THE RED FLOWER & THE FUTURE OF ENERGY

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EPISODE 24 – Featuring Irene Himona

Welcome, fellow energy explorers!

In this episode of "2050 Investors" we're embarking on a wild and thrilling adventure into the world of energy. Why is the energy transition taking so long? And what await us when we eventually deplete our energy reserves?

Kokou Agbo-Bloua addresses all your energy concerns. Learn about the intriguing concept of energy density and its significance in our quest to find sustainable energy sources.

Later in this investigation, Kokou invites Irene Himona, Societe Generale's Oil & Gas equity research analyst, to explain the strategic approaches energy companies are adopting amidst this transformative era. Could we be heading towards an energy bipolar world?

Get ready for some electric insights into the future of energy!

SOCIETE GENERALE

2050 INVESTORS – EPISODE 24 SCRIPT

The Red Flower & The Future of Energy (ft. Irene Himona)

Welcome to 2050 Investors, the podcast that deciphers economic and market mega-trends to meet tomorrow's challenges.

I'm Kokou Agbo-Bloua, I head up Economics, Cross-asset and Quant Research at Societe Generale.

In each episode of 2050 Investors, I'll investigate a key mega-trend that relates to the Economy, the Planet, Markets and You.

(Beginning of episode 24)

"Now don't try to kid me, mancub. I made a deal with you. What I desire is man's red fire to make my dream come true. Give me the secret, mancub. Clue me what to do. Give me the power of man's red flower. So, I can be like you."

Now, we all remember the enchanting lyrics of the Monkey Song, 'I wanna be like you', from the 1967 Walt Disney film "The Jungle Book".

Mowgli, a mancub raised by wolves, befriended Bagheera, the black panther and Baloo the bear, who decided to help him escape the evil tiger, Shere Khan.

Later in the movie, Mowgli was captured by a troop of monkeys and brought to a ruined city where King Louie, a large orangutan, holds court.

King Louie desperately wants to be more than the king of the monkeys in the jungle.

He wants to be a man like Mowgli.

To realise his dream, he's convinced that what he needs is 'Man's red flower', a term jungle animals use for fire. The animals don't understand fire. It spreads deep fear and terror in them. And for good reasons!

This ability to create fire, "red flower", is clearly human's best kept secret. It's the energy source that made us stand out from the animal kingdom and rule over planet Earth and every other species.

In an ironic twist, Mowgli, a made-up name by Rudyard Kipling for his fictional character, means 'frog' and describes his lack of fur.

[Siri] What a coincidence! This is one of the most recurring metaphors of 2050 Investors!

Hello, Siri. Good to see you, full of energy and 100% charged. Yes, you're right, as usual! The 'Frog in boiling water" is a befitting metaphor of the human species and its lack of decisive action to fight climate change. [spoiler alert] In case you missed the news, our climate, despite all the

collective efforts and warnings from the IPCC and, humm our podcast too, is slowly but surely warming up. It's on track to be well above the 1-point-5-degree level of the Paris Agreement by the end of the century, a level which could trigger irreversible negative loops and make life on earth very unpleasant , to say the least...

We've used and abused the power of the "red flower". First by burning biomass and then with energy dense fossil fuels to generate most of the energy needed to transform our environment, build our cities over the centuries, power our economies, our transportation systems, and produce the crops and livestock needed to feed over 8 billion people today.

Of course, according to the UN, burning all these fossil fuels accounts for 90 percent of CO2 emissions. And global annual GHG emissions have now reached a record 54 billion tonnes of CO2 equivalent, and counting, with a carbon budget of only 500 Gt before hitting the 1-point-5-degree threshold.

We urgently need to transition away from fossil fuels to carbon free, renewable, and more sustainable forms of energy to reach net zero emissions by 2050. In other words, it is about transitioning from burning molecules to generating electrons as we expand the electrification of our energy systems.

[Siri] Ok, this sounds straight forward. Why can't you simply leave the Red Flower alone?

