Nate Hagens (00:00:00):

You are listening to The Great Simplification with Nate Hagens. That's me. On this show, we try to explore and simplify what's happening with energy, the economy, the environment, and our society. Together with scientists, experts, and leaders, this show is about understanding the bird's eye view of how everything fits together, where we go from here, and what we can do about it as a society and as individuals.

(00:00:33):

Peak oil, a phrase that was on a lot of people's minds and lips 15 years ago. We don't hear about it so much anymore. What happened? Did it disappear? Was it discredited? Was it debunked? Was peak oil no longer real? The core tenets of this podcast, The Great Simplification, treat peak oil as a given. I think, 15 years ago, people focused, which would be the date of peak oil because that will change everything. We've now learned that things are a little bit more complex, there's geopolitics, there's money, there's decline rates, there's new drilling, et cetera. But peak oil is a reality, a present reality, and it is the decadal observation of the century, long and millennium long carbon pulse, which we are all living through.

(00:01:34):

I think the important questions, not only are when the date of global oil production will hit a maximum, but how quickly will it decline after that, and will the shortfall in oil availability that is needed to power global economic growth result in either a financial kind of rubber band dynamic or some sort of geopolitical competition for the remaining exports. With me, today, is my close colleague, Art Berman, who in sharing some graphs with me. We discovered something fascinating and disturbing about US oil production. So, today, we're not going to talk so much about the date of peak oil as the stealth adjustment of the quality of what we call oil. This is a very important podcast, and I'm very fortunate to have Art sharing his graphs and analysis and wisdom with me. Please welcome Art Berman.

(00:03:04):

Art Berman, great to see you.

Art Berman (00:03:06):

Good to see you too, Nate.

Nate Hagens (00:03:08):

Should I tell the public my nickname for you when I call you?

Art Berman (00:03:13):

You're welcome to.

Nate Hagens (00:03:15):

Senior Petroleo. So-

Art Berman (00:03:20):

I am guilty.

Nate Hagens (00:03:25):

So, having you on as kind of this bonus, unscheduled podcast because as you know, but no one else knows, whenever I'm about to make a big public or government presentation, I call you, "Art, I need some updated graphs." And I've used your graphs for almost a decade. And in doing that, last week, I needed an update on peak oil. And in the creating of the graphs, you did a lot of sleuthing and data collection, and we discovered some things, and that's what we're going to talk about today. Because in 2019, I started publicly stating that there was over a 90% chance that fourth quarter, 2018, will be known as peak oil. And here we are three and a half years later, and you sent me some charts that speak to that, and that's what we're going to talk about today.

Art Berman (00:04:37):

Right.

Nate Hagens (00:04:38):

But we didn't, on our first podcast, really talk about peak oil. Maybe we could just do that very briefly.

Art Berman (00:04:47):

Sure.

Nate Hagens (00:04:48):

So, from your perspective, Art, what is peak oil and why is it important?

Art Berman (00:04:57):

So, I'm an earth scientist, I'm a geologist, and although I know some things about economics and all those sorts of other subjects, I look at peak oil from an earth science perspective, which is to say an earth systems perspective. And I've been in the oil business now for over 40 years, and what I see is that this business has gotten increasingly complex, just like all other human systems. And what that has meant is that oil is harder to find, and when we do find it, it is much more complicated or complex, they're not the same thing, but I think you know the difference, to produce, and of course, that has implications for cost. But about halfway through my career, which is to say in the '80s, the industry became incredibly risk averse. In other words, it started getting a lot of pressure from investors.

(00:06:02):

And so, we stopped taking risk and that ultimately led to the shale plays, which were viewed as a no-risk proposition, the oils there, all you got to do is drill it and kaboom, you're in good shape. The problem obviously, with that is twofold. Number one, these are incredibly complex reservoirs to drill and produce. And number two, once you're done with the shale plays, you haven't been exploring for 25 or 30 years, so what are you going to do? And so, as I look at it, and again, I could go on about price and

inflation adjustment, but I won't. Because I think you have some ideas about the economics and the link to ecology and human behavior and some other things.

(00:06:48):

But just keeping it as simple as possible, there are just some basic earth systems constraints that have bothered me for half of my career. And as much as I try to get on board with, "Oh, well, technology will save us," or "We're going to find..." I keep coming back to the same conclusion, which is, it's not really changing. And then, the subject we're going to dive into once we get through with the peak oil part is the issue of oil quality. And so much of what we call oil today, it's just not even oil. So, I'm just going to leave it there. That's the concern that I have.

Nate Hagens (00:07:34):

Well, let me define peak oil then very simplistically, that humans extract energy, fossil energy in this case, and we expand the scale of that, and eventually, we will hit a maximum of the amount that we extract from the earth. And then, from that point forward, there will be less, either a little bit less or gradually accelerating to more, or a sharp decline, or some amount less. And the reason it's important is energy underpins our economy and oil. Liquid at room temperature, incredibly dense, very cheap, used for our global transportation system is the master energy resource. So, once it peaks and starts to decline, we still have plenty of oil, and a climate change activist would say too much oil, but what we don't have is the enough to continue economic growth at the level required to pay back and maintain our existing financial claims.

