

## Episode 166: Mark Mills

Speaker 1 ([00:00:04](#)):

Welcome to the Bill Walton Show, featuring conversations with leaders, entrepreneurs, artists, and thinkers. Fresh perspectives on money, culture, politics, and human flourishing. Interesting people, interesting things.

Bill Walton ([00:00:24](#)):

Welcome to Bill Walton show. I'm Bill Walton. Today, we want to take a look at our big picture macro-technology future. Conventional wisdom has felt technology will change the future goes something like this. There's one group that believes in a new normal, which is we're ordering a ride, or a food, or smartphone, or trading in bitcoins is about as good as it's going to get. Then, that's roughly where we are today.

Bill Walton ([00:00:54](#)):

Others, the dark side, see a dystopian future where because of artificial intelligence, we'll see widespread digitally-driven job and business destruction. Then there's a third group, which seems to be much in the headlines today that believes the only technological revolution that will matter, we found with renewable energy and electric cars.

Bill Walton ([00:01:17](#)):

According to Mark Mills, my returning guest, friend, and a senior fellow at the Manhattan Institute, and who specializes on science, technology, energy, and future manufacturing technologies, these views are wrong or at least incomplete. Mark's new book, *The Cloud Revolution: How the Convergence of New Technologies Will Unleash the Next Economic Boom and a Roaring 2020s*, outlines how with the political class and the regulatory state will simply get out of the way.

Bill Walton ([00:01:50](#)):

We'll see a convergence of technologies that will instead drive a broad economic boom over the coming decade, and one that history may come to know as the roaring 2020s. Welcome, Mark.

Mark Mills ([00:02:03](#)):

Thanks for having me back. It's great to be here.

Bill Walton ([00:02:05](#)):

It's great to see you again. You've written a big, important book that sets forth a much more optimistic view of the future than most of us are feeling right now, but there are a lot of roadblocks. Right now, today, we've got this obsessive focus on climate change, so-called renewable wind and solar energy, environmental justice, electric cars, and the batteries that electric cars need. When you know the economic and physical realities, these seem like madness. Thoughts?

Bill Walton ([00:02:41](#)):

First, before we get into that though, I do want to tee it up because I do want people to know we do want to talk about what's going on right now. What's the thesis of your book?

Mark Mills ([00:02:50](#)):

Well, to cut the chase, the thesis of the book is that the future that in fact is exciting. To use a phrase, it's already happened. That is, making predictions about technology is in terms of what it will do to society, how we can live our lives.

Mark Mills ([00:03:09](#)):

Impacts in all manner of daily commerce don't come from when things are invented now. It comes from things that are invented in the recent past, 10, 20 years ago. They're just now reaching maturity, being viable and useful. This has always been true.

Mark Mills ([00:03:25](#)):

It's obvious when you state that the car was invented in the late 19th century, the auto age really took off in the 1920s. People went from a few percent owning cars to half of homes. The radio was invented long before the 1920s, and the idea of the radio had been around for more than two decades before the 1920s. The radio as a product took off in the 1920s. Same with electrification, same with pharmaceuticals, polymers and plastics, all these things back in 1920s.

Mark Mills ([00:03:58](#)):

It's a long way of saying that we are now living at a time where we are seeing similar profound revolutions to the three domains how all technologies operate. The three domains of technologies are information. What we know about things, how we share information. Machines, how we make everything and operate everything, do stuff. Every service requires machine. Materials, everything is built from something. Everything in civilization falls in those three buckets.

Mark Mills ([00:04:27](#)):

If you get revolutions in the products and the underlying technologies, and any one of those, it's a big deal. Computers fall on information domain. It's a big deal. Computers are different than anything human beings have had for a long time. When you have contemporaneous convergence of revolutions in all three domains, which is what's going on now.

Bill Walton ([00:04:48](#)):

We're going to show a chart on that. You've got the three Venn diagrams. When the three circles overlap-

Mark Mills ([00:04:54](#)):

Exactly.

Bill Walton ([00:04:54](#)):

... what happens in the middle?

Mark Mills ([00:04:56](#)):

You get what [Joel Mokyr 00:04:58] stole a word from physics. Joel Mokyr is a Nobel class economist at Northwestern. He calls this a phase change in an economy. Of course, if you remember your high school physics or chemistry, phase change is when water becomes ice or water becomes a vapor. It's still water. It's still the same molecule, but a phase change is profoundly different with the same components,

results in something profoundly different. You get phase changes in economies when you have profoundly different convergence of the conditions of the technologies that allow things.

Mark Mills ([00:05:31](#)):

The book is optimistic in this sense based on what's actually happening in the technology domains broadly, not just in energy, not just in computing, but in the three big spheres of materials, and machines, and information. It's optimistic because those are the facts, not because I'm an inventor optimist.

Bill Walton ([00:05:49](#)):

Give me an example of that. In the book, you used the iPhone. You said that was a conversion of these three elements. Describe that.

Mark Mills ([00:05:58](#)):

So if you think about the iPhone, this magic machine. We know that Steve Jobs gets credit for pushing the first iPhone, the first smartphone that succeeded in 2007. There were smartphones before that. They were lousy. I mean, they were handheld computers. There was the Newton. There was the PalmPilot. There were lots of things for those who remember their long ago history-

Speaker 1 ([00:06:18](#)):

Are those PalmPilots with those stylus?

Mark Mills ([00:06:20](#)):

Yeah.

Bill Walton ([00:06:21](#)):

That was convenient.

Mark Mills ([00:06:21](#)):

Yeah. Well, the stylus could be useful but it's not exactly convenient.

Bill Walton ([00:06:27](#)):

Okay.

Mark Mills ([00:06:28](#)):

What happened was that you needed three things to happen. You needed a maturation of three kinds of technologies to make smartphone possible. You needed microprocessors to be small, and cheap, and powerful enough to make a microprocessor class radio and a microprocessor class logic chip. The microprocessor revolution had nothing to do with Apple. They didn't invent the microprocessor, but it matured to a point where it was really small, very efficient.

Mark Mills ([00:06:53](#)):

You also needed little, tiny flat screen, TVs. LCD screen was not invented by Apple, and it was a contemporaneous completely unrelated invention. In terms of the realm of computing, it's a material science invention. In fact, that came along and matured.

Mark Mills ([00:07:11](#)):

You needed power. You need a battery. You need a lithium battery. In fact, there'd be no smartphones if you're using automobile class lead-acid batteries. It would look bigger than the goofy brick in that wall in Wall Street.

Bill Walton ([00:07:23](#)):

We're going to talk some more later about batteries.

Mark Mills ([00:07:26](#)):

Well, but the lithium battery was magical. With the other two revolutions in maturation of a capacity to make the technologies at scale, a lot of innovator like Steve Jobs, like Apple, they'll say, "I can assemble these disparate components into something that's really remarkable."

Mark Mills ([00:07:44](#)):

This is by the way, the pattern of revolutions and technology through all of history. That's how the car came to be. Henry Ford did not invent high-strength steel or rubber.

Bill Walton ([00:07:53](#)):

The three elements of that were the materials was the steel?

Mark Mills ([00:07:56](#)):

No. The materials of the liquid crystal display, the flat screen?

Bill Walton ([00:07:59](#)):

No. I mean, forget the phone.

Mark Mills ([00:08:01](#)):

The car?

Bill Walton ([00:08:02](#)):

Let's do the car. Let's do the model C.

Mark Mills ([00:08:02](#)):

Sure. So if you think about the car, somebody had to invent the idea of a combustion engine. Ford didn't do that. It had to get good enough, and sophisticated enough, and cheap enough that you could mass produce it. You could apply the idea of mass production to it. It couldn't be a craft production.