Well, this is what we're about to find out, Siri. In this episode, we're investigating the future of Energy: What is the true nature of Energy and what Laws of Physics does it follow? Energy sources come in many shapes and forms but what about energy density from fossil fuels to renewables? Where are we in our transitional path to renewable energy? And why are things taking so long? In the second part of this investigation / Later on, we will explore the transition strategies adopted by energy companies with Irene Himona, Societe Generale's Oil & Gas equity research analyst, who will tell us if we're heading towards an energy bipolar world? And what happens next when we run out of oil?

Let's start our investigation!

Or as Julie Andrews sang in "The sound of Music": "Let's start at the very beginning, A very good place to start".

So, what is energy, really?

[Siri] Well, isn't it the red flower you humans can't get enough of?

Yes. But without going through a full physics class, there are FOUR very important concepts we should all remember from our school days.

First key concept: The Encyclopaedia Britannica states that "Energy is the capacity for doing work". And work in physics is a measure of energy transfer that occurs when an object is moved over a distance by an external force.

Second: Energy exists in different forms: Potential, Kinetic, Thermal, Electrical, Chemical, Nuclear and other forms such as heat and work. So, heat transferred may become thermal energy while work done may manifest itself in the form of mechanical energy. Now, all forms of energy are associated with motion.

For example, when Mike Tyson throws you a punch in the boxing ring, his fist, in motion, carries kinetic energy which is fuelled by a chemical energy chain reaction in his biceps. For the case of Potential energy, it is best explained by a tensioned device such as a bow or spring, even though it is not moving, it has the potential for creating motion.

One of my work colleagues once told me that as market strategists, “we’re in the energy business”. It takes energy to come up with ideas and promote them. One could even argue that ideas are forms of potential energy that can become actions.

[Siri] Fair point. Aristotle once said, “The energy of the mind is the essence of life”.

I like that. Third, and this is the most fascinating concept that took me some time to grasp in high school. Energy can be neither created nor destroyed, but only changed. This principle is called “the conservation of energy” or “the first law of thermodynamics”.

[Siri] Ah! So when your face receives a punch carrying kinetic energy, it is transformed into heat and work as you collapse and pass out.

Yes! I think you forgot the pain too. Maybe another form of energy.

Finally, the fourth concept. In the International System of Units, Energy is measured in joules. Watt is the number of joules produced every second. So, a 40-Watt light bulb needs 40 joules every second.

Let’s put all of this into perspective:

- Typing a letter on a keyboard, takes 0.01 joule of energy.
- The human heartbeat takes half a joule.
- Raising one apple to a height of one meter takes roughly 1 joule.
- One AA battery has 1000 joules.
- A candy bar 1 million joules.
- Human daily diet: 10,000,000 joules. The same amount is used for a day of heavy manual labour.
- One year of electricity for an average house, 10 billion joules.
- Annual global energy consumption on earth, 580 million trillion joules or 580 x 10^15.
- Yearly solar emission is 10^34. This is an enormous source of energy.

- Now, the amount of energy released by the big bang at the creation of the universe is 10^68 joules. That is 68 zeros. I will let that sink in.

[Siri] Why did we need to go through all of this? You know, you could simply have asked ChatGPT for help.

Ha! I still like to use the chemical energy from my brain cells for now. And by the way, remember this quote by billionaire hedge fund manager Paul Tudor Jones "No man is better than a machine and no machine is better than a man with a machine".

Ok now we can move to the next step. I hope we haven't lost our listeners. Anyone still listening? Allo ?! [echo effect]

[Siri] They are still around according to the network of smartphone sensors. But I think we need to get back to fossil fuels and renewables. This is still the "2050 Investors podcast", not the "2050 Electricians", right?

