Fireside Chats with Gaia

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This series of articles on environmental stewardship in oil and gas industry (Michelle meets Gaia) is dedicated to Svante August Arrhenius. Arrhenius was the first to use basic principles of physical chemistry to estimate the extent to which increases in atmospheric carbon dioxide are responsible for the Earth’s rising surface temperatures. We have been arguing about that conclusion now for the last 115 years. Michelle has really learned a lot from this journey. I hope that we all can benefit as well.

- Svante August Arrhenius was a Swedish scientist, originally a physicist; but often referred to as a chemist.
- He was one of the founders of the science of physical chemistry and received the Nobel Prize for Chemistry in 1903, becoming the first Swedish Nobel laureate.
- In 1905 he became director of the Nobel Institute, where he remained until his death in 1927.
- Arrhenius was the first to use basic principles of physical chemistry to estimate the extent to which increases in atmospheric carbon dioxide are responsible for the Earth’s increasing surface temperature.
- In the 1960’s, David Keeling demonstrated that human-caused carbon dioxide emissions are large enough to cause global warming.
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Forward

The Future Ain’t What It Used to Be

People usually call upon an expert for advice about the future. Whether that is about investing their money, deciding on a vacation spot to visit, which school or discipline should they pursue or what industry career they should prepare for. That advice is usually pretty sound when things are stable, when the past is a pretty good predictor of the future. In a time of dislocation and rapid change, the knowledge and experience of that expert may not be that valuable or relevant.

There is a lot of talk these days about transitions. Sometimes, I wish history would slow down to let most of us catch up. The headwinds and the tailwinds are both blowing pretty strong and it is hard to stay on the road at times. There are technology transitions (digitization and digital transformation) going on. There is talk about Industry 4.0, when many parts of the world are still trying to get to Industry 3.0. There are demographics (The Big Crew Change) and cultural transitions in the workforce and in society-at-large with a new generation with new ideas taking over from my generation (getting old is a bitch). I have lost track. Are we in Generation Z or Millennials or what are we calling the next generation these days? All I know is that my generation is getting assigned a seat at the back of the room.

Public health pandemics and Climate Change cannot be ignored. Economic recessions of very large magnitude can’t be ignored either. But the one I want to focus on in this article is the so-called Energy Transition. All though to be fair, all of these transitions get mixed up into one pot and each affects the others.

Environmentalist are talking about an energy transition to a new Green Energy world, net-neutral-carbon-zero world to mitigate against the impacts of Climate Change and predict that we don’t have much time to get there. The oil and gas industry has started to talk about sustainability and the use of natural gas as a bridge fuel between coal for power generation (electricity is the new target) and renewables. All but the crustiest oilman can probably get that direction. Even SPE has it’s GAIA technical committee under their Health, Safety and Environment technical committee. And while several European Oil and Gas majors are rebranding themselves as International Energy Companies (IEC) instead of IOC (International Oil Companies), my question is how long should a transition take, especially with something as central as the role of fossil fuels in the energy mix of our society.

The facts say, that despite the rapidly growing role of renewables, fossil fuels are responsible for 75-80% or the world’s energy production right now. In some places, countries are still building coal fired power plants. But here is where the challenge lies. Many existing energy experts suggest that by 2050, the world will still depend on fossil fuels for a significant majority of energy production, while many politicians and activists cry out for carbon-free long before then. Here the experts are looking to the past to predict the future.
I am not debating the role of fossil fuels in climate change. It has both provided affordable energy to life billions out of poverty and created unimaginable wealth as well as significantly contributed to rising green-house gas in the atmosphere. I believe the data from environmental studies. The impact is real and we have to do something about it.

Let’s stop arguing about the science and start talking about what we need do during this transition. This is a question for the oil companies as well as the politicians. This is a question of engineering and economics as well as policy and environmental studies. Can there be a common ground, an agreed path to a new energy economy or will we stay shouting at each other and calling each other names while not only the temperature rises but many people are trapped in poverty?

In my experience, answers to complex questions are often found in the middle between two extremes. But compromise has gone out of style. You don’t get elected anymore by appealing to the middle. You don’t get on TV talk shows by appealing to the middle and common sense. You don’t win market share by working with your competitors on common standards. But all this verbal sparring may get your heart beat up but it rarely finds creative and practical solutions.

Both sides need to give some ground and both sides need to agree on some common objectives. The oil side needs to get out of denial. It needs to clean up its act in many places. It needs to invest in something it already has the skills to do like carbon sequestration and reducing methane emissions from natural gas production. The green side needs to answer the economic question of how are we, as a society, going to pay for this transition and the employment question of how to transition hundreds of thousands of workers to these promised new ‘green’ jobs, many of which pay a lot less than a petroleum or drilling engineer. And both sides need to remember to address those on the other side of the energy divide who still don’t have reliable, affordable electricity and can’t afford to pay their bills as it is.

Every journalist will easily quote you the dramatic decline in fossil fuel demand due to the Covid-19 virus but few will go further and discuss that 2020 will see that global growth in new renewable energy capacity will experience its first annual decline in 20 years this year amid the coronavirus pandemic according to the International Energy Agency. The world is set to build fewer wind turbines, solar plants and other installations that produce renewable electricity this year as energy demand has been reduced across commercial and industrial sectors and logistics issues delay projects.

Growth for 2020 and 2021 combined is expected to be 10% lower than the IEA had previously forecast before the coronavirus outbreak. Almost all mature markets are affected by downward revisions, except the United States where investors are rushing to finish projects before tax credits expire (Chestney, 2020).

To sort this out we need to look at the big picture. The really big picture. While Denmark (population of 5.82 million about the size of the state of Colorado) is fossil fuel free and they
are counting the days in Britain since they last needed to turn on their coal fired power plants, there are about 1.1 billion people in the world living without reliable electricity. We could focus new energy sources on this vulnerable population but they can’t pay for it, so who is going to cover the bill?

My dream would be that we all get together and bring each of our skills and resources (energy companies, NGOs, economists, engineers, scientists, environmental activists, renewable energy firms and yes even a few politicians/lawyers but not too many) and develop an All-of-the Above energy transition strategy with the aim of carbon neutral, sustainable, affordable energy as soon as practical. With practical being a modifier on urgent. We have to do more than stand behind a podium and state energy is a human right. Of course, it is but how do you get there is the challenge; but I am a realist and don’t think that will probably happen.

We are good at name-calling. The Energy transition has become yet another divisive issue. Line up on your side and start slinging mud at the other side. Get ready, set, sling. Meanwhile the planet gets hotter, the poor still don’t have the energy they need to get out of poverty. All the bad consequences are starting to happen (wild fires, pandemics, weak health systems, stronger hurricanes, melting ice caps, growing wealth divide, etc. etc.). This would be a big challenge even if we were all pulling in the same direction, but we are not.

So now down to my specific challenge. What do I tell the young engineering student about the future of oil and gas? Should he or she (I wish there were more women in the industry they might be the one searching for common ground and practical solutions) pursue a degree in petroleum engineering or earth science? Or should they follow the longer line at the enrollment table (virtual these days) for computer science and law? We need those young engineers to help solve the problems of more sustainable fossil fuel production, more efficient oil and natural gas production techniques, a smaller environmental footprint, carbon capture and sequestration, halting methane emissions, enhanced oil recovery, etc. etc.). But who are they going to listen to in deciding their futures?
**Production & Processing**
1. Onshore Petroleum & Natural Gas Production
2. Offshore Petroleum & Natural Gas Production
3. Total Crude Oil to Refineries
4. Petroleum Refining
5. Gathering and Boosting
   *Data collection began in FY 2016*
6. Gas Processing Plant
   *May contain NGL Fractionation equipment*
7. Natural Gas Liquids (NGL) Supply

**Natural Gas Transmission & Storage**
8. Transmission Compressor Stations
9. Underground Storage
10. Lithified Natural Gas (LNG) Storage
11. LNG Import-Export Equipment
12. Natural Gas Transmission Pipeline
   *Data collection began in FY 2016*

**Distribution**
13. Large End Users
14. Natural Gas Distribution
15. Natural Gas & Petroleum Supply to Small End Users

- **Red**: Subpart W: Emissions from petroleum & natural gas systems
- **Blue**: Subpart Y: Emissions from petroleum refineries
- **Orange**: Subpart MM: CO₂ associated with supplies of petroleum products
- **Green**: Subpart NN: CO₂ associated with supplies of natural gas & natural gas liquids
- **Black**: Not reported under GHGRP
I want to introduce you to one the leading actors in this story, Michelle. Michelle is the Chief Operating Officer of a publicly traded oil and gas producing firm. While her CEO focuses on strategy, it is her job to focus on execution. Her metrics are production, safety and costs. There has been some discussion recently at the executive committee about adding some metric around the environment and sustainability but there hasn’t been a final agreement on that yet.

Recently, on one of Michelle’s normally busy days, her thoughts were interrupted by her smart phone chime for a new email. Michelle gets hundreds of emails daily so she has to rely on a normally effective spam filter to reduce this deluge to a relative manageable number of relevant messages. Michelle looked down at her phone and saw a message for a source she didn’t recognize. Someone called Gaia. Without a second’s thought she hit the delete button and made a mental note to talk to IT about updating the list on her spam filter and went on with her day.

The story doesn’t end there, it is only getting started. The next day and the same message was received. Michelle had to acknowledge that this Gaia person or company was persistent. She looked a little closer and read the title: “need to talk to you ASAP, we don’t have much time.” That sounded like a marketing trap if she ever heard one, so the delete button was called into action and on to her next meeting.

The next day was Friday when her schedule was a little lighter so Michelle could catch up with email backlog and some outstanding paperwork. At the same time as the previous two days, the email from this strange source arrived once more. Michelle was annoyed but curious so she fell for the bait and opened the message. Thankfully it was short. It had the same title but inside was a short message: “I know that you have a meeting with your HES staff next week. I want to talk to you before then. I really need your help.”

Intriguing but still mysterious. How in the world did this Gaia company know that she did have her first meeting with the new sustainability team and her new direct report, Linda, the team’s supervisor next week. Someone hacked her calendar. That definitely was an IT security issue to look into. But there were other priorities. Her company had just had a permit to drill a dozen wells denied because of concern by the state regulator on methane emissions and noise pollution for a community near to the drilling pad. She needed to deal with that immediately. Without those new wells coming onstream, that asset team might not make their production target this year and the rig to drill the wells had already been chosen. So, for the third time, the delete button was employed and back to the job at hand.

Finally, the weekend was here and Michelle had a little time to get away from the pressures at the office. Saturday morning, she decided to take a jog in the park. It was a nice day with the sun and the birds out. She really enjoyed being out of the office in a little bit of nature. Most of her friends felt the same way. Her industry is often criticized for wrecking the
climate but Michelle truly believed that most of her friends and colleagues in the industry were environmentalists at heart. They just had a job to do to produce the energy that everyone needed to live their lives. Oil and Gas was always getting bad press they didn’t deserve.

She finished her two-mile pre-planned route, was resting on a bench and taking a sip of water when her text message alarm went off. She thought it might be a friend of hers that had invited her to lunch so she took out her phone to answer it. There was that damned Gaia again. Now someone had hacked her personal phone number. This was getting serious. Was she being stalked?

The message made her a little at ease. It read: “I am sorry to keep bothering you and I know you are busy but I really need to talk to you. I need your help. I know that you are a good person, trying to help you company operate in the safest and best manner you know how but there is more you need to do.” Just then a second message followed the first. “I am just down the road at the Starbucks you visit on the way back home. Please give me a few minutes and I will buy you one of those Pumpkin Lattes you have been looking forward to.”

The lure of the Pumpkin Latte overcame her apprehension at being hacked. Everyone has their weak moments and vulnerabilities, so Michelle text back her acceptance and jogged towards the local Starbucks. This mystery was about to take an interesting turn.

As she entered the coffee shop, a woman gestured to her from one of the tables. Her latte was sitting there as promised so at least that part of her gamble was going to pay off. So now what was the inevitable sales pitch that Michelle knew was going to follow.

The woman had one of those “you can trust me” smiles that lowers your guard down a little. Still, this wasn’t Michelle’s first rodeo and she was a pro at turning down a persistent salesperson. It was a little difficult for Michelle to estimate her age. She was older, probably older than one might guess but the latte was there and Michelle was curious how this conversation was going to go. The lady introduced herself as Gaia and Michelle sat down in the booth.

Somehow, Gaia knew all about Michelle’s permitting issues and about the new state regulations that were being discussed. Gaia was very professional, no hard sales talk. She was very knowledgeable and even showed interest and empathy for the costs and delays that Michelle’s company was going through. She wasn’t selling a new technology or service to lower emissions. She told a story about how to look at the problem from a different perspective.

She was persuasive and didn’t ask for any commitments at this initial meeting. Michelle felt like she was talking to a sympathetic advisor, not an emotional environmental activist. She felt that there was common ground to discover in talking to Gaia further. They set up a follow up meeting for the day after Michelle’s meeting with Linda. Michelle was interested, not brain-washed but she was so involved in the conversation about sustainability that she forgot to ask Gaia how she managed to hack all her personal information. Gaia handed her a card to use to
get back into contact. On one side it just had her name, Gaia. On the other side it had a web address, Gaia@motherearth.org.

And now for the rest of the adventure.
What Does a Sustainable Energy Future Look Like? (01/16/2021)

Michelle was getting ready for her first meeting with the new Sustainability committee and their lead Linda. She had read the pre-read that Linda had sent her. It was pretty interesting, full of forecasts of energy trends by several global organizations like BP, ExxonMobil, IEA, the EU and several UN groups. It was pretty obvious to spot the differences between today's contributions from fossil fuels (nearly 80%) and the dramatic headlines from the “leave it in the ground” activists. Once again it seems like the two sides were living in different worlds, using different data and coming to very different conclusions.

Almost all the forecasts had oil and gas (maybe not so much for coal) contributing over half the global energy needs still in 2050. That even calls for greater investment in oil and gas to offset natural reservoir decline. But Michelle knew that the pressure is on the industry for climate change GHG emissions. She also read the sections where the consequences of current energy trends meant that the 1.5 degree C and probably even the 2.0 degrees C targets of the Paris Climate Change accord would be missed. This Energy Transition thing is not going to be easy whatever it turns out to be. But what can an oil and gas producer, like her company, do to make a measurable difference and still remain in business returning value back to shareholders, jobs for employees, and energy for their customers? She sure hoped that Linda had some recommendations.

It wasn’t surprising that the energy forecast had the largest growth in Asia with most of the rest of the world staying pretty flat (Kahan, 2019). With all the publicity that Tesla gets, she was surprised that most of the electric vehicle sales were in China. Michelle was also a bit surprised about the magnitude of the structural change required to make the Paris Climate targets.

“In its World Energy Outlook (WEO) report published on Tuesday, the IEA said global emissions must fall by 40% by 2030 on the path to 2050 carbon neutrality. This would involve large scale investment in renewables and electric cars, behavior change and innovation in new technologies like hydrogen (Lo, 2020).”

Even with all the ‘green new deal’ publicity in the news these days, it was obvious the world was not on the road to achieve the targets that the politicians and environmental scientist agreed to in 2016. Michelle needed to remind herself on what the Paris Agreement actually meant after the last four years of the US trying to pull out.

“The Paris Agreement is an agreement within the United Nations Framework Convention on Climate Change, dealing with greenhouse-gas-emissions mitigation, adaptation, and finance, signed in 2016. The agreement’s language was negotiated by representatives of 196 state parties at the 21st Conference of the Parties of the UNFCCC in Le Bourget, near Paris, France, and adopted by consensus on 12 December 2015. As of February 2020, all 196 members of the UNFCCC have signed the agreement and 189 have become party to
it. Of the seven countries which are not party to the law, the only significant emitters are Iran and Turkey (Lo, 2020).”

The path to carbon neutrality was indeed a challenging one. Some progress has been made but there was more rhetoric than action. The switch from coal to natural gas is one of the helpful changes but if it took a global recession, caused by the health pandemic, to reduce emissions, we were going to have to find a better path forward. If we are going to get anywhere it was time for engineers, entrepreneurs and economists to get involved with the Energy Transition, not just the community that has been engaged to date. It was a pretty sobering pre-read to say the least. Maybe that is why Gaia has reached out to her.

“Under the net zero scenario, coal use plummets to provide only 6% of the world’s electricity by 2030, unless fitted with carbon capture and storage technology. By the end of the decade, 500 GW of solar power capacity is added each year. In 2019, 110 GW was built and the world’s biggest solar farm is 2.2GW. A third to a half of homes should be retro-fitted to save energy and more than half of passenger cars should be electric in 2030 on a path to carbon neutrality (Lo, 2020).”

Michelle hadn’t met Linda before. She was a relatively new, experienced hire from an environmental consulting firm. She seemed very competent at first introduction. She introduced herself and talked about her law degree, her environmental credentials and interestingly enough her degree in petroleum engineering. Maybe she spoke the language and understood the oil industry culture after all and could be a bridge between the two worlds. Michelle was looking for an advisor with those skills.

Linda’s presentation was practical and grounded in the reality and priorities that Michelle’s company had at this moment. But her list of recommendations was challenging as well. Linda recommended implementing new management goals for carbon reduction, even making them part of the beloved bonus program. She recommended that Michelle set ambitious targets for methane and CO2 emissions reductions from their scope 1 and scope 2 operations. That was going to take some selling to asset and facility managers that were already under cost and margin pressures.

She was prepared, but was Michelle’s company ready to implement such an ambitious plan? Linda recommended research investments into carbon capture technologies and in new lower carbon energy approaches (like use of solar power to help with secondary recovery programs or offshore power generation). Could Michelle really see her company investing in offshore wind farms? Linda also recommended that Michelle’s company take a higher public profile by joining groups like OGCI (Oil and Gas Climate Initiative) and even the new SPE Gaia Sustainability Program. There was that name again. Gaia, why was she turning up again?

Michelle looked up the new SPE program and this is what she read:

“The SPE Gaia Sustainability Program, created by our HSE and Sustainability technical discipline, aims to enable all individuals in the oil and gas industry to act in the service of
sustainable socio-economic development through their professional societies—
empowering those at all levels within organizations to create actions to address the
planet’s sustainability challenges (SPE, 2003).”

What did this have to do with her chance meeting with the mysterious character at the
coffee shop? Michelle didn’t think that she was done with Gaia yet. What was the next step in
this new journey? Michelle knew she was being pulled down a new path, one not of her
making. Was she headed off a cliff or starting a new program of fundamental change? At this
point, Michelle really didn’t know.

Michelle always considered herself one of those “We need It all” type of people in looking at all the various forms of energy, including renewables, but her eyes were about to be opened just a little bit wider this week. The next morning, Michelle opened up her email folder and there was an email from Gaia. Now Michelle was intrigued so she didn’t delete this one. When she opened the message that was just a link to an internet site, https://switchon.org.

From clicking on the website link, Michelle learned that the Switch Energy Alliance is a 501(c) 3 corporation was founded by Dr. Scott Tinker. SEA is a very interesting organization dedicated to education about energy futures and in lifting people around the globe out of poverty through access to safe, affordable energy. Michelle read this short quote from their website.

“Energy fuels the engine of the modern world and has the power to bring billions more out of abject poverty. Because energy reaches into every facet of our lives, it is highly political. Biases and emotions run deep, and facts and data are often distorted, or worse. SEA’s global video- and web-based approach engages students and general viewers in a positive conversation to work collaboratively on energy challenges. SEA reaches millions of people of all ages where they live and learn: online, in classrooms, in professional training, and in museums (Switch Energy Alliance, 2012).”

Michelle remembers that Linda has suggested that she watch their latest video Switched On so she didn’t want to tempt fate and later that evening she found the video and sat down to watch.
“Energy poverty is lack of access to modern energy services. It refers to the situation of large numbers of people in developing countries and some people in developed countries whose well-being is negatively affected by very low consumption of energy, use of dirty or polluting fuels, and excessive time spent collecting fuel to meet basic needs. It is inversely related to access to modern energy services, although improving access is only one factor in efforts to reduce energy poverty. Energy poverty is distinct from fuel poverty, which focuses solely on the issue of affordability (Simcock, et. al., 2019).”