Mark Mills ([00:08:18](#)):

You needed to have high-strength steels to do this. The alloy class of metals, which didn't exist throughout history. We had alloys, but they weren't like high-strength steels. You needed an industry

that could produce a fuel, all gasoline, diesel fuel. That was an entirely independent magisteria of technology and invention. All of them matured, roughly contemporaneously.

Mark Mills ([00:08:39](#)):

Same as true by the way of the electric age. We had to have, again three different things to take place, not just one.

Bill Walton ([00:08:48](#)):

What about the radio? I worked for Bill Paley at CBS. What was the convergence that created radio?

Mark Mills ([00:08:56](#)):

Well, somebody had to invent the vacuum tube for starters. So deForest, Kelly, had nothing to do with RCA. RCA brought the first radios into the world in the 1920s. If you owned stock in RCA in early 1920s and held it say for six years, you got out before the crash of '29. You didn't have to hold it for all nine years. You saw more than 10,000% increase in the stock value of what you held in RCA.

Mark Mills ([00:09:19](#)):

The velocity of the introduction of the radio equaled or exceeded the velocity of introduction of the smartphone, big deal. Radios by the way at 1920s, cost as much as the entire budget for furniture for the average household in America in the 1920s. So, the fact that they took off told you that people wanted that product.

Bill Walton ([00:09:37](#)):

So radios would have been as much as five, or 10, or 15% of household income then?

Mark Mills ([00:09:42](#)):

Yes.

Bill Walton ([00:09:42](#)):

Okay.

Mark Mills ([00:09:42](#)):

Of the middle class household income. By the way, as is our budget for communications today, when you look at the all in spending by people on their communications budget. There's cable TV. There's smart phone and the like. Back to the radio, so you need a vacuum tube. You needed the idea of what a radio wave was.

Mark Mills ([00:10:03](#)):

The information revolution was the discovery of electromagnetic waves, what they were, how they could be manipulated. They were an invisible phenomena unknown in history part of that. So you had information. You had the vacuum tube. Again, you needed a separate infrastructure. You needed power. You needed electric power that was available, reliable. Without all three simultaneously, all came out of different domains, in different spheres, different inventors. All reached the level of maturity sufficient to do something that RCA did, which is build a practical home radio.

Bill Walton ([00:10:39](#)):

You showed this time, after time, after time in your book. There are lots of examples. What's an example of what you see converging today?

Mark Mills ([00:10:47](#)):

Well, that's good question. Why would I be optimistic? Let's just do robots because everybody has a dystopian feeling about robots. Most things that we have, people have imagined but couldn't build the idea of an anthropomorphic robot. Let's set aside what you would do with a robot that could walk and assist in a task.

Mark Mills ([00:11:09](#)):

Making robots useful requires revolutions in three domains. Again, you need information processing capabilities unprecedented in history. By that, I mean billions of times more powerful than existed at the dawn of the computing age in the '70s and '80s. For that, you could make a robot walk because it's not like you're emulating a human, but you're emulating ambulation which is not easy.

Mark Mills ([00:11:31](#)):

You also need materials revolution. The class of materials, which you can build a robot have to emulate biology. You have to have lightweight high strength materials. It's not so easy. Then you need actuators, again back to power. You need motors and batteries at a level of cost, and precision, and power, that again with unprecedented history. They had to mature to a level where you could build a machine that had the processing power, the energy/power, and the mechanical strength to emulate, let's say a dog.

Mark Mills ([00:12:06](#)):

So when you look at Boston Dynamics robot called Spot, which some people may have seen. If you haven't, you use the magic Google machine.

Bill Walton ([00:12:14](#)):

Spot's pretty comical.

Mark Mills ([00:12:15](#)):

Pretty funny to watch it. When you think about it, if you watch the video, it's eerily biologically is natural.

Bill Walton ([00:12:22](#)):

Spots on YouTube. Everything's on YouTube.

Mark Mills ([00:12:23](#)):

It's on YouTube. You can find-

Bill Walton ([00:12:25](#)):

Even this show.

Mark Mills ([00:12:26](#)):

Even this show. You look at it and say, "Well, this is eerie." Now, here's an interesting factoid for you. Here's Spot. It's the first commercially available quasi ... When I see anthropomorphic, it's obviously, there must be a word for dogomorphic or something. It's not obviously looks like a human. It looks like a dog.

Mark Mills ([00:12:43](#)):

It walks natural like an animal. You can lease it. So Boston Dynamics based on public information sells the robot for about \$70,000. It sounds like a lot of money, but in real dollar terms, the very first cars. In fact, the first car in America was a Duryea Wagon. It was considered revolutionary there in very late 1800s.

Mark Mills ([00:13:07](#)):

It costs about \$70,000 in today's dollars to buy a Duryea Wagon. Not many people bought them. They made a bunch. It was not very many years later that we got the model T, the model A. We are at the-

Bill Walton ([00:13:19](#)):

There are also no roads then.

Mark Mills ([00:13:21](#)):

Well, you had to build infrastructure roads to make the cars useful. We will do the same for robots. The infrastructure for robots, will not be a physical roads. The right thing about a robot is that it can operate in the environment we're in, if it's a walking robot. That's a magical transformation in terms of utility.

Mark Mills ([00:13:39](#)):

If you can have an automated machine, do things that help you in the environment you want it naturally be in versus building a specific infrastructure or cages where you park robots, so they don't hurt people.

Bill Walton ([00:13:51](#)):

This is the Bill Walton Show. You can find us on the billwaltonshow.com and all the major podcast platforms. I'm here with Mark Mills, senior fellow at Manhattan Institute. We're talking about how technological change happens, and how it's convergence of three elements, and maybe what our future with robots might look like.

Bill Walton ([00:14:13](#)):

I want to get in. I want to go deeper into this. First, I mentioned at the outset. There's this obsession now with climate change, with solar, wind energy, and batteries. You've written at length, and I think with great clarity on why. What a world with 100% wind and solar would look like and the environmental cost that, that would impose, and the economic cost. Do you want to lay out the realities here?

Mark Mills ([00:14:43](#)):

Well, there will not be a world powered entirely by wind, and solar, and batteries. The reason I said that is because it's not possible. We don't have the materials. We can't afford it in either environmental or economic terms. Let me explain why but sort of a calibration point first.

Mark Mills ([00:15:03](#)):

Imagine it's early 1900s and you have entrepreneurs who are very excited about changing the kind of food they use for horses. Then, you got another group of entrepreneurs who have started to make automobiles that are turned into tractors, and are turned into trucks, and ways to transport people. So we have one group that's changing what they feed the horse and buggy, and the other group that's inventing the car.

Mark Mills ([00:15:25](#)):

Today, we have a lot of enthusiasts. We're changing what we feed the horse and buggy. The different fuel for car leaves it still a car. It's not a revolution. It's important. It's consequential. When you change what you feed the car, but it's still a car. So, it's economic value. It's economic utility. It's productivity impacts are exactly the same. There's no change in what economists call the utility function.

Mark Mills ([00:15:48](#)):

So, it's a misdirected view of what a revolution constitutes. Flying cars would be a revolution, and they're not possible. We make flying drones. Flying cars would be harder, but drones that carry cargoes are already being used that are autonomous. That's a revolution, much more so than changing the fuel.

Mark Mills ([00:16:06](#)):

When I say it will not happen, it's easy to explain why. To produce the same unit of energy delivered to society, whether it's propelling a mile, carrying a pound of something, making a pound of something, making steel or making silicon. Whatever the ultimate goal is, you always have to use energy.