(00:08:42):

So, peak oil, to me, always meant an inflection point of the growth and the monetary and currency system. Okay, I'm going to tell you why I don't like the concept peak oil, but maybe if you want to opine on that first. What problems do you have with that concept? The oil drum was 15 years ago, and here we are, and there were a lot of people that were clamoring that 2008 was the peak, and then, we would be in perpetual decline, but here we're not. So, do you want to say what problems you have with peak oil briefly?

Art Berman (00:09:27):

Sure. So, the problem that I see with peak oil is that we very quickly, and I was engaged in it even before we met, it's that we got involved with trying to predict the peak without really worrying about any of the underlying causes or reasons that we were even talking about a peak. And everybody got obsessed with, well, it will be 2008 or was it 2005, or is it going to be 2012? And to me, that's where every movement, if you will, falls apart. It forgets why it started.

(00:10:06):

And so, I go back to 1931 and King Hubbert, who was the fellow who at least is blamed for the peak oil concept, he and a fellow named Howard Scott came up with an idea that basically, what you said, 1931, that since energy underlies the entire economy, those guys wanted to get rid of money and they wanted to replace it with what they called energy certificates. And energy certificates were going to be based on what the energy cost was to produce everything, and nothing else. So, money was going to be a

thing of the past and everything would be denominated in energy. Now, Hubbert, of course, went on and he had some interesting ideas, he had some crazy ideas too, but that was where he started.

(00:11:02):

And despite the fact that Hubbert worked in the oil business, he worked for Shell, he really wasn't a petroleum guy, he was a resource guy, he was a statistician. And his concern, or where he left all of this after his infamous speech in San Antonio, I think it was in 1956, where he actually showed his data predicting the peak of US oil, the part that everybody forgets is what he said. And what he said was that if we can somehow solve basically, our social and psychological problems, and not destroy ourselves with nuclear weapons, and somehow get population under control, then we could begin to talk about how to apportion our energy resources correctly for perhaps, 300 years. Now, clearly we failed on all three of his criteria. So, to me, that was always the core of peak oil, not because King Hubbert invented it, but because what he said made a lot of sense to me. And he said it 90 years ago for crying out loud. So, that, that's my perspective, Nate.

Nate Hagens (00:12:25):

Actually, I think it was Kjell Alleklet that coined the word peak oil, not the concept, but the term. So, here's some of the problems that I have with the concept and the term, and then we'll get into some data. So, correct me if I'm wrong, but there's at least two things going on. There are all the existing fields and wells that were drilled in the past that are continuing to produce oil. And if you aggregate all of those with no new drilling at all, they are declining at something like 6% a year. So, that's like all the stuff in the past. And then, on top of that, we are having new discoveries and new investment, and new drilling, and new fields maybe in the Arctic, or in the ocean, or in a new shale play in the US, and we're adding that production on top of this large number of declining wells. And as long as the net of those two is increasing in total, we are making new production highs over time. Is that correct?

Art Berman (00:13:39):

That's right.

Nate Hagens (00:13:41):

So, here's one thing that I got wrong. When I wrote about this stuff 15 years ago, I wrote my PhD on the concept of net energy, which is it takes energy to get energy, which is obvious, and correct, and important. And I thought that as oil depletion would accelerate, that we would need a lot more energy to allocate to the energy sector, and therefore GDP would decline. The first part of that was right, the second part was wrong, because when we have to drill more, and hire more rigs, and have more trucks extract water and all the other complex resource and energy inputs into drilling, that all actually adds to GDP. So, one of the problems with the term peak oil is it's a moving target because even as net energy is declining, GDP represents gross energy until we have an actual shrinking economy, then that will change.

(00:14:52):

So, that's been going on lately, is we've been growing the total amount of global oil production. And as we're going to talk about in a moment, it's not even oil that we're growing, but we are gradually slowly turning into what I call a mordor economy, which is more and more of our energy is directed to the energy sector, meaning that the rest of the world has to pay higher prices or use less because the energy sector is pulling that up. And we hit a low, as a society, in 1999 of around 5% of our energy going to the energy sector, and now, it's 10% or above en route to something larger. So, I do totally agree with you that the focus on the date of the peak, and I've been guilty of this belies the fundamental reality, which is we've based an entire civilization on this. And let's not worry about what day the peak is, the peak is soon. And what are we going to do with our financial system, with our geopolitical, who's getting what share of the pie? All these sorts of questions are important.

(00:16:15):

Now, let's get to the point of this podcast. So, I had some things wrong, but I actually had some things right as well. Let me read you the first paragraph from the very first article I wrote on the oil drum. In 2006, peak oil will silently morph into peak liquids. This is relevant because the definitional layers that we add on top of crude oil are not equal in what they provide to society. It is also relevant in that the logistical heuristic used by M. King Hubbert was not intended to include corn and sugar cane derived ethanol, tar sands, or natural gas liquids in its predictive theory of oil basin decline. The concept of peak oil already not widely believed will start to be very confusing and probably even more combative.

(00:17:21):

In essence, we need to either A, adjust EIA data to exclude growing biofuel, NGL and coal liquid inputs, or B, recognize that for practical peak oil societal impact purposes, we really do primarily care about the net liquid fuel available and the costs of same, which would require categorical adjustments and handicapping for energy quality. Well, one thing that hasn't changed in 16 years is I still use a lot of words, but first of all, what do you think about that statement? I'm assuming you largely agree with that.

Art Berman (00:18:09):

Oh, I think it's absolutely dead on, Nate. And I say that after a fairly deep dive here in the last week or two into just exactly what is it that we call oil.

