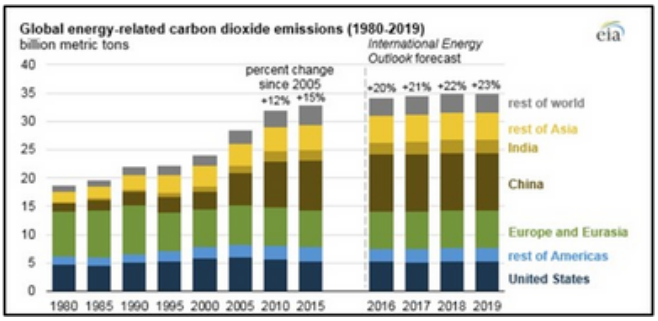



Figure 11: Global energy related CO2 emissions by region. **EIA 2019**

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.

# Energy 101: A Rational Approach Towards Our Energy Future *...continued*

DR. JORY A. PACHT, PRESIDENT OF ALTAIR RESOURCES LLC

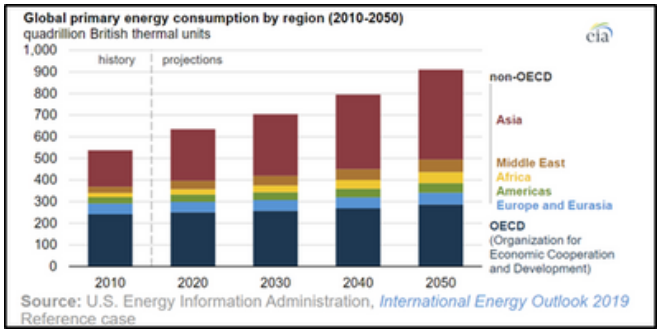



Figure 12: Expected global increase in energy use by region. **EIA 2018**

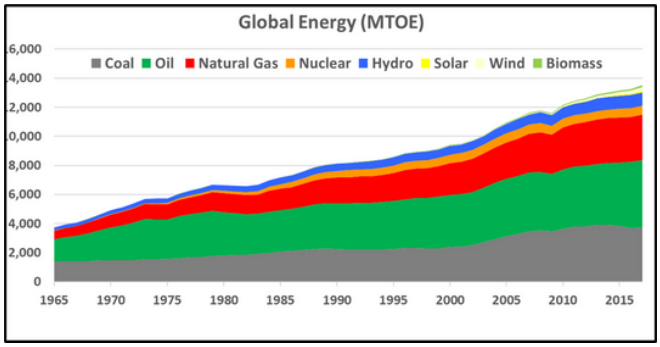



Figure 13: Chart which shows growth in global energy in (Millions of Tons of Oil Equivalent (MTOE) Note that renewable sources (wind and solar) comprise a very small portion of today's energy mix In fact solar energy is not even visible on this chart **(Tinker, 2019)**.

**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?

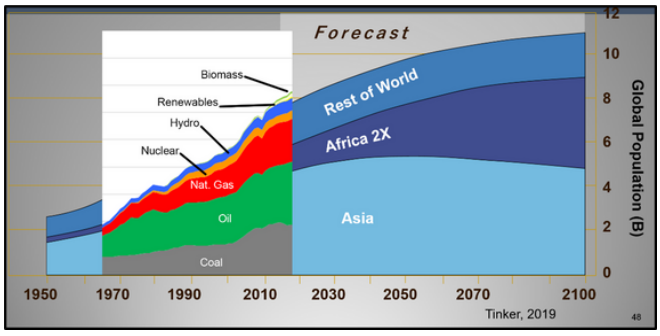



Figure 14a: Figure 13 superimposed on a chart of projected world population growth. **(Tinker, 2019)**

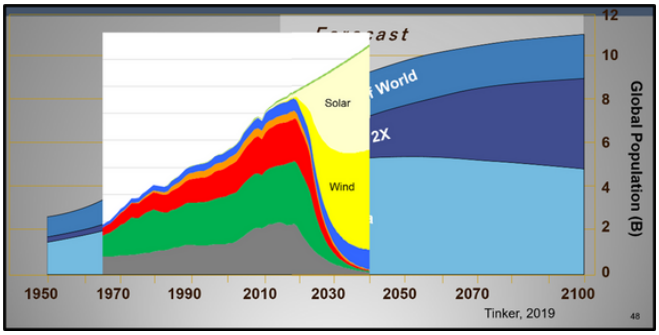



Figure 14b: Shows world energy consumption by source superimposed on a chart of projected world population growth assuming a move to 98% free carbon sources. Note the huge increases in wind and solar energy which would be necessary. These increases are not possible given global issues with energy distribution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