(Michelle has to admit that sometimes she just googled a topic from Wikipedia!)

In 2010, World Economic Forum defined energy poverty as the lack of access to sustainable modern energy services and products. To be more precise, it is not only a matter of sustainability: energy poverty can be found in all conditions where there is a lack of adequate, affordable, reliable, quality, safe and environmentally sound energy services to support development.

In an article from The Economist (Fire Escape, May 8th, 2021), the estimate is that nearly four billion people in the world cook their food over a smokey fire using dirty fuels, such as wood, charcoal or kerosene. In sub-Saharan Africa that estimate is nine out of ten people are in this situation. Some 2.5 million to 4 million people die prematurely every year because of indoor air pollution according to the Paris based International Energy Agency (IEA) and the World Health Organization. Breathing soot is particularly dangerous for infants; worldwide it may cause almost half of all fatal cases of pneumonia among children under five.

Yet there are barriers in cost of cleaner fuels and in changing people’s minds and routines. India and China have made progress in reducing indoor pollution from cooking fires but progress has been slow in Africa and Africa’s population is growing faster than any other continent. Another obstacle is that rich country donors are reluctant to back investments in any fossil fuels even though the alternatives to natural gas are worse for the environment. Remember the Energy Transition is different from the viewpoint of Stockholm, Sweden than from sub-Saharan Africa.

Rich country donors suggest Africa leapfrog the energy transition roadmap to move straight to alternative forms of clean energy. Africa is responsible for less than 2% of global carbon emissions. Its’ people, the world’s poorest, are being asked to bear the costs of a sudden energy transition that many rich countries have been reluctant to do. Maybe LPG cookers rather than roof top solar panels are the more practical next step in Africa’s energy transition to net-zero. It is a matter of economics as well as perspective and politics.

Despite the fact energy is the engine of civilization, nowadays access to adequate and affordable sources is not equally distributed on the planet. Its presence is strongly and constantly intertwined with economic and social development: as a result, poorer countries are those usually equipped with the worst energy services, which contribute to malnourishment, unhealthy living conditions and limited access to education and employment.
Food insecurity often gets more headlines than energy poverty. Both are horrible circumstances that we all should be trying to fix. This last year, 2020, wasn’t very good for food insecurity either with the Covid pandemic.

“The United Nations reported that efforts to end world hunger and malnutrition by 2030 were dealt a serious blow by covid-19. The prevalence of food insecurity has been rising slowly in recent years, but in 2020 an additional 320 million people did not have regular access to food, as many as the increases for the previous five years combined. Last year also saw the biggest rise in undernourishment (food intake that is below the minimum needed) in two decades. The economic turmoil in 2020 that caused sharp rises in food prices has left 2.4 billion people without adequate food (Oduro-Bonsrah, 2021).”

Michelle, it doesn’t look like things are getting much better.

Michelle recognized that Gaia wanted her to understand that energy use and climate impact were two sides of the same coin. Gaia is a wise mentor and Michelle had a lot to learn from these lessons. Insufficient energy usually translates into the impossibility to develop agriculture and manufacturing, thus keeping the poorest countries trapped in a vicious circle: they cannot afford the energy that can drive them out of poverty. Energy access is not equally distributed around the globe: it is estimated that the almost 3.5 billion with limited access are responsible for less than 10% of the total household final energy demand, while 1 billion people with energy consumption levels at or above European standards is responsible for half of global energy consumption.

We are all shocked by the death tolls of the current pandemic, but do we realize that millions of people around the world die every year from respiratory illnesses caused by poor ventilation and use of biomass as cooking fuels?

According to 2018 IEA World Energy Outlook there are currently 1 billion people in the world – 13% of the total population – with no access to electricity, mostly in Africa and South Asia. In sub-Saharan Africa, it is estimated that approximately 600 million people – 57% of the population – live without electricity, against the 350 million people – representing 9% of the population – who lack access in developing Asia. The UN Agenda for Sustainable Development placed as one of its Goals the achievement of universal energy access by 2030.

If we compare current data to early 2000s, there has been a noticeable improvement: regions such as East Asia and Latin America have now reached a better energy access thanks to the extension of electricity networks. Similarly, many other developing countries have experienced significant progress. In Indonesia, for example, the electrification rate is almost at 95%, up from 50% in 2000; in Bangladesh, electricity now reaches 80% of the population, up from 20% in 2000; Kenya passed from 8% in 2000 to 73% in 2017; in Ethiopia, electricity now reaches 45% of the population compared with just 5% in 2000 (Habitat for Humanity, 2022).

Most people define the term Energy Transition as the move (as quickly as possible) away from fossil fuels and towards renewable energy sources (wind, solar, hydro). However, Scott
Tinker defines the term Energy Transition as two issues: 1) lifting poor people out of energy poverty and 2) cleaning up the environmental impact of all forms of energy. Michelle kind of likes that definition better.

The loud voices are calling for the end of fossil fuels, but the quiet voices acknowledge that we need all kinds of energy sources for the needs of all the citizens of the planet, Gaia’s planet. Gaia cares about all her residents both humans and animals. This is not just a call to action on one industry, the oil and gas industry, but a call to all of us. So, we have to find a way to lower the GHG emissions for oil and gas while still providing the benefits that oil and gas bring. There isn’t a choice.

Michelle is realizing that the one cup of pumpkin latte has led her down a life-changing path. Why her? What can she do? She is just one individual. How can she save the planet? She needs another cup of coffee.
How Much Will This Cost and Who is Going to Pay for All of This? Green is Not Going to be Cheap! (02/13/2021)

This headline caught Michelle’s attention. It came from a group called Carbon Tracker and the report was titled “Beyond Petrostates: The burning need to cut oil dependence in the energy transition.” The report, focused on the 40 countries with the greatest fiscal dependence on oil and gas revenues – the petrostates. These are the most oil and gas-reliant countries (as a % of GDP) and are predominantly in the Middle East, North and West Africa and South America. Many of the greatest impacts will come in countries/communities least able to deal with them.

The news isn’t good.

“Carbon Tracker recognized that there is a fundamental shift underway as the global economy begins to decarbonize. Populations that are heavily reliant on fossil-fuel production face lower government revenues and job losses as the pace and inevitability of the energy transition increases. Compared with industry expectations, petrostates’ government revenues would be $9 trillion lower over the next two decades under the low-carbon scenario.”

Somebody is going to lose out big.

Over 400 million people live in the 19 most vulnerable petrostates (including Nigeria, Mexico, Iran, Angola and Venezuela). Some wealthy petrostates, like Saudi Arabia and the UAE have started to think about diversifying their economies and have the funds to do so, but the populations of economies that are heavily reliant on fossil-fuel production are perhaps the most obvious example where the transition will also have negative impacts including lower government revenues and job losses. Decisive and forward-looking policies will be required to prevent and mitigate these impacts, both on the part of domestic policymakers and the overseas community (Carbon Tracker Initiative, 2021).

The fuel (wind and sunlight) for renewable energy sources may be free, but that won’t be the full cost of the energy transition and certainly not the total bill to the consumer. Michelle has started to wonder how much all this is going to cost and who is going to have to foot the bill. She appreciates the sense of urgency and the cost of climate change on the economy but we (the US) are still using ten times more coal now than we did 70 years ago. A normal energy transition would take several decades (maybe a century) but if you want to accelerate the pace, it is going to take some real investment (Sönnichsen, 2021).

The key challenge of renewables, as Linda has pointed out, is their intermittency. the wind doesn’t’ always blow and the sun doesn’t always shine. Using less energy is one of our options but energy in whatever form powers our world today. So, along with a massive infrastructure upgrade and the development of the wind farms and the solar plans, we need batteries, a whole lot of batteries. Again, Michelle turns to some of the background reading that Linda has provided.
“The critical factor in 100-percent renewable energy with no nuclear power depends on
the future of utility-scale battery storage. Studies estimate that 1,600 gigawatts of new
wind and solar capacity would be required to replace all U.S. fossil fuel generation and
900 gigawatts of battery storage backup would be needed. There are only 5.5 gigawatts
of battery storage world-wide in operation or under construction. If wind or solar
replaced a 2-gigawatt nuclear power plant, and batteries provided the only backup, 6 to
8 gigawatts of battery storage would be required.

The U.S. power grid has about 1,060 gigawatts of total capacity, of which about 130
gigawatts is wind and solar capacity. One hundred-percent renewables by 2030 would
require adding more wind and solar power in the next 11 years than the total capacity of
these two sources installed in the past 20 years. As of 2015, almost all—99.3 percent—of
the available grid-scale storage was pumped-hydro. The percentage cannot keep,
however, because pumped-hydro has limitations. Batteries appear to be the alternative,
at a cost.

The costs of new wind and solar units needed for a 100-percent renewables standard
would be about $1.5 trillion. Adding the required battery storage would raise the cost to
about $4 trillion and adding new transmission lines would increase the cost to $4.5
trillion. The United States currently has about 200,000 miles of high-voltage
transmission. The report estimates that achieving 100 percent renewables would require
doubling the transmission lines, which would add $700 billion to the total price. The cost
estimate does not include additional supply chain costs that could result from the
increased demand for steel, construction equipment, or other supplies (IER, 2019).”

From another study:

“$15 trillion: this is the amount of money to be invested in new power capacity globally
over the next three decades. Most of this – 80 percent – will be poured into renewables.
This certainly makes the energy transition far from cheap, but no one – at least no one
reputable – ever said going green would be cheap. Yet the number of investments to be
directed towards expanding wind, solar, and associated systems will not be the only
costs to be borne during the transition. There may well be steep environmental costs as
well (Slav, 2020).”

BloombergNEF, which conducted the analysis that resulted in the investment estimate
for the next 30 years in energy, also said that between 2020 and 2050, another $14 trillion will
be invested in the grid, likely to adapt it for a surge in solar and renewable power deployments,
which, according to the analysis, will constitute 56 percent of total global generation capacity
by 2050. And it will have spurred a mini golden age in mining.”

Michelle heard one speaker call this transition one from Big Oil to Big Shovel. Wind
power, like solar power, requires a lot of metals and other minerals to produce essential
components for the installations. Therefore, as the demand for wind turbines and blades
jumps, so will the demand for the metals they are made of. It’s the same with the metals and minerals necessary for the production of a solar panel. The IEA calculates that an electric car needs six times the mineral content of one with an internal combustion engine. The average onshore wind farm is nine times more resource-intensive than a gas-fired power plant.

China dominates the global supply chain for solar power and is the leading exporter of solar panels and critical components for making solar panels. For instance, about 95 percent of solar modules rely on one mineral — solar-grade polysilicon, and China produces 80 percent of the world supply of polysilicon. Xinjiang alone is responsible for 45 percent of the world’s supply of polysilicon.

Michelle is amazed at the ability of Linda to find these articles that help tell this complex story. There are just so many parts to this tale to get your head around. Linda found this one in a short article in the Denver Business Journal (May 21-27, 2021, Vol 72 no. 54), about a Colorado based company by the name of Westwater Resources that was formerly a uranium mining company. They have sold off all their uranium business and are going all in for graphite. “You see a Tesla coming down the road. I see 800 pounds of batteries with 200 pounds of graphite in them,” quoted Chris Jones, president and CEO of Westwater Resources. Today, imports from China account for all high-quality graphite used in rechargeable batteries. Westwater will be investing more than $100 million to open up a mine and processing plant north of Montgomery, Alabama. That amount is enough to fund building the first phase of a plant that could make 7,500 metric tons of purified graphite annually. The Alabama Graphite Belt is reportedly the only domestic reserve of pure underground graphite.

Here’s another example that could perhaps illustrate the trend: according to a 2017 report by the World Bank, demand for silver could soar from the then-current 24,000 tons annually to more than 400,000 tons. And that’s under a best-case scenario that features a greater penetration of silver-free thin-film PV panels in the energy mix, at the expense of crystalline silicon panels that use silver. Under a worst-case scenario, demand for silver could top 700,000 tons. This is quite an increase that will require a major expansion in mining and mining is an energy-intensive, not particularly environmentally friendly way of getting finite resources out of the ground. Michelle wonders if we are trading one crisis for another. The big five mining companies (Anglo American, BHP, Glencore, Rio Tinto and Vale) are not rushing to invest in big new projects as over the last couple of decades they have been burned by rushed projects and they now stick to capital discipline their investor applaud (but what will this discipline mean to future mineral supply to renewable power growth?) although capital spending has grown since 2015, it is still 50% below its peak in 2012.

Shifting towards ‘green’ metals is, however, proving harder than moving away from ‘dirty’ minerals for these international giants. The big-five mining company portfolios are weighed down with commodities from the last super-cycle. Iron ore and fossil fuels still account for over half their mining revenues and three-questers of their grow operating profits. (The Economist Newspaper, 2021)
Wood Mackenzie estimated the energy transition will require $1 trillion in investments in several key metals. In other words, the world will need nearly twice as much investment in critical energy-transition minerals over the next 15 years as it has invested over the past 15 years. And then, 20 to 25 years later, many of the installations made from these metals would need to be retired. This means going into landfills because not all solar and wind equipment can be recycled. If the Big-Five are only going to play a smaller part in this market, who will step up to shoulder the rest of the load? Some of these markets (like lithium and cobalt) are small for these firms, but copper is one that will get their attention. However, prospected deposits are getting smaller and ore grades worse. Resource nationalism in many countries will look to mining firms to make up the tax revenues that they will lose from lower oil and gas production. The economics and geopolitics are looking tough. (Anyone for a big 15 year, several trillion-dollar investments in copper-rich Democratic Republic of Congo (DRC)?)

As part of his $2 trillion “Build Back Better” climate plan, President-elect Joe Biden has established a goal of decarbonizing the country’s electricity sector by 2035. Even with significant progress in reducing CO2 emissions from power plants, Biden’s goal is ambitious. And new federal legislation will likely be necessary, though not enough, to achieve it (Bazilian, et. at.)

How is all of this going to hit our monthly electric bills, Michelle wonders. One example from Colorado comes from a new proposed rate hike from Excel Energy-Colorado for a nearly 13% rate increase for residential and small business customers that would start in 2022 and raise about $US 343 million for the largest utility provider in the state. That is about $9.46 per month for the average residential customer and $14.46 monthly for the typical small business.

The rate hike request is important because of its timing in helping pay for the ambitious renewable energy and power delivery modernization projects that Excel Energy has committed to. About $US65 million of the total request would pay for the company-owned Cheyenne Ridge Wind Farm that came online in 2020. That $US735.6 million project in northeast Colorado supplies as much as 500 megawatts of electricity to Excel when enough wind is blowing. (Denver Business Journal, July 9-15, 2012 by Greg Avery)

A trillion US dollars is a lot of money at a time where so many other economic issues that need to be addressed and before we can think of any of this, we have to pull out of a significant recession, tame this pandemic and begin to address the many areas of inequality in our society. Michelle wonders where is the money going to come from? This is not a Gaia issue and of course there are many serious economic consequences from not tackling climate change now that may even be higher, but the economics aspects of this transition will not be an easy challenge to solve. Michelle looks at her reduced capital budget for this year and has to shake her head. She hopes someone has the answer.
What Happens if We Don’t Make the 1.5 Degrees Target? (02/26/2021)

Gaia was thinking that Michelle needed a break from all this information overload that Linda had been sending her. Another cup of coffee might just help to settle her nerves and help her to focus on what her company can do. This debate can get a little heated and even when someone wants to do the right thing, it can be difficult to know just what that is. So, Gaia and Michelle met last Saturday at that same coffee shop for some caffeine and some fellowship.

It is a lot to think about. After Michelle turned the page by accepting the science of Climate Change and decided to throw out the label of Global Warming and turn to Climate Change to be more accurate, the challenge of what to do about the science is a complex one. First energy poverty, then the cost of going green and the recognition that this probably touches just about everything we do these days. Michelle pulls on one string of the story and several other loose ends seem to appear. However, Gaia wanted Michelle to add one more troubling issue into the pot before Michelle’s education was over. What happens if we don’t change?

Here was Gaia’s personal story. The planet is getting warmer, leaving humankind with a limited number of options. One will be to drastically reduce consumption in industrialized nations to meet the acceptable maximum of CO2 emissions in a framework that prevents a 2°C temperature increase by 2050. This goal looks difficult without considering the aspirational 1.5 degree C target the activists anticipate, especially is we are already at 1 degree C to start with. If this approach is not successful, societies will need to completely electrify their energy supplies (and increase reliance on renewables or nuclear)—which, in all likelihood, will require enormous investment. Unfortunately, if humans do not succeed in curbing climate change, they will face the consequences.

A study by NASA took a look at a possible world with greater than 2.0 degree warming. Both Linda and Gaia asked Michelle to read that report. Michelle didn’t like what she read (Buis, 2020).

Here is just a summary of the scariest parts of this story. Each of the following selected projections are from the IPCC special report. In most instances, climate-related risks for natural and human systems were found to be higher, often significantly so, under the hotter temperature threshold. The degree of these risks depends on many factors, such as the rate, duration and magnitude of warming; geographic location; levels of development and vulnerability; and on how humans respond through adaptation and mitigation options. Some regions, such as small island states, will experience multiple climate-related risks that compound upon each other.

A key point of the special report is there is no single 1.5-degree warmer world. The impacts of climate change haven’t been spread evenly around our planet and they won’t be in the future, either. Temperatures increase at different speeds everywhere, with warming
generally higher over land areas than oceans. The strongest warming is happening in the Arctic during its cool seasons, and in Earth’s mid-latitude regions during the warm season.

In many regions, warming has already surpassed 1.5 degrees Celsius above pre-industrial levels. More than one-fifth of all humans live in regions that have already seen warming greater than 1.5 degrees Celsius in at least one season. Climate-related risks were found to be generally higher at lower latitudes and for disadvantaged people and communities.

Most land regions will see more hot days, especially in the tropics. At 1.5 degrees Celsius warming, about 14 percent of Earth’s population will be exposed to severe heatwaves at least once every five years, while at 2 degrees warming that number jumps to 37 percent. Extreme heatwaves will become widespread at 1.5 degrees Celsius warming.

At Earth’s mid-latitudes, the hottest days will be up to 3 degrees Celsius (5.4 degrees Fahrenheit) hotter at 1.5 degrees Celsius warming and up to 4 degrees Celsius (7.2 degrees Fahrenheit) warmer at 2 degrees Celsius warming. The warmest extreme temperatures will be in Central and Eastern North America, Central and Southern Europe, the Mediterranean (including Southern Europe, Northern Africa and the near-East), Western and Central Asia and Southern Africa. Longer warm spells will affect many densely populated regions. At warming above 1.5 degrees Celsius, twice as many megacities as today are likely to become heat stressed, potentially exposing 350 million more people by 2050.

The report states that up to 50 percent fewer people on Earth may see increased climate change-induced water stress by limiting global warming to 1.5 degrees Celsius, depending on future socioeconomic conditions, though the degree will vary regionally. People in river basins, especially in the Middle and Near East, will be particularly vulnerable.

**Loss of Species and Extinction** — The report studied 105,000 species of insects, plants and vertebrates. At 1.5 degrees Celsius warming, 6 percent of the insects, 8 percent of the plants and 4 percent of the vertebrates will see their climatically determined geographic range reduced by more than half. At 2 degrees Celsius warming, those numbers jump to 18 percent, 16 percent and 8 percent, respectively. The consequences of such range changes could be considerable.

**Sea Level** — The report’s authors find that even if the temperature increase is limited to 1.5 degrees Celsius, sea level will continue to rise, as heat already stored in the oceans from human-produced warming causes them to expand. But that increase is projected to be 0.33 feet (0.1 meters) lower at 1.5 degrees Celsius warming than at 2 degrees. If warming reaches 2 degrees Celsius, more than 70 percent of Earth’s coastlines will see sea-level rise greater than 0.66 feet (0.2 meters), resulting in increased coastal flooding, beach erosion, salinization of water supplies and other impacts on humans and ecological systems.