Nate Hagens (00:18:24):

Okay.

Art Berman (00:18:24):

And I've known this for a long time. We've all known, I say, all of us that have been deeply interested in energy, that there has always been a substantial component of strange things like natural gas liquids and refinery gain and all of that. But until, for me, at least, until I actually immerse myself in the data and make graphs, it never quite sinks in to what extent that has become the truth and the reality, and that was really the aha. Not that any of it surprised me, it was the magnitude of it that surprised me.

Nate Hagens (00:19:09):

So, let's look at the headline numbers. I have said publicly often that peak oil is likely with 90% odds to be November of 2018. Can you give us an update on where this stands?

Art Berman (00:19:28):

Yeah. So, November, 2018 world production was somewhere in excess of $100 million barrels a day, 2020, the world fell apart, and the economy was-

Nate Hagens (00:19:43):

And we had had -$37 a barrel per oil price for a while.

Art Berman (00:19:49):

And we had no place to store oil, which is why it got to -37 for one day, and production dropped many, many million barrels. And in about mid 2020, we kind of got our act a little bit together, or at least we put some band-aids on it. And since then, oil production has been increasing, and as of November, we're up to $100 million barrels a day. So, you look at the data and say, well, we're almost there. We've 99% recovered to that peak level in November of 2018. And looking at the slope of that recovery, you'd say, "Well, Nate, you're going to be wrong because we're going to get past that 102 million barrels a day probably next year, the year that we're in right now. So that's that's the update

Nate Hagens (00:20:47):

Yup, probably, unless there is an eminent global recession and-

Art Berman (00:20:53):

Or a big war or something like that, sure.

Nate Hagens (00:20:55):

... or a big war or something like that. And just briefly to point out though, is each time these things happen, that underlying decline rate becomes a larger load stone relative to the new drilling. So, we may make new highs, but we're not going to go to 110 or 120 million barrels unlikely, right?

Art Berman (00:21:16):

No. And if you look closely, and when we do look at this data, you see that the rate of increase does appear to be slowing, but nonetheless, that's the superficial reality. So, all we're looking at is everything we call oil and it says, "Well, life is good, and all the up peak oil guys are wrong again."

Nate Hagens (00:21:42):

So, you have much better data for the USA than globally. But let's look at another chart. Has the US surpassed the 2018, '19 peak recently or not?

Art Berman (00:22:00):

Yes, it has. So, for the United States, that peak actually wasn't in 2018, it was just before COVID shut us all down, the US is sort of on its own timeline here. But that monthly peak was about 20 and a little bit million barrels a day, and as of last month we're at 20.8. And so, we've now beaten that level. And so, all of the things that you and I have also said, at least superficially, just looking at everything we call oil, were both wrong.

Nate Hagens (00:22:44):

So, in the creation of this chart, what did you discover?

Art Berman (00:22:49):

Well, I discovered a couple of things. And so, the first thing I did to this chart was to segregate it into what is actually oil and what I call production of non-petroleum. Now, petroleum, it's a Greek word and it means rock oil. And som everything that comes from oil, I'm calling in here, oil production, and we can split hairs and argue esoterically about that. But the non-petroleum fraction is everything else, which is to say things that come from plants, the biofuels that you were talking about, the natural gas liquids, they don't come from oil, they come from natural gas. Natural gas is a hydrocarbon, but it's not petroleum. It's not a liquid petroleum, and it does contain some liquids that we can talk a little bit about how they get separated out. But again, they don't have anywhere near the energy content or the heat content of crude oil.

(00:24:07):

And then, there are other funny things in there like refinery gain, which is a volumetric expansion that just happens when you refine something dense like oil into less dense products like gasoline and kerosene. And what I found when I made that graph was, holy cow, what we call oil, only 60% of it is actually what I would call oil. So 40% of what we're counting as oil and saying, "Okay, no problem, we're already ahead of it in the US and we're almost there in the world," is because this large portion that doesn't even come from oil is growing at a faster rate than the oil production is. So, all of a sudden we're back to peak oil again.

Nate Hagens (00:24:58):

4% or 40%?

Art Berman (00:25:00):

40%.

Nate Hagens (00:25:02):

40% of what the International Energy Agency and the Energy Information Agency in the USA call oil in their production reports is not oil?

Art Berman (00:25:16):

It's not oil. I'm not saying it has no value. I mean-

Nate Hagens (00:25:21):

No, I know, I know. But-

Art Berman (00:25:23):

It doesn't even come from oil. It's not a petroleum product.

Nate Hagens (00:25:28):

Okay. And you listed out several things. There's ethanol, there's refinery gain, there's natural gas, plant liquids, what else?

Art Berman (00:25:37):

No, there's all sorts of funny things. There's asphalt and there's things that actually come from petroleum but are not used as a fuel. And so, in these natural gas liquids, for instance, the biggest single component is ethane. Natural gas liquids are the largest non-petroleum component. But what do we use ethane for? We make baggies out of it for the most part. It could be used as a fuel, but it's not used as a fuel. And I'm not in any way criticizing the EIA, or IEA, any of these organizations, I'm just saying, look, this is their accounting system, and it's useful as far as it goes. But for those who are deeply concerned about how we're going to maintain our civilization, since it's based on oil, we better look at how much of that is actually oil and what we have to discount, as you said earlier on, all the rest of it, so we can actually look at how does our future seem to us?