Ok Siri. Bear with me. So, we talked about Energy transformations and their different forms. But to really understand our obsession with fossil fuels and the secret of the 'Red Flower', we need to talk about Energy Density. I came across this very interesting article on International Energy Agency-dot-org:

"Many energy transformations are relatively inefficient. The human body is a good example. The human body is like a machine, and the fuel it requires is food. Food gives a person energy to move, breathe, and think. However, the human body isn't very efficient at converting food into useful work. The human body is less than 5% efficient most of the time. The rest of the energy is converted to heat, which may or may not be useful, depending on how cool or warm a person wants to be."

[Siri] Now I finally understand why, in the movie The Matrix, machines decided to use humans as a power source by harvesting their body heat.

Hum.. Let's hope this stays science fiction. You agree, right? Right, Siri?

[Siri] … 'Silence' … well, of course, Kokou

Over the centuries, to increase our energy output human have used renewable forms of energy first. Animals: donkeys, cows, horses , camels and so on, for a wide range of tasks, from agriculture to transportation. Wind for windmills or sailing ships, hydropower etc.. With the industrial revolution in the 19th century and thanks to the discovery of energy dense fossil fuels, we eventually created a formidable complex of machines and were able to do a lot more work. Coal fired steam engines, internal combustion to the electrical motors.

However, these machines need to be fed an insatiable amount of energy. A car engine burns gasoline, converting the chemical energy in gasoline into mechanical energy, instead of having to run around carrying people on your back.

[Siri] Did you really have to give up renewable energy for fossil fuels? This was the true original sin.

Yes, because we could do so much more with fossil fuels thanks to the armada of machines we invented. They were free and abundant. The energy density of fossil fuels was also incredible compared to traditional biomass!

Let's dig into this a bit further. Energyeducation-dot-ca/encyclopedia has a table on energy density that I found fascinating. A quick reminder, energy density is simply measured in terms of energy in Mega Joules, that is 1 million joules for every kilogram.

The energy density of wood, a traditional biomass, is only 16 Mjoules. Coal is 24, that is 50% more energy intensive! Who would not want to make the upgrade? Crude oil is 44, that is 83% more energy intensive than coal. Natural gas is 55, 25% more than Oil.

And here's a fun fact: 1kg of fat has 39 MJ .

[Siri] Wow! I did not know that fat was a fossil fuel?

Well not technically, but it is made of carbon molecules too. When we exercise, we burn fat with the oxygen we breathe in, creating chemical energy that releases CO2 as we breathe out and water via sweat. What is fascinating is how efficient it is as a store of energy. By the way, a quick tip: 1 calories is equal to 4.2 joules of energy and to lose 1kg of fat you need to burn 7700 calories.

Now two facts blew my mind when it comes to renewable energy:

- Uranium-235 has 3.9 million MJ of energy density.
- Liquid Hydrogen is 141.
- Biodiesel 38, Ethanol 26.8

And a Lithium Battery has… 1.8 MJ, yes you heard me right. 1.8MJ

[Siri] This means battery storage is 21 times less energy dense than fat ?

Yes. This is the key challenge for the storage of renewable electricity generated by solar and wind. It takes a lot of battery capacity to store large quantities of energy. It is not surprising therefore that an EV car is 50% heavier than a petrol car for example.

Moreover, it requires a lot of metals, cobalt, lithium, nickel, and other rare earths. Similarly, offshore and onshore wind, solar panels are more metal intensive compared to fossil fuels as discussed in our Greenflation episode.

[Siri] What about Nuclear? Is it renewable?

Well, there's a big debate because of the nuclear waste and past nuclear incidents, think Chernobyl. But when you look at the energy density, it's simply at another level. 3-point-9 million MJ vs 44 for oil, and it doesn't emit CO2. It's a no brainer.

[Siri] And Hydrogen?

It's quite energy dense. 141 MJ per kg but it's a gas. While it's the most abundant molecule in the universe, it doesn't exist on its own. You need energy to break its chemical bond with oxygen if you

produce it via water electrolysis. You also need energy to compress it into liquid form and it needs to be kept at very low temperatures, which requires a lot of investment in infrastructure. But as a storage of energy, it looks great. This is something we've discussed in the "Calling Hydrogen to the stand" episode, if you're interested.