**Polar Ice Sheets** — The report states, with medium confidence, that at an increased level of warming between 1.5 and 2 degrees Celsius, instabilities in the Antarctic ice sheet and/or the
irreversible loss of the Greenland ice sheet could lead to multi-meter (greater than 6 feet) sea level rise over a time scale of hundreds to thousands of years.

**Ocean Temperatures, Acidity, Oxygen Levels** — The oceans will become more acidic due to higher concentrations of carbon dioxide at 1.5 degrees warming that will become even higher at 2 degrees warming, negatively impacting a broad range of species, from algae to fish. Ocean oxygen levels will also decrease, leading to more “dead zones,” areas where normal ocean waters are replaced by waters with low oxygen levels that won’t support most aquatic life.

**Impacts on Humans** – At 1.5 degrees Celsius warming, the report projects that climate-related risks to human health, livelihoods, food security, human security, water supply and economic growth will all increase, and will increase even more at 2 degrees warming. Disadvantaged and vulnerable populations, some indigenous peoples and communities with livelihoods based on agriculture or coastal resources will be at the highest risk. Regions at highest risk include Arctic ecosystems, dryland regions, small-island developing states and the least developed countries. Some populations will see increased poverty and disadvantages. Limiting warming to 1.5 degrees Celsius could reduce the number of people susceptible to climate-related poverty risks by as much as several hundred million by 2050.

Impacts will vary by region due to many factors such as the ability of populations to adjust to changes in their environment, vulnerability of populations, their human-made surroundings and access to air conditioning. The elderly, children, women, those with chronic diseases and people taking certain medications will be at highest risk.

And the forecasts keep getting gloomier. A major study says by 2025 there's a 40% chance of at least one year being 1.5C hotter than the pre-industrial level. That's the lower of two temperature limits set by the Paris Agreement on climate change. The conclusion comes in a report published by the World Meteorological Organization (WMO). The analysis is based on modelling by the UK Met Office and climate researchers in 10 countries including the US and China. In the last decade, it was estimated that the chance of any one year reaching the 1.5C threshold was only 20%. This new assessment puts that risk at 40%.
Now Michelle recognizes that these are all computer model projections. Computer models are only as good as the data that feeds them and the understanding of the modelers of the processes involved. There is a lot of uncertainty in climate science so these projections may be off by quite a bit. But Michelle’s wonders that while ‘all models are wrong (due to uncertainty and poor data), but some are useful.’ What we are betting on is the quality of life for the planet, for Gaia’s health. This is something to pay very close attention to and not sit back on the couch and leave it to others to deal with. Michelle asks for another cup of coffee and Gaia obliges (Shukman, 2021).
What About a Just Transition for Current Workforce? Avoiding Being Thrown Under the Bus (03/27/2021)

Michelle’s grandfather was a coal miner. She remembers going to visit her grandparents in their small mining community in Wyoming for holidays. It may have seemed like an environmental disaster area for some, but she had a lot of great memories with her family in that place. That community was made from coal, but was also made from the love of a lot of good families over generations. Her grandfather and his friends were good people. Her grandpa took her on walks in the hills behind their home and always told her to respect the environment and the wildlife. She got her love of bird watching from those hikes with grandpa. She gets a little hot under the collar when she reads articles like the one in The Economist (Make coal history, December 5, 2020). Her grandparents were not losers.

“The other step is to compensate losers. The lesson from destitute mining towns in south Wales and West Virginia is that job losses store up political tensions.” Is that how environmentalists think of people like her grandparents? That they are losers and a potential source for political tension? That makes her angry. She gets the industry’s contribution to climate change and the need to clean up her industry, but she is convinced that is not the way to start the conversation. Is that the way the politicians and green activists see her company and her friends? Michelle needs to talk to Gaia about Just Transition.

Just Transition is a framework developed by the trade union movement to encompass a range of social interventions needed to secure workers’ rights and livelihoods when economies are shifting to sustainable production, primarily combating climate change and protecting biodiversity. It has been endorsed internationally by governments in different arenas, including the International Labor Organization, the United Nations Framework Convention on Climate Change in the Paris Agreement, and others.

Linda overheard Michelle talking about her grandparents and she found this article about the impact on a coal community in northwest Colorado, not far from where Michelle’s grandparents lived.

Colorado’s Just Transition law, passed on the final day of the 2019 legislative session as a bill establishing Colorado’s decarbonization goals, is the most systematic effort in the United States in regard to coal, says Dr. Dimitris Stevis, a professor of political science at Colorado State University who co-edited a book, “Just Transitions: Social Justice in the Shift Towards a Low-Carbon World.”

COVID-19 may temporarily frustrate the good intentions expressed by Colorado legislators in HB 19-1314, titled “Just Transition from Coal-based Electrical Energy Economy.” The state budget had to be cut 21%, and budget analysts expect deeper cuts next year and beyond. That will make it hard to find state funds to assist workers.
Then most of the impacts will begin in about five years. As one committee member says, it will probably be easier to ask for $10 million then than $1 million now. Is that wishful thinking, Michelle wonders. The law passed in May 2019 assumes state assistance, most directly for workers in coal mines and plants and on the railroads. It also seeks to assist impacted communities but does not presume to have all the answers.

School and other taxing districts rely even more heavily on the coal mines and coal-burning plants because of their reliance upon property taxes. The same goes for oil and gas in other communities. At the Hayden School District, the Hayden Generating Station pays 57% of the property taxes to pay for a new K-12 school. It pays the same proportions for the local fire district and other taxing districts. When the coal plants close, the taxes of others will necessarily rise or public services will have to be cut.

“Coal built this country, whether you like it or not,” says Doug Monger, a life-time resident of Hayden and a Routt County commissioner. “We can go away from it now, but we need to figure out how not to throw us under the bus.”

The draft report identifies a need for three and possibly four buckets of money to be drawn from state and philanthropic sources.

- By far the largest need will be assistance to the 2,100 workers in coal mines, plants and railroads. Most make $80,000 to $100,000 per year, and it will be challenging, if not impossible, to find similar wages in new jobs while remaining in their communities.
- A second monetary need will be the assistance to aid economic development by impacted communities. The Colorado law makes clear that the state won’t decide how Craig, Hayden and other impacted communities will reinvent themselves. That has to be driven largely from the grassroots. It can, however, assist them.
- A third and overlapping fund will be needed to help with the private or public sector strategies to attract investment capital into the communities. How do you incentivize capital and entrepreneurs in a relatively risky environment?
- The fourth and final bucket, much smaller, will be the financing to continue and perhaps expand the Just Transition office, which currently consists of one employee.

If Colorado’s track record on falling behind on funding education and infrastructure is any lesson, this is not going to be easy. Again, Linda research helps Michelle understand the situation. The International Energy Agency (IEA) is launching a global commission to address the impact on employment and society from the transition to renewable energy from fossil fuels. The commission, chaired by Denmark, will include energy ministers from Canada, Norway, Mexico and Oman. It will also include U.S energy officials, as Washington shifts course under President Joe Biden, who has pledged to tackle climate change.

“We believe the real success of this transition is critically hinging on whether or not citizens will benefit from the opportunities and how we navigate the disruptions of clean energy
transitions,” IEA Executive Director Fatih Birol said. “Employment will change, some sectors will gain significantly while others inevitably decline. Governments will need to proactively prepare for change and to protect those adversely affected”.

Mr. Birol said he was optimistic the new U.S. administration would join other major economies in committing to a net zero emissions target by mid-century. President Biden has temporarily suspended the issuing of permits for oil and gas drilling in federal acreage, reversing the direction taken by his predecessor Donald Trump who had sought to maximize output from federal areas. Critics say Biden’s initiative will cost jobs. Federal leases account for close to 25% of U.S. crude output, making them a big contributor to energy supply but also a major contributor to America’s greenhouse gas emissions.

All this still doesn’t add up for Michelle. She just heard a talk from Daniel Yergin, co-chairman of IHSMarkit and global energy expert. He seems to have all the data straight and he said ‘the numbers don’t work.’

“If you think in terms of markets, particularly in natural gas, Asia matters most. They need more electricity and they need less pollution. Wind and solar, even with the aggressive commitments to building them in India and China, can’t meet that demand by themselves”. And for the United States, Yergin said “A leave it in the ground policy is really just an import more oil policy. Is it better to have the money here in our economy to help support schools and health services and jobs? Or is it better to just export our money, shop it overseas and import more oil (Yergin, 2021)?”

“Climate change at its heart is not a planetary problem, it’s a people problem,” says Gina McCarthy, the new American climate advisor to President Biden. “A good way to get folks on board all the changes that a climate change/ energy transition will bring is to offer them an alternative with a good job and a way to get retrained to find one of those new “clean energy” jobs.”

Politicians don’t have a good track record with just transitions. Just look at the communities in the coal fields and the former manufacturing “rust belt” and ask them how the politicians promise worked out for them.

Michelle began thinking about her grandparents again. She thought that her grandparents would have liked to meet Gaia. Maybe in some way they did. Michelle truly believes that you can be someone working in the fossil fuel or mining industry and be for the environment. That may not be a popular opinion in some circles but we are all on this planet together and we have to find a constructive way to talk to each other about the climate change crisis. We have to find a way. If it is about winners and losers than Michelle thinks we are all going to be losers.
What is ESG Investing? (04/10/2021)

Michelle has just come back from a financial workgroup meeting. The news wasn’t very good. The CFO, Holly, gave a report that told the depressing story that their company was having trouble raising the capital they need for next year’s drilling and exploratory budget. Commodity prices were rising, costs were down and their profitability and debt picture looked pretty good, so why are they having problems raising capital? Michelle’s company had always been a good sound, predictable investment, except of course when the oil price dropped. But now the financial markets were adding other criteria to their expectations. This was the first time she heard the term ESG investing.

According to Holly: Environmental, Social, and Corporate Governance refers to the three central factors in measuring the sustainability and societal impact of an investment in a company or business. Analysis of these criteria are thought by some to help to better determine the future financial performance of companies.

The financial and investment community is increasingly focused on understanding and mitigating its vulnerabilities arising from the causes and impacts of climate change. At present, many investors who wish to base their investment decisions on assessments of environmental risks and opportunities lack the data to accurately evaluate companies’ performance. Such investors often look to environmental, social, and governance (ESG) ratings of the companies they may invest in. But today’s ESG ratings can confront investors with more complexity and confusion than clarity and definitive insight (Hayes, 2022).

With over 600 ESG ratings and rankings available, the ESG landscape is fragmented. Different ratings schemes often employ non-transparent methodologies – ‘black boxes’ — with little or no standardized scoring methodology. Compounding the problem is the fact that ESG ratings firms must depend on unreliable public data when it comes to emissions. It is therefore hardly surprising that a given company’s rating can vary wildly from one ratings agency to the next. Holly is responsible for the company’s Sustainability reporting but she doesn’t really know which one tells their story accurately and which one reaches the investment community.

Many in the investment community conclude that they cannot rely on either ESG ratings or the oil and gas companies’ own measurements of emissions. What is needed instead are reliable and impartial data of actual performance. In regard to environmental attributes (the ‘E’ in ‘ESG’), satellite data on methane emissions might be able to provide badly needed, uniformly applied, authoritative verification but that data isn’t readily available yet. Better high-resolution methane satellites are on the drawing boards but they haven’t been launched yet. Investors are expecting to see new satellite-based methane information as a tool to press for real-time and accurate disclosures of methane emissions. The financial community will also be likely to face growing divestment pressures in regard to those oil and gas companies that fail to reduce and prevent methane emissions. But when will that data be available and will it answer everyone’s questions?
At the workshop, Holly distributed some disturbing information about investment trends.

“BlackRock, the world’s largest asset manager, announced a year ago that it would eliminate from its active investment portfolios any companies that generate a quarter of their revenues from thermal coal production. At about the same time, BNP Paribas asset management said it would exclude companies that derive 10 per cent of their revenues from coal production. The company said it would also exclude high-carbon-emitting power companies.

But a different strategy has gained traction as investors have started to worry about global warming. In 2014, Norway’s $1tn Government Pension Fund Global studied divestment as a way to combat climate change, and decided against automatically exiting coal and oil companies. Climate change risk, it concluded, was best managed by active engagement with these businesses. Similarly, Japan’s $1.36tn Government Pension Investment Fund (GPIF), the world’s largest pension program, has called on its managers to engage with companies on climate change rather than divest (Temple-West, 2021).”

Michelle also learned that her company has new competitors in the capital market, the so-called, ‘renewable supermajors.’ Michelle had never heard of most of these companies like NextEra, an America utility which briefly eclipsed ExxonMobil in value in 2020, Enel (a US$100billion Rome based utility) and Iberdola (Spain’s second largest company) but the investment community certainly has.

Oil companies used to look down their noses at utility companies in term of investment returns but now many envy them. Somehow, they were raising big money to invest in their renewable’s portfolio while the oil and gas business were fighting for their lives in the recent downturns (Enel plans to invest 160 billion euros by 2030 and Iberdola has a capital plan of 75 billion euros for renewables and grid infrastructure by 2025).

When you identify the largest manufacturers of wind turbines you include companies like Siemens, Vestas, GE Renewables and Enercon, three out of four are European companies. Add the manufactures of solar panels and you include JS Solar, Trina Solar, Jinko Solar and Seraphim Energy Group, all Chinese companies. Don’t forget the large-scale Lithium battery manufactures and you get LG Chem (South Korea), CATL (China), BYD (China), Panasonic (Japan) and Tesla (US). It looks like this Energy Transition means trading dependence on OPEC for a dependence on China, with more money in Elon Musk’s pocket. Maybe Michelle should ask Gaia for some investment advice next time they have coffee.
Investors in renewables companies want a decent financial return just as other investors do in other sectors. But will good ‘green’ intentions also bring good financial returns? Holly shared this Wall Street Journal article with the management team so show that every investment decision carries market risks, even ‘green’ ones.

"Wind-turbine manufacturers have big plans to supply the booming green-energy market. But burgeoning demand doesn’t guarantee continued profitability in the near term. Late Wednesday night (07/14/2021), Siemens Gamesa Renewable Energy, the leading manufacturer of offshore wind turbines, issued a profit warning. On Friday morning, shares were down 16% since the announcement. Management said group earnings margins would be flat or slightly negative and revenues would be at the low end of forecasts. Only last quarter, recently appointed Chief Executive Andreas Nauen outlined his turnaround plan for the offshore division where the problems are centered.

There are three main problems. Ramp-up costs for the group’s new “5.X” onshore wind-turbine platform is higher than expected. Raw material costs are up too: Copper, resin, steel and logistics are all more expensive. The pandemic has also created supply-chain bottlenecks and project-execution delays, particularly in Brazil.

These aren’t uncommon problems for many global manufacturers these days. But investors seem particularly concerned about the wind-turbine industry: By Friday morning, rival Vestas shares had fallen 7% since the profit warning. Both companies have significantly outperformed the Stoxx Europe 600 index over the past three years, though as with other green-energy stocks, optimism has started to wane recently.

Ambitious global decarbonization plans mean demand for wind turbines is forecast to explode. While that growth is welcome news, Thursday’s warning highlights that there could be downsides too. Raw-material prices are likely to be volatile as new sources are discovered and developed to meet the growing demand. Supply-chain bottlenecks are
also possible: Investment bank Jefferies predicts a shortage in offshore wind-turbine installation vessels in 2023.

Competition is growing and could reignite the margin squeeze that was only tempered in 2018 by industry consolidation. Customers are accustomed to falling prices, which have come from the better efficiency of larger turbines, scaling up manufacturing and industrializing installation. Those trends will continue, but the pace may slow as the industry matures.

The profit warning also highlights the industry’s risk of long-term contracts. New turbines take years to bring to market, building wind farms are often multiyear projects and service agreements can be very long. Siemens Gamesa seems to have been caught out by recent events, which isn’t unreasonable given the massive and unpredictable changes of the past year. Its new contracts are being adjusted but existing ones could still hold some nasty surprises.

It is some comfort that the problems center on its onshore division. Mr. Nauen has a turnaround plan and his experience leading the group’s offshore wind-turbine business, which is the world leader, lends him credibility. Siemens Gamesa has provided a timely reminder for green investors that industry growth can be a mixed blessing for profitability (Toplensky, 2021).”
Michelle’s company has always thought their strategic plan called for a “higher purpose” but I guess some investors are challenging that. A focus on safety, on contributing to the economic wellbeing of the communities they work in, for a good financial return to their shareholders, compliance with local regulations, good paying jobs for their employees and now a focus on limiting the environmental impact of their operations used to be called a “higher purpose.”

Michelle has always considered herself an ethical person and a capitalist. So where do they go now? This Energy Transition thing is getting less clear the more she understands. Risk and uncertainty have always been part of oil and gas operations but these are new risks and even more uncertainty. Gaia isn’t going to have all the answers for her company. They are going to have to figure out this one on their own.

The reputation of black gold got more tarnished yesterday as a trifecta of trouble hit the oil industry. While environmental groups and activist investors have stepped up the pressure in recent years to address concerns about climate change and fossil fuels, some of these historic defeats are being looked at as a watershed moment that will shift the oil-and-gas landscape. Shareholders, investment giants and lawmakers are increasingly raising their voices about a sustainable future, while some even see the transition as a way to secure future profits given changing trends and an ESG world.

**Exxon** - Activist hedge fund Engine No. 1 won at least two board seats on the company's board, which will likely force it to confront growing concerns about climate action. While it's still too soon to gauge what the green-tinged members will do, fundamentally, it was a blow to the oil major and shows that shareholders are no longer buying a permanent future in the oil-and-gas arena. The Exxon (XOM) battle was one of the biggest proxy shocks in Wall Street history, especially for a campaign that only began last December.

**Chevron** - Shareholders voted 61% to cut emissions from the end-use of its fuels, while the firm barely lost a non-binding vote calling for a report on the business impact of achieving net-zero emissions by 2050. The decision signals a "new sense of urgency," said Mark van Baal, who leads a climate advocacy group that placed resolutions calling for emissions cuts at Chevron (CVX) and elsewhere. Earlier this month, ConocoPhillips (COP) shareholders also rejected the company's board to support a similar push for a full-scope emissions reduction target.

**Shell** - Emissions goals were deemed insufficient by a Dutch court, which ordered the oil major to curb its carbon outflows by 45% by 2030 compared with 2019 levels. It also said that Shell (RDS.A, RDS.B) was not only responsible for lowering its own direct emissions from drilling and other operations, but also those of the oil, gas and fuels eventually burned by consumers. While Shell said it will appeal the ruling, Rystad Energy feels it has a "negligible chance" in court, and it also raises eyebrows on the company's decarbonization agenda that was considered one of the stricter plans in the industry. (Seeking Alpha, May 27, 2021)
Can Technology Save the Planet? The Loud and Quiet Voices (07/03/2021)

Technology is always the “shiny new toy” in the room (or at the conferences that Michelle sometimes attends). If you are a new startup and want to raise capital for your new venture, just come up with a new tech toy and the investors will beat a path to your door. Or at least that is the story that the entrepreneurs want to believe. For now, the theme catching everyone’s attention (and investor’s billions) is green tech. Gaia is more practical than that. She is not so sure that technology alone can save the planet. Humans are going to have to pitch in as well.

Michelle sat down one afternoon and did some googling around some of these new technologies. Some major oil and gas companies are making big bets on these technologies. One CEO even predicted that her company would evolve into a carbon management firm rather than an oil and gas production company. The two most popular shiny new toys were Direct Air Capture and Carbon capture (with geothermal running a distant third):

- **Direct Air Capture** is a technology that captures carbon dioxide directly from the air with an engineered, mechanical system. Direct air capture is a process of capturing carbon dioxide directly from the ambient air and generating a concentrated stream of CO2 for sequestration or utilization or production of carbon-neutral fuel and wind-gas. Carbon dioxide removal is achieved when ambient air makes contact with chemical media, typically an aqueous alkaline solvent or functionalized sorbents. These chemical media are subsequently stripped of CO₂ through the application of energy, resulting in a CO₂ stream that can undergo dehydration and compression, while simultaneously regenerating the chemical media for reuse.