Nate Hagens (00:26:53):

Well, one of the biggest benefits that we get from oil is its energy density, how much BTUs are smashed into a tiny little bit of volume, so there's a lot of heat potential there. What is the heat potential of natural gas liquids relative to oil?

Art Berman (00:27:14):

Well, it's a lot less. And so, in rough numbers, it's like 67%, so it's 33% less heat content or energy density than oil. And that assumes that you're going to use it all as a fuel. And I just told you that 55% of it's used to make baggies. So, we have to start understanding what are we really talking about here.

Nate Hagens (00:27:46):

So, in the same way that the Bureau of Economic Analysis might create a CPI metric that over time, since people are poorer and they don't want to show high inflation, they're now eating hamburger instead of steak, and therefore they don't show much of a headline. This is like a hedonic adjustment for peak oil.

Art Berman (00:28:11):

Yeah, it's hamburger helper.

Nate Hagens (00:28:15):

So, what percent of our oil production in the gross sense is natural gas liquids? You said it's 40% of all those things, what percent is NGL?

Art Berman (00:28:27):

Well, again, it matters whether you're talking United States or world, but-

Nate Hagens (00:28:35):

Just the US

Art Berman (00:28:37):

It's 30%.

Nate Hagens (00:28:38):

So 30% of what all the energy hedge fund managers and everyone looking at how much oil we're producing, 30% of that is natural gas liquids, which have two-thirds only of the heat content. And there's a big component of plastic baggie inputs in that figure as well.

Art Berman (00:28:59):

Precisely. And if you look at that 2020 COVID drop that shows up in every graph of just about everything, but certainly oil production, there was a huge jump in that relative percent of NGL in the year 2020. And so, went because the oil production dropped and the NGL production didn't, where do we get-

Nate Hagens (00:29:27):

Where do we get NGLs from? Is that a byproduct of drilling for natural gas?

Art Berman (00:29:31):

It is natural gas. So, natural gas gets produced, some of it with oil and some of it all by itself, in the ground buried at great depth, and temperature, and pressure. It's all a gas. And when it comes to the surface and you reduce the pressure, then some of it drops out as a liquid. And-

Nate Hagens (00:30:02):

So, is that kind of what we do with creating LNG to ship across to Europe? We're doing what Mother Nature does?

Art Berman (00:30:11):

It's the reverse. We take methane, which is the lightest fraction of natural gas and the part, and that's exactly what we burn in our stoves, and our furnaces, and all of that, and we cool it. We put it under tremendous pressure and drop the temperature to something like almost 300 degrees below zero, and we force that methane to precipitate into a liquid. We put that into pressurized containers on a tanker, send it wherever somebody wants to buy it, and then when it gets there, then they have a special terminal that regasifies, that lets off all of that pressure and allows the gas to come back to room temperature and then it turns back into a gas.

Nate Hagens (00:31:07):

So, if we, hypothetically, we're running low on oil and society is fundamentally dependent on oil, not natural gas or coal, though, those are also important, could we boost dramatically boost our natural gas production and turn a loss at a cost, turn it into liquids, like you just said, that could be used for oil with a lot of baggies as an externality?

Art Berman (00:31:41):

Well, no, so just turning it into a liquid like I just explained with methane into LNG, you can't burn it at 300 degrees below zero and-

Nate Hagens (00:31:57):

Right, right.

Art Berman (00:31:59):

... and 10 times the atmospheric pressure. So, you're in the same place. And once you've allowed that to come back to room or surface temperature, it has no liquids in it to begin with. It's just methane. It's the simplest hydrocarbon molecule, it's just carbon and hydrogen. So, to your question though, natural gas, much of it contains other things like ethane, like butane, like propane, pentane, and those are liquids at surface temperatures and pressures. And we remove those from the natural gas because the gas pipelines don't want to have anything to do with that because they mess up their pipeline process. And so, we strip those out in a plant, and that's why it's called natural gas plant liquids. We send the natural gas to a plant where they, through gravity, and some screen meshes, and a few catalysts, they force all that liquid to segregate by gravity away from the natural gas.

(00:33:11):

They send the natural gas, the methane, often a pipeline to your heater or your gas stove, and then, we have some fraction of liquid that remains. And those liquids, none of them have anywhere near the heat or the energy content of crude oil, but they have more than methane. So, they're good for things. So, what do we use those for? Well, you go out and you buy, we used, when people smoke cigarettes, I guess, they still do, you go out and you buy a BIC lighter, well, that's butane. Or when you light your gas charcoal grill and you buy something at the supermarket, that's butane. Propane for people like you that live in the country and don't have the benefit of piped methane to your house, a guy comes out

and fills a tank with propane and you heat your house with propane. So, propane, it's good stuff, but it's not crude oil. It doesn't have anywhere near the heat or the energy content of crude oil.

Nate Hagens (00:34:16):

So, all the world's existing oil wells are in aggregate decline of something like 6%, right?

Art Berman (00:34:27):

Right.

Nate Hagens (00:34:28):

And we are adding new drilling around the world, new fields, new discoveries, but much of what we're adding and what we're adding at an increasing rate is effectively the 'low-cal' additions from the heat and energy quality standpoint in the form of N G P L and other things.