*"Figure 13 shows where we are at now. It shows our current energy mix. Note that you cannot even see solar on this chart."*

## *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.

# Energy 101: A Rational Approach Towards Our Energy Future *...continued*

DR. JORY A. PACHT, PRESIDENT OF ALTAIR RESOURCES LLC

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. Canada 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."

# Energy 101: A Rational Approach Towards Our Energy Future *...continued*

DR. JORY A. PACHT, PRESIDENT OF ALTAIR RESOURCES LLC

## *About the Author*

**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.

## *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.

# 2021

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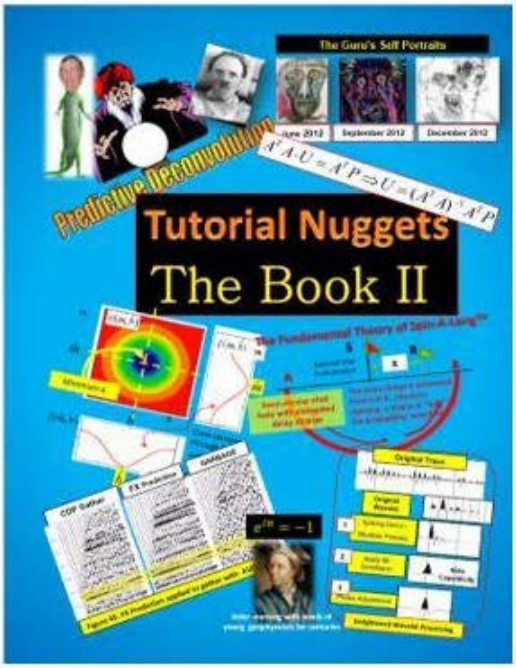


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# *Remembrance*

**THOMAS E. JOHNSON**
**1938-2021**

Tom spent a lifetime loving his family, his work in the oil industry, traveling, the outdoors, and sports. Tom was born in 1938 in Yonkers, New York. He grew up in Teaneck, New Jersey, where he ran cross country, played ice hockey, and participated in the Boy Scouts and Junior Seabees. He attended Rensselaer Polytechnic Institute (BS Geology 1962) He served in the U.S. Army in Korea as an engineer, continuing in the Army Reserves for seven more years. He moved to New Orleans to work for Pan American Petroleum and soon after married the love of his life, Peggy. He studied for his Master's Degree at Tulane University.

Tom spent his career as a petroleum geologist, exploring and identifying South Louisiana and Southeast Texas oil and gas prospects. He was a partner at Solatex in Houston before following his heart and moving his family to Steamboat Springs, Colorado. He began Steamboat Exploration Company and spent ample time fly fishing, hiking, and cross country and downhill skiing. After returning to Houston, he worked with Texas Meridian and continued working independently after retirement. Tom was an active member of the American Association of Petroleum Geologists, the Houston Geological Society (Joined 1/1/74), and the New Orleans Geological Society. Throughout his lifetime, he enjoyed the nature around him, setting up multiple model train sets, which thrilled his grandchildren, and building wartime era model airplanes. Tom and Peggy both loved being close to family and also exploring the world, continuing to travel regularly after retirement.

A devoted family man, Tom is survived by his wife, Peggy K. Johnson; 2 sons and one daughter; 9 grandchildren.

*Summarized from Sunday, July 11, 2021 Life Tributes Section of the Houston Chronicle.*

# *Remembrance*

**BRET ROTHWELL**
**1947-2021**

Bret Gordon Rothwell, 74, passed away peacefully at home on Thursday, June 10, 2021 in Katy, Texas. He was born April 9, 1947 to H. Gordon and Laurel Rothwell in Wauseon, Ohio. On April 11, 1970 he married his best friend Chery Ann Tomczak in Milwaukee, Wisconsin.