- **Geological Carbon Dioxide Storage**, also known as **carbon sequestration**, has been used safely and effectively by industry for decades, with more than 200 million tons of CO2 successfully stored in geological sites all over the world. Leading international bodies, such as the Intergovernmental Panel on Climate Change (IPCC), have assessed this practice and concluded that when storage sites are properly regulated, selected, and managed, CO2 can be stored permanently for millions of years with very low risk. Suitable locations for carbon storage exist in many regions around the globe and collectively have the capacity to store hundreds of years of CO2 emissions underground (Carbon Engineering, 2021).

Despite the severe crisis that befell the oil industry in 2020, the importance of oil and natural gas in the global energy mix will not diminish anytime soon, but climate activists say that energy companies must play their part in the energy transition by investing in emissions reduction projects and carbon-free tech, said Chevron Chairman and CEO Michael Wirth during a podcast. "I think we’re going to need a lot of technologies and solutions that don’t exist today to actually take carbon out of the atmosphere to get to net zero," Wirth said.
Michelle was having trouble pulling herself away from the computer screen. Her mid-sized company doesn’t have a low carbon ventures group, a tech ventures group or a global chemicals business. She searched for what their competitors were doing and found the following:

- **HOUSTON** – December 15, 2020 – **Oxy Low Carbon Ventures, LLC**, a subsidiary of Occidental (NYSE: OXY), announced today it was awarded a contract to provide Carbon Storage Consulting Services for Project Tundra, an initiative led by Minnkota Power Cooperative, to build the world’s largest carbon capture facility at the Milton R. Young Station – a coal-fired power plant, near Center, North Dakota (Occidental Petroleum Corporation, 2022).

- Faced with mounting shareholder criticism, CEO Darren Woods promised that ExxonMobil would become a leader in low-emission technologies. The company is counting on carbon capture sequestration and utilization (CCUS) as the initial way to reduce greenhouse gas (GHG) emissions. Hydrogen energy also is on the table longer term (3, C. D. M., Davis, 2021).

- On the other hand, on the lower carbon strategy, the company will increase its renewable energy investments; also, its carbon offsets strategy, and will invest more in lower carbon tech, such as hydrogen and carbon capture. Finally, Chevron expects to “invest more than $3 billion in the coming years to advance our energy transition strategy.” Said Mike Wirth (Editor, 2021).

- **Shell** sees chemicals as a growth business because they create the products that will help drive the transition to lower carbon intensity energy and transport. This ties in with Shell’s own target to become a net zero carbon emissions energy business by 2050 or earlier (Beacham, 2022).

So, who do you believe, is technology the answer?

Some of these ideas sound pretty amazing and some sound like pie-in-the-sky moon-shot ideas. Remember the phrase about fusion power, it is 30 years out and always will be. Technology doesn’t always have to be bleeding edge. Michelle read that in the US 27,000 trees are chopped down every day just to make toilet paper. That felt like too many to one manufacturer, so a new start-up **Honeycomb** created 100 percent sustainable toilet tissue made from bamboo. Why is bamboo better? It grows 80 times faster than an average tree, creating thousands of rolls in the same time it would take for a single tree to grow back. Honeycomb’s 3-ply texture strikes the perfect balance between soft and strong — it feels just like regular high-end toilet tissue, but it doesn’t harm the planet. Sustainable toilet paper anyone?

Looking at all this new activity can be exciting and a bit overwhelming Michelle concludes. Yes, it is all cool stuff but getting too focused on the bright shiny new toys where most of them won’t make it past the peak of on Gartner Group’s technology maturity curve.
and can get a company chasing its tail trying to keep up with all the new announcements. There are a lot of little things her operations staff can do in the field with existing tools that can help “green-up” their production (like reducing flaring or improving combustion efficiency, removing tank batteries and building pipelines to collect natural gas in larger gas processing sites, electrification for onsite power, etc.). The loud voices in the room promote the new technology, the quiet voices in the room recommend better operational practices. Michelle knows that she needs the focus and patience to listen to the quiet voices (Kennedy & Gilblom, 2019).

Gaia has counseled Michelle that innovation is more than just the cool new technology and hanging out with the venture capital crowd. It also has to do with the mindset of your company. If all the new technology gives everyone a lot of data to look at, we will have to do something about it. When we don’t have that data, we can still pretend that business as usual is ok. Having the new tech doesn’t mean your company will actually use it to change the way you do business. If she hasn’t learned anything else from her career, she is well aware of that reality.
The Age of Actor-Less Threats and Good Intentions Gone Wrong (05/22/2021)

How sustainable is your sustainability initiative? The challenging thing about sustainability is that you have to sustain it. You can’t just make a press release and then hope everyone forgets about it when other headlines come up. Michelle realizes that the world has entered an age of the “actor-less” threats. Mitigating or adapting to slow-onset, actor-less threats like climate change...requires a reimagining of your priorities from personal behavior to national security. Climate change gives rise to cascading risks of habitat destruction, infectious disease outbreaks or biodiversity loss. These threats have already started to cause loss of life at significant scales. But on the other hand, an unplanned energy transition will throw many out of work and upset existing economies. These risks have added friction to various aspects of geopolitics and the relationship between states and people. The alarm bell has sounded but we don’t know where the emergency exist is.

It is much easier to rally to the defense of a cause that has a tangible enemy, a ruthless dictator, a corrupt businessman, an evil warlord or an alien superbad guy. It is clear that the world needs energy to produce the quality of life we all want. Some of the world is doing quite well while much of the rest of the world is trying to catch up. Energy comes in many different forms. While energy from fossil fuels have enabled our current growth, the future might look different. Other than renewables, Michelle reads about nuclear, hydroelectric and even hydrogen. Her company is still an oil and gas producer but she reads that some of the international majors are now calling themselves energy companies and even investing in power generation and carbon management. Michelle wonders just how well that will go.

Michelle knows that energy has to be affordable, reliable and clean. It has to be all three not just one or two of these goals. And the target is always moving as the global population grows toward the nine billion people estimate that some demographers predict. This is a very, very big challenge and Michelle doesn’t think that many people really recognize how big it really is. On the cleaner target, there is better energy efficiency, shutting down flaring, monitoring methane emissions and carbon capture. Gaia does a good job of carbon capture through her forests and oceans and there is more that we can do to help her but we have to be transparent. For everything we do, there are consequences.

Some researchers offer some hope. According to the scientists working on the Global Methane Assessment released by the Climate and Clean Air Coalition (CCAC) and the United Nations Environment Program (UNEP), with support from SEI researchers, shows that human-caused methane emissions can be reduced by up to 45% this decade.

“Reducing human-caused methane emissions is one of the most cost-effective strategies to rapidly reduce the rate of warming and contribute significantly to global efforts to limit temperature rise to 1.5°C. Available targeted methane measures, together with additional measures that contribute to priority development goals, can simultaneously reduce human-caused methane emissions by as much as 45%, or 180 million tons a year.
(Mt/yr.) by 2030. This will avoid nearly 0.3°C of global warming by the 2040s and complement all long-term climate change mitigation efforts. It would also, each year, prevent 255 000 premature deaths, 775 000 asthma-related hospital visits, 73 billion hours of lost labor from extreme heat, and 26 million tons of crop losses globally (Kuylenstierna & Michalopoulou, 2021) (Ocko, et. al, 2021).”

There are some traps that we can fall into as we all rush to cut our ‘carbon footprint’ or shaming our neighbors for taking that long-planned trip to Europe or not buying an electric vehicle. Gaia tells Michelle the story of how the planet is trying to sequester carbon from seas to the forest but she warns against the concept of treating power from biomass as a green energy source like the EU has done. Linda has another video for Michelle to watch. It is called Burned: Are Trees the New Coal, the documentary on biomass created by Alan Dater and Lisa Merton. Here’s a summary of the movie:

“BURNED tells the little-known story of the accelerating destruction of our forests for fuel, and probes the policy loopholes, huge subsidies, and blatant green washing of the burgeoning biomass electric power industry.

BURNED is a feature-length documentary, which takes an unwavering look at the latest electric power industry solution to climate change. The film tells the story of how woody biomass has become the fossil-fuel industry’s renewable, green savior, and of the people and parties who are both fighting against and promoting its adoption and use (Dater & Merton, 2017).”

According to Alan Buis, of NASA's Jet Propulsion Laboratory, we could reduce the severity of global climate change by planting hundreds of billions of trees to remove excess carbon from our atmosphere. A recent study published in the journal Science sought to provide answers by estimating the global potential of restoring forested lands as a possible strategy for mitigating climate change. But we have to make sure that we are really making a difference and not just pouring money into some opportunists’ pockets. Some of these carbon offset schemes are valuable some are not.

The international research team, led by Jean-Francois Bastin of ETH-Zurich in Switzerland, used direct measurements of forest cover around the world to create a model for estimating Earth’s Forest restoration potential. They found Earth’s ecosystems could support another 900 million hectares (2.2 billion acres) of forests, 25 percent more forested area than we have now. By planting more than a half trillion trees, the authors say, we could capture about 205 gigatons of carbon (a gigaton is 1 billion metric tons), reducing atmospheric carbon by about 25 percent. That’s enough to negate about 20 years of human-produced carbon emissions at the current rate, or about half of all carbon emitted by humans since 1960. The study attracted worldwide attention, as well as some criticism within the science community (Buis, 2019).
The United States is home to approximately 766 million acres of forestland covering about 33 percent of the nation’s total land area. Forests are found throughout the country and contain more than 800 species of trees. Although significant regional changes have occurred, the total area of forestland has been fairly stable for the past 100 years.

Fifty-eight percent of U.S. forestland is privately owned—by individuals, families, Native American tribes, corporations and nonprofit groups. The rest is under the control of federal, state and local governments. Ownership patterns vary by region, with private ownership dominating in the North and South and public ownership dominating in the Rocky Mountains and Alaska.

The country’s publicly and privately owned forests and grasslands can sequester and store a tremendous amount of carbon, and have significant potential to do more. The U.S. Forest Service reports that the nation’s forests and forest products offset nearly 16 percent of domestic carbon dioxide emissions by storing 866 million metric tons of carbon dioxide per year, a quantity equivalent to the annual emissions from 50 million gas- or diesel-fueled vehicles.

Forests absorb carbon dioxide from the atmosphere and store it in different repositories, called carbon pools, which include trees (both living and dead), root systems, undergrowth, the forest floor and soils. Live trees have the highest carbon density, followed by soils and the forest floor. Harvested wood products and landfills also store carbon. When a carbon pool decomposes or is burned, it releases carbon as carbon dioxide back into the atmosphere (Durkay & Schultz, 2016).

Is planting a tree an effective approach to reducing our carbon footprint? Linda has shown Michelle a few articles that talk about “Green Colonialism” where the developed world pushes off their mitigation solutions on places in underdeveloped nations. There always seems to be a more complex story around every issue. Wind farms can be economically sound and beneficial to the environment — but only if they’re done properly. The Sámi people, an Indigenous group that populates northern parts of Norway, Sweden, Finland and Russia, have opposed the development of wind farms on their territories. Not because they oppose green infrastructure, but because wind farms disrupt reindeer herding, a crucial aspect of Sámi culture. Having dubbed wind energy efforts ‘green colonialism,’ the Sámi argue that turbines do more harm than good and that existing energy resources, like hydroelectric dams, should be upgraded before building any new infrastructure.

Good intentions, even for actions that aim to help Gaia with climate change, can go wrong. Michelle reflects on the fact that humans always seem to rush from one idea to another without really thinking about all the consequences. There are a lot of possible sustainability solutions being discussed, but not enough really comprehensive debate on sustainability transformation. Michelle hopes that humans can do the right things without doing more harm in this energy transition but it looks like it is going to be a difficult journey.
Michelle got a wry smile from Gaia when she suggested that the next Marvel superhero movie be about Gaia and the Avengers battle Ultron, if there was just an alien super-being we could fight to save the climate. It turns out that Gaia is a secret admirer of the Black Panther, Wakanda forever.
Measure What Matters or Actually Estimate What We Think Matters
(04/23/2021)

Michelle just had a very tough love type conversation with Gaia. Gaia has challenged Michelle to do what is right, not just what it takes to get by, in her company’s new environmental strategy. Gaia is following very closely what the industry’s response has been to the climate change debate. It seems like most have gotten past the acceptance that the planet’s environment is changing and human activity is largely responsible, and that the politics in the developed world have aligned around the call for low carbon or carbon neutral expectations. But Gaia is worried that the industry hasn’t really figured out how to respond and she is asking Michelle to be a leader in doing what is right.

There are still some companies that are in denial or think they can hide behind the headlines and keep doing what they always have done and skate by. Maybe their operations are in states that are still friendly to the industry and the pressure is not as intense. Other companies are making ambitious announcements about targets set decades in the future, venture capital investments in renewables or carbon capture technology advances and even support new carbon taxes that they know they can largely pass along to their customers. But how much of this is sincere and doable and how much is ‘green washing’?

Michelle is finding out that doing the right thing is actually getting harder to do. If they make the investments and changes in operations to cut methane emissions will the regulators give them the permits, they need to keep drilling and producing? Will their shareholders reward them with continued investment? Will the environmental activists give them credit for the changes they are trying to make or just continue to protest and cry to ‘keep it in the ground’? Will the markets reward them with a ‘responsible gas’ premium over their peers who chose not to respond the same proactive way? It seems like there are a lot of folks out there trying to catch her company when they slip up and very few rewards or accolades for doing better.

In the budget meeting there was a lot of push back on the cost of the new monitoring program. The discussion focused on how to minimize the monitoring program to do just
enough to keep the regulators happy. What is the cheapest sensor, who is the least expensive service company, how few monitoring sites can they get away with? Instead of measuring what matters, the industry is just trying to estimate what they think matters and see if that is enough to get by.

Michelle knows that is not the right goal. If they can recognize their opportunities and not just try to blame the next producer down the road, they can identify the 5% of the leaks that produce 50% of the methane releases and get to them faster and repair the right equipment and capture the gas for sales. That is the right goal. That is what Measure What Matters is supposed to be about.

Trust of the data Michelle’s company submits to the federal and state regulators is getting to be a major sticking point. For years now her operations folks used the tried-and-true emissions factors approach to complete the annual reports. They have followed the regulations to the letter but now compliance isn’t enough. Voices are now saying they are under-reporting, their data can’t be trusted and needs third party verification. Public trust is in pretty short supply these days in many areas.

‘Trust but Verify, cut once but measure twice,’ whatever old saying you want to go by there has always been a problem with trust. If it isn’t about the measurement, it is about the messenger. This stuff can get complicated and most folks don’t want to follow the science, so they follow a celebrity or a politician. With our information bubbles and our social media networks how do you get inside one of those tight nit communities to tell your story? They are trying to prioritize to spend limited budget in the right places and measure ‘fit-for-decision’ sustainability factors to support industry operations, commercial results, employees’ well-being, and stakeholders including investors, activists, academia, future employees and the public. That is a lot of folks to try to keep happy.

For decades, oil and gas companies have been collecting terabytes of data, tracking everything from equipment repairs and spare parts, to safety trends, to what is happening in the oilfield. Much of this information sits in antiquated data bases or file cabinets in the local field office waiting to be digitized: too dense to parse and too costly to learn from. The latest consulting and research fad is to tap into artificial intelligence to analyze these data – coupled with new, custom ways created to delivering just-in-time reporting and predictive results, with a real return on investment that would translate into hundreds of millions of dollars in operational efficiencies. Can Michelle’s company realize these goals? Somewhere in all this data are the insight in how to operate with a lower environmental footprint. Her company is buried in data but is lacking in how to make sense of it all.

Stakeholders throughout the energy industry value chain want to make environmentally sound decisions, but often lack the data necessary for effective emission reduction. New regulations will focus on gathering data and increasing reporting requirements for operations, aimed at finding sources of gas emissions at every stage of the industry. Venting and flaring,
typically routine actions in the industry, as well as leaks of faulty equipment, are all important sources to measure and monitor. The data gathered in the field should help operators to develop steps to the capture methane emissions and maximize natural gas production and sales. The objective is simple, Measure what Matters. The challenge is to know what Matters and how to effectively measure it.

Linda found a good paper from the EDF on Hitting the Mark. Another one to add to Michelle’s reading list (Atkinson, 2018).

Michelle is starting to believe that this world has gone crazy. There are many, many new ways to report something that she doesn’t really know how to measure. But some folks (Bloomberg in this case) are investing $100 million to launch new high-res methane sensing satellites to catch the industry cheating against new standards we don’t even know about. There is no common understanding on what Energy Transition is supposed to mean (as Daniel Yergin points out in his book The New Map).

There is too much at risk not to get the fundamentals right, but there is so much political and investor pressure on putting forward some kind of net-zero position that we haven't found anyone willing to go back to the basics of how to measure emissions (a waste product not a sales product) for oil and gas operations (especially for fugitive emissions, not flaring). There is a growing understanding that the industry's current practices are under-reporting emissions (not intentionally but due to the limits of the emissions factors method) sometimes substantially. Raising the bar on reporting (which everyone is doing) doesn't help the fundamental challenge of measuring (and reporting) what matters. Traditional estimates are not going to be enough.
Green Innovation (07/17/2021)

“Governments are lining up to set new climate targets for the middle of the century. But targets are easier to set than meet. Today around 85% of the world’s industrial energy comes from fossil fuels. Getting consumption to near zero will involve enormous economic shifts. It will require huge changes in how energy is generated and used. And it will also require a sustained barrage of innovations to improve how steel or cement are made or how buildings are designed and managed (The Economist Newspaper, 2020).”

Michelle guesses that is why innovation is one of the four Pathways in the Gaia framework from the SPE Sustainability section. The Gaia framework aspires to leverage innovation and the industries best abilities in service of sustainable socio-economic development staying within planetary boundaries. That is the right intention but let’s get back to the data from the Economist. “The share prices of firms with climate-sustaining technologies have soared. Tesla’s value has reached $384bn, overtaking the combined total of the next three biggest carmakers. NextEra, a clean-power utility, surpassed ExxonMobil to become America’s biggest energy firm.” So, are we investing enough in green innovation to get us to the promised finish line?

The US administration has set some ambitious targets for renewable energy. The target for offshore wind is 30 gigawatts by 2030, the equivalent of 37 project like the Vineyard wind farm being constructed off the coast of Massachusetts today. Britain, China and Germany also have similar ambitions. Bernstein, a research firm, estimates that the world’s offshore wind capacity may reach 254GW by 2030, more than seven times today’s level.

However, the fact that wind farms, solar farms and battery-powered vehicles are now cost-competitive does not mean they can be built at whatever pace politicians choose. They require raw materials, siting permits, infrastructure for electricity transmission and recharging stations. They also need lot of capital and human labor. All the necessary materials, sites and investment are to various degrees in short supply. The price of Lithium has more than doubled in the past year. Copper prices are up about 70%. Fights over permits on the best sites are breaking out for new mines, wind and solar farms. It can take nearly a decade to get a new mine up and running.

Building infrastructure to deliver green power from panels and pylons in plains and deserts to the places where it is needed faces some of these same challenges. Grids that are both bigger and smarter than todays are needed (remember what happened to ERCOT in Texas this winter) to make use of intermittent renewable sources at the scales being planned later this decade.

Capital remains poorly allocated. While rich countries rush to start new projects, poorer countries with rising emissions remain starved for investment. Enel, an Italian utility, is the
largest foreign investor in green energy in emerging markets. If efforts to overcome these constraints fail, the world’s decarbonization plans will stall. BloombergNEF chief economist has said “The natural rate of change is far, far too slow to achieve climate targets.” You guessed it Michelle has a subscription to The Economist.