Art Berman (00:34:50):

Well, that's right. So when we look at part of the complexity that I talked about, the biggest complexity in continuing to find and produce oil is that it's deeper. And the deeper it gets, the hotter it is and the hotter it is, the farther along, the natural thermal maturation process it is. And so, the earth is like a refinery. And so, most of the oil that we're finding today, it has a larger percentage of natural gas in it than the oil that we found, say 50 years ago, simply because the it was from a part of the earth that was shallower, and therefore it wasn't naturally refined as much. So, a higher and higher percentage of what we produce when we find oil and gas together is natural gas.

(00:35:54):

Conversely, less is crude oil. And the crude oil that we find is a lighter grade of crude oil that also has a lower energy density, not hugely lower, but six, seven, 8% lower. So, the shale oil that people talk about doesn't have the same energy content as the crude oil say that's produced at Ghawar. It's discounted by 7% or 8% and a huge amount of it. So, when they talk about, "Oh, well, our wells in the Permian are making a million barrels a day." Well, that's a million barrels of oil equivalent, they're converting a whole ton of natural gas into its oil equivalency number, even though it's still natural gas and not oil.

Nate Hagens (00:36:47):

So, it's kind of stealth peak oil in a way.

Art Berman (00:36:51):

That's a good way to put it. Absolutely, yeah, yeah.

Nate Hagens (00:36:54):

Okay. So, I'm looking at the charts you just sent me an hour ago. Look at number nine. We've been talking about the United States, can you describe what's been going on globally?

Art Berman (00:37:09):

Okay, so this is a, first of all, it's an incremental chart, which doesn't change anything about it except that it makes it easier to see the volumetric relationship. So, the blue is everything that is crude oil and condensate, condensate being the light liquid fraction of crude oil, lighter than crude, but still in that 93% of energy content. So, the lion share, if you will, is crude oil and condensate. But then the other stuff, the hotter colors, that's everything else. So, you can't really see the hottest of the orange very well. So, I've put a little arrow there, that's refinery gain. And refinery gain is strictly, as I said before, it's simply when change something more dense into less dense refined products, you get a volume expansion. You start with one barrel and you get 1.15 barrels out because the stuff coming out is a lower density, so you get a little pop from that.

(00:38:27):

The next category up is what's called other. Okay, other, those are a whole slew of products that are not used as fuel. They are technically from petroleum, but they're things that we simply do not use as a fuel. And then the highest category is NGL, which is natural gas liquids or natural gas plant liquids, which we've been describing in some detail. Now, the world has a slightly different breakdown of those percentages than does the United States. And as it turns out, the percentage of natural gas liquids is not quite as high, but it is high and it's growing. So, again, the United States is just a more mature petroleum province and a more advanced economy, so the rest of the world's getting there.

Nate Hagens (00:39:30):

An observation and a question. So, 25 years ago, the amount of oil that we produced was almost all oil, crude and condensate-

Art Berman (00:39:41):

Correct.

Nate Hagens (00:39:42):

... but the amount of the other things, the refinery gain, the other, and the NGL, globally, according to this chart are now what percent of the total oil?

Art Berman (00:39:57):

I don't have it on the chart, but I'm going to say it's like 20%, or 22%, or 23%, yeah, yeah,

Nate Hagens (00:40:04):

That's a big deal. So, what is the NGL mostly being used for?

Art Berman (00:40:14):

The NGL is mostly being used to make plastics, and it's being used, as I said, for... So, the biggest portion, which is ethane is used to make various kinds of plastics. The butane and the propane, which are the other biggest components, are used for other stuff, like heating homes and cigarette lighters.

But the point, before I move on, because you made an excellent point, and that is, you go back to the early, mid '90s and almost everything we produced was crude oil and condensate. But look at how much less the world used back in those days. So, we're only using 70 million barrels a day of whatever you want to call oil back in the mid '90s. And today, we're using more than a hundred of whatever you want call oil. So the world has used half the oil that it's ever used since 1995, half the world's production and use has come in the last 27 years. So, the rate of use has accelerated tremendously. And that's not surprising because look at the population.

Nate Hagens (00:41:44):

I have a bunch of questions, Art. So, the US, you said, is closer to the higher thermal mother nature refining, we have lighter oil here, which we talked about on your last podcast, which was quite excellent on diesel and refining, and I encourage people to watch that. But combining the message of that with what you just said now, what are the implications for the United States where a lot of what we're terming oil is for plastics and baggies, et cetera, and we have a lot of light fraction sort of crude. So, we're set up for driving and putting fruit and food in freezer bags, how does this position us peak oil currencies, financial markets aside, what does this suggest as far as risks for the US economy, given the natural gas liquid and our light oil situation?

Art Berman (00:43:00):

The US is set up to sell stuff. That's what we do and a good-

Nate Hagens (00:43:06):

We're an energy launderer.

Art Berman (00:43:09):

We are absolutely an energy launderer. And so, that means that we have to buy other people's oil because ours is super light. And I'm not criticizing us. We have reduced our imports a lot in the last 20 years, but we've reached a level where we just can't use anymore of our light crude oil, we just can't. And so, we send it overseas. We're exporting something like 3.5, 4 million barrels of light crude oil a day because we just don't need it, we can't do anything with it. And we are importing 6.5 Or 7 million barrels a day of heavier oil from, you name your source. But people who produce refinery ready oil, which has higher energy density, and it's thicker oil because we need that in our refineries in order to produce things like diesel, which is the biggest cash cow in the world. And it is a fairly heavy compound. And if you look at its heat content, diesel, depending on how it's produced, it can actually have a greater heat content or energy content than crude oil.