Bret received his Bachelor of Science from University of Wisconsin-Oshkosh in 1969, went on to proudly serve in the military and received his Master's degree in Geology from University of Wisconsin-Milwaukee in 1973. Relocating to Houston in 1973 to work for Texaco, he started his career as a certified Petroleum Geologist exploring the Gulf Coast region.

He was an avid windsurfer who loved being outdoors, tending his garden, mastering bread making, roaring around back roads on a motorcycle, spending time with his family and making breakfast for Cheryl.

Bret is survived by his wife Cheryl of 51 years, children Brett and his wife Suzanne, Paul and Allison, grandchildren Casey, Azalin, Falaena, Nathan, Bennet and Quinn.

*Published in the Life Tributes Section of the Houston Chronicle on July* 19, 2021.

# *Remembrance*

**DR. THERESA FRANCES FLYNN SCHWARZER**
**1940-2021**

Born & raised in Troy, NY Dr. Schwarzer married & had one daughter before moving to Houston, TX in 1969 where she called home.

She was considered among the pioneer women of the Geo Sciences. She graduated Valedictorian from Lansingburgh HS in 1958 always knowing she wanted to attend Rensselaer Polytechnic Institute (RPI) in NY.

In the Fall of 1958 she entered RPI as one of five women in the freshman class of 1200, a year later she became the first woman to major in Geology at RPI.

She received her B.S., M.S., and in 1969 her Ph. D. in Geology from RPI. Shortly afterward she moved to Houston, TX as a Post Doctoral Research Fellow at Rice University. There she conducted natural radioactivity surveys from Oklahoma to Puerto Rico in helicopters flying so low they barely cleared trees and power lines. While at Rice she was awarded a fellowship to attend a NATO Advanced Study Institute on uranium prospecting held in England.
In 1972 she joined Esso Production Research Co. as the first woman PhD hired by the organization and participated in frontier oil exploration research and development of new Geophysical and Geochemical Techniques. She also founded and chaired the Association of Women Geoscientists under the American Geological Institute. She joined Houston Geological Society on 9/1/2000.

In 1978 she transferred to Exxon Co., USA as a Senior Exploration Geologist, and by 1980 Dr. Schwarzer was the head of Exxon Texas Offshore Exploration Group involved in the search for domestic oil and gas along the Gulf of Mexico. After 24 years with Exxon, Dr. Schwarzer retired in 1995 as a Senior Supervisor within the Exploration and Production Division. Her golden years were spent travelling the world, playing the piano, attending the Houston Symphony and Rice University concerts, baking her famous apple turnovers, putting together amazing photo albums as gifts and sharing her terrific stories with everyone around. She was preceded in death by her parents, Francis & Nelda Flynn, her husband Dr. Rudolph R. Schwarzer in 1993 and her only daughter Cynthia Anne Schwarzer Buznego in 2015. Dr. Schwarzer led an inspiring and accomplished life and was a true joy and blessing to know and spend time with. She will be missed greatly by relatives, colleagues, and many friends and neighbors.

# *Remembrance*

**JAMES "JIM" G. SULLIVAN, JR.**
**1929-2021**

Jim was born in Clayton, Louisiana, on November 2, 1929, to Odile Sullivan and James Sullivan, Sr. and grew up in Louisiana. Upon graduating from Ferriday High School, he enlisted in the United States Air Force and proudly served as a pilot from 1951-1955. Jim was a lieutenant in the Korean War and flew F-86 Sabre fighter jets in the 67th F.B.S. and 18th F.B.G. He was a lifetime member of the F-86 Sabre Pilots Association.

After his service, Jim attended Louisiana State University and graduated in 1957 with a B.S. in Geology. He met the beautiful love of his life, Betty, while studying at LSU, and they were married on June 2, 1957, at University Methodist Church in Baton Rouge, Louisiana. They eventually moved to Texas and settled in Houston.

Following his time at LSU, Jim began his career as a geologist at Union Producing Company in Shreveport, Louisiana. After spending time as a geologist in Jackson, Mississippi, and Lafayette, Louisiana, he settled in Corpus Christi, Texas, and eventually Houston, joining Pennzoil, where he spent his career. Jim was a member of the National Geological Association and the Houston Geological Society (1/1/1998) and a notable geologist holding positions of increasing importance over the lifetime of his career.

