Allan Tweddle

Interviewer: Michael Kline
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Michael Kline: **0:00:02.4** Okay, so today is the 16th of January 2014, and I'm Michael Kline. I'm here with Carrie Kline, and it's a beautiful day here in Charleston, West Virginia, on Southeast Virginia Avenue. Would you please say, "My name is," and introduce yourself?

Allan Tweddle: Yeah, my name is Allan Tweddle, T-W-E-D-D-L-E.

MK: And your date of birth?

AT: I was born August 16, 1932.

MK: In '32, okay. If you would Allan, maybe just start off here and tell us a little bit about your people and where you were raised.

AT: Well, I was raised in the Toronto area and was, in fact, a high school dropout. And I bummed around, pumped gas, drove a truck, did things that dropouts do until my mid-20s, realized that was pretty dumb. So I actually went—in those days you could—I went back to high school in Toronto and graduated from high school. It took 2½—a year and a half in 1 year, and at that time grade 13 was required to get into university in Ontario. I didn't want to spend another year with a bunch of young teenagers. I was in my mid-20s and so on, so I started looking around for an American university to attend, because I wanted to get an engineering degree. I was told by the Association of Professional Engineers for the Province Ontario that only 5 universities in the United States at that time would be acceptable without me going back and going through some sort of rigorous examination and so on. And the only state school was Michigan, so that's how I wound up going to Michigan. I also had a strong interest in the automotive world, so that's another good reason to go there. So I went to Michigan, then I went back to Ontario when I graduated—sorry, went to Montreal when I graduated—and immediately was working with a company that dealt with air pollution and air quality in everything from surgeries to steel mills.

MK: The name of the company?

AT: The company was American Air Filter of Canada. The American firm was based in Louisville, Kentucky. I evidently satisfied their performance requirements. They very quickly promoted me to run the Ontario operation, so I became the manager in Toronto, which was my home. It was great to go back home. But after only a couple of years of that, they wanted me to

then go and take over Southern California, so I did. So I had jumped from being a sales engineer in Montreal to running an operation in California that was actually probably close to the population of Canada. So that's how I got to California. And they wanted me to move back there. The next step was to move to Louisville, Kentucky, and I'm a sailor, and I'm sorry. You can't do much on the Ohio River in terms of the kind of sailing I was doing. So I switched to their competitor who was headquartered in Los Angeles and became their national sales manager. And I later went out on my own. I switched from the companies—the suppliers—to engineers and architects over into the design professions themselves and rose up through several firms and finally wound up president of an architectural firm in Los Angeles called Theodore Barry and Associates. It no longer exists. And we did a lot of things essentially in manufacturing plants and the film studio. I was responsible for the entertainment industry, so I had all the studios as clients, but I also had Lockheed and Rockwell and Hughes Aircraft and big aerospace companies as clients, as well. So, it was a good experience. I then went out on my own, and I've been on my own ever since. So as the partnership started to break up, sort of a divorce among the partners, and that firm has since been, I understand, absorbed somewhere else. It doesn't even exist today. But that's okay. It was a good move for me.

0:04:39.8 And, well, to wrap it up, the '94 Northridge earthquake got my wife Barbara's and my attention. I had met her in graduate school. We both had put ourselves back in school. I went back and got my MBA at age 50, and she was there in the same executive program. Long story short, I first started working with her, and then we became personally involved, and we've been now married for 26 years. After, as I say, the Northridge quake sort of, if you'll pardon the pun, shook us up, we decided to leave the more challenging life of Southern California and come back here to West Virginia where her family home was sitting empty. So that's how we got back to West Virginia.

I since became involved here, as I think you know. I was on the West Virginia Environmental Council as a lobbyist. Governor Manchin appointed me to the West Virginia Public Energy Authority, which unfortunately hasn't accomplished very much, if anything.

MK: What is it supposed to accomplish?

AT: Well, the West Virginia Public Energy Authority, or PEA, has some interesting powers including the power or eminent domain over any energy-generating cycle of any kind. We could do an eminent domain on a power plant, on transmission lines, and so on. But it's never done that. What it's supposed to do is hammer out logical policies for the governor and the legislature on where the future of energy is going in West Virginia. But that's like beating your head against the wall, because if it doesn't include coal as a dominant force, nobody's interested, and that's what, to me, is very, very sad. And if you like, I'll give you one example that goes back to my home connection.