Nate Hagens (00:44:32):

Maybe describe to our listeners slide 11 that I will put on screen.

Art Berman (00:44:41):

Yeah. So, slide 11 shows what all of the various refined products that come out of a refinery, whether they come from natural gas or they come from crude oil and it shows the amount, the energy content, and it shows the percent of the total product that that's produced. So, for instance, if we look at something like crude oil, which in this graph is in red, so its heat content is something like 5.7 British thermal units-

Nate Hagens (00:45:32):

Million BTUs-

Art Berman (00:45:34):

... million BTUs per barrel. And we look at diesel and it's actually slightly higher, it's 1% more than crude oil, because it's one of the densest products that we make. Heating oil's even a little higher, residual is even higher. But look at all of the other stuff down the line. The gasoline, it only has a heating content of 89% of crude oil, butane that we talked about for cigarette lighters, it's got 74%, propane, 67%, and then you get all the way down to ethane, which has got less than half the heating content. So, these are the realities.

Nate Hagens (00:46:21):

40% of our oil now is natural gas liquids, and the main component of natural gas liquids is ethane and ethane is 49% of the heat content of what we used to consider as crude oil.

Art Berman (00:46:36):

Correct.

Nate Hagens (00:46:37):

How many people know that in your field?

Art Berman (00:46:40):

I think a lot of people have a notional sense that that's true. And I say that because before I made these charts a couple of weeks ago, that's pretty much what I had. I think I had a stronger sense that these numbers were lower than the average person in the oil business. The average person in the oil business is real smart, but isn't focused on this stuff. That person is focused on what he's paid to do, which is where do we drill the next well? How do we optimize production? How do we make the economics work? The stuff you and I are talking about is related to the system. How is this serving civilization, the economy, economic growth, and people are not paid to look at that. Somebody in the company is, but they're not.

Nate Hagens (00:47:36):

Well, the heat content is ultimately what's powering our system. But everything in these charts is sold somewhere like it's used. So, someone is buying all these other things towards some economic activity.

So the fact that we're growing, the total amount still results in an economic output. It's just the flame is dwindling.

Art Berman (00:48:09):

Exactly. That's why I said, in the United States we're in the business of selling stuff and we do it very, very well. And we are-

Nate Hagens (00:48:20):

We're also in the business of buying stuff though but with large, but you're talking about energy and oil products.

Art Berman (00:48:27):

Yeah, sorry. I absolutely am talking about that. So, my point is, is that the US oil industry, refining industry, petrochemical industry is doing exactly what its investors expect from it. It's maximizing shareholder value, it's maximizing profit, ROCE, return on capital employed, doing all the stuff that everybody wants it to do, demands that it do, but it's not necessarily doing that for the wellbeing of the United States. And I take that phrase directly from M. King Hubbert.

Nate Hagens (00:49:12):

But no one's doing that. We're in service to the superorganisms and corporations are miniature superorganisms. It's no one's fault they're following the rules that were set out. But let's get back to... I want to make sure that we cover your main points graphically. Looking at your slide eight, there's two things that we didn't talk about. So, you said that 40% of what the EIA and other people label as oil is not oil. We talked about natural gas liquids and refinery gains. What is the light orange fuel ethanol? Is that corn ethanol, and then what is the renewables and oxygen that's the little yellow on top?

Art Berman (00:49:55):

So, going through this systematically, what we see is that we've got this big swath of blue, which is oil, and of that, we have two categories, one is conventional oil, the other's tide oil. And conventional oil, this is United States, is at best, been flat forever. It's actually declining a little bit. And all of the growth is in tide oil. And we've discussed how it has a slightly lower energy density, and it's lighter, and all that. The-

Nate Hagens (00:50:31):

And a much faster decline rate once the wells drilled.

Art Berman (00:50:35):

Well, and as we've discussed before, everything newly drilled in the United States has a much higher decline rate, a stunningly high decline rate of 47%.

Nate Hagens (00:50:46):

Well, you don't have that graph in this deck, but briefly, you should show that basically, if we stop drilling in the United States today, our total amount of oil, and I don't know how natural gas liquids fit into that, would drop by 40% in the first year, and then another double digits the second and third year. Because it is truly the Red Queen phenomenon that we have to keep drilling in order to offset the steep decline of the light oil, the tight oil, which is the largest fraction of our oil right now.

Art Berman (00:51:27):

It's about 60%, yeah. So, we've talked about refinery gain, that's just the volumetric expansion of taking something real dense and splitting it into lower density products like gasoline, and kerosene, et cetera. Fuel ethanol is something that 10% or 15% of everything you put in your car or your truck is not gasoline anymore, it's fuel ethanol. And that was a change that came about in the early 2000s, I think, during the Bush administration, when oil prices got real high. And the idea was, well, we need to conserve our gasoline, so if we add fuel ethanol, which is basically alcohol, it's denatured alcohol, then we can make our gasoline go further. Well, fuel ethanol comes from corn, most of it's corn. We can make whiskey with corn. We can make another kind of denatured alcohol to put in mixed with gasoline, and that's from corn also. So, there's a big-

Nate Hagens (00:52:39):

And we can make tamales and chips.