Jim, lovingly named "Poppy" and later "Pops" by his grandchildren, is survived by his daughter, Sherry Menger; son, Shawn Sullivan and wife, Sheila; granddaughter, Misty Morales and husband Adam and great-granddaughters, Meadow, Milan, and Monet Morales; grandson, Matt Menger and wife Elaine and great-grandsons, Maximus and Miles Menger; and granddaughter, Sydney Sullivan; Jim was a generous, selfless, and unconditionally loving husband, father, grandfather, and great-grandfather.

He was a proud patriot of our great country, a giving member of Chapelwood United Methodist Church, and a forever LSU Tiger alumnus who faithfully read Tiger Rag until his final days. He enjoyed reading and supporting National Geographic and collecting rocks, minerals, and gemstones and later sharing them with his grandchildren. Jim was a skilled vegetable gardener, growing delicious tomatoes, cucumbers, jalapeños, and bell peppers for his family and neighbors

# *Remembrance...continued*

**JAMES "JIM" G. SULLIVAN, JR.**
**1929-2021**

to enjoy. On fall days, he loved watching Houston Astros baseball and making homemade apple and pumpkin pies. One of Jim's favorite activities was following the stock market, which he did with consistent enthusiasm over many years. Pops' pockets weren't to be found without Werther's Original Candy, a white handkerchief, and plenty of quarters to share. Above all, he devoted himself to the lives of his family.

The memories of our dear father and grandfather run deep and wide as he is our unwavering rock of love and support. His gentle spirit, honorable character, unparalleled love for his family, and faith in our God will forever guide us through times of joy and sorrow, finding light in the dark and turning tears to smiles.

A private graveside service will honor his magnificent life and everlasting legacy.

# *Remembrance*

**CLARK E. SUTLEY**
**1931-2021**

Clark Sutley passed away peacefully on June 16, 2021. He lived for 89 years.

Clark received a B.S. in Geology from Texas Tech in 1957 and joined HGS in 1/1/71.
He worked for Pennzoil and as a Consultant.

Clark leaves behind his loving wife of more than 57 years, Sally, son Chris and daughter-in-law Hellen and Justine, as well as granddaughter Eden and her husband Greg. He was preceded in death by his elder son Ray.

*Summarized from Sunday, July 11, 2021 Life Tributes Section of the Houston Chronicle.*

# *Remembrance*

**ALBERT EUGENE "GENE" WOODWARD**
**1929-2021**

Albert Eugene "Gene" Woodard, 91, passed away peacefully on Thursday, August 12th at his home in Houston. Gene and his wife, Royce Brunt Woodard, celebrated their 69th wedding anniversary together, just three days before they both went to be with the Lord.

Gene was born in Tampa, Florida on November 15, 1929, and was the second son of George and Bess Woodard. The Woodard Family moved to Houston early in Gene's childhood, where he attended Lamar High School and the University of Houston, earning a degree in Geology. During that time, he met the love of his life, Royce, on a blind date and "convinced her to marry him." They were married at Bethany Christian Church, and shortly after welcomed four children. The Woodards moved to a new neighborhood out west, Briargrove Park, and built a life surrounded by family, friends, and laughter.

In his early career, Gene took an interest in geology and Houston's prolific oil and gas industry. He began his professional life with Harrison Interests, a career that Gene routinely referenced as some of the best and most formative years of his life. Gene retired from Harrison Interests in 1985 to create his own oil company, Woodard Energy. His tenured career took Gene throughout many parts of Texas, hunting for oil and making friends along the way. Gene was a member of the Houston Geological Society, AAPG, the National Rifle Association, and was a member at Bethany Christian Church and Grace Presbyterian Church.

Gene's passions extended beyond oil, as he was a fan of hunting, fishing, and loved the outdoors. He frequented their properties throughout Texas, but loved cultivating the land at The Wood-Duck Club in Damon, Texas. Gene worked with Ducks Unlimited to foster a sustainable hunting and fishing club, and was able to share the experience with his family and friends alike.

Above all else, Gene most cherished the family he and Roycie created. Their four children, six grandchildren, and 8 great grandchildren were Gene's proudest accomplishments, and he routinely let them know that he was honored to be their patriarch. Gene showed that love in many ways, but he was particularly fond of the practical joke. He will be remembered as a prankster with a huge smile, a man that would do anything for his family, and most of all, a true gentleman.