In 2003 and 2004, the province of Ontario, the governor and the Minister of Health and the Minister of Energy were—primarily the Minister of Health—was trying to figure out why the healthcare costs were spiking in certain parts of the province. They were way over all the other areas until he realized that there was an air shed—air shadow connection of these people and their lives to coal-fired power plants.

MK: An air shadow connection?

AT: Yeah, in other words they were downwind from the plant. The pollution coming out of the plant was falling on these people. Well, Ontario has control and ownership of all the means of power generation. There is no AEP in Ontario. It's a government—quasi-government company—what we would call in Canada a Crown Corporation—that generates, and a separate one that distributes electricity around the province. There's 1 or 2 tiny power companies located in remote areas of the province, but the majority of the power for Ontario comes from the Ontario Power Authority and the Ontario Power Generation Authority, I think it's called. I forget that right now. It used to be called Ontario Hydro, because the bulk of the power came from the hydro-dams at Niagara Falls way back when.

0:08:30.1 Well, when they studied—they called for a 2-year study—of why the health spikes in the vicinity of coal-fired power plants, they realized that if they got rid of the coal-fired power plants, that health problem would go away. But one of the financial conclusions they came to is that coal-fired power plants, when you add the price of healthcare and you add the price of environmental damage to the price of coal, then coal turns out to be far more expensive than even solar energy. So, the province embarked in 2005 on a major policy step—to shut down all their coal-fired power plants. Now, that's not an easy thing to do, because these plants were huge. One of the largest coal-fired power plants in North America, in fact, was located just outside of Toronto. And that process was completed just this last fall, and they've replaced it with solar energy, wind, some geothermal. They have 51% nuclear and those plants are aging, so they've got a problem there too. But the interesting thing is, it's my understanding that in doing this, the cost of power went down so much they've actually had a slight reduction in power rates, and of course, they're saving all the money that they were spending to fix cancer, asthma, heart disease, and everything that was being caused by coal-fired power plants. So, Ontario now brags—I just saw a headline about a week ago, and I was trying to find it again to show you, and I will find it for you—"Ontario is Now Coal Free." That was a big headline in Toronto.

MK: Exciting to people there.

AT: Yeah. So, you know, to me that's not just something happening as an isolated event in Ontario. It is the future, because there are lots of studies—I could get you some references of analysis by independent scientific organizations and economic sources—that will tell you that coal is far more expensive than renewable energy. But solar is cheaper than coal if you attribute the real total cost of coal that includes healthcare and environmental damage. But the industry is so powerful and so in control of the legislature here, nobody's even going to think about what the alternatives might be and press hard at all for solar energy or wind energy. Now, wind energy is happening in the States. Solar is beginning to. But the coal industry—and the other is fossil fuel—people have done an excellent job of convincing everybody that solar is too expensive. I even had a conversation when I was first on the Public Energy Authority with Governor Manchin, and he said, "Well Allan, solar won't work in West Virginia." I said, "Governor, who told you that?" He said, "Well, you know, the people that advise me told me." I said, "Well, you tell Bill Rainey he doesn't know what he's talking about."

MK: Bill Rainey is—?

AT: **0:11:58.3** —is head of the Coal Association. The Ontario government has now got what's called a CSP plant—concentrated solar power plant—in Sault Ste. Marie. The governor's claim was that we're too far north on the globe to get the benefits of solar energy. You've got to be down near the equator or you've got to be in Arizona, or solar doesn't work this far north. I said, "Really? Then why do you suppose the Ontario government is building a CSP plant in Sault Ste. Marie which is on the north shore of Lake Superior, or where Lake Superior and Lake Huron join? So, whoever's telling you that is wrong." And Germany has less sun available to them than we have in West Virginia, and Germany is on track to achieve a 30% solar energy by 2020. And they've done it by introducing what's called a F.I.T. Program. That's F-period-I-period-T-period, and it stands for feed in tariffs, in which they add a few pennies—maybe not as much as 25 cents —to everybody's utility bill, and they've built a fund that then helps to subsidize people buying solar systems. Now, that's one way of doing it. And the F.I.T. Program has actually expanded around the world. Ontario has one. Several states are now getting into a F.I.T. Program. It is a logical way for everybody to share in the cost of the transition from coal to alternative renewable energies. Now, the coal industry and the fossil fuel guys will argue, "Oh, you're doing nothing but subsidizing those industries." And coal is not subsidized? It's one of the most heavily subsidized—oil and coal are one of the most subsidized industries in the United States. And anybody that argues against that, there's all sorts of citations to back that up.