Last but not least, the Sun energy is enormous, but it is not dense. According to sunwindsolar.com, on a sunny day around sea level we receive 1000 joules of energy per second per square meter perpendicular to the Sun. So, a lot of space needed for Solar panels to capture all of these photos.

[Siri] And this only works on a bright sunny day. So, what is the energy with the highest energy density?

Do you remember Einstein's special theory of relativity?

[Siri] Yes, E = m c squared. The world's most famous equation.

Well, it says that matter is energy, and the energy content of matter is equal to its mass times the speed of light squared. And that is 300-thousand km/s. So, antimatter is the densest form of energy as it would destroy matter. 1g of antimatter is 10^14 joules or the same amount of energy as the Hiroshima atomic bomb. This isn't science fiction as it was produced in the CERN large hadron collider in very small quantities .

[Siri] I think we will leave antimatter for now. The last thing we need, is yet another human made planetary extinction event.

Now for the last aspect our investigation, what is the current energy mix at the global level and what is the future of energy?

A very important graph that I love is the one from Ourworldindata-dot-org entitled Global primary energy consumption by source. Here are the main takeaways.

- In 2021, the world consumed closed to 160,000 Tera Watt hour of energy. This is a whopping 5.7x more than in 1950. And 28-times more than in 1800.
- In 1800, 98 percent of energy consumption was traditional biomass or wood. In 1950, traditional biomass fell to 26-point-8 percent, Coal increased to 45 percent, Oil 19-point-5 percent and Natural Gas 7-point-48 percent.
- In 2021, our energy mix at the planet level is: 7 percent for traditional biomass, 28 percent Coal, 32 percent Oil, 25-point-4 percent Natural Gas, 1-point-76 percent Nuclear, 2-point-7 percent Hydropower, 1-point-17 percent Wind and 0-point-65 percent Solar.

So, an incredible 85-point-6 percent of energy consumed today at the planet level is STILL fossil fuel.

[Siri] Hum… I guess Human cannot get enough of the red flower.

Well, it is complicated. All of this reminds me of the 'Ring of fire' by Johnny Cash song: We fell into a burnin' ring of fire / We went down, down, down / And the flames went higher…

There is a lot of energy transitioning ahead of us if we don't want our planet to burn to the ground and this will require significant investments.

To understand the challenges ahead for our energy complex, let's get more insights from Irene Himona, Oil & Gas equity research analyst at Societe Generale.

[INTERVIEW TRANSCRIPT]

The main reason animals feared the red flower in the Jungle Book is obviously because of its destructive power. It has and continues to destroy their natural habitat, forests. I will conclude this episode with the story of the Hummingbird as told by Professor Wangari Maathai, a Kenyan environmental and political activist, Nobel Laureate, and writer:

The story of the hummingbird is about this huge forest being consumed by a fire. All the animals in the forest come out and they are transfixed as they watch the forest burning and they feel very overwhelmed, very powerless, except this little hummingbird.

It says, 'I'm going to do something about the fire!'

So, it flies to the nearest stream and takes a drop of water. It puts it on the fire, and goes up and down, up and down, up and down, as fast as it can. In the meantime, all the other animals, much bigger animals—like the elephant with a big trunk that could bring much more water— are standing there helpless.

And they are saying to the hummingbird, 'What do you think you can do? You are too little. This fire is too big. Your wings are too little, and your beak is so small that you can only bring a small drop of water at a time.'

But as they continue to discourage it, it turns to them without wasting any time and it tells them 'I am doing the best I can.'

Thank you for listening to this episode of 2050 Investors and thanks to Irene Himona for her time and valuable insights.

I hope this episode has helped you get a better sense of the future of energy. You can find the show on your regular streaming apps. Please subscribe, leave comments and stars anywhere you like and spread the word!

See you at the next episode!

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