# *Remembrance...continued*

**ALBERT EUGENE "GENE" WOODWARD**
**1929-2021**

Royce and Gene were preceded in death by parents George and Bess Woodard, Roy and Jessye Brunt; siblings Jack Woodard, William "Bill" Woodard, and Jessye Ruthe Holleman, son-in-law Mike Fields, niece Patricia Kirkwood Crawford, and countless other friends they made throughout their lives. Left behind to carry on their immeasurable light and legacy are children Cathy Woodard Fields of Alice, Susan Woodard Emerson of Houston, Daniel Roy Woodard of Hempstead, and Albert Eugene "Rusty" Woodard Jr. of Corpus Christi; grandchildren Charles "Chris" Christian, Kelly Fields Murdoch, Amy Fields Gunn, Ally Hall Hare, Jaime Emerson Brochu, Matt Fields, 8 great grandchildren, and long-time Woodard Energy employee and friend, Gail Jones.

*Published by Houston Chronicle on Aug. 22, 2021.*

# HGS *Bulletin* Instructions to Authors

All materials are due by the 15th of the month, 6 weeks before issue publication. Abstracts should be 500 words or less; extended abstracts up to 1000 words; articles can be any length but brevity is preferred as we have a physical page limit within our current publishing contract. All submissions are subject to editorial review and revision.

**Text** should be submitted by email as an attached text or Word file or on a clearly labeled CD in Word format with a hard copy printout to the Editor.

**Figures, maps, diagrams**, etc., should be digital files using Adobe Illustrator or Adobe Photoshop. Files should be saved and submitted in .ai, .eps, .tif or .jpg format. Send them as separate attachments via email or CD if they are larger than 5 MEGs each, accompanied by figure captions that include the file name of the desired image. DO NOT EMBED them into your text document; they must be sent as separate files from the text. DO NOT USE POWERPOINT, CLIP ART or Internet images (72-DPI resolution) as these do not have adequate resolution for the printed page and cannot be accepted. All digital files must have 300-DPI resolution or greater at the approximate size the figure will be printed.

**Photographs** may be digital or hard copy. Hard copies must be printed on glossy paper with the author's name, photo or figure number and caption on the back. Digital files must be submitted in .tif, .jpg, or .eps format with 300-DPI or greater resolution at the printing size and can be accompanied by figure captions that are linked by the file name of the image. The images should be submitted as individual emil attachments (if less than 5 MB) or on CD or DVD.

## HGS *Bulletin* Advertising

The *Bulletin* is printed digitally using InDesign. Call the HGS office for availability of ad space and for digital guidelines and necessary forms or email ads@hgs.org. Advertising is accepted on a space-available basis. **Deadline for submitting material is 6 weeks prior to the first of the month in which the ad appears.**

| Random Inside Ad Placement<br>Black & White Prices Shown – Color add 30% to prices below | | | | | Specific Page Color Ad Placement | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. of Issues | Random Eighth Page | Random Quarter Page | Random Half Page | Random Full Page | Inside Front Cover Full Page | Inside Back Cover Full Page | Page 2 Full Page | Outside Back Cover Half Page | Back of Calendar Full Page | Calendar Quarter Page |
| 10 | $950 | $1,350 | $2,550 | $4,750 | $8,000 | $7,500 | $7,050 | $6,850 | $6,650 | $3,000 |
| 9 | $800 | $1,300 | $2,500 | $4,700 | | | | | | |
| 8 | $750 | $1,250 | $2,250 | $4,300 | | | | | | |
| 7 | $600 | $1,100 | $2,200 | $3,850 | | | | | | |
| 6 | $550 | $950 | $1,800 | $3,500 | | | | | | $2,000 |
| 5 | $500 | $800 | $1,600 | $3,000 | $4,700 | $4,500 | $4,350 | $4,000 | | |
| 4 | $450 | $650 | $1,300 | $2,500 | | | | | | |
| 3 | $300 | $550 | $950 | $2,000 | | | | | | $1,000 |
| 2 | $250 | $400 | $700 | $1,500 | | | | | | |
| 1 | $150 | $250 | $450 | $1,000 | $1,500 | $1,400 | $1,250 | $1,000 | $1,250 | $850 |
| Professional Directory Section Business Card Ad: 10 Issues – $160 ($30 for each additional name on same card) | | | | | | | | | | |