Carrie Kline: Talk just a little bit about it.

AT: Well, look at the roads. I mean, look at the damage due to these heavyweight trucks. The legislature a couple of years ago, when it was revealed that the coal trucks were running around the state with up to 180,000 pounds in one truck when the legal limit is 80,000 pounds on any US highway, and the West Virginia highways had the same legal limit. So they got through the legislature. They moved the state's standard up to 120,000 pounds under pressure from the coal company. Never mind the fact that that means these trucks, which have been beating up the roads, are allowed to continue to beat up the roads. And there's virtually no enforcement. These guys still load their trucks to 180,000 and are running all over the countryside. Now those drivers, some of them independent truck operators, are trying to feed their families, and they work on a per-ton basis, and so they're racing back and forth to carry as much as they can in a given day. So, you know, their personal lives are dependent on how much they can earn. But who pays for the roads? We do as taxpayers. Who's going to pay for all this pollution? Do you think the coal industry? The governor's already said 3 times in his first press conference, "This is not a coal industry problem." Sure it isn't. Why is that chemical there? One purpose—to clean coal.

CK: What chemical are you talking about?

AT: The chemical that just spilled into the Kanawha River—MTMH, I think it's called. It's got a name about 6 inches long, and it's unregulated. It is virtually a chemical that nobody knows anything about it. And it is used to clean coal. It's one of the chemicals they put in with the water when they clean the coal. Now I don't know if you knew this, but in West Virginia, the coal industry uses about 5 tons of water to clean 1 ton of coal. So these ponds—don't you love that

word? I mean, when you say the word pond, don't you imagine like the Matisse painting and lovely pond with lily pads and—you know—it looks wonderful—little goldfish jumping up. Marsh Fork Elementary School has a pond behind an earthen dam which has never been seismically tested, I'm told, and I'm an engineer from California. You don't build anything without seismically defining how it will perform in an earthquake. And we're in an earthquake country.

CK: We are?

AT: **0:16:48.1** Oh yeah, Appalachia is—the mountains—we're earthquake state place. Do you know where the biggest earthquake in the history of the United States took place? Any idea? It was epicentered in St. Louis. It reversed the Mississippi—the Mississippi or the Missouri River. It rang church bells in Washington, DC.

MK: 180—?

AT: 18-something, yeah. I've forgotten.

CK: So you don't do anything without seismic testing.

AT: You should never build anything without seismic testing. When I see buildings going up around here, and I look at the structures, I think to myself, these guys—good God. If they ever had a Richter of 8, that building would collapse.

CK: A what?

AT: Richter. We design—in California, we have to design to withstand a Richter of 8. Anyway, back to Marsh Fork. That dam is holding back—the last number I saw—was 3.2 billion gallons of toxic waste. Now, the assumption is it's going to stay there in perpetuity. Well, wait a minute. Coal companies come and go. They bankrupt themselves to avoid liabilities all the time. That's their history. They're one of the worst in that in the United States in any business. They're constantly doing that. Look what's just happened with Patriot and Arch and so on, transferring all the liabilities that screwed the miners out of their pensions and so on that's just gone on. They pay lawyers millions in order to avoid their own liabilities. The pond behind Marsh Fork Elementary School is a disaster waiting to happen, and I believe the number is—I'm not sure of this—1200 ponds like that around the state. Well, why are we allowing that? Why are we wasting our precious water to clean coal when the technology, in fact, exists to clean it without water. You do not need water to clean coal. You can clean it with air and air dry it in ovens. Well, it would add cost. It might hurt the profits of the coal company. God forbid. So we waste our water. And I had a number here I found recently of—

MK: Take your time.

AT: Well, this was an interesting number. The National Academy of Science estimates—now here's where the cost of coal is so artificial. The National Academy of Science estimates that 120

billion a year is directly attributable to healthcare costs due to the fossil fuel energy production industry.

MK: $120 billion a year?

AT: **0:19:48.0** Yeah, a year is attributable to illness caused by coal-fired power plants and other fossil fuel sources. I haven't read that study, so I don't know for sure.

MK: Repeat the amount again.

CK: And say dollars.

AT: $120 billion per year. And 49% of the water that's used in the United States is used for power generation. None of us can survive more than a few days without water. We can only survive a few minutes without air. And yet we allow these industries to consume our water and to pollute our air. Because the constituency of normal citizens who are working stiffs, they've got to get to work and worry about their family and have a life, don't have time or aren't organized in order to resist against the huge lobbyist army that's well paid to maintain that status. And I don't know when it's going to end, because it's going to economically ruin this country. And healthcare costs are going to ruin this country as they continue to explode. And that's related to coal, in our case, in this area. But healthcare costs are across the country related to it.