Art Berman (00:52:41):

Well, if we are interested in Senior Petroleo, we like all those things. Then we talk about that-

Nate Hagens (00:52:48):

Well, if you're someone that actually is living and wants to have food to survive, you're also interested in those things.

Art Berman (00:52:56):

And I like those things.

Nate Hagens (00:52:57):

So, quick-

Art Berman (00:53:00):

Renewables and oxygenates-

Nate Hagens (00:53:01):

... hold on, just a quick side note there. You probably don't know this, but it was my one time that I was in the Journal Science was in 2005 talking about this on the fact that corn ethanol was hardly net energy positive and it was more of an energy conversion than an energy source because we use fossil

fuels to grow the corn, and natural gas to dry the corn, and the whole process to convert this corn into usable liquid fuel for vehicles. But again, just like ethane or natural gas liquids, ethanol also has a lower heat content per gallon, correct?

Art Berman (00:53:51):

Well, it does. So, yeah, basically, you don't get the same range. You fill up your tank with 15% ethanol and your car doesn't go as far as if you've filled it up with 100% gasoline.

Nate Hagens (00:54:05):

Or the flex fuel vehicles that have up to 70% or whatever it is, they even have a lesser range?

Art Berman (00:54:13):

For sure. And the other thing of course is that you're competing, you're using food for fuel. And so, that has the effect of you use less of what you grow to feed people, and it also increases the cost of agricultural land, which, and again, we get into this whole complexity cascade that... It seemed like a pretty good idea to somebody when we did it, but when you actually start analyzing it, we wish that we hadn't done... Most people wish we hadn't done it, but we're stuck with it. It's a million barrels a day,

Nate Hagens (00:54:54):

Why are we stuck with it? Why couldn't we wind that down with a three-year phase out or something?

Art Berman (00:55:01):

Oh, we could physically do it, but all the farmers would scream, all the congressmen who support those farmers would scream. We can't do anything unless everybody agrees that it suits their constituents. And so, the likelihood of that happening I think is very close to zero. We could do it very easily.

Nate Hagens (00:55:25):

Back to slide eight, you were about to talk about the renewables and oxygenates.

Art Berman (00:55:31):

So there's a very small percentage of all of this. The renewables, those are things like biodiesel, those are things like, you know, mentioned, you know, can actually create some sort of fuel from coal. It's such a small percentage that I don't really even want to talk about it because it's something that gets a lot of press, but it doesn't contribute hardly anything to the bottom line. And oxygenates are just things to increase the oxygen content to make it burn hotter, but it doesn't last, it's a decline rate kind of problem.

(00:56:11):

So, the real message of this graph and every other one that I've shown so far is simply that any way you look at it, whether you look at the world, whether you look at the United States, which of these components you focus on, whether you look just at the composition of the natural gas, whether you look

at the composition of the oil, you keep coming back to the same thing, and that is that oil ain't what it used to be. And that has implications. We don't get as much energy out of what we call oil today as we did a few decades ago back when... I was still 20 years into my career in the mid '90s.

(00:56:59):

And so, the world, the basis for our energy proposition has fundamentally changed, but the only thing people pay attention to is the top line. Are we producing 100 million barrels a day? Are we producing 95? Because if it's only 95, that's bad. If it's a hundred, that's good. But we're just looking at how much are we cranking out? We're not looking at what goes into it and what we therefore get out of it. And so, with those big impressive numbers that people use all the time to say, "Oh, peak oil, those are just a bunch of alarmists."

(00:57:40):

Those guys didn't know what they were talking about, they're clearly wrong. And I'm not trying to defend peak oil or criticize those that criticize peak oil, but I would say that neither of them really knows or knew what they were talking about. Each focused on an end number and not actually looking at how all of this stuff interrelates across the spectrum from crude oil to natural gas liquids, or renewables and oxygenates. And when you do, back to your dissertation, the net energy that we get out of it is lower than where we were not very long ago.

Nate Hagens (00:58:23):

So the bottom line, if the economy holds up in 2023, we could pierce a 2018 quarter for new all-time record of what is considered oil. But that's actually all liquids. But the fine print, the hedonic adjustment as it were, is a massive fraction of what we're considering oil. In the United States, 40% is natural gas liquids and other things that have lower heat content and can't be directly used as oil.

Art Berman (00:59:10):

That's correct. That's absolutely right. And if you break out the crude oil fraction of all of this, what you find is not only are we nowhere near recovering even to the late 2018 level, but the rate of increase of crude oil and condensate production is either flat or in decline. So, the future, at least with the limited data we have right now, is not real encouraging for us ever getting back to the 85 million barrels a day of crude oil and condensate that the world produced just a couple of years ago.

Nate Hagens (00:59:57):

If there was a energy related Nobel Prize called the Hubbert Prize or something, you should deserve one for your energy sleuthing on this. You're a real pit bull, once I give you a question and a challenge, you come up with these charts and graphs and you double-check them. And I'm grateful for your curious and diligent mind, Art.

Art Berman (01:00:23):

Well, thank you, Nate. I love a challenge. And many years ago I was giving a talk, and I guess somebody thought it was depressing, and he said, "What motivates you to do this kind of research and

give these kind of talks?" And it was a fair question. And the answer I gave him still remains, and that I'm fascinated by what I don't understand. And so, I'm not a doomster, I'm not trying to bring people down. I'm a scientist, I'm describing the state of things, in this case, the state of energy. And to me, it's neither optimistic or pessimistic, it's just what it is. And when I find out, "Gee, I misunderstood that," or "I only understood it partly." That motivates me to understand it better.