Mark Mills ([00:16:25](#)):

If you use hydrocarbons, oil, gas, and coal, and you switch to wind, solar, and batteries, the quantity of materials acquired to be extracted from the earth to produce the same unit of energy goes up a thousand percent. So, I say that again. If I want to get the same mile driven, I have to mine stuff, build stuff. You always have to do that. Everything starts with mining-

Bill Walton ([00:16:49](#)):

Let's break it down into something more we can visualize like a solar panel. Let's do a wind farm. A wind farm produces X amount of energy and requires what to create. How much wind do we need to replace fossil?

Mark Mills ([00:17:04](#)):

Let's do an easy ... If I can, I'm easier with the car.

Bill Walton ([00:17:06](#)):

I like easy.

Mark Mills ([00:17:07](#)):

The car-

Bill Walton ([00:17:08](#)):

Okay, car.

Mark Mills ([00:17:08](#)):

... because everybody's excited about electric cars. States and countries all over the planet are promising to ban internal combustion engines because we now have electric cars. More accurately, we have Teslas. More than two thirds of all electric car sales in the United States are Teslas, just to be clear. So he utterly dominates, and good for him, the electric car market. Everybody else is making electric cars.

Mark Mills ([00:17:33](#)):

So the battery in an electric car weighs about a thousand pounds. That's a thousand. Most people don't know that. The thousand pound battery is replacing a 70 pound-

Bill Walton ([00:17:42](#)):

The total weight of the car is what?

Mark Mills ([00:17:44](#)):

The battery only, just the battery.

Bill Walton ([00:17:46](#)):

The total weight of the car is what, 8,000 pounds?

Mark Mills ([00:17:48](#)):

Oh, no. Depends on the car, 2,000 to 3,000 pounds.

Bill Walton ([00:17:50](#)):

So two third of the weight or half the weight?

Mark Mills ([00:17:53](#)):

Half the weight of a car is the battery, if it's electric car.

Bill Walton ([00:17:56](#)):

Okay.

Mark Mills ([00:17:58](#)):

The weight of the fuel to go the same distance in an internal combustion engine car is about 60 pounds. So, I have a 60-pound fuel tank. I'm replacing it with 1,000-pound fuel tank. Now, that's not nothing because it means that obviously I have to use lightweight materials to make up for some of that weight. I'm using aluminum, carbon fiber, all of which are energy intensive, but let's just stick with the battery.

Mark Mills ([00:18:19](#)):

To make the 1,000-pound battery, to fabricate it, I have to mine and dig up somewhere on the earth 500,000 pounds of materials. 500,000 pounds for one car to make the nickel, copper, the manganese, the lithium, the lithium carbonates. All of that requires mining equipment and mining machinery, almost all of which is oil fired. It requires transport to refining facilities, most of which by the way are in Asia

and China, where energy in that case both coal, and oil, and gas are used to convert it into a chemical that's useful to make a battery. Then, you make a battery. You use energy to make the battery.

Mark Mills ([00:18:55](#)):

So when you go through that whole process, you've now made something to store energy. It doesn't produce energy and to make a battery that could hold the energy equivalent of a barrel of oil. So make enough batteries that they could hold the energy of a barrel of oil. I'll have had to spend between 100 and 300 barrels of oil equivalent of energy to fabricate that battery.

Mark Mills ([00:19:15](#)):

Since that's typically done all over the world in mines and processes in China, Asia, and South Korea, Taiwan, that means somewhere else energy is being consumed and carbon dioxide is being emitted. Put in the carbon terms, which is why the preoccupation with switching from internal combustion to electric cars is resident. When the electric car shows up in your driveway, it comes with a carbon debt just to make it.

Mark Mills ([00:19:42](#)):

The debt can be measured in tons of carbon dioxide, depending on where you drive that car and how the battery was made. You may never pay the debt off, to compare you're avoiding the carbon dioxide emissions from burning gasoline. This is not an anti-EV observation. This is just locked into the physics and the chemistry of these machines.

Bill Walton ([00:20:02](#)):

A lot of this is going to be manufactured in China, and China gets about 80% of its energy from coal?

Mark Mills ([00:20:08](#)):

60% of the electricity from coal, right. They get like the rest of the world, hydrocarbons account for about 80, 85% of all energy.

Bill Walton ([00:20:18](#)):

So, that's where the debt is incurred. Also, you talk about the mining required. Mining is not going to happen in United States. We've got not in my backyard mentality with mining. So, we outsource it. We shove it off to Africa or South America where you can find this. The place you find, it would be, I don't know, rainforests?

Mark Mills ([00:20:41](#)):

Sure.

Bill Walton ([00:20:41](#)):

Environmentally-

Mark Mills ([00:20:42](#)):

Fragile areas. Yeah, exactly. There's an economic and geopolitical feature.

Bill Walton ([00:20:47](#)):

The tundra in the north pole.

Mark Mills ([00:20:49](#)):

That's right. Last year-

Bill Walton ([00:20:52](#)):

All these places we want to protect is where you'd go to mine, the materials to do the electric cars.

Mark Mills ([00:20:57](#)):

We do that. We do that by virtue of pushing out mining possibilities in North America, especially in the United States.

Bill Walton ([00:21:04](#)):

So this is an elite pushing all of these problems out to the third world?

Mark Mills ([00:21:08](#)):

Sure, exactly.

Bill Walton ([00:21:10](#)):

Gee, that's a great idea.

Mark Mills ([00:21:11](#)):

It's a good idea. Think about it. We don't-

Bill Walton ([00:21:13](#)):

If you're in Davos maybe.

Mark Mills ([00:21:16](#)):

Well, I think to be fair and it's hard to be fair because some of the ideas-

Bill Walton ([00:21:20](#)):

They're not fair.

Mark Mills ([00:21:22](#)):

Exactly. Some of the ideas are so insane. To be fair, a lot of people have no idea how stuff is made. They just have no idea. They don't know that electric car uses 300% more copper than a regular car. So what that means is if you increase electric car use, and the solar panel use, and wind turbine use, all of which use more copper in the conventional generation. You increase demand for copper, whatever.

Mark Mills ([00:21:44](#)):

Where do we get the copper? Who mines the copper? Well, one of the biggest copper mines in the world is in Chile. Chile is a place that just had an election. For the first time I think in 40 years, now has a socialist leader who is-

Bill Walton ([00:21:57](#)):

It's been a wonderful economy, and now they're just voted in a 35-year old who wants to take it back to the dark ages.

Mark Mills ([00:22:02](#)):

So, let's see how the copper mine does in that environment. How the price of copper, which is already trending up because of the demands of copper. It takes decade to open new mines because they don't open up in a few years. Even in environments, in places where they give you permits quickly, it takes more than a decade to open a new mine.

Mark Mills ([00:22:21](#)):

So, we are pushing an energy path. It increases the call on minerals like nickel, like steel, like copper, like of course cobalt, manganese, lithium in particular. That increases demand for those materials by 400% to 4,000%. Nowhere in the world is anybody planning to increase our ability to mine by that amount of demand.

Mark Mills ([00:22:47](#)):

So we are going to a face inevitable, to use the French phrase, the denouement. We'll get to a point very quickly within a year or two where the supply of the minerals are not sufficient to meet the aspirations to build that many batteries in solar and wind farms.

Bill Walton ([00:23:04](#)):

So, you have a chart in the appendix of your book. You save the best for last in my view. I'm just going to put it at the end of this show, but I want to do it right now because it bears on what you just say. It's called Paradigms for Forecast.

Mark Mills ([00:23:17](#)):

I know.

Bill Walton ([00:23:18](#)):

We'll put it up so everybody can see what I'm talking about. It's basically the less you know ... Well, I'll let you describe it. This is your chart.

Mark Mills ([00:23:28](#)):

Yes. The famous Dunning-Kruger-

Bill Walton ([00:23:30](#)):

Okay.