“Spending on R&D has three main sources: venture capital, governments and energy companies. Their combined annual investment into technology and innovative companies focused on the climate is over $80bn. For comparison, that is a bit more than twice of the R&D spending of a single tech firm, Amazon. One of the world’s most pressing problems (climate change) thus receives about 4% of the global total spent on R&D. VC investments in green startups accounts for about a tenth of all VC investments and firms which sell goods and services that cut emissions make up just five of the top 100 firms in this year’s public-listing bonanza. The private sector’s record on climate innovation has been a hit-and-miss affair, at best. Having boomed in the mid-2000s, green VCs went bust a few years later (The Economist Newspaper, 2021).”

Michelle was surprised by this with all the publicity that new green start-ups are getting in the press.

Michelle remembers a briefing where Linda told her about energy company investment focus areas. They included ExxonMobil on biofuels, Occidental on direct air carbon capture, BP and Equinor’s interest in offshore windfarms and the new OGCI focus on carbon sequestration. Geothermal is starting to get a little more attention and the US DOE’s FORGE project in Utah is an interesting test bed. There were others but she can’t remember then all. She wants to ask Gaia at their next meeting if she thinks that is enough to do the trick. Michelle’s is not a big fan of big government solutions but what is their role in Green Innovations? Remember Government can only tax or print the money for their share. Many green investors shy away from mining projects as it tarnishes their environmental credentials so Michelle wonders where all the money is going to come from.

Linda pointed out to Michelle another article from The Economist (The Lessons of Fukushima, 2021) which show how sometime we get the history lessons wrong. In the aftermath of the earthquake, tsunami and nuclear plant disaster at Fukushima in March 2011, the reaction against nuclear energy in Europe and the United States has led to plants being shut down prematurely. Those closures and the retirement of older sites mean that advanced economies could lose two-thirds of their nuclear capacity by 2040 according to the IEA. Some scientists regard nuclear energy as a major answer to the Energy Transition. Even Bill Gates launched a Nuke start up (TerraPower in 2008) which has plans for build a demonstration site for its Natrium site in Wyoming by 2028.

However, that is not the case in China. Having paused after Fukushima, China’s nuclear plan accelerated as part of an effort to reduce reliance on coal. China produced four times as much nuclear energy in 2019 as it did in 2011; it has 16 reactors under construction and
another 39 planned. Countries wanting new nuclear plants now look to China and Russia as suppliers, not the US or Europe.

Solar and wind power are getting much cheaper thanks to innovation and the economics of manufacturing at scale, but their power is intermittent. Providing a reliable grid is a lot easier if some of its generating capacity can come from a baseload available all the time. Nuclear provides such capacity (so does geothermal) with no ongoing emissions, and it is doing so safely and at scale around the world. Cutting nuclear power at a time of climate change doesn’t make sense to Michelle or Linda but that is politics for you.

There are other consequences as well. Linda has just added another report to Michelle’s reading list. The International Energy Agency (IEA), the world’s preeminent source of energy information for governments, has entered the political debate over whether the U.S. should spend trillions of dollars to accelerate the energy transition favored by the Biden administration according to an article in the Wall Street Journal (May 12, 2021 by Mark Mills).

The current energy transition plan is to use far more ‘clean energy’ and far less hydrocarbons—the oil, natural gas and coal that today supply 84% of global energy needs. The IEA’s 287-page report released this month, “The Role of Critical Minerals in Clean Energy Transitions,” is devastating to those ambitions. A better title would have been: “Clean Energy Transitions: Not Soon, Not Easy and Not Clean.” or if you are lazy like me you can just listen to the video summary; Michelle prefers the audio versions.

“In practice all this means the government should expect to foot some or all of the bill for new nuclear power plants, new charging grids for electric vehicles or thorough investigations of new technologies such as geoengineering. Carbon taxes are growing and will soon cover a fifth of global emissions. Pricing carbon is an essential step, forcing firms, and ultimately consumers (that means you and me), to bear the cost of their emissions, and in turn leading investors to allocate capital more efficiently (Ahmed, et al., 2021).”

The current infrastructure bill being debated in Congress has a lot of money for charging stations.

Michelle’s company really doesn’t spend much on R&D. they focus more on operational efficiencies and exploration than on research. They pretty much depend on the market for their technology and services. But what part does the private sector need to play?

“The private sector still has a crucial role to play. Investors and entrepreneurs are the best at commercializing new ideas, from efficient grids to hydrogen-powered vehicles. As a fried of Michelle always says that engineers are better at solving problems than regulators. The public market provides a vast source of capital for more mature firms, helping them to scale up fast. Yet so far, the asset-management industry has stuck to marketing its green credentials in superficial ways. In the latest quarter the net inflows
of cash into sustainable funds, which often track the shares of big firms that have little effect on climate change, were twice the size of the annual investment into green VC (Ahmed, et. al., 2021).”

Gaia doesn’t have anything against the capitalist market, but she needs more help than she is getting today to develop the innovation needed to pull off this energy transition. There are a lot of interesting press releases but too little ‘shovel-ready’ projects. Gaia is a big supporter of all of the above including renewables (wind and solar), safe and possibly smaller modular nuclear plants, geothermal is one of her favorites as it comes from the earth and a fossil fuel industry that practices better operations with a lower carbon footprint and a strong emphasis on carbon management (carbon capture, utilization and sequestration. That is green innovation for her.
Collaboration: There’s No Planet B (09/11/2021)

Michelle was a little girl at the time of the first moon landing. She doesn’t remember much of the news coverage of Apollo 11. But it was more than just a moment of history for her. It was a moment of new opportunity, one of a dream coming true. She never wanted to go into space herself, but the fact that humans could go to the moon and return safely opened a lot of dreams for a lot of young people. For those of you who missed it, Apollo 11 was the spaceflight that first landed humans on the Moon. Commander Neil Armstrong and lunar module pilot Buzz Aldrin formed the American crew that landed the Apollo Lunar Module Eagle on July 20, 1969.

It was kind of sad to hear of the passing of Michael Collins recently. Michael Collins was the pilot that Apollo 11 while it was Neal Armstrong that got all the headlines by being the first human to step on the moon.

“There is but one Earth, tiny and fragile, and one must get 100,000 miles away to appreciate fully one's good fortune in living on it.” - Michael Collins, NASA astronaut, command module pilot for the Apollo 11 mission to the moon (1930-2021). Here is how the famous astrophysicist Carl Sagan described this view in a lecture he delivered at Cornell University in 1994 (Sagan, 2010).

To ensure new collaborations consistent with scale and urgency of these challenges – inside and outside of the industry, companies are being challenged to prove progress on climate goals, So, many new initiatives (from UN, EU, G20, API, industry (OGCI), NGOs, tech companies and management consulting firms (Sustainability Playbook – Microsoft and EY), switchedon.org (Scott Tinker), API Sustainability Gaia (Johanna Dunlap) are started up that Michelle can’t keep track of them all.

Michelle has always tried to find a solution that helped to create a good, ‘win-win,’ compromise. Where most of what all sides wanted was achieved and no one went away from
the table upset. She knows from experience that this is not the path to gain popularity. When all sides criticize her equally then she feels like she found a reasonable middle ground. These days, many people head for the extremes not the common ground. While more things bring us together then separate us, many want to dwell on divisive opinions. Is climate change one of those issues?

One example of this challenge to find the middle ground is the debate on methane emissions. There is a lot of discussion that is moving from scientific journals to public media on this subject. To a large extent, the new spotlight on methane is simply the reflection of the visibility of methane emissions, thanks to recent breakthroughs in satellite imaging and image processing. That is ironic in that methane is invisible and odorless but new imaging technique can make it look dramatic. New methane detection capacity shows worrisome disparities between old-fashioned bottom-up estimates of methane emissions and new top-down atmospheric measurements. Reconciling the two is clearly a top priority. That is the challenge for Michelle and her peers.

The phrase ‘the road less traveled’ means a choice made in one’s life that is unconventional, a choice that leads one in a different direction than most people. The connotation is of a choice that expresses individuality and leadership. The expression the road less traveled is a paraphrase of a line in Robert Frost’s poem (Frost, 1915).

Michelle always like that poem. Despite the flack she keeps getting, she still wants to find the common ground. Her mother keeps reminding her of the time as a child she wanted to broker the peace between the family pets. She carefully brought their dog into close contact with their cat so they could become friends. All she got from that encounter was a scratch on one arm and a bite on the other. So much for compromise.

Gaia had been encouraging Michelle to listen to other perspectives, even the very strong environmental activists. So, she asked Linda for a suggestion of where she might find such a group. Linda had attended many of these meetings but she was a bit cautious about the idea of a general manager in an oil company attending one of these meetings. But at Michelle’s insistence, she found a meeting nearby and gave her the information on when and where the meeting was to be held. It turned into a really bad idea.

At first all was well; Michelle found the meeting and she sat in the back intending on listening to the speakers. But when it came to question time, her general manager DNA came out and she rose to question some the facts that had been offered that she knew to be false. Her true identity soon came out and the criticism rang from the rafters. One moment she thought they were going to physically throw her out of the room. With her reputation bruised and battered, she made a quick retreat vowing to talk to Gaia about how in the world could she find a compromise with people that didn’t want to listen to her.

It turned out the next week, she found herself in what she thought was safer ground, an industry conference on the new climate regulations coming from the state oil and gas
commission. The passions ran high at that meeting as well and the blunt criticism of the environmental position was as extreme as the anti-industry fever ran in the previous meeting. Michelle hadn’t learned her lesson yet. She rose to try to explain and defend some of the more pragmatic elements in the new regs and told the audience of her peers how her company would work to comply with those new rules. Well, you would have thought she was going to get physically thrown out of that meeting as well. From Michelle’s perspective there was a lot of common ground to build on, but all she found was the extreme elements shouted by the loud voices in the room. Once again, like her mother told her, she came away with bruises on one hand and bites on the other. It looks like collaboration is an unnatural act, the road less travelled in the poem.

Michelle really needed another chat with Gaia, this was not going well. Somehow Gaia knew that Michelle needed a conversation, some support and another pumpkin latte. They met again at the same coffee shop. Michelle was pretty discouraged. Gaia didn’t have the magic answer for her but she was a really good listener and told Michelle she was proud of the actions she was taking. That helped a little. She assured Michelle that collaboration was a process, sometimes a long process. Taking the road less traveled had stretches of some a very lonely journey but she couldn’t give up. People needed protecting, jobs and the economy needed protecting and the earth needed protecting. Michelle wasn’t going to win any rewards by taking this path, but she just might convince enough people to do the right things to move the needle in the right direction.

THE ROAD NOT TAKEN
BY ROBERT FROST

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Listening & Communication (08/28/2021)

After all the meetings with Linda, after all the articles and videos and all the conversations with Gaia at the coffee shop, Michelle’s head is spinning. There is so much to learn and she not sure we’re giving ourselves the conditions in which to understand and then change our actions and behaviors based on that new knowledge. We want to throw mud at the other guy, blame everything on the old order and never get out of our bubble to just listen.

Michelle is starting to think that her staff are getting tired of her talking about climate change and environmental stewardship all the time. She can’t just get on a soap box and quote the latest UN Climate Report every staff meeting. She needs to get their buy-in but to do that she has to do some listening as well. Some people are shouting about emergency actions but others just want to get on with their lives. How can she light a fire under those that just want to do their jobs and go home to their families? This maybe the hardest challenge she has ever had to face.

A number of Michelle’s colleagues have often told her that listening and patience were her leadership super-powers. In order to create the conditions for trust and success through listening and sharing technical knowledge (no place to hide) someone has to reset the industry’s reputation with the general public. The loud voices in the room are shouting the industry down. Those voices have the ear of many politicians and media celebrities. Before anyone is going to listen, we have to stop shouting at each other.

Michelle recently attended (virtually, of course) a professional society meeting with two speakers on Leadership. The message in their book really struck a chord with Michelle as she wrestles with her role in leading her company towards a more sustainable future. There is a very good reason why the SPE Gaia community made sure to include Listening and Communications in their Sustainability framework. The authors speaking in the webinar were Maria Angela Capello and Hosnia Hashim.

From Learned in the Trenches: Insights into Leadership and Resilience Complied by Two Women Leaders in Energy; by Maria Angela Capello and Hosnia S. Hashim

“I would be absolutely pointless to have a vision, to be committed to it, to have accountability, to be confident about being able to achieve it, if a leader cannot communicate with his or her team. the communications ability of a leader is one of the most remarkable traits that propel them to success. Communications in every sense:

• **Lateral**: to liaise with his peers and colleagues within and outside the organization. the capacity to be ‘one of the packs’ is crucial, as leaders easily may get adversaries among peers who complete for top roles, and competition becomes harder at every step upward. Remarkable leaders collaborate and gain from the collaboration among peers, understanding and leveraging on the value of this approach (Hashim & Capello, 2017).
• **Cascading:** to communicate the vision, objectives and path to the team members. This many times is a capacity to literally translate those to all in the team. An operator needs to hear from a leader the corporate goals in a simple language, applicable to his or her daily asks. A laboratory technician requires to understand how the corporate goals are applicable to her daily routine, and here, the translating capacity of the leader boosts his or her efficiency. The remarkable leaders are also excellent storytellers and develop an intriguing capacity to adapt the core of their messages to all sorts of audiences. They feel confident communicating in reduced circles as well as in large audiences (Hashim & Capello, 2017).

• **Upwards:** Liaising with supervisors when you feel inside of you the strength of your own leadership in not always easy. This is why the communications of leaders with other leaders who are steps above them in the leadership ladder is significantly important. Humbleness and self-consciousness become increasingly relevant in his segment of the communicational ability of leaders. It is in their interest, and they do it magnificently, to communicate their vision, their goals, and their expectations with clarity. But it is more significant the ability they have to communicate their needs and those of their teams to achieve the set goals. In the communications with their bosses, the leaders also ask critical questions, without filters, and provide their own insights on challenges and strategic decisions, many times becoming indispensable for the organization, that start to count on them for taking important steps into the future. It is precisely this capacity that many times triggers their own growth in the organization (Hashim & Capello, 2017).

Michelle accepts that she has the responsibility to be an effective communicator both inside her company and outside. She is comfortable with the inside role, but more than a little nervous about speaking to the general public. Her experience has taught her how to talk to engineers and operators but she has never had any training on how to talk to anyone outside the industry. She has even gotten some flack recently at industry meetings as her opinion is a little ‘greener’ than some of her colleagues.

Changing industry’s traditional attitude towards the environment and getting the public to see that things have really changed is a tall order that Ms. Capello and Ms. Hashim describe. Can Michelle become this sort of remarkable leader? I am betting on her, but it ain’t going to be easy.
Is There a Business Case for Sustainability or Are We on the Cusp of Another Energy Crisis? (09/25/2021)

It is time to update the business strategy for Michelle’s company but there are so many uncertainties out there it is tough to peer through the fog and get prepared for what might be coming. When Michelle talks to Gaia economics topics don’t really come up. But Michelle can’t ignore the business case for what her company does. Moral arguments are powerful but the investors want to see the bottom line and the investment returns. The CFO just replies ‘show me the money.’

Both the opportunities and the challenges are buried in the current demand and supply forecasts. But should Michelle prepare a new business case for sustainability, are we on the cusp of another Energy crisis within the Energy Transition, or will things work out and only have a moderate impact? North American shale producers are talking about capital discipline and are not bringing back production as fast as they can. On one hand you have those predicting the ‘end of fossil fuels and the other side sees a new demand peak after the pandemic subsides. Which side is right or is there a balance? Here are what a few of the experts say:

“Global energy markets in general, and oil markets in particular, are slipping into a structural deficit as we speak. We believe energy will be the most important investment theme of the next several years and the biggest unintended consequence of the coronavirus. Investors’ focus has shifted to how quickly supply can be brought back to meet recovering demand. While most investors believe the lost production will be easily brought back online, our models tell us something vastly different. While OPEC+ production will likely rebound, non-OPEC+ supply will be extremely challenged. Instead of recovering, our models tell us that non-OPEC+ production is about to decline dramatically from today’s already low levels (Goehring & Rozencwajg, 2021).”

“Everyone is talking about the future and how wonderful it will be. Greener, more equal, we will be more productive and happier and all with low carbon infrastructure. When looking at a possible future of smart grids powered by renewable sources, you can get into the buzz and feel pretty good. But who is going to pay for upgrading the current infrastructure? Ask the people of Jackson Mississippi about the cost to upgrade their 100-year-old water infrastructure if you want to get a handle on the size of this challenge (Davis & Dankosky, 2021).”

A new book from Steven E. Koonin, a former undersecretary for science in the Obama administration’s Department of Energy and chief scientist at BP titled Unsettled: What Climate Science Tells Us, What It Doesn’t, and Why It Matters offers a much less alarming prediction.

“For most economic sectors, the impact of climate change will be small relative to the impacts of other drivers (medium evidence, high agreement). Changes in population,
age, income, technology, relative prices, lifestyle, regulation, governance, and many other aspects of socioeconomic development will have an impact on the supply and demand of economic goods and services that is large relative to the impact of climate change.”

A 2018 article written by one of the IPCC’s coordinating lead authors reviewed a further four years of published papers and came to a similar conclusion: The total economic impacts of climate change are negative, but modest on average, and . . . the severe impacts on less developed countries are caused primarily by poverty (Koonin, 2021).”

The current proposals going around Washington DC are only a drop in the bucket to deal with the aging US infrastructure and when you think about the global scale then you see that China is helping Pakistan build coal-fired power plants (recent announcement say they are going to stop). We are not on the same page, Michelle concludes. If an oil and gas company like Lundin can bring power from shore for their Norwegian offshore brand-new production facilities and tap into the plentiful Norwegian hydroelectric grid certainly you can make the case for carbon zero operations soon, especially offsetting the world’s highest carbon tax in Norway. But how does Michelle use market incentives (additional production, price for natural gas, cost of bringing infrastructure to wells, cost to modernize production facilities, price uplift for responsible gas, penalties from regulations (remember the Firestone fire settlement that Occidental had to pay), carbon taxes, carbon credits, etc. to enhance her business plan?

There is some interesting press on the topic of a market incentive for Responsible Gas.

“Here is how it might work: by melding two essential and connected ideas: disclosing greenhouse gas emissions and then using that data to differentiate products (like natural gas) in a way that ensures that cleaner ones carry a financial premium. A while ago we came to the thesis and strong belief that people will care how a barrel of oil is
produced and a bushel of corn is grown. We set out to develop a [digital] platform that supports that and enables differentiated commodities to be priced differently (Harder, 2021).”

These are the thoughts on a new company called Xpansiv.

Xpansiv, which was founded in 2016 and whose investors include BP and S&P Global, focuses on more than just natural gas. Using production data to create digital versions of a variety of commodities, it enables similar transactions on oil and plans to eventually do the same with water, cement, steel, hydrogen and sustainable aviation fuel.

The Rocky Mountain Institute, an environmental nonprofit, is helping to develop a new methane standard to help ensure the gas used is the cleanest. “We don’t believe that gas has a role long-term in the energy system but we’re quite grounded in the reality there is quite a bit of gas being sold today,” says Ned Harvey, the nonprofit’s managing director (Harder, 2021).

A recent article in the Denver Post suggests that some of this Responsible Gas market premium might actually be coming true.

“Amid escalating worries about climate change and pollution from oil and gas operations, Colorado’s largest electric utility is going to buy natural gas from a company that is continuously monitoring its emissions and working to certify its product as responsible. Xcel Energy said Wednesday that it will buy some of its gas for use in Colorado from Denver--based Crestone Peak Resources as part of a pilot project to show that it’s dedicated to delivering a cleaner energy product.” Xcel was the first utility in the country to announce a goal of delivering carbon--free electricity (Kohler, 2021).”