## Website Advertising Opportunities

There are currently 5 opportunities to help spread the word about your business or event and generate traffic to your website or campaign. Please submit all ad materials five (5) days prior to the go-live date for testing.

| Placement | Rate | Specifications/Description |
|---|---|---|
| HGS Website Home Page Banner Ad | $800 – Monthly<br>$1800 – 3 Months<br>$2800 – 6 Months<br>$3600 – 12 Months | 275 x 875 pixels; home page top banner ad. All Home Page Banner Ads rotate every 10 seconds. |
| HGS Website Home Page Column Ad | $700 – Monthly<br>$1500 – 3 Months<br>$2400 – 6 Months<br>$3600 – 12 Months | 200 x 400 pixels; home page right column ad |
| HGS Website Event Page Ad | $600 – Monthly<br>$1200 – 3 Months<br>$1600 – 6 Months<br>$2600 – 12 Months | 200 x 400 pixels; calendar page left column ad. All Event Page Ads rotate every 10 seconds. |
| Geo-Jobs | $50 – 14 days<br>$100 – 30 days<br>$300 – 3 Months<br>$600 – 6 Months<br>$1200 – 12 Months | Posting of job opportunities on HGS website. Click the Geo-Jobs tab to get started. Must be filled out completed and the dates set appropriately. |
| Vendor Corner | $250<br>*4 Pack option with 1 FREE bonus event for $1000.00 available. Send request to vendorcorner@hgs.org. | Company logo, company website, and company description will be highlighted on HGS Calendar website event. This is an opportunity to display company wares, gain personnel exposure and hand out product information at HGS dinner meetings. |
| Event/Short Course Calendar Ad | $100 – Monthly | An event ad posted within the HGS website calendar under the Events tab. |
| Bundle & Save! | • 30% off website ads when combined with print ads in all 10 HGS *Bulletin* issues.<br>• 20% off website ads when combined with print ads in 5 HGS *Bulletin* issues.<br>• 10% off website ads when combined with print ads in 3 *Bulletin* issues. | |

# APPLICATION TO BECOME A MEMBER OF
# THE HOUSTON GEOLOGICAL SOCIETY

## *Qualifications for Active Membership*

- Have a degree in geology or an allied geoscience from an accredited college or university; or
- Have a degree in science or engineering from an accredited college or university and have been engaged in the professional study or practice or earth science for at least five (5) years.

## *Qualifications for Associate Membership (including students)*

- Be involved in the application of the earth or allied sciences.
- Be a full-time student enrolled in geology or in the related sciences.

***Apply online at www.hgs.org and click "Join HGS". Annual dues expire each June 30.***
***Annual dues are $30; Emeritus members pay $15; Students are free.***

***To the Executive Board:*** *I hereby apply for membership in the Houston Geological Society and pledge to abide by its Constitution and Bylaws.*

Full Name _____ Membership Type (*choose one*): Active Associate Student

Current Email (*for digital Bulletin & email newsletter*) _____

Phone _____

Preferred Address for HGS mail _____

Employer (required) _____ Job Title ***(required)*** _____

Will you volunteer? (Y/N) _____ Committee choice: _____

Active & Associate membership for one year (July 1st - June 30th) $30.00_____

Student membership $0.00 _____

*OPTIONAL* Scholarship Contributions: Calvert/HGS Foundation-Undergraduate $5.00 _____

**Total Remittance** _____

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Check # _____

Credit Card: V MC AE Discover Credit Card #: _____

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Signature: _____ Date: _____

Company _____ Company Street Address _____

City _____ State _____ Postal Code _____

School ***(required)*** _____ Major ***(required)*** _____

Degree ***(required)*** _____ Year Graduated _____

School (*optional*) _____ Major (*optional*) _____

Degree (*optional*) _____ Year Graduated _____

Years Work Experience ***(required)*** _____
Please submit a brief statement regarding your work experience in the practice or application of earth science or an allied science.