Mark Mills ([00:23:31](#)):

... piece of psychology research done in some years ago, about I think 25 years ago. It's a piece of a serious clinical research. If you were being a wag to your point in looking at the results of the clinical research, it would say the less you know, the more confident you are, or you're too stupid to know you're stupid. I guess, to be unkind.

Mark Mills ([00:23:54](#)):

That was a very interesting piece of research. When people learn a little bit about something, they suddenly learn something, and they feel very confident in what that information means, whether it's medical information, whether it's about energy, whether it's about sociology. So, they looked across all domains.

Mark Mills ([00:24:12](#)):

Then what they learned is that as people learned more, their confidence dropped precipitously. The more they learned, the less confident they were that they knew the answer to something, or the less confident they were in what they self-expressed as I understand this domain.

Mark Mills ([00:24:29](#)):

Again, it didn't matter whether it was in physics, or in engineering, or whether it was in psychology, or in finance. Then as they learned more, so the curve has this interesting shape. As they learned yet more, their confidence started to rise. It began to have enough understanding to know that there was a reason to be able to reach a conclusion that was reasonably accurate, but they never reached the same level of confidence that they had when they knew a little bit. So, it's a version of that adage on, he who knows not, he knows not. The Chinese proverb, teach him. He who knows not he knows not is a fool. Shun him.

Mark Mills ([00:25:06](#)):

It's reasonable to be worried that you don't know enough. Every researcher knows this. Any analyst, any student knows this. The more you study, you do get to a point. It's kind of an epiphany. When you realize you've done enough digging, you've done enough studying that you begin to see patterns. You begin to understand what might be true. This is what education's about. It's what we do, whether self-educated or in schools.

Mark Mills ([00:25:30](#)):

The Dunning-Kruger occur is delicious because they did it clinically and analytically and then generated this curve, which is years after it became infamous.

Bill Walton ([00:25:43](#)):

Well, this is the Bill Walton Show. I'm here with Mark Mills. He's the author of a terrific book, The Cloud Revolution, which we're going to get to in just a minute. We're talking about how when you know a little, you think you know a lot.

Mark Mills ([00:25:57](#)):

That's right.

Bill Walton ([00:25:58](#)):

When you know something, you realize you don't know much. Only after lots of years of work and study, you have actually really go in some clarity. I think most of us we're operating in the middle of your curve here.

Mark Mills ([00:26:10](#)):

We are.

Bill Walton ([00:26:11](#)):

I know, I am. I seem to know a little about a lot of things, but not enough about any one thing. I want to stick with the illustration though, with the solar and wind. I know we did cars and batteries. You described last time you were here about the enormous footprint that solar and wind would have on the planet.

Bill Walton ([00:26:33](#)):

So, you create a renewable supposedly. It's a form of electricity, a form of energy you can't store very readily. So, it gets back to our battery issue. What's the footprint and the cost of solar and wind?

Mark Mills ([00:26:46](#)):

Sure.

Bill Walton ([00:26:47](#)):

Just briefly, a couple of minutes.

Mark Mills ([00:26:48](#)):

Easiest way to visualize it would be if you wanted to make 100 megawatts of electricity, 100-megawatt power plant, which is 75,000 homes, depends where they are. 75 to 100,000 homes need about 100 megawatts of power generation to stay lit. You could do that with wind turbines. As long as the wind's blowing, they'll produce the necessary power.

Mark Mills ([00:27:08](#)):

You need about 100 square miles of land to distribute the wind turbines in. You need tens of thousands of tons of steel, fiberglass, plastic, copper, concrete to build those turbines, each one of them the size of the Washington Monument. So, you're going to have something in the order of 30 or 40 Washington Monument-sized wind turbines spread out over. It will feel like it was going to the horizon, 100 square miles.

Mark Mills ([00:27:37](#)):

You can build 100 megawatt natural gas-fired turbine, which fits inside about the footprint of a residential house. It's about how big they are inside of a building about the size of maybe a barn on a farm, and the gas pipe too is buried. That's it. That's all you'll see.

Mark Mills ([00:27:55](#)):

The quantity of materials, so that the land footprint is a house versus 100 square miles. Pretty big difference on land footprint. Material footprint, you go up roughly 1,000% in all the primary materials needed to manufacture the wind turbines versus the gas turbine.

Mark Mills ([00:28:13](#)):

If you count just the critical minerals, copper, steel, rare earth elements, molybdenum and those things, you go up somewhere from 500 to 5,000% more materials required, deliver the same amount of energy. So, you use more land and use more materials. You use more minerals, all of which have to come from somewhere. You have to use the land somewhere and all of which have to be mined somewhere, processed somewhere.

Mark Mills ([00:28:38](#)):

Then, this is the critical point. This misnomer renewable energy, it misses the fact that there's no such thing. The machines wear out. All machines wear out, including wind turbines and solar panels. When they wear out, you have to replace them. Since everything wears out, in effect, nothing's renewable.

Mark Mills ([00:28:53](#)):

It's a complete misnomer. It's a complete misdirection. The fact that the wind blows because we have nothing to do with it is no different than the fact oil exists because we have nothing to do with that either.

Bill Walton ([00:29:04](#)):

The wind don't blow and the sun don't shine. We have Texas from last year where they had a blackout.

Mark Mills ([00:29:10](#)):

We do.

Bill Walton ([00:29:10](#)):

I want to put up this other chart. Our favorite genius, Bill Gates, titled bring math to the problem.

Mark Mills ([00:29:18](#)):

It's a good line.

Bill Walton ([00:29:19](#)):

It's a great line. This is a good example where you can be a genius in one field and an idiot in another.

Mark Mills ([00:29:29](#)):

I'll give him more credit than that because I have a bias. My first book on energy-

Bill Walton ([00:29:34](#)):

He liked your book?

Mark Mills ([00:29:35](#)):

... he liked the book and praised it.

Bill Walton ([00:29:37](#)):

Okay. Well, you're compromised.

Mark Mills ([00:29:39](#)):

I'm compromised now.

Bill Walton ([00:29:39](#)):

What was the name of that first book?

Mark Mills ([00:29:41](#)):

Also, at the bottom as well.

Bill Walton ([00:29:42](#)):

Okay.

Mark Mills ([00:29:43](#)):

It was about energy. We forecast the state of the world as it would be.

Bill Walton ([00:29:47](#)):

When did you write it?

Mark Mills ([00:29:48](#)):

20 years ago.

Bill Walton ([00:29:49](#)):

How the forecast come out?

Mark Mills ([00:29:51](#)):

Well, it sounds like I'm going to dive deep in a lake.

Bill Walton ([00:29:54](#)):

You can be self-serving.

Mark Mills ([00:29:56](#)):

Dive deep in the lake hubris. We were right about everything. Let's just put it that way. That was the era of peak oil supply. We're going to run out of oil, run out of gas, run out of everything.

Bill Walton ([00:30:08](#)):

Bill Gates is a guy who is easy not to like though. He's very arrogant.

Mark Mills ([00:30:11](#)):

Well, it's true of most billionaires.

Bill Walton ([00:30:13](#)):

That's true.

Mark Mills ([00:30:15](#)):

I don't want to be mean to billionaires.

Bill Walton ([00:30:17](#)):

If we took this red chart down to its conclusion, we'd end up with about half the country covered with solar and wind fields?

Mark Mills ([00:30:24](#)):

Exactly.

Bill Walton ([00:30:25](#)):

Literally half the land mass?

Mark Mills ([00:30:27](#)):

If you were to try to provide all the energy America needs using just wind and solar, the physical land area would have to occupy pretty close to half the continent of United States. You think about that, "So well, does that matter?" "Yeah, I think it matters." That's my opinion, but there are people who don't.

Bill Walton ([00:30:47](#)):

Who?

Mark Mills ([00:30:48](#)):

The green advocates who keep saying we have to have 100% went to solar.