Michelle is starting to think that there is a business case for sustainability after all. If she could keep Gaia happy and her investors and operations staff happy all at the same time, she just might get that next promotion but then again if she misses one of those goals, she just might lose her job. She wonders if Gaia might be able to help her get a new job if she messes this one up.
Michelle tries to keep on top of the news about climate change, but she feels like there are two totally different conversations going on. One theme is urgent and even sometimes alarmist. It says there is no time to wait for new technologies (like carbon sequestration or direct air capture) or more efficient and cleaner operations. The entire globe, led by the largest polluters (US and China), must abandon fossil fuels right now and if the economic systems won’t get us there fast enough, governments will have to step in and make everyone change. One of those reports just came out from the International Energy Agency (IEA), Titled ”Net Zero by 2050.”

The IEA report suggests that to solve the climate change crisis, human beings must stop using gasoline-powered cars within 14 years, abandon the pursuit of new coal mines, end oil exploration and set about ”a total transformation of the energy systems that underpin our economies.” The report examines the pledges made by world governments to dramatically reduce greenhouse gas emissions and concludes that the goal of keeping global temperatures from rising 1.5 degrees Celsius above preindustrial levels will prove ‘extremely challenging.’

"The number of countries that have pledged to reach net-zero emissions by mid-century or soon after continues to grow, but so do global greenhouse gas emissions," the report states. "This gap between rhetoric and action needs to close if we have a fighting chance of reaching net zero by 2050 and limiting the rise in global temperatures to 1.5 °C (IEA, 2021)."

In its report, the IEA lays out 400 steps that, if taken immediately, would meet the goal of cutting current greenhouse gas emissions in half by 2030 and down to nearly zero in 2050. In the event that such a massive, united global undertaking were successful, global temperatures could be kept below a level that would cause mass extinction, devastating sea level rise,
unprecedented death from worsening heat waves, and other consequences that the Environmental Protection Agency has found are already occurring.

The phrase ‘extremely challenging’ sticks in Michelle’s head. Governments and economies struggle with significant challenges for years (how long has the US been debating infrastructure upgrades and now bridges are falling down and the politicians are still debating). The IEA is giving the world 400 steps to achieve ASAP. Come on now that isn’t “extremely challenging” it is downright impossible and those folks should know that.

The pledges made by the two countries with the highest emissions (US and China), as well as those of other industrialized nations in the Paris Agreement, are mostly nonbinding, aspirational goals, the IEA report notes. But "there are still pathways to reach net zero by 2050," it states, even though "that pathway remains narrow and extremely challenging, requiring all stakeholders — governments, businesses, investors and citizens — to take action this year and every year after so that the goal does not slip out of reach (IEA, 2021)."

According to the report, the actions required to transform global energy consumption and production include:

- Increasing the use of renewable sources of energy from 29 percent in 2020 to 90 percent in 2050
- Halting construction of all new coal plants this year, unless they are built with carbon-capture technology (countries are still building coal-fire power plants in southeast Asia to bring reliable power to many who have never had it, remember Dr. Tinker and switchon.org)
- Implementing a ban in 2025 on the sale of new oil and gas furnaces to heat buildings
- Phasing out the sale of automobiles that use gasoline by 2035 (Michelle needs to buy a new car next year, should she buy an electric vehicle? Will there be enough chargers installed to provide some confidence that she won’t end up stuck somewhere with a low battery?)
- Conversion of vehicle fleets to either electric or hydrogen fuel sources by 2050
- Shifting power plants away from carbon emissions to renewable sources of energy by 2035
- Closing all coal-fired power plants not fitted with carbon-capture technology by 2040
- Transitioning half of all plane-travel energy sources to hydrogen or biofuels by 2040

The report, however, is quick to acknowledge that meeting the goals it lays out will be enormously difficult. "The world has a huge challenge ahead of it to move net zero by 2050 from a narrow possibility to a practical reality," it states. "Global carbon dioxide emissions are already rebounding sharply as economies recover from last year’s pandemic-induced shock. It is past time for governments to act, and act decisively to accelerate the clean energy transformation."
The other theme sounds quite differently. Here is some of that conversation from the OGCI website:

“OGCI Climate Investments brings new technologies and business models to high-emitting sectors focusing on areas that have lacked innovation and/or capital. Achieving significant impact requires global implementation and commercial frameworks. At OGCI Climate Investments, we collaborate with innovators, investors and governments to fund, deploy and scale impactful solutions. We look for outcomes that reduce methane and carbon dioxide emissions, and that can recycle or store carbon dioxide, reducing methane emissions, reducing carbon dioxide emissions and capturing carbon (OGCI, 2022).”

Individual companies like Occidental Petroleum are making public commitments around the climate impact of their operations (scope 1 emissions). Michelle read one from Vicki Hollub, CEO of Occidental:

“In 2020, Occidental expanded its vision for a low-carbon future by leveraging its carbon management expertise to achieve net-zero in our operational and energy-use emissions by 2040 and our total emissions inventory by 2050. Amid an unprecedented global pandemic and low oil prices, we made progress in advancing carbon capture, utilization and storage (CCUS) technologies with the potential to benefit our business and the climate. We set new targets to reduce greenhouse gases (GHG), including methane, and remain on track to end routine gas flaring by 2030 (OCGI, 2022).”

Michelle’s company statement would read a lot like this one. The oil and gas industry are making progress in reducing emissions but not anywhere near the expectations of the NGOs and environmental activists. Vicki and Greta (Thunberg, Swedish environmental activist) are having two very different conversations.

There are smart dedicated people in the IEA and EDF, and in the OGCI, API as well as Daniel Yergin. Why are there conversations so different. Michelle believes that there is only one set of data and one reality, but we have made them into two separate conversations with two very different approaches. There are always conspiracy theories about any controversial topic, but Michelle doesn’t go in for conspiracy theories on climate change motives.

It seems like the differences of opinions have started from very different perspectives and are just too large to bridge and form a consensus strategy to move forward with (remember the green new deal will look different in Stockholm, Sweden then the one in Lahore, Pakistan). One is incremental and pragmatic and focuses on existing forms of energy and the potential of new technology. The other is transformational, changes much in our current energy portfolio, asks everyone to change quickly and with a very aggressive timeline. While the politicians and activists (and scientists and engineers) are arguing, Gaia is wondering if she is going to have to take things in her hands.
‘Extremely challenging’ doesn’t seem to even come close to describing what it really going on for Michelle. Which reality do you live in?
Can Gaia Go Digital? (10/07/2021)

Industry needs to operationalize sustainability, but it would be great if there was a general understanding on what the target was and how to measure our progress without being too prescriptive. Michelle’s operations staff know what they are doing and really don’t want to be told how to do their jobs. Give them a goal and they will achieve it. Give them a lot of paperwork to fill out and it will waste time. One thing that Michelle can always count on is that Big Al’s group will comply. Comply with state and federal regulations and with internal company best practices. But Michelle also expects her operations group to comply with those regulations at the lowest possible costs. Their primary job is to produce oil and gas safely and efficiently. Their primary job is not environmental reporting.

When Michelle’s group looks at the data, they want to do something about it not just produce reports that no one is going to look at. Michelle knows there is nowhere to hide from site-based, remote monitoring of emissions. There are already organizations that are doing this (EDF, JPL, NASA, EU). However, the conversations that Michelle has had with Linda and with big Al suggests that they really don’t know how to measure their methane and Co2 emissions very accurately, they don’t know what they don’t know.

Michelle would prefer a consistent performance-based regulations approach. Give her group a goal and they will figure out the best way to achieve it. The current regulatory approach is a prescriptive one, focused on components not the total result. Reports based on emission factor models based on ideal conditions in lab environments is not the real answer. Regulations out ahead of practical ability to comply isn’t the right answer either. Instead of regulators writing detailed rule on operations details they have never experienced, let her engineers and operators figure out how to hit the target.

Gaia is going to care about the ultimate result, not whether Michelle uses a specific type of pneumatic value or what kind of tank thief hatch they use or whether they use an electric
fracking rig or a diesel powered one. The challenge right now is that the industry DOES get that methane emissions is very important. They are investing and collaborating on a variety of ways to fix the problem including new technology and carbon capture and sequestration. There is an alphabet soup of organizations out there trying to give advice (IPIECA, US EPA GHGRP (greenhouse gas reporting program), OGMP with their OGMP 2.0 Gold Standard template and the IMEO (International Methane Emissions Observatory), API Environmental Partnership, the OGCI (Oil & gas climate initiative) and dozens of other regionally based associations. Actually, the industry performance on methane intensity basis is getting better (going from about 2% in 2005 to nearly 1% in 2019 and 0.23% in 2020) but that hides the problem that gas production during that time grew from 18tcf to almost 30tcf in the US so the amount of methane emissions Gaia felt actually grew. Measure what matters.

Linda and Big Al agree on many things but two issues that really bother both of them are 1) the uncertainty of measurements (i.e., is flare stack efficiency 98% or 93%, what is the accuracy of remote sensing measurements, can satellites detect small, infrequent flares, etc.) and 2) how to certify/validate their reporting so that everyone will trust the numbers. Both sticky problems that don’t have easy answers. And of course, having less paperwork to fill out (a consistent reporting framework) would be nice as well. If Michelle’s company works to a higher standard, will they be penalized or incented to do the right thing? Is there a level playing field here or will some of her competitors be able to game the system?

Going Digital will hopefully allow Michelle’s company to perform better at what they do. The goal is to be data-driven, predictive, and more efficient. Schlumberger estimates that the O&G digital data market will be $1.9 billion by 2025. We are in a world of data platforms not data bases. Michelle wonders how her IT department (remember Kim is the CIO) can keep up with the fast-paced world of digital technology?

Michelle’s last meeting with Big Al and Mike was a real complaint session. Big Al pointed out that they are trying to upgrade their operations procedures to adapt to the new environmental metrics Michelle has given them. They are trying to cope with all the new paperwork regulations from states and federal agencies (why can’t they all just agree with one standard so the effort to comply with the permits wasn’t such a pain?). Holly is trying to come up with the new set of financial and operations standards to meet the ever-changing expectations of their ESG investors and bankers.

Environmental service companies are offering a new set of certification standards and now they are just learning that the midstream/pipeline company has a new set of standards (with independent verifiers) to meet to get a sales contract for their natural gas production. Big Al thought we were trying to reduce manpower to cut costs, but all we are doing is replacing field operators with back-office paperwork clerks. Is that what we are supposed to be doing? Remember comply but at the lowest possible cost is the field DNA.
In 2017, The Economist magazine said that the world’s most valuable resource wasn’t oil anymore but it was data. In 2012 Harvard Business Review said that data science was the sexiest job in the 21st century (Brynjolfsson & McAfee, 2022). Michelle wonders if the most valuable resource in the world isn’t clean air and water, with an energy mix that provides the lights and heat and power to raise everyone out of poverty; but how can she argue with the Economist, Thomas Davenport, Silicon Valley, and Elon Musk? Michelle is feeling tired.
Penetrating the Clay Layer (03/13/2021)

Michelle knows it is time to take some meaningful steps in her operations plans to include managing carbon and reducing their carbon footprint. This is where the rubber meets the road. Her experience with their safety programs in the last decade tells her that carbon management can’t be an add-on to current operations objectives, there is already too many of them. It has to be an integral part of the expectations and rewards. But Michelle recalls a famous quote from Dwight Eisenhower. “What is important is seldom urgent and what is urgent is seldom important.” There new metrics are important but how will they compete with the urgent goals to reduce costs?

Next week she has an important meeting with Mike, the Asset Manager and her operations supervisor Big Al to set the production plans for the next year. These are the folks that have to buy into a new way of working if her company is going to make progress on the goals set at the executive committee. She has some ideas about environmental stewardship goals but it won’t be easy to get everything done with a lower budget. She plans to invite Linda along to give a presentation to set a new context for the company direction.

Michelle is not sure how Big Al and Mike will react. They are very intelligent and dedicated managers, who have a great track record of getting things done and meeting performance metrics. They are not the problem, but they have to be part of the solution, a middle ground isn’t going to cut it. But the entire organization is stretched thin right now. Michelle has given her operations team higher production goals over the last several years and then switched to tougher costs management goals as well when the market crashed last year. There are fewer folks around now with greater responsibilities. How is she going to add more to that full plate?
Mike and Big Al have been pinching pennies, getting tough with suppliers, cutting programs and watching costs like a hawk. There is no fat left to cut, only muscle and experience. OPEX has come down even though some production targets were missed. There are always safety goals, “everyone goes home safe every night” that are more company values than performance targets, as well as more stringent compliance rules that finance and legal has rolled out. Michelle recognizes there is a lot of her operations folks’ plates right now. Adding more might just break their backs and morale. She can’t let that happen.

Folks like Big Al and Mike are being told to make the top line, make the bottom line and oh! save the planet at lunch time while you’re at it. They are intelligent, they read the papers about climate change just as Michelle does. Michelle doesn’t think they will be skeptical about the new environmental goals (like reduce flaring to less than 5% of gas produced that could increase production, recycle produced water for fracking – that could save costs, monitor fugitive emissions of methane – that is going to take some new technology, use electrical power onsite when feasible, be more transparent with production and emissions volumes and the list goes on) but, they are already stressed! She doesn’t need lip service buy in, she needs real commitment and their experience and knowledge to figure out how to make all of this work.

These guys aren’t the middle management clay layer where idea go to die. Mike gets the big picture and is a good communicator. Big Al is more tactical and pragmatic. He just wants Michelle to give him a goal that can help him operate better, not one that catches him doing something wrong he didn’t even know about or can’t do anything about. Mike and Big Al read many of the same articles that Michelle does. Both of them have families and Michelle thinks that both of them have grandkids by now. She knows Big Al likes to take his grandson out fishing when they have the time. Why would you think they want to ruin the planet?

The current air quality monitoring solutions produce so many false positives that produce no actionable alerts, that has his maintenance crews running around like chickens with their heads cut off. They all need to sit down with Linda and talk about what the real obstacles to integrating sustainability practices with current operational practices? Reducing flaring and venting are a great idea but what about the safety of his crews working around a production upset or equipment failure? We have to be realistic or else someone might get hurt.

What does Mike and Big Al need to know? What incentives does they need? How about a performance bonus when they meet lower flaring targets just like they get when they meet production targets? Michelle just can’t forget all the other metrics and focus on the new environmental ones. They have to make money, keep everyone safe. Michelle knows that you can’t keep doing the same things and expect different results. So, what changes in workflows, knowledge, mindset that are need to operate cleaner. Michelle wants to know what Mike; Big Al and the rest of the operations crew needs in terms of help from her and Linda. If the field is skeptical of the new operational plan, it’s because there are not getting the support they need. Gaia is not going to be able to solve this one for her.
Machiavelli was right that change is dangerous because; “he who innovates will have his enemies. All those who are well off under the existing order of things, and only lukewarm supporters in those who might be better off under the new.”

Michelle saw a YouTube video by Matt Gallagher (former CEO of Parsley Energy at the NAPE 2020 conference) that set the tone she wants to start with. She knows that her company and this industry can’t rest on their past accomplishments. We have to adapt and innovate and execute. This won’t be the first time the industry has faced new circumstances and it won’t be the last.

There needs to be a “New Shale Deal” to provide her operations team with something positive that her group might rally around. Being too negative and asking too much from her staff is not going to get her company where she knows they need to land. Her staff are tired of being called liars about their emissions reporting. How can her company establish trust with regulators, investors and the communities around their oil and gas production facilities?

There are a lot of loud voices out there that are critics of the oil industry. The old value proposition of jobs, taxes, lifting people out of poverty, increasing GDP is enabled by increasing use of fossil fuels isn’t cutting it anymore. Not that that value proposition isn’t true or valuable, it just isn’t enough these days. Her new operations plan has to reset KPIs to drive different behaviors but she knows her staff are already overwhelmed by safety and cost management and now carbon management is piled on.

All these thoughts are going through her head as she prepares for the operations planning meeting. Sometimes all of this gets too much for her as well. She empathizes with Mike and Big Al. She is asking a lot from them and she has to be there to support them not just criticize them. She doesn’t think that Mike and Big Al are interested in a pumpkin latte but maybe she should take them out for a beer after the meeting. Michelle could do with a stiff one right now as well.
Nobody Wants to Deal with the Little Stuff Anymore (07/31/2021)

Michelle’s company is going thru that periodic strategy exercise commonly call portfolio realignment. That means that they bundle up a group of wells, facilities and leases that are past the most productive phase of their life (at least from her company’s perspective) and plan to sell them to an independent producer for some cash to invest in their ‘growth’ assets. Most large companies do this to help keep their focus on the important assets. It also feeds a part of the industry that most people don’t think about too much, the independents or the ‘mom and pops’ as they are sometimes called.

There is little impact to the company’s bottom line and a lot of older wells with increasing maintenance bills are cut from the operations. Local field staff often find jobs with the new owner and the cycle of life in the oil business goes on. But with Michelle’s newly found passion for environmental stewardship, she wonders how the small independents are coping with all the change. She takes the time to sit down and talk with Ed, the president of the company that has just bought the acreage package in Colorado that her company just sold.

Ed is an interesting guy, a real oilfield veteran. One with the proverbial ‘oil in his blood’ mindset. His father got into this business of buying old marginal wells, often called stripper production, back in the 1960s and Ed has followed in his father’s footsteps (and even pays him a royalty check every month now that he lives in a nursing home). Ed loves the oil patch. He spends as much time with his lease operators as he can, getting grease under his fingernails to help get an old well back online. But Ed is getting worried about how much longer his part of the industry will survive.

Ed’s small business is all about keeping the oil and natural gas production flowing from his collection of aging wells trying to make enough money to pay mineral rights royalty owners, suppliers and other costs and then split the profit (if there is any) with his shareholders with a little left over for him when times are good and oil prices high.

With rules and regulations growing more complicated and reporting requirements more numerous and expensive to keep up with, Ed wonders about the viability of small stripper producers that have played an important role in the industry for decades.

Most folks don’t know (Michelle didn’t realize it either) that thousands of wells are operated by hundreds of small companies like Ed’s. For example, in Colorado there are 53,700 producing oil and gas wells but 49,100 are classed as stripper wells (less than 15 bopd or 90,000 cubic feet of natural gas and are exempt from paying state severance tax). In 2020, these 91% of the wells produced just 7% of the total oil production and just 11% of natural gas volumes. In many traditional oil and gas basins in North America, major producers operate most of the stripper wells. In Colorado 87% of stripper production is operated by the largest 20 producers and only 13% are operated by the smallest 291 operators. According to the EIA (US Energy
Information Administration) in 2015 there were 380,000 stripper wells making up about 10% of total production in the United States (Perrin, 2016).

In the new production approach, majors are moving towards plugging the older vertical wells as they drill the new directional wells from super pads where 12, 24 or more wells can be operated from a single concentrated facility. That is the direction that Michelle’s company is headed towards. Those older wells won’t be around in the future for Ed and his colleagues to buy and operate. Major operators often decommission older gas gathering systems that they don’t need and are too expensive to modernize. That leave many operators like Ed without an access to market. According to Ed, “the old world is gone. It’s big well pads and big development, and nobody wants to deal with the little stuff anymore.”

There has been an avalanche of new regulations on the industry in the last several years. While some state agencies try to keep an ear open for the small producers and some of them have organized into lobbying groups to try to get their message heard, most regulatory agencies don’t have much time or flexibility in applying new regulations and regulations are written without regard to size of business. So, Ed has to play by most of the same rules that the big boys go by. Ed has to prove his operations do no harm, even by putting combustors on oil tanks that have never produced much natural gas. Guilty until proven innocent by many measures. This part of the industry doesn’t have many friends at the state capital anymore.

One big issue is around financial assurance or the bonding that operators have to have to ensure that well abandonment and site reclamation will be paid for if the legal operator can’t of won’t take care of this responsibility (the “orphan well” inventory). Colorado is discussion have a $80,000 per well bond which really concerns Ed and his peers. They argue that that amount is far higher than it takes to plug an old well and setting financial limit that high well drive many out of the business.