AAPG Member Number _____ HGS Sponsor's Name _____

Signature: _____ Date: _____

# *Professional Directory*



## Advertise your Business Card!
## $175 per 10 Issues

**Contact:**
713-463-9476 or *office@hgs.org*

# New Members Effective August 2021

### ACTIVE MEMBERS

Nicole Wilson

Natthawee Hinthong

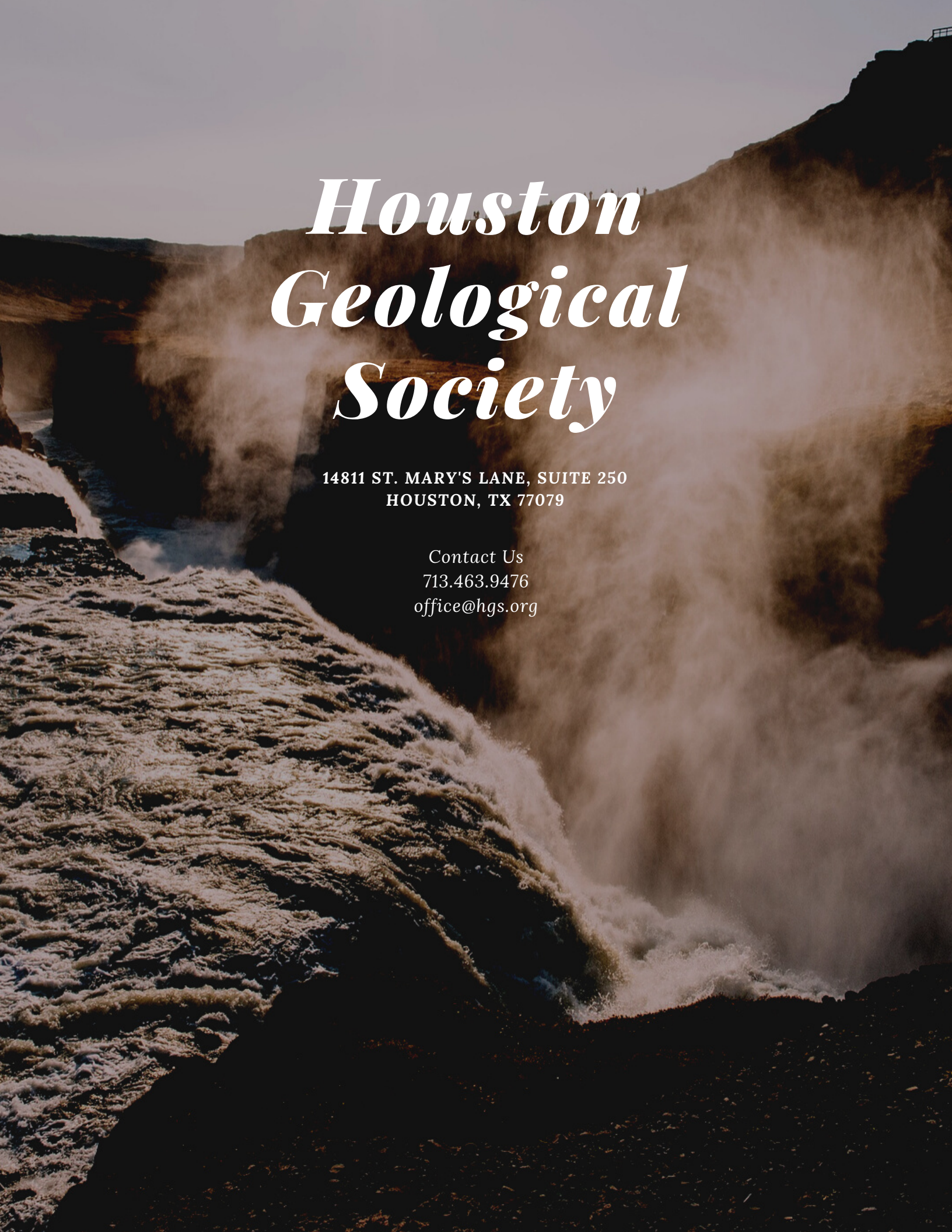
Chris Clayton

### STUDENT MEMBERS

Natalie Odegaarden

Bryan Moore

Denzer Keaton



# Houston Geological Society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