Bill Walton ([00:30:52](#)):

If you got the whole thing covered with mirrors, what's being-

Mark Mills ([00:30:55](#)):

Well, you're not going to be all covered with them because you're going to have the wind turbines are spaced.

Bill Walton ([00:30:59](#)):

They'll kill billions of birds a year.

Mark Mills ([00:31:02](#)):

Well, it's birds. I guess all of our society-

Bill Walton ([00:31:05](#)):

The blades, they don't last forever.

Mark Mills ([00:31:08](#)):

They're non-renewable plastic. Remember when the wind turbines was first built in California, when this era began 20 years ago. We'll give the Audubon Society credit for. They opposed them and call them a condor Cuisinarts. The Audubon Society called the wind turbines condor Cuisinarts-

Bill Walton ([00:31:26](#)):

Oh gosh.

Mark Mills ([00:31:26](#)):

... because they were worried about the condors being whacked by the wind turbine blades.

Bill Walton ([00:31:31](#)):

Well, they were, actually.

Mark Mills ([00:31:33](#)):

I like wind turbines. I like solar panels. I like electric cars. It's just this wired into me. I like machines, but I also like reality. The problem is, when you invent cheaper ways to make energy, society naturally goes to it, not complicate it. For certain applications and certain parts of the country and the world, wind and solar can be cheaper than building a next gas plant, or coal plant, or hydro dam, but not universally the case.

Bill Walton ([00:31:58](#)):

Do you want to talk about this chart?

Mark Mills ([00:32:00](#)):

Go ahead. They're one of my favorite charts too.

Bill Walton ([00:32:01](#)):

I want to talk about it. You bring a physics of energy.

Mark Mills ([00:32:08](#)):

That's the problem.

Bill Walton ([00:32:09](#)):

Educate.

Mark Mills ([00:32:09](#)):

When I talk about the limits to what you can do in energy, I read it down to the physics of energy. You can't make batteries as useful as oil because it's locked into the physics of the materials. So they say, "What do you mean? Just throw money at it. We have tech guys." I mean, I'm a tech bull because as you know my book's a lot about computing and technology.

Bill Walton ([00:32:32](#)):

Well, your PhD is in physics.

Mark Mills ([00:32:33](#)):

Well, I don't have a PhD. I quit graduate school. If I was smart, I would have quit undergraduate school like Bill Gates. Then, I could have been really-

Bill Walton ([00:32:39](#)):

You could have made some money?

Mark Mills ([00:32:40](#)):

Exactly.

Bill Walton ([00:32:40](#)):

Okay.

Mark Mills ([00:32:41](#)):

I stayed and finished undergrad. I quit grad. I was working. I like to make stuff though.

Bill Walton ([00:32:46](#)):

Well, you're a very successful polymath then.

Mark Mills ([00:32:49](#)):

Well, I just never settled in one subject. That was the problem. So, back to physics. Here's the fact. Let's do the energy. We'll do cars and airplanes because people are obsessed with that. For good reason, cars and airplanes are a big deal. They use a lot of the world's energy for good reasons because they produce something of value.

Mark Mills ([00:33:07](#)):

The most valuable thing in the universe is the time that we have to live on earth. It's irreplaceable. Almost no human beings ever lived more than a million hours. So, what is so much of what history has been devoted to is making our time available to do other things, which translates into speed, and convenience, comforts. It always takes energy. Airplanes and cars consume energy and they save something precious, our time. So anyway, how do we get there?

Mark Mills ([00:33:36](#)):

Well, you have oil, which is at a fundamental level which are molecules that have energy potential in them. I have lithiatic chemicals which have the fundamental physical chemistry that allows them to release their energy. If I forget the batteries, forget engines, just start with the underlying physical chemistry of the materials, which is where one has to start.

Mark Mills ([00:33:57](#)):

A pond of oil has 50-fold, not five-fold, not 5%, 50-fold more energy in it than a pound of lithiatic chemicals, 50-fold or in percentage terms that's 5,000%. So, I have 5,000% more energy per pound in a pound of hydrocarbons than I have a pound lithiatic chemicals. Okay.

Mark Mills ([00:34:17](#)):

Which would you want to use if you're making an airplane or a car? You'd start with the thing that has high energy density because when you make a vehicle, your goal is to carry cargo or people, not fuel.

Bill Walton ([00:34:27](#)):

You don't want a bunch of thousand pounds batteries in your airplane.

Mark Mills ([00:34:32](#)):

You could have in cars, it would be fine. There'll be millions and millions more electric cars because there are so many uses for cars. There are so many niches. I have no doubt about that. Will they replace all cars with the physics that we'd have today and the batteries we know we can make today? No.

Bill Walton ([00:34:49](#)):

So this chart though, you've got an energy density in biophysics, but we get elephant up there out in the upper right quadrant. Explain this to me.

Mark Mills ([00:35:00](#)):

I use that one because-

Bill Walton ([00:35:01](#)):

Who's this nice lady on the left?

Mark Mills ([00:35:02](#)):

I know. This was a screenshot from the 1950s cheesy science fiction movies where radiation was going to make everything become mutated, the big, the giant ants, and giant spiders. Of course, the favorite movies was the rampage of the giant woman.

Bill Walton ([00:35:21](#)):

This is it?

Mark Mills ([00:35:22](#)):

This is it. I think it was called the Attack of the something, Giant woman.

Bill Walton ([00:35:26](#)):

Giant woman, yeah.

Mark Mills ([00:35:27](#)):

Goofy title. Goofy movie. I show that because there's this ...

Bill Walton ([00:35:33](#)):

There was also them, which is about giant ants.

Mark Mills ([00:35:35](#)):

There was giant spiders that radiation was going to mutate everything and made everything big and horrible. It was a favorite theme in science fiction. The point of this is just like the King Kong movies of today, these giant creatures. They can't exist. It doesn't matter. They can't exist. So, the physics doesn't permit it.

Mark Mills ([00:35:53](#)):

So what this graph shows you is that there's one-to-one relationship between the size of something, in this case biological size of something, and the energy it has associated with it. So, it's a straight line or put differently. You can't make something the size of an elephant or 10 times that size like the giant woman, but use the energy that would be associated with something that was much smaller. You just can't do it, can't happen in the universe we live in.

Mark Mills ([00:36:20](#)):

Since you need energy to fuel everything, it just can't exist. It just will not exist. In comic books, it exists. In Hollywood imaginations they exist, but it can't exist in the universe we live in. Same thing as saying that can a battery ever get as good as an internal combustion engine?

Bill Walton ([00:36:35](#)):

Then a lot of our environmental study think tanks.

Mark Mills ([00:36:39](#)):

Well, I've used a line that people believe in unobtainium. They want all these perfect attributes.

Bill Walton ([00:36:47](#)):

Which element is that, unobtainium?

Mark Mills ([00:36:50](#)):

That's why, unobtainium. I want it to have high energy density. I want it to weigh nothing. I want it to cost me nothing getting out of the earth, and I want it to be free. Okay.

Bill Walton ([00:37:01](#)):

That's good. This is the Bill Walton Show. I'm talking here with the brilliant Mark Mills about everything.

Mark Mills ([00:37:10](#)):

Too much.

Bill Walton ([00:37:11](#)):

He's written a great book on the cloud and about how that really is such a huge, exciting thing for our future, but most of us don't understand it and don't understand what the implications are. We've got a chart here which shows the change of rate of information brought about by the cloud. Before getting to the chart, let's just describe why this is the basis for your book and why this is the key to the kingdom.

Mark Mills ([00:37:39](#)):

Well, it's always tough to pick a title for a book because it can misdirect people. The reason we ended up arguing and talking about starting with The Cloud Revolution is because it is a revolution. We have to first understand what the cloud is. Let me tell you what it isn't.