Nate Hagens (01:01:21):

So, I have a lot of takeaways from this conversation, but the simplest one is "When is peak oil?" is really not a helpful question because of everything we just discussed. However, the broad concept that oil will peak and decline has massive implications for society in our future.

Art Berman (01:01:48):

Those are the two major takeaways. And how did we somehow get here and nobody noticed or how did so few people noticed?

Nate Hagens (01:01:55):

That would be- Well, maybe the answer to that question is because we, and I say that with a very broad stripe, cared about identity and making predictions and being right about something when the larger story was so complex and so vital that now there's this cry wolf thing. Can you believe it? Art that here we are 16 years after I wrote that article, no one cares or understands about peak oil anymore. I think the bullets were spent in 2007, '08, '09, '10, and we are in such a more of a dire situation today, oil wise, geopolitical wise, financial overshoot wise. And now what do we hear? "Oh, we're not going to need oil because of peak demand," or "There's plenty of oil for 100 years." I think, peak oil, and not to us and the circle of people that we do analysis with, but to the broader public, peak oil has been debunked.

Art Berman (01:03:09):

Yeah, it's a failed idea. And it's interesting that so many people talk about it as if it's a theory. They call it the peak oil theory. And whether it was right, wrong, or neutral, it was never a theory, it was an observation. It was a an empirical kind of thing. It said, "Hey, we have a limited volume of this stuff. At some point we're going to have to spend a whole lot more money and work a lot harder to get what's left." That was never a theory and that was never wrong. But it's fascinating that we talk about things that happened 20 years ago. But when Hubbert gave his talk in 1956, the company he worked for, Shell, immediately launched an investigation of him to find out where he-

Nate Hagens (01:04:14):

I didn't know that.

Art Berman (01:04:15):

Oh, yeah, yeah. They launched an investigation of him to show where he was wrong, which of course they never could do it.

Nate Hagens (01:04:25):

Well, he ended up being right about US oil peaking in 1970 because at that time, just like Malthus or Ehrlich know about the fossil carbon pulse, and globalization, and debt, he didn't know about the Gulf of Mexico, the North slope, and then shale oil, he was just projecting conventional crude, right?

Art Berman (01:04:48):

And was the point of what he was doing was not any kind of gloom and doom. He was just saying, "Hey, guys. We got to start working on other stuff." And by the way, he was big into nuclear. He thought nuclear was a big part of the energy solution, but he was simply saying, we need to think about this. We've got to get our population under control. We've got to get our consumption under control, and we got to make sure we don't kill each other with nuclear weapons. And surely, there's a way that we can figure out how to make this last as long as we need it mean. That was all he was saying. And yet, the controversy that he raised was greater, I think, at the time than anything that the people in peak oil experienced 10, or 15, or even a few years ago. He was really on the hot seat.

Nate Hagens (01:05:47):

Yeah. Well, it's threatening to the status quo to say that there may be less in the future. And so, what's happened the last 15 years is we've kicked a hell of a lot of cans, rule changes, too big to fail, quantitative easing, artificially low interest rates, the larger straw, which is the shale experiment. And this might go on for a while longer, but after it stops, there's, I think, a doozy of a hangover because we've been consuming beyond our means for a long time. And this decline rate that underpins what you've discussed isn't going away. And so, we're trying to offset that. And not only that, but the stuff that we're offsetting it with isn't worth as much from an energy heat standpoint. So, this has all been super helpful, Art. Let me put you on the spot here. What else are you curious about and what might you like to discuss on a future podcast appearance here?

Art Berman (01:07:05):

Well, I'm really curious about when the world will realize that all of the alternatives to oil are basically only good for electric power generation, and electric power generation is a relatively smaller portion of the total energy consumption that we have. And so, I'm not, again, being critical or saying anything other than observation. And that is the fact that people think that somehow renewable energy is going to solve everything we've been talking about, it's simply not true, it cannot. We can't do all the things that we need to do in our civilization just with electric power. And so, in a way, we're solving the easy part of the problem and convincing ourselves that once we finally get it right, we'll have the whole thing solved. And again, I'm all for renewable energy. I'm totally in favor of renewable energy, but it's simply not going to solve any of the stuff we've been talking about today.

Nate Hagens (01:08:27):

Well, I agree with that. In my writings, I say renewable energy can power a great civilization, just not this one. So, I'll give you six weeks to come up with those charts and graphs and we'll talk again.

Art Berman (01:08:42):

Okay, Nate, that sounds good.

Nate Hagens (01:08:44):

Mucho gracias, Senior Petroleo, this has been great, very helpful. I hope people understand the importance of what you've laid out here. I found it fascinating and it makes total sense now that I've seen the graphs.

Art Berman (01:08:58):

Well, I enjoyed the research and hopefully, this will get a few people thinking and asking questions. And if not, we'll find another subject that maybe will get their interest in a different way.

Nate Hagens (01:09:13):

Thanks so much, Art. I'll talk to you soon.

Art Berman (01:09:17):

My pleasure, Nate. Always good to talk to you.

Nate Hagens (01:09:19):

If you enjoyed or learned from this episode of The Great Simplification, please subscribe to us on your favorite podcast platform and visit thegreatsimplification.com for more information on future releases.