Ed is not trying to destroy the planet, just trying to make a living in an industry he has devoted his life to and really loves getting out into the field. He wants to have a working environment where everyone comes home safe, every day. He wants to pay his bills and meet his responsibilities. But it is getting harder. Regulations meant for the large producers are adding a real burden to his small business. Regulations that raise his costs but really don’t make his operations cleaner or safer don’t help either. The inspections are growing, the paper work is out of control. When oil prices are high enough, he can still make a living but it is getting harder and Ed is not that optimistic about his part of the industry. He tells his kids to go to school and study computer science. He doesn’t think it is smart to follow in his footsteps.

Michelle sees a part of the history of the industry passing away. It is sad but change isn’t always good for everyone. Ed is a good guy, works hard to do his job. The industry will be poorer losing the Eds of this world. (Inspiration for this story comes from “Little Oil, Big Risk,” Denver Business Journal by Greg Avery.)
The Climate has Always Been Changing (05/07/2021)

Michelle’s conversations with Linda and Gaia are becoming all consuming. Now she is thinking about and talking about climate issues to just about everyone. Some of those conversations go well and others not so well. this certainly is a complex and controversial subject in her company. But she had an interesting conversation with the head of the geosciences group, Max, recently that put a whole new spin on her thinking.

It was right after the quarterly reserves review meeting. Michelle was finishing up some paperwork that she had to sign off on and Max was putting away some of the maps and charts he had used. Max had done his usual good job in explaining their reserves position and changes to the SEC reporting that was required after the results of their latest drilling program and the recent changes in the companies’ long term price forecast. So, Michelle took the opportunity and asked the question that she had been asking everyone, what did Max think about climate change? She was surprised by his answer.

Max answered, I am an earth scientist, I take the long view, the geologic view. there is just too much evidence in the geologic record to deny climate change. The biologists also have their line of evidence but I am mostly interested in the rocks. the only thing I get annoyed by is the thinking that this is just a recent event. the climate has always been changing throughout the 4.54 billion years history of our planet. there is evidence in the glacial record, in the fossil record, and even in the sedimentary record. the real question is what is the driver this time around for the more rapid change in global temperature.

The first thing to understand, Max tells Michelle, is that the Earth has experienced periods of warming and cooling. This is due to something referred to as Milankovitch Cyclicity. This is named after a Serbian scientist who hypothesized that variations in eccentricity, axial tilt, and precession resulted in cyclical variation in the solar radiation reaching the Earth, and that this orbital forcing strongly influenced the Earth's climatic patterns.

There is a bit more to this story, Max adds. It turns out that the Earth usually does a good job of regulating these climatic changes and the Earth's average temperature by regulating the amount of CO2 in the atmosphere through the 'rock weathering cycle'. Max tells Michelle that if she wants more details, she needs to listen to one of Richard Alley’s lectures on the CO2 cycle. Alley also points out that Milankovitch cycles may not cause as a big a variation in average solar energy reaching the earth, 'it moves the sun around but does not have a big impact on average temperature'. So, you end up with the CO2 rock weathering cycle being the major driver, along with some special events (Microsoft, 2015).
The idea is that the Earth naturally produces CO2 through volcanism. This CO2 in the atmosphere causes a greenhouse effect and warms the Earth, making it conducive to developing life. CO2 is the gas of life; it both warms the Earth and is used by plants and calcareous shelled animals and reef-builders in the oceans. Without volcanism and CO2 there would probably be no life on our planet. But, if CO2 were to keep increasing in concentration in the atmosphere, we would have a runaway greenhouse effect, and the Earth would cook. A runaway greenhouse effect is what happened on Venus. Luckily the Earth moderates CO2 through the 'rock weathering cycle'. As Richard Alley puts it, CO2 and the Rock Weathering Cycle is the Earth's Thermostat. Of course, it takes millions of years to respond, so due to natural cyclical variations of the Earth, we do get glacial and interglacial periods. Still, the extremes are moderated by CO2 and the rock weathering cycle.

It was a little hard for Michelle to wrap her head around the fact that her new friend Gaia was 4.54 billion years old, but she was going to have to deal with that image later as she listened further to Max. “OK, Max, what is the impact of these large climate changes on life on earth?” Max replied, “they can be big, really big, ever hear of an extinction event?”

Here is a short explanation:

“An extinction event is a widespread and rapid decrease in the biodiversity on Earth. Such an event is identified by a sharp change in the diversity and abundance of organisms. It occurs when the rate of extinction increases with respect to the rate of speciation. Estimates of the number of major mass extinctions in the last 540 million years range from as few as five to more than twenty (Nee, 2004).”

I won’t bore you with the minor events, but the six major extinction events are as follows:

- **Ordovician–Silurian extinction** event (450 million years ago) probably caused by global cooling and sea level drop, possibly caused by a Gamma-ray burst, or global warming related to volcanism and anoxia
• **Late Devonian extinction** (375 million years ago) Overall, 19% of all families and 50% of all genera became extinct. The extinction seems to have only affected marine life. Hard-hit groups include brachiopods, trilobites, and reef-building organisms; the reef-building organisms almost completely disappeared. Leading hypotheses include changes in sea level and ocean anoxia, possibly triggered by global cooling or oceanic volcanism. The impact of a comet or another extraterrestrial body has also been suggested, such as the Siljan Ring event in Sweden.

• **End-Capitanian extinction** event (260 million years ago) The loss of marine invertebrates during the Capitanian mass extinction was comparable in magnitude to the Cretaceous–Paleogene extinction event. Again, the volcanism of the Emeishan Traps (now in southwestern China) is probably the driver behind this even.

• **Permian–Triassic extinction** event (252 million years ago) the End-Permian Extinction, and colloquially as the Great Dying, formed the boundary between the Permian and Triassic geologic periods. Potential causes for this even include one or more large meteor impact events, massive volcanic eruptions (such as the Siberian Traps), and climate change brought on by large releases of underwater methane. This was way before mankind go involved.

• **Triassic–Jurassic extinction** event (201 million years ago) the most widely-held theory for the cause of the Tr-J extinction places the blame on the start of volcanic eruptions in the Central Atlantic Magmatic Province in what is now the mid-Atlantic rift.

• **Cretaceous–Paleogene extinction** event (66 million years ago)

As Max tells Michelle, there are times when Earth has broken its own thermostat. At the of the Permian, about 250 million years ago a massive eruption event formed the Siberian Traps. The eruptions continued for about two million years and were the major cause of the Permian-Triassic extinction event, the most severe extinction event on record. 90% of marine animals and 75% of land life became extinct.

So, what do we think happened? Massive amounts of CO2 and methane were released during the volcanic event. It is also thought that the volcanism cooked oil and coal deposits which was also emitted as hot gas into the atmosphere. The event converted a large amount of once-living carbon into CO2. This led to two outcomes, an increased greenhouse effect. At the same time, the excess CO2 was absorbed into the oceans, causing the oceans to become more acidic, resulting in the loss of shelly carbonate producing animals and eventually loss of sponges and carbon reefs.

The last one was the really big one, Max continued.

“It is now generally thought that the K–Pg extinction was caused by the impact of a massive comet or asteroid 10 to 15 km wide, 66 million years ago, which devastated the global environment, (a sudden mass extinction of three-quarters of the plant and animal species on Earth), mainly through a lingering impact winter which halted photosynthesis in plants and
plankton. The impact hypothesis was bolstered by the discovery of the 180 km Chicxulub crater in the Gulf of Mexico's Yucatán Peninsula in the early 1990s, which provided conclusive evidence that the K–Pg boundary clay represented debris from an asteroid impact.”

Michelle stopped Max for a question.

“How does the current climate temperature rise compare with some of these really big historic events?” “That is a difficult question to answer. Of course, there were no humans around then to measure the temperature but some studies suggest the K-Pg event and the asteroid impact pushed atmospheric CO2 levels up from 350–500 ppm to approximately 2300 ppm, which would have been sufficient to warm the Earth’s surface by ~7.5 °C.”

Just think of what Max could have come up with if Michelle wanted to know about the minor events. Now armed with more geologic history then she will ever need or remember, Michelle was convinced there is scientific research behind what Max was telling her. She felt sorry for Gaia having to go through those traumatic extinction events. You have to watch out for massive meteors, and large volcanic eruptions.

What is causing the climate change now? Max shrugged his shoulders and replied, “It look like we are the cause. the increase in green-house gases (mostly CO2 and methane) from our fossil fuel sourced industrial lifestyle have upset the balance once again. It is the other side of the fossil fuel coin. On one hand, this is what developed world rich and has helped
lift a whole lot of people out of poverty. But on the other hand, we got a rising global climate to do something about.

Max recognizes that CO2 is rising faster than at any time in geological history, except for maybe the Siberian Traps event. However, while the magnitude might not be as great, the rate of change is probably faster. To add to this problem, we have lost many of the carbon sinks, similar to how they were lost during the Siberian Traps event. Our oceans are also becoming acidic, risking the death of shelly carbonate building animals.

Max is right, the earth is a dynamic system, not a static one. Gaia is alive and changing all the time. We just need to work with her and not upset the balance. Now it is time to get to work and re-establish that healthy balance (Rees, 2021).

Long-term Carbon Cycle

Weathering, metamorphism and formation calcium carbonate rocks control carbon cycle over geologic time scales (>10,000-100,000 years)
Energy Transitions Are Not New; But They Are Not Quick Either (08/14/2021)

The context from Max was valuable. Michelle guesses that it is normal to focus, or get distracted, by the headlines of the moment. The winter storm that hit Texas and the US Gulf Coast and nearly brought down the power grid was certainly a headline that got everyone’s attention. Having the context really helps her put things into perspective and make better decisions. A book that Linda recommended (The New Map, Energy, Climate and The Clash of Nations by Daniel Yergin) has certainly helped her put a lot of things in perspective.

“Mapping the path to a lower-carbon world will be a defining challenge in the decades ahead. Climate change caused by humans has been a topic of serious study for four decades. But the mobilization of public opinion on climate is more recent, driven not just by studies but by an increasingly intense focus on events around the world – forest fires, droughts, torrential rainfalls, coastal flooding, heat waves, melting ice and hurricanes.

The alarm about climate is the great motivator for the “Energy Transition.” The term is widely embraced – possibly the two most used words in talking about the future of energy. It aims to limit temperature rises to less than two – or 1.5 – degrees centigrade about pre-industrial levels, but beyond that there is no clear consensus. Is it to be a transition to a “lower-carbon energy” system – that is, one in which CO2 emissions from human activities go down over time? Or is it to “deep decarbonization,” in which emissions go down much faster? Or is it a “zero-carbon energy” system – no human-related emissions? Or a “net zero carbon system, in which emissions are canceled out by mechanism that absorb the carbon? There is certainly no consensus as to the speed of the transition, nor as to what the transition will look like decades from now, nor as to the cost – nor as to how it is all to be achieved.

Energy transitions are not new. They have been going on for a long time and unfold over time. Previous energy transitions have primarily been driven by technology, economics, environmental considerations, and convenience and ease. The current one has politics, policy and activism more mixed in.

The first energy transition began in Britain in the thirteenth century with the shift from wood to coal. Rising populations and destruction of forests made wood scarce and expensive, and coal came to be used for heating in London, despite the fumes and smell. The need for coal for warmth became more urgent during Europe’s several century-long Little Ice Age, from which the world has since warmed. It was so cold that the Thames froze over, and it was said that Queen Elizabeth I strolled on the ice. Coal’s advantage was price and availability, not superior or differentiated performance.

For a specific data in the first energy transition – coal’s becoming a distinctive industrial fuel, superior to wood – January 1709 could well do. That month, Abraham Darby, an English metalworker and Quaker entrepreneur, working his blast furnace in a village
called Coalbrookshire, figured out a way to remove impurities from coal, thus turning it into coke, a higher-carbon version of coal. The coke replaced charcoal, which is partly-burned wood, and had been the standard fuel for smelting. Darby was convinced, he said, “that a more effective means of iron production maybe achieved.” He also was ridiculed. “There are many who doubt my foolhardy,” he said. But his method worked.

Though it took a few decades to spread, Darby’s innovation lowered the cost of smelting iron, making iron much more valuable for industrial use, helping to spur the Industrial Revolution. Coal was the fuel source for Thomas Newcomen’s steam engine, developed around the same time as Darby’s innovation to pump water out of the coal mines, and for James Watt’s much-improved engine, the commercial introduction of which in 1776 – the same year as the outbreak of the American Revolution and the publication of Adam Smith’s Wealth of Nations – was a decisive moment in the Industrial Revolution. But as energy scholar Vaclav Smil observes, “Even with the rise of industrial machines, the nineteenth century was not run-on coal. It ran on wood, charcoal and crop residues.” It was not until 1900 that coal reached the point of supplying half of the world’s energy demand. Oil was discovered in northwest Pennsylvania in 1859. But it took more than a century – not until the 1960s – for it to supplant coal as the world’s number one energy source. Even so, that hardly meant the end of coal, for consumption has continued to grow. As for natural gas, global consumption has increased 60% since 2000 (Yergin, 2021, Chapter 41).

Michelle was fascinated by this book. Just like his other books like The Quest, Yergin manages to describe an historical journey full of lessons that we need to understand and apply today. Even if it is over 400 pages long. Modern journalism seeks the quick headline, the simple explanation, the photo opportunity, the 30 second sound bite. But complex problems are rarely solved by soundbites. It takes hard work and patience to stick to the journey. Michelle wonders if our information-overloaded, attention-starved culture has what it will take to make this Energy Transition journey or even to sit down and form a consensus on where we want to end up.

Linda found a shorter video reference then The Map book for Michelle to share with her colleagues. The talk was by Professor Robert Perrons from Queensland University titled “Climate Change and the Oil and Gas Industry: Transitioning to a Zero-Carbon World” presented to the UNECE Resource Management week in June 2021 (Queensland University of Technology: Brisbane Australia, 2021). With a slightly more upbeat emphasis on emerging technologies, Professor Perrons also talked about the slower pace of the Energy Transition. Gaia is not going to like this message unless we take care of (mitigate) the emissions from legacy assets which make up most of the energy the world depends on and in truth is still growing.

Where are the places that talk about, even celebrate, the contribution from fossil fuels to society? Michelle found one in Calgary, called the Black Oil Tapestry. This work of art by the Canadian artist Sandra Sawatzky is a:
“220-foot hand-embroidered The Black Gold Tapestry tells the story of how oil has impacted human civilizations around the world, from bitumen bubbling up in the waterways and marshes of Iraq 5,000 years ago to the enormous influence of oil on the global economy today. Examining how oil and natural gas have fueled human ingenuity, progress, warfare, disaster, prosperity and commerce across the globe, The Black Gold Tapestry highlights fascinating vignettes from the past and the present that will surprise and even delight viewers of this truly epic project (Sawatzky, 2022).” If you are ever in Calgary check this out.

Michelle final thoughts after reading the book are well summarized by a paragraph at the end of Mr. Yergin’s book. This sums up her conclusions better than she could put into words. Thank you, Daniel Yergin.

“Experience proves how hard it is to diversify away from overdependence. It requires a wide range of changes – in laws and regulations for small-and medium sized companies, in the educational system, in access to investment capital, in labor markets, in the society’s values and culture. These are not changes that can be accomplished in a short time. In the meantime, the flow of oil revenues creates a powerful countercurrent that favors the status quo (Yergin, 2021).” Michelle has to make the payroll.
We Used to Know How to Do This (10/22/2021)

When Michelle first heard the idea ‘Build Back Better’ It sounded like a good idea. Can Michelle’s company make the needed investments to maintain and grow their production, while make the new facilities safer, more efficient and have a lower carbon footprint? It sounds like a ‘win-win’ strategy. Then Dr. Don the chief technology officer asks a tough but relevant question, “Do we know how to build a ‘greener’ infrastructure?”

Michelle’s company, like most of the oil and gas industry was built for certainty, certainty of prices (although in a commodity business there will be ups and downs that you have to prepare for), certainty of market, certainty of regulations. Given a stable economy, this industry can adopt new technology where appropriate and can continuously improve operations to improve profitability. “Unfortunately, right now, we seem to be in a world that doesn’t have a lot of certainty.” (quote from Bill Ford of Ford Motor Company about the automotive industry, but it applies to Michelle’s world as well)

Michelle was invited to give a talk to a group of local high school students. She talked about her company, the opportunities, the exciting new technologies and their commitment to lowering their impact on the environment. The first question was a bright young student caught her off guard. The student stood up and asked her, isn’t the oil and gas industry a dying industry? Won’t renewables replace fossil fuels? Won’t we all be riding in autonomous electric vehicles soon? How do you answer questions like that? Elon Musk is really effective in getting his message across to this generation, much better than oil and gas has done to date. This is a challenge not to lose an entire generation of the talent her company and industry really needs. That was a tough crowd.

Dr. Don always had his way of asking tough questions just when consensus had almost been achieved by the rest of the management team. His timing was awkward but he always made an important point. With lower oil prices over the last several years, Michelle’s company hadn’t started a major capital project in a while. She knew that the construction companies they had used for years had laid off a lot of staff. Her company even dismantled their major projects groups and spread that expertise around to operations groups for smaller maintenance work on existing facilities.

If they wanted to start up a new major capital program, where would the talent come from? That was Dr. Don’s point. They used to know how to design, build and commission very sophisticated facilities, but most of that expertise had retired or been let go. And with “Build Back Better”, they would have to incorporate new designs, link to renewable power sources with the required backup capacity, and to build in carbon capture technology. Since everyone was doing the relatively same thing, the competition for scarce talent would be fierce and prices would soar.
“Politicians everywhere are calling for more infrastructure spending. Yet few industries have a worse record of coming through on time and on budget. If the incipient boom is to produce better results, governments and firms must learn to adopt best practices from around the world. The new infrastructure infatuation is understandable. Public and private investment has stagnated a 3-4% of GDP worldwide. That is too little to maintain ageing assets in developed countries – a third of American bridges are creaky – or to provide enough clean water and electricity in emerging world. Low interest rates mean financing is cheap, and many economists think that the payback from infrastructure is attractive. Meanwhile, climate change and the digitization of the economy are creating vast demand for renewable-energy systems and connectivity, including 5G networks. However, the track record of major capital projects is poor with cost-overruns often exceeding 25% (The Economist Newspaper, 2021).”

Michelle is a petroleum engineer by background. She wonders about the role of petroleum engineers and geoscientists in a green energy world. This time Dr. Don is more optimistic. He reminds her you still need to drill and complete wells in a geothermal project and carbon capture and sequestration require a lot of knowledge of the subsurface, so even in a green energy world, there will be jobs for drilling, completions production and reservoir engineers and trained operators to run these facilities.

Michelle knows her company needs the new investments, but they can’t afford any major slips in project construction. She hates to rely on subsidies and tax breaks to make the economic returns that her investors are demanding. The demand will be here, the technology will probably be there too, but where will she find the people with the experience to “Build Back Better” at an affordable cost?
Empty Planet, Gaia’s Plan B

“Some day the earth will weep, she will beg for her life, she will cry out with tears of blood. You will make a choice, if you will help her or let her die, and when she dies, you will die.” – John Hollow Horn, Orlala Lakota (1932)

Michelle wasn’t having a very good day. You know one of those days where you start out on the wrong side of the bed and things just keep getting worse. The day started with a notice from the state regulator that her company was going to get a large fine from missing their emissions target on one of the largest production sites. The operations folks have had a series of equipment failures and had to vent quite a bit of natural gas to make sure the site was safe for the repair work. They had self-reported the problems well in advance but that hadn’t bought them any good will.

Then there was the news that Linda had decided to take another job at an environmental consulting group and she would be able to work on projects beyond oil and gas production. Michelle had trusted Linda to give her the straight story, without any office politics, and she would miss her council. To finish out a bad day, Holly had announced that the new investment firm had decided to reduce their exposure to the oil industry and the funding that they had promised to help with next years drilling program had been pulled. She needed that cup of coffee and understanding ear so she called up Gaia and they decided to meet at the coffee shop after work.