Mark Mills ([00:37:56](#)):

The cloud is just different from the internet as internet was different from telephony. We all know why the internet was important and different from telephony. You got mail of AOL days, which is very different, led to a very different trajectory than just the telephone.

Mark Mills ([00:38:13](#)):

The internet used the telephone networks initially. It's what it used. It used the exact same networks built on it. The cloud is not a communications meeting. It uses communications meeting. It uses the internet. The cloud is a combination of communications that are wired and wireless. So the wireless

revolution, the smartphone again was a big deal because it created networks of unprecedented flexibility and length that never existed.

Mark Mills ([00:38:38](#)):

We connect people with networks. We like cables. Once we went wireless, the magnitude of the networks self-evidently changed. It went from millions of homes to billions of people, and now to billions of machines all wirelessly connected. So we have networks and we have computing in the middle, the data centers, which is what they're called.

Bill Walton ([00:38:56](#)):

Well, the data centers as I understand, there are about 500 of them now?

Mark Mills ([00:39:00](#)):

There are thousands of data centers in the world.

Bill Walton ([00:39:03](#)):

The big ones are like a million square feet, bigger than the shopping mall.

Mark Mills ([00:39:06](#)):

The so-called hyperscale data centers-

Bill Walton ([00:39:08](#)):

Okay, hyperscale.

Mark Mills ([00:39:09](#)):

... which are far bigger than shopping malls, look like warehouses, millions of square feet. One square foot of a data center like that has more computing power than the whole world had in the early 1980s. So you have this massive expansion of an infrastructure, a physical infrastructure.

Mark Mills ([00:39:25](#)):

So, it's not invisible. The fact we don't see it, doesn't mean it's ... It's not virtual. So the cloud is in a physical sense the network of devices that we have. Our smartphones or things like that, laptops, tablets, networks that connect us and them to the cloud, to the data centers.

Mark Mills ([00:39:46](#)):

Then we have computers that engineers famously re-label these giant data centers as warehouse scale computers. Essentially a computer the size of a warehouse, which there are thousands. The hyperscale ones are the equivalent of the Burj Khalifa. They're like skyscraper equivalent, which there's far more them than there are skyscrapers in the world. So you have this-

Bill Walton ([00:40:10](#)):

Empire State Building was about two million square feet and a data, one of these.

Mark Mills ([00:40:14](#)):

We have hundreds of data centers with million square feet, exactly.

Bill Walton ([00:40:16](#)):

Okay.

Mark Mills ([00:40:16](#)):

So think of it in terms of what it does, what it is, why it's different than the internet. I'm not sending mail. Everybody that does Uber, or DoorDash, or Airbnb, mapping, these are not communications functions. As I say it, it's obvious. What you've done is you've asked a remote computer to do some processing, give you some advice, not instructions, but advice.

Mark Mills ([00:40:42](#)):

So it's not just a question, and relate counterparties and look at all kinds of variables to say, "Well, this counterparty would probably like this one," whether that's a place you're renting, whether it's a car ride you like to have, whether it's a financial transaction. That activity is what the cloud does. It's not just storing information like cat videos or five YouTubes of Spot the dog. It's doing processing, but it's not just doing computation, it's giving advice. It's giving ideas. It's helping in research.

Mark Mills ([00:41:15](#)):

So when we think about Zoom as a communications medium, which become very common, or YouTube is a way to broadcast, that's a communications medium. It's very powerful for that because it's a cheap way to do it. That's the least of it because what we are doing by this intermediating old businesses, whether it's in finance, the hot thing is FinTech.

Mark Mills ([00:41:33](#)):

Also true in healthcare. Already the one silver lining, there's a few silver linings in the great lockdowns, is we finally got rid of the ridiculous prohibition where you couldn't talk to your doctor, get medical advice or prescription in a video call. What a dumb restriction.

Mark Mills ([00:41:49](#)):

We know why the restriction was there in terms of licensing and safety, but we've long ago solved those problems. That's been wiped out by the great lockdowns. That's just the beginning of finding and improving the efficacy with which you could get access to expert advice of all kinds and get access to doing new kinds of things, education and training.

Mark Mills ([00:42:10](#)):

Remember when MOOCs started? Everybody was so all excited. They said that it was the end of universities, that massive online courses. It's not the end of universities. The cloud and online education is actually an amplifier for education, not the end of it.

Bill Walton ([00:42:24](#)):

Well, how does this get us out of what I call the new normal, where we're basically just being more efficient at ordering a ride, or food, or doing things we're already doing? How does this free up time? How does this make us more productive?

Mark Mills ([00:42:40](#)):

So the essence of productivity is easy to state because it's an economics 101. You want fewer inputs, less time, especially less labor and fewer materials to get the same or better output. Productivity is how wealth is expanded. Without productivity, there's no wealth expansion.

Mark Mills ([00:42:58](#)):

Until you can do things more productively, the only way people became richer was to steal other people's stuff. They stole their land. They stole their goods. They stole their people and enslaved them. That's how wealth was created to a few. If you expand the productivity-

Bill Walton ([00:43:12](#)):

Everything was zero sum until at 1750.

Mark Mills ([00:43:15](#)):

In 1500s you can argue, the Middle Ages, there was a huge wealth expansion because of again, the same kind of revolution we're facing today was the machine age. The first machine age, camshaft, water wheels, windmills to grind things. It was the dawn of the information revolution, the first information revolution. We understand processes though that created productivity. England became the epicenter of wealth because the first industrial revolution was at that time. So, it created more wealth for more people. More wealth, of course, is how we buy time.

Mark Mills ([00:43:49](#)):

Let's put this in energy terms. Time is measured in dollars. That's how human beings have always done it since before the age of the invention of money in pre-history. We measure in dollars. So for all of human history until the industrial revolution, which brought productivity fueled by hydrocarbons, between 70 and 90% of every economy's GDP was associated with acquired food and fuel. That's what it does to survive. The other 20 to 30%, you could do other stuff like educate, or entertain, or travel, or make your life more comfortable or interesting.

Mark Mills ([00:44:26](#)):

For now, until we foolishly reversed it, about 15% of the GDP is tied up with food and fuel. So, that freed up all the rest of the economy, freed up our time to do other things, which is why we have more literacy, which is why we have more comforts, why we have more healthcare. It comes from wealth.

Mark Mills ([00:44:48](#)):

So back to your question, how does the cloud give us productivity? Okay. Let's just do a very simple example. Any one of us imagine how much of your time it took pre-DoorDash to get food that way? Let's just say, or pre-Uber to get a ride, or pre-Airbnb to find something to rent. At the dawn of this concept, the airlines had to do this. They were forced to do it because of the complexity of their system.

Mark Mills ([00:45:14](#)):

They pioneered use of computing to take friction out of how you could coordinate all these complex relationships of flying person A to place B and have the right pilot. All these complexities take time. They're hard to do. Computing makes it happen quickly, effortlessly without friction. The more we do that, the more we increase the velocity of those things, things that have to be done to affect something.

Mark Mills ([00:45:40](#)):

Let's use a hyper specific examples in the news a lot, that the cloud and what's going on now will alleviate supply chains. We've rediscovered a supply chain. Well, what a shock. Alexander the Great understood supply chains. One of his historians would tell you and I both, one of the reasons he was so successful was because he figured out how to have a material supply train to his front line.

Bill Walton ([00:46:04](#)):

All the way to India.

Mark Mills ([00:46:05](#)):

Supply chains matter and they've always mattered. The thing about supply chains is they're always complicated. There are so many elements to it. The more global we are, we are more global. The more people there are and the more products there are, the more kinds of services there are. Of course, we have hundreds of services that never existed before. We have thousands of products that never existed before. All of them are complex.

Mark Mills ([00:46:25](#)):

Automobile used to be made from six different kinds of things. By things, I don't mean components. It was made from rubber, steel, copper, not much. You can count on two hands the materials that went into a car. Now, something like 800 different kinds of materials go into a car, not just-

Bill Walton ([00:46:38](#)):

Which is why we can't fix them.

Mark Mills ([00:46:41](#)):

It's also why they last so long.

Bill Walton ([00:46:43](#)):

Okay.

Mark Mills ([00:46:43](#)):

We're both of an age.

Bill Walton ([00:46:44](#)):

Well, that's true.

Mark Mills ([00:46:45](#)):

I remember tuning a car up pretty frequently.

Bill Walton ([00:46:47](#)):

I had a lot of cars that I spent a lot of time wearing the muffler back on to it.

Mark Mills ([00:46:50](#)):

Exactly. Mufflers don't fall off very often anymore. That's materials revolution. Spark plugs last 100,000 miles instead of being replaced every 10. That's materials revolution. Back to the productivity-

Bill Walton ([00:47:01](#)):

I remember doing my old car in the Bronx Expressway in New York. That was exciting.

Mark Mills ([00:47:07](#)):

I've had to repair cars in Canadian winters with taking your gloves off, trying to make the thing to start.

Bill Walton ([00:47:14](#)):

The good all days.

Mark Mills ([00:47:15](#)):

I'll take the complexity if it buys me reliability, which is what it's done.

Bill Walton ([00:47:20](#)):

If you have the time, I'd like to do a bonus segment here because I've got about as usual. I got about 5% of stuff I want to cover with you. This is Bill Walton Show. I'm talking with Mark Mills. We're talking about the cloud and all the exciting things it can do for us.

Bill Walton ([00:47:36](#)):

I want to ask the question you don't really cover in the book. I want to speculate here. Are we a lot more vulnerable because all of our information's up there, and we've got all these big data centers? We live in a world with a political class and an aggressive China, and people who want to be disruptive.

Bill Walton ([00:47:55](#)):

Peter Pry came on talking about EMP and the vulnerability we have. It seems like the more we put in the cloud, the more we lose control of our own information and our day-to-day. We lose control of our personal security. We've seen with social media companies. We become more susceptible to censorship. I mean, it seems like there's a dark side to it as well.

Mark Mills ([00:48:18](#)):

The yin and yang of technology has always been there.

Bill Walton ([00:48:24](#)):

Let's explore that.

Mark Mills ([00:48:26](#)):

I'm not naive about it, and I don't ignore it in the book. In fact, not to be facetious, probably the first piece of technology ever invented by humans. Humans are wired to advanced stuff. It was the sharpened stick to get food. Well, it was also used for other things, right?

Bill Walton ([00:48:43](#)):

Yeah, too bad.

Mark Mills ([00:48:45](#)):

Sometimes people. So, while I'm an inventor optimist in the sense of particularly about United States, I do begin my book pointing out that it's possible to Sovietize an economy. We know that because the Soviets did that to their economy. In the 20th century's gain, and wealth, and productivity that was enjoyed by American, Russian people didn't come close to getting the same benefits.

Mark Mills ([00:49:10](#)):

So, politics matters. Politics matters enormously. We can destroy growth. Governments can destroy growth, inhibit growth. It's not nothing. I guess I would say technology can't fix stupid, obviously.

Bill Walton ([00:49:25](#)):

You make an important point of the book that the future is what we believe it will be.

Mark Mills ([00:49:28](#)):

Yes.

Bill Walton ([00:49:30](#)):

So setting expectations-

Mark Mills ([00:49:32](#)):

Exactly.

Bill Walton ([00:49:32](#)):

... and providing leadership that was potential for the future, which is utterly what we don't have in today's leadership, which is gloom and doom.

Mark Mills ([00:49:44](#)):

Again, I'll quote Joel Mokyr, the economist at Northwestern. I say again, he's a Nobel class economist, brilliant guy, had written some amazing stuff. What he said is first line in one of his most recent books was economic growth depends, and I'm close to exact quote. Economic growth depends more on what people believe than most economists care to admit. Now, not believe naively.

Bill Walton ([00:50:09](#)):

What do you mean? Amplify it.

Mark Mills ([00:50:11](#)):

If you don't feel optimistic about the future, if you don't believe ... By that he didn't mean I believe I can fly like a bird jump off a cliff. He was talking about believe in a better future. If people are optimistic about conquering problems, there are always problems, both environmental, social, physical, mechanical, risks, geopolitics. If you're not optimistic at some level about it, society's ability to conquer these problems is diminished or even destroyed.

Mark Mills ([00:50:39](#)):

So, I think that's true. I think the point of my book was to paint a picture of what's been invented that promises remarkable advances in workplace, healthcare, our productivity, wealth expansion, all the things that we talk and care about have solutions not perfect. So we're back to your point on cybersecurity and loss of our personal controls.

Mark Mills ([00:51:04](#)):

Of course, the social media, the social tech giants have taken control of the news business. This is not the first time we had struggled with the issue of news, news fairness, news accuracy. We've been through this battle before. It's an important one to fight and get right. I'm not naive about the dangers of an environment where people can't speak freely. I think that's true for a lot of Americans.

Mark Mills ([00:51:31](#)):

We're having that fight now to resolve the mechanics of who gets to say what, where, and when. I'm very optimistic about how we'll work it out, but I'm not naive that it will take some fighting to get worked out properly. Just as again, a calibration point. 1920s, I picked up there were 20,000-

Bill Walton ([00:51:51](#)):

Hey, you got a good chapter in the '20s about how there was the boom, but there was also a lot of darkness.

Mark Mills ([00:51:56](#)):

A lot of dark stuff. There were 20,000 newspapers in United States then. Many of them published three times a day. That's the dawn of yellow journalism. How would you get eyeballs, so to speak at that time? Same thing we call click bait today. They made news up.

Bill Walton ([00:52:09](#)):

Fake news.

Mark Mills ([00:52:10](#)):

Fake news. It was fake news then, literally made up news. Of course, all kinds of negative fallouts from that as well as positive in the sense that there was more information that flow. On security, the reason I'm optimistic that we'll have more control over our privacy and more control over securities because those features of security are information features.

Mark Mills ([00:52:33](#)):

Now, it's extremely difficult to provide security physically. If it's army, it still requires guns and boots on the ground. They just does and explosives. People don't like that, requires cops. People may not like that. Those things have never changed. They've never changed and they're no easier now than they were. In 1920s, we had massive race riots.

Mark Mills ([00:52:52](#)):

Information security can be improved with other information tools. Information tools get better at exponential rates, nothing else does. So the kinds of solutions to a security which is the word blockchain, which you've heard. This class of network offers a security potential that really is unprecedented information domain.

Mark Mills ([00:53:14](#)):

So, I'm very optimistic that we can see a near future where you're going to feel a lot more comfortable about your personal information, your control of it, and the transparency, but it still require sensible approach on regulation and governance. If we do it in a heavy-handed way, governments are never good at setting frameworks for industries when they're heavy-handed.

Mark Mills ([00:53:36](#)):

Well, I'll use an example again from history. Pre-World War I, this was the dawn of the Interstate Commerce Commission. It was created to regulate the railroads because they were getting too big, too powerful. There are monopolies. They changed the world. The transformation from agrarian to post-agrarian society is marked not by the car, but by the railroad that changed America.

Mark Mills ([00:53:59](#)):

Those who brought it, brought incredible benefits to people. Lower cost transportation, lower cost food, lower cost materials. It was all to the benefit of the consumer. They didn't do it for the consumer in that sense, but it all benefited consumers. Yet, they got big and we wanted to break them up to control them, Interstate Commerce Commission.