Gaia wasn’t in a very good mood either. The news at the latest UN meeting about the climate was bad. While the scientists kept warning that the temperature target from the Paris accord was going to be missed if the major economies didn’t do something urgently, the politicians just kept arguing the same tired themes. The small countries wanted the big countries to pay for climate mitigation and new energy systems. The big countries didn’t want to be seen as losing ground to their rivals and the spirit of cooperation seem to fade. The NGOs were furious, big energy companies hid behind their press releases, protestors started to riot (Extinction Rebellion was all over the news) and the police started to use tear gas. What a scene. The famous saying of “why can’t we all just get along” seemed appropriate to describe the situation. The closing statement from the conference wasn’t very optimistic and Gaia was not impressed.

So, what would happen if humans didn’t come together to figure all this out. This time it was Gaia that gave Michelle an article to read. Again, it was from the Economist (‘Just the few of us’, March 27th, 2021). Even Gaia subscribes to the Economist but Michelle thought she got a free subscription from someone. Given that the world was just recovering from the Covid-19 pandemic, the dark clouds were starting to part and some of the consequences were starting to show up. Michelle knew the pandemic had hit developing societies harder than the rich ones. Some people had made a lot of money (Facebook, Apple, Amazon, Netflix, Google owner Alphabet and Microsoft saw their combined worth jump to £3.8trillion last year – the same as
the gross domestic product of Japan. And the rise in value was equivalent to the size of the Spanish economy, which is the fifth biggest in Europe and 14th in the world.) while most had to take a big step backwards. Too many people in too many places had dropped back into poverty. The Energy Poverty scenario was proving out to be a big factor.

This article described another consequence Michelle hadn’t thought about before. She knew that the fertility rate in developed economies had been dropping and, in many countries, had dropped below the 2.1 children per woman replacement. In Japan, the population was even declining as there was negligible immigration into that country.Nearly half the world’s population now lives in countries with fertility rates below replacement levels. But the new revelation that along with the Covid death toll, there was a world-wide baby bust. According to that article, births fell by about 15% in China and just about the same percentage in the United States (between February and November, 2020). By some projections, the pandemic may have brought forward the projected date of peak global population by as much as a decade – into the 2050s.

The coronavirus pandemic cut US life expectancy by a year and a half in 2020, down to 77.3 years, according to CDC data released on Wednesday. The huge drop was also driven by increased deaths from overdoses, murders, diabetes, and alcohol-related liver disease. The steepest one-year US drop in life expectancy since World War II, it follows years of smaller drops in life expectancy linked to heart disease, chronic illness, addiction, and poor healthcare.

All this news adds up to a really bad day.

This will be painful

The debate on climate change is passing from the science and activist realm to the policy and politics realm. Michelle wonders if our politicians are up to the task. Climate policy is, after all meant to hurt. Some behavior is supposed to become more awkward and expensive (like owning a car, or taking a trip, or paying more for electricity). This contrasts with politician’s normal conversation with voters that their promises will make things better with lower costs on the voter. Politicians only promise that things will get easier and cheaper for everyone with almost no costs or consequences. That is how they get elected. The one that makes the most promised to the most people get the most votes, right?

We should expect a NIMBY (not in my backyard) reaction to many changes. People will go along with energy transition proposals as long as they are out of site, happening to someone else or in another country, just not in my backyard. Many people will be glad to see the end of drilling rig and production facilities but will they trade them for wind farms and mining activity for critical minerals? Climate change may even be resisted by nature conservationist worried about wildlife, biodiversity, noise and pollution. European and British groups are debating between solar farms, wind mills, new development and ‘re-wilding’ programs returning land to a ‘natural state’ (read that as no human impact).
Taking the lead (like the European Union) on energy transition leads to the problem of the impact of your tougher regulations versus lower ones from elsewhere and the impact that has on global trade. Will the currently proposed “Carbon Border-Adjustment Mechanism” or CBAM, create the momentum for a global response for a carbon tax on all activity or just be seen as naked economic nationalism with so many loopholes that is becomes yet another big government program impossible to execute efficiently?

Climate change will bring unpopular reforms, not only for the “other guys” but for just about everyone. Slashing emissions is a rotten problem for our politicians to solve. It costs now but the benefits come only in a generation. Industry lobbyists and politicians are happy to accept targets for 2050, (when most of them will be retired) but much less enthusiastic for targets in 2030 when most of them still expect to be employed. Voters too are happy to support green objectives as long as their lives don’t change significantly. Politicians are better at shifting the blame than taking to tougher road and telling the citizens the real costs. We have to solve this as a global community, not as individual nations or states. When was the last time we did that (The Economist Newspaper, 2021).

A shrinking population might seem like a welcome thing given the planet’s environmental challenges. But according to other forecasters, fewer people may also mean fewer new ideas, yielding a very different sort of future than optimists tend to imagine. This new normal really sucks, Michelle thought to herself.

An ‘empty planet’ or at least an ‘emptier planet’ could potentially reduce pressure on scarce resources (like water and energy), decline in environmental damage, higher wages for a smaller labor pool and increased autonomy for women, but not without some severe economic disruptions in many places like a scarcity for care workers for an aging population and an economy with rising sustainability debt. The article that Gaia gave her describes the fears of Charles Jones, an economist from Stanford University who suggest the good news might be canceled by the “reduction in humankind’s creative capacity (and technological progress and innovation).” “If ideas drive growth and people are the source of ideas, then the fate of our species depends crucially on long-run populations trends”. Michelle reflects that there is always someone out there to point out the bad news (the skunk at the picnic).

Michelle confessed to Gaia that all the changes necessary to meet the climate targets maybe too hard for humans to agree to and act on. There didn’t seem to be enough time for all these changes. Gaia just shrugged her shoulders and said “it is really up to you to earn your place here. I have seen this scenario before (at least 7 times according to Max, the geoscientist) and somehow life managed to survive despite the damage we will have to endure for a few million years.” This was not the way to end an otherwise bad day. Maybe Michelle needs something stronger than her pumpkin latte this evening.
Conclusion

My shoes are too tight, but it’s OK, I have forgotten how to dance....

Michelle doesn’t know about you but one phrase that she has really learned to despise is ‘the new normal’. It seems that everyone is using it and everyone is trying to describe what the new normal looks like. Michelle would like to know what is normal about what is going on right now?

Michelle gets it. The old ‘normal’ has really taken a battering from the global trials and tribulations of Covid-19, the economic slump caused by our reactions to the public health pandemic, the consequences of inequality (in its many forms that seem to be built into our old ‘normal’), the increase impact of climate change (fires, hurricanes and melting polar ice) and the resulting call for an energy transition. There are a lot of local challenges as well if you want to count them. It is a long list that seems to be getting longer every broadcast of the Nightly News. If you dare to dream about what life is going to be like once we get a handle on the Covid-19 virus, what will normal be like?

Michelle is suffering from quarantine fatigue. A few weeks or even a month or so of hunkering down at home with virtual working and binge-watching old TV shows can be tolerated, but it has been sixteen months now with no real end in sight. I think they should name a new mental health, clinical depression related syndrome after Dr. Fauci and Nora O’Donnell, CBS Nightly News. All Michelle has to do is see their face or hear their voice and immediately, a mental trigger of bad news floods comes across the screen and her brain. It is not their fault, it is not Fake News, it is the new normal.

In the old ‘normal’ we got used to not trusting politicians, lawyers and used-car salesmen and facing elections with the depressing choice of picking the lesser of two evils. But now we are not sure if we can trust the neighborhood police, especially for young men of color, or even the neighbor who walks by without a mask. Are we being conditioned to fear anyone else who might come in contact and be the carrier of illness and suffering? Is that fear, or at least anxiety, going to replace community or even family in the new normal?

According to the latest data from the WMO (World Meteorological Organization) our planet is 1.1 – 1.3 degrees C warmer than it was before the steam engine was invented. The 2015 Paris agreement created a compact to limit global warming to “well below 2 C degrees” above pre-industrial, ideally seeing it rise no more than 1.5 C degrees. We are getting pretty close to that target now.

That more stringent target was demanded by among others, small-island states which see the amount of sea-level rise inherent in two-degrees warming as an existential threat. A report by the IPCC found that the difference between the two targets would wipe away the livelihoods of millions. It would devastate Artic ice cover. Those Paris targets were, and remain, both prudent and incredibly ambitious.
The people who negotiated the Paris agreement were fully aware of this contradiction. The NGO Climate Action Tracker keeps a model of all the consequences of national and corporate climate promises. Their results put the world on track to be 2.7 C degrees hotter by 2100. The Paris planners hoped that countries would make new and more ambitious plans as technology progressed. To some extent, that is happening, but is it enough? If all government promises and targets are met, including ones not yet formally announced but not yet formally entered into the Paris agreement, warming could be kept down to 2.4 C degrees. But there are a lot of uncertainties in those estimates as Michelle has found out from Gaia. (Burning Down the House, The Economist Newspaper, 2021)

Who do you trust?

As newspapers fold from lack of subscribers, we turn to network news channels and social media for information. In the old normal, you were allowed to have your own opinion, but everyone agreed there was only one set of facts. When Michelle was growing up, she remembers her parents watching CBS Evening News. Everyone trusted the newscaster Walter Cronkite who served as anchorman for the CBS Evening News for 19 years (1962–1981). We have now entered a world where opinions are what divide us and we can always seek out facts that support our varied perspectives. There is more that unites us then divides us the old saying goes, but now what divides us seems to take on a higher priority. We can choose our own political party, our own news channel, our own blogger or website and it defines who we are and who the enemy is. Conspiracy theories and fringe political groups are on the rise.

“In real life, the hardest aspect of the battle between good and evil is determining which is which.” - George R.R. Martin, writer

A psychiatry professor at Harvard Medical School, Dr. Judith Lewis Herman, describes three stages of healing: re-establishing safety, remembrance and mourning and reconnecting with others. Social distancing complicates all of them. Fatigue and forgetting can lead social networks to deteriorate. This new normal isn’t looking all that appealing to me.

“Mental health professionals say that no single event has left so many people, in so many places, traumatized at once. In a world paralyzed by death, survivors are everywhere; ICU patients who faced the horror of covid-19, doctors and nurses who cared for them, relatives forced to mourn over WhatsApp and Zoom and delay funerals that would bring some closure, families that have lost their livelihoods and missed so many special occasions to be together, students and teachers who used to sing and play now are reduced to small faces on a Zoom screen.” (The Common Tragedy, The Economist Newspaper, 2020)

“The digital divide will even impact virtual learning.” Educators forecast the old normal ‘achievement gaps will become ‘achievement chasms’ as researchers from McKinsey predict that the typical American student will suffer about a seven months of learning loss if in-person instruction does not return this year. As usual the virus takes advantage
of existing inequality divides in our society. This learning loss would fall heaviest on black pupils, who would regress by over ten months and poor ones who would fall behind by more than a year. There could also be almost 650,000 more high-school drop outs. One study calculated that American school children in 2020 will learn 30% less reading and 50% less math than they would in a typical year. Previous attempts at virtual learning have not been that successful. Technology is not going to save us.” (Learning and Covid, The Economist Newspaper, 2020).

Michelle has a friend that has just gotten started teaching online, is anyone listening? Michelle doesn’t like this new normal at all! Maybe she should stop reading the Economist.

To even go to church to pray for an end to all this, Michelle was restricted to once a month and she had to register on a website to reserve a seat in a nearly empty church for most of 2020. It is like going to war with an invisible enemy. Is this the new normal?

Just as today’s world is not uniformly 1.2 C degrees warmer than pre-industrial world, climate change will not have equal affect everywhere. Some regions, chiefly oceans and parts of South America will warm less, others get much hotter. The Artic, including northern Canada, Siberia and Scandinavia will receive the brunt of the warming according to most climate models. But all these uncertainties and modeling parameters confuse most of the average public. Scientists are having a hard time translating their work into a simple sound-bite that everyone can trust and understand.

In one of Michelle’s recent binge-watching sessions of an old sci-fi series, Babylon 5, one of the main characters, Ambassador Londo Mollari of the Centauri Republic uttered a line that has stuck with her. He said ‘my shoes are too tight but it’s OK, I have forgotten how to dance’.

In the new normal, with isolation the norm and many who have lost the hope that we have worked so hard to build up over the last several generations since the last World War, will we forget how to dance? Storms pass by but what will we find in their wake? Most communities will prove to be pretty resilient to disasters and people have been helping their neighbors cope, but will a collective PTSD (post-traumatic stress disorder) follow along after the virus is contained?

When has social distancing become a political statement? Will we want to go back to work, go back to the Malls to shop, go back to cinemas, return to public transport, go back to restaurants, go back to school, go back to church or even reconnect with friends and family? When will a hug be welcomed again and not seen as a super-spreader event? Michelle knows that many will want to get back to old habits but how many of us will opt-out? Inspirational leadership can bring people back together after a crisis but we don’t seem to be doing very well in that regard either.
**Personal Comment**

I know that most of you who follow my blogs probably think I have very weird tastes and some strange attitudes toward the future. You are probably right. I describe myself as a skeptical evangelist. About a decade ago I came across a song by the country western artist, Lee Ann Womack, *I Hope You Dance*; I even bought two copies of the song and gave it to our daughters back then.

I want to thank Michelle, Gaia and Linda and the other characters that help me put my thoughts and fears into words. It seems in the new normal, we are faced with the critical choice between the vision that this song portrays and the world that Ambassador Mollari fears. I know that I am getting old so this new normal will mostly be defined by the next generation. I wonder which path they will choose.

**Retreat of Mountain Glaciers**

**The Future Ain’t What It Used to Be**

People usually call upon an expert for advice about the future. Whether that is about investing their money, deciding on a vacation spot to visit, which school or discipline should they pursue or what industry career they should prepare for. That advice is usually pretty sound when things are stable, when the past is a pretty good predictor of the future. But in a time of dislocation and rapid change, the knowledge and experience of that expert may not be that valuable or relevant.

There is a lot of talk these days about transitions. Sometimes, Michelle wishes that history would slow down to let most of us catch up. The headwinds and the tailwinds are both
blowing pretty strong and it is hard to stay on the road at times. There are technology transitions (digitization and digital transformation) going on. There is talk about Industry 4.0, when many parts of the world are still trying to get to Industry 3.0. There are demographics (The Big Crew Change) and cultural transitions in the workforce and in society-at-large with a new generation with new ideas taking over from my generation (getting old is a bitch). Michelle has lost track. Are we in Generation Z or Millennials or what are we calling the next generation these days? All she knows is that her generation is getting assigned a seat at the back of the room.

Public health pandemics and Climate Change can’t be ignored. Economic recessions of very large magnitude can’t be ignored either. But the one I want to focus on in this article is the so-called Energy Transition. All though to be fair, all of these transitions get mixed up into one pot and each affects the others.

Environmentalist are talking about an energy transition to a new Green Energy world, net-neutral-carbon-zero world to mitigate against the impacts of Climate Change and predict that we don’t have much time to get there. The oil and gas industry has started to talk about sustainability and the use of natural gas as a bridge fuel between coal for power generation (electricity is the new target) and renewables. All but the crustiest oilman can probably get that direction. Even SPE has it’s GAIA technical committee under their Health, Safety and Environment technical committee. And while several European Oil and Gas majors are rebranding themselves as International Energy companies (IEC) instead of IOC (International Oil companies), my question is how long should a transition take, especially with something as central as the role of fossil fuels in the energy mix of our society.

The facts say, that despite the rapidly growing role of renewables, fossil fuels are responsible for 75-80% or the world’s energy production right now. In some places, countries are still building coal fired power plants. But here is where the challenge lies. Many existing energy experts suggest that by 2050, the world will still depend on fossil fuels for a significant majority of energy production, while many politicians and activists cry out for carbon-free long before then. Here the experts are looking to the past to predict the future.

Michelle is not debating the role of fossil fuels in climate change. It has both provided affordable energy to life billions out of poverty and created unimaginable wealth as well as significantly contributed to rising green-house gas in the atmosphere. She believes the data from environmental studies. The impact is real and we have to do something about it.

Let’s stop arguing about the science and start talking about what we need do during this transition. This is a question for the oil companies as well as the politicians. This is a question of engineering and economics as well as policy and environmental studies. Can there be a common ground, an agreed path to a new energy economy or will we stay shouting at each other and calling each other names while not only the temperature rises but many people are trapped in poverty?
In Michelle’s experience, answers to complex questions are often found in the middle between two extremes. But compromise has gone out of style. You don’t get elected anymore by appealing to the middle. You don’t get on TV talk shows by appealing to the middle and common sense. You don’t win market share by working with your competitors on common standards. But all this verbal sparring may get your heart beat up but it rarely finds creative and practical solutions.

Both sides need to give some ground and both sides need to agree on some common objectives. The oil side needs to get out of denial. It needs to clean up its act in many places. It needs to invest in something it already has the skills to do like carbon sequestration and reducing methane emissions from natural gas production. The green side needs to answer the economic question of how are we, as a society, going to pay for this transition and the employment question of how to transition hundreds of thousands of workers to these promised new ‘green’ jobs, many of which pay a lot less than a petroleum or drilling engineer. And both sides need to remember to address those on the other side of the energy divide who still don’t have reliable, affordable electricity and can’t afford to pay their bills as it is.

Every journalist will easily quote you the dramatic decline in fossil fuel demand due to the Covid-19 virus but few will go further and discuss that 2020 will see that global growth in new renewable energy capacity will experience its first annual decline in 20 years this year amid the coronavirus pandemic according to the International Energy Agency. The world is set to build fewer wind turbines, solar plants and other installations that produce renewable electricity this year as energy demand has been reduced across commercial and industrial sectors and logistics issues delay projects.

Growth for 2020 and 2021 combined is expected to be 10% lower than the IEA had previously forecast before the coronavirus outbreak. Almost all mature markets are affected by downward revisions, except the United States where investors are rushing to finish projects before tax credits expire (Chestney, 2020).

To sort this out we need to look at the big picture. The really big picture. While Denmark (population of 5.82 million about the size of the state of Colorado) is fossil fuel free and they are counting the days in Britain since they last needed to turn on their coal fired power plants, there are about 1.1 billion people in the world living without reliable electricity. We could focus new energy sources on this vulnerable population but they can’t pay for it, so who is going to cover the bill?

Her dream would be that we all get together and bring each of our skills and resources (energy companies, NGOs, economists, engineers, scientists, environmental activists, renewable energy firms and yes even a few politicians/lawyers but not too many) and develop an All-of-the Above energy transition strategy with the aim of carbon neutral, sustainable, affordable energy as soon as practical. With practical being a modifier on urgent. We have to do more than stand behind a podium and state energy is a human right. Of course, it is but how do
you get there is the challenge. But Michelle is a realist and doesn’t think that will probably happen.

We are good at name-calling. The Energy transition has become yet another divisive issue. Line up on your side and start slingling mud at the other side. Get ready, set, sling. Meanwhile the planet gets hotter, the poor still don’t have the energy they need to get out of poverty. All the bad consequences are starting to happen (wild fires, pandemics, weak health systems, stronger hurricanes, melting ice caps, growing wealth divide, etc. etc.). This would be a big challenge even if we were all pulling in the same direction, but we are not.

So, now down to her specific challenge. What does she tell the young engineering student about the future of oil and gas? Should he or she (Michelle wishes there were more women in the industry they might be the one searching for common ground and practical solutions) pursue a degree in petroleum engineering or earth science? Or should they follow the longer line at the enrollment table (virtual these days) for computer science and law? We need those young engineers to help solve the problems of more sustainable fossil fuel production, more efficient oil and natural gas production techniques, a smaller environmental footprint, carbon capture and sequestration, halting methane emissions, enhanced oil recovery, etc. etc.). Who are they going to listen to in deciding their futures?
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