Mark Mills ([00:54:15](#)):

That resulted in the demise in the railroad's efficacy unfortunately right before World War I, which caused the government to do what? Take over the railroads and make them even worse.

Bill Walton ([00:54:26](#)):

That worked out really well.

Mark Mills ([00:54:28](#)):

Well, exactly. We're at that point again where we have that risk where the government would say, "You know what? I'll run Facebook and Google." We aren't there yet.

Bill Walton ([00:54:39](#)):

I'm not a fan of that at all.

Mark Mills ([00:54:41](#)):

Do you want to break them up? Breaking up is probably not the right word. I mean, it's hard to agree with Mark Zuckerberg, but it's advertised as about getting the regulations right for news and social media. It's right about that. The detail is, what does that mean? The size is not the problem. As you and I both know, it's your ability to actually have a voice and not be blocked by somebody who has a different opinion.

Bill Walton ([00:55:04](#)):

Well, I think about that is that I don't think breaking them up is even remotely a good idea, because you're going to instill up with the same kind of dynamics-

Mark Mills ([00:55:12](#)):

Sure.

Bill Walton ([00:55:12](#)):

... because of who would be running them.

Mark Mills ([00:55:14](#)):

Yes.

Bill Walton ([00:55:15](#)):

It's almost better to keep them bigger and watch them and have some sensible regulation, but then you ask the question, "Okay. Who are going to be those sensible regulators?"

Mark Mills ([00:55:22](#)):

This is the problem. Now, you're on the slippery slope towards how we got Ma Bell. So, we ended up with Ma Bell because we believe that communication was very important. So, we anointed a single operator for the whole country, and we regulated them.

Mark Mills ([00:55:38](#)):

We did okay. There were people who were pretty happy with that, but it stifled innovation for sure. Until they were deregulated, we didn't get innovation.

Bill Walton ([00:55:48](#)):

One last question, then we got to get out of this because you're going to come back.

Mark Mills ([00:55:53](#)):

Happy to.

Bill Walton ([00:55:53](#)):

We got more to cover. The external threats, China. I worry about them disrupting our cloud. I mentioned EMP. How vulnerable are we if somebody is knocking out a bunch of these data centers and all of a sudden we lose access to all this great information?

Mark Mills ([00:56:14](#)):

Well, the EMP won't knock out the data centers in the sense that you're talking about. It can knock out the power.

Bill Walton ([00:56:18](#)):

Okay.

Mark Mills ([00:56:19](#)):

What keeps them lit. All data centers of consequence have backup power. Usually, diesel generators by the way, back to hydrocarbons. Oil is easy to store. Generators are cheap and powerful. So, you keep them surrounded by lots of big diesel generators. An inconvenient fact, let's just call it.

Mark Mills ([00:56:35](#)):

I'm worried about China too, but my worry ... I'll just do short term and long term quickly. In short term, of course, there was a serious competitor in every sense, and there are serious threat in other senses, can't be naive about their political aspirations. They're very different than ours.

Mark Mills ([00:56:52](#)):

I'm not talking about the Chinese people. I've been to a dozen cities in China. I like Chinese people. I've met hundreds of Chinese engineers and dozens of their companies. Best, we're talking about the politics, the government.

Bill Walton ([00:57:03](#)):

Chinese Communist Party.

Mark Mills ([00:57:04](#)):

Chinese Communist Party, they have different goals than we do. The Chinese have a problem. It's a problem that means that I think the 21st century is America's century, not theirs. Their problem is just two things. Demographics, 2020 was the year that their growth rates went negative, not because of Covid, but because of demographics.

Bill Walton ([00:57:28](#)):

Population growth.

Mark Mills ([00:57:29](#)):

Population growth is going negative.

Bill Walton ([00:57:31](#)):

One-child policy, et cetera.

Mark Mills ([00:57:33](#)):

United States will be a country of about six or 800 million people in 30 or 40 years. They'll be a country of about a billion change. They'll be smaller and we'll be bigger. More importantly with demographics, we'll be a younger country than them. Demographically, that's profoundly important, economically profound.

Mark Mills ([00:57:49](#)):

They're getting older, and we're not getting older at the same rate. Set aside whether we should have more or less immigration illegally or legally. Obviously, I'm an immigrant, Canadian. I vote for legal. I like immigration because it's always infused America. We have immigration and birth rates combination, which are very good for our country.

Mark Mills ([00:58:09](#)):

The Chinese system, the communist party is very nervous about entrepreneurs who feel free to do what they want. They really are. They've just clamped down recently. You do not get next generation innovation in that kind of environment.

Bill Walton ([00:58:22](#)):

I'd say that's the third big factor.

Mark Mills ([00:58:22](#)):

It's a big factor.

Bill Walton ([00:58:24](#)):

What Xi is doing is really killing the golden goose.

Mark Mills ([00:58:26](#)):

He is. So, what he's counting on is inertia from using yesterday's technologies to make stuff for America like solar panels and cheap microprocessors. We make the expensive ones. They make the cheap ones. That trade gives them money and gives them revenue, but he's not creating the seed corn for the future.

Mark Mills ([00:58:45](#)):

In fact, as I document in my book and as you know, I have hundreds of citations. I make the point, and I think it's correct. Not only are the leading universities and innovators in the research domain dominantly in America, but the leading inventions, majority of new things being invented, things like bio-electronics, and next generation therapeutics and pharmaceuticals, next generation robotics and materials, they're being invented in the United States.

Mark Mills ([00:59:12](#)):

We utterly dominate the world in the long term stuff. In the long term, guess what? The long term stuff matters. So for the 21st century, I think China has a problem.

Bill Walton ([00:59:24](#)):

Which is getting back to the thesis of your book or one of the thesis is that this stuff that's been recently invented. That's also the leading edge that converges to create the tremendous growth, and they're not doing that.

Mark Mills ([00:59:37](#)):

They're doing very little of it.

Bill Walton ([00:59:38](#)):

Okay. This is Bill Walton Show. I've been talking with Mark Mills, who's written a terrific book, The Cloud Revolution. It's much, much more than that. It gets into all sorts of aspects of work life, and history, and future. It's a treasure trove of very interesting stuff.

Mark Mills ([01:00:00](#)):

Thank you.

Bill Walton ([01:00:01](#)):

I thank you for writing it. It had to be prodigious to pull this together.

Mark Mills ([01:00:06](#)):

Thank you for promoting it. When you write a book, you want somebody to pay attention.

Bill Walton ([01:00:08](#)):

Well, I'm paying. We're paying attention. I hope you all are paying attention too. Anyway, thanks for joining. Thanks, Mark.

Mark Mills ([01:00:14](#)):

Thank you, Bill.

Bill Walton ([01:00:14](#)):

We'll see you again next time. Of course, you can find us on the [billwaltonshow.com](#). Also, we're on CPAC NOW on every Monday nights. You also find my radio gig on China with Frank Gaffney on Frank Gaffney's radio station on Mondays as well. So, thanks for joining. Mark, get you back again soon.

Mark Mills ([01:00:35](#)):

Right. Use the evil Amazon machine to buy my book Cloud Revolution.

Bill Walton ([01:00:38](#)):

It's on Amazon. It's already got five-star ratings.

Mark Mills ([01:00:43](#)):

Good.

Bill Walton ([01:00:43](#)):

It's very highly rated. So, a lot of people agree with us.

Mark Mills ([01:00:47](#)):

That's good.

Bill Walton ([01:00:48](#)):

Okay. All right, Mark. Thanks.

Mark Mills ([01:00:50](#)):

Thank you.

Bill Walton ([01:00:50](#)):

Thank you.

Speaker 4 ([01:00:52](#)):

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Speaker 4 ([01:01:12](#)):

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