I'm building my manufacturing business in Ontario because they have this silly idea called universal healthcare that everybody has a right to healthcare. It isn't a privilege. So there's no insurance companies involved in healthcare in Ontario, unless you want to buy a Cadillac policy that says you get your own masseuse and a vibration bed in your hospital room—something silly. And I don't think they pay for Viagra. They consider that not necessary healthcare. But the basics of healthcare in Ontario and all across Canada, which was introduced by Tommy Douglas in 1960-something—I can't remember his—he was premier of Saskatchewan. And, by the way, Kiefer Sutherland is his grandson. Well, he introduced universal healthcare, and it's a success in Canada. And as a result in my case, my payroll burden for my factory technicians, which are fairly well-paid aerospace technicians—my payroll burden here would be 36%. In Canada, it's 18%. Now, that's a significant differential when you start thinking about paying workers starting salaries of $60,000 a year, and I'm going to have—hopefully if our forecasts are realized—we're going to have a good 250, 300 people working in the plant. Well, you take 18% of the payroll on those kind of workers, and that's the differential between here and there. So the economics of being here versus the economics of being there are just very simple and straightforward, and it's healthcare costs.

So we need a universal healthcare in this country. But while Obama was in favor of it at one point, he doesn't seem to be in favor of it anymore, and probably because he got into the White House and realized that the reality is, he'll never get it through Congress. So he had to go for what he did, the Obamacare plan, as it's called. I called it a stumbling good start in the right direction. Can we get to universal healthcare? Not in this Congress. In the future, in my lifetime? Well, I'd like to think so, because it's killing us economically around the world. We're the only

Western country that does not have single-payer universal healthcare. So, that's another soapbox of mine.

MK: That's a great one

AT: **0:24:16.2** (laughs) I don't know what else I can tell you. Oh, there's an interesting company, an interesting story, that shows you what can be done. There's a book called *Creating Climate Wealth* and it's written by a man named—I think his name is Jigar—J-I-G-A-R—Shaw. That sounds like he's either Indian or Pakistani descent, I don't know, but he was born in the United States, and he's been totally committed to solar energy since he was a little boy. He just always felt it was such a logical thing, and it is. I mean, the sun delivers enough energy in 24 hours to the earth to power the earth for 22 years. (laughs) That's how much energy.

MK: Say that again.

AT: The sun—this is an estimate that's been done by some scientists, and I can't remember the source now. I could search it out. And even if it's off by a factor of 10, it's pretty impressive. Or even a hundred. The sun delivers in 24 hours enough energy to power the earth for 22 years. So, why are we burning coal and poisoning the planet? We've done it for over 100 years. We now realize—we have the scientific evidence, and we have the technical options—optional systems—that are economical—that we should be transitioning, and we must. The climate change crisis is bloody serious. I'm sorry, that's my Englishman.

MK: That's all right.

AT: This climate crisis is far worse than most people realize. I've been conducting a personal survey of all my friends and all my business contacts, when we're having lunch or at business meetings or something. I'd say, "Oh, by the way, can I ask you one more question?" I'd say, "I don't want to get into discussing the issue, I just want to ask you a question. Do you ever discuss with your colleagues, your family, your children, your relatives, your neighbors the subject of climate change?" I have yet to find anybody to say emphatically yes. I've had 2 out of maybe 40 people I've talked to have said, "Well, yeah, we talked about it when there was something in the paper about it."

The general public is not aware of how serious the climate crisis is. There's—and I could get you some citations and some papers to look at—but there's scientific evidence that 2 generations out, we're in trouble for one reason. We will adapt as humans. We've always been very adaptive, because we can think and reason through alternatives. Other animals can't. And plants certainly can't. What the problem is going to be is that we're going to lose our plants as food. That's already beginning to happen around the world. And our fresh water supplies are disappearing. They're going down while the population is going up. So we're on a collision course here. And I would predict the next wars are going to be fought not over oil but over water. It's just so critical to life. Nobody ever died because they didn't have a drink of oil or couldn't get lunch with a coal sandwich. You must have water to live. You must have air to live. And we ought not to be messing around with either one of those at all.

So, but the alternatives are out there that are economically sound, and we can transition to them. One of the alternatives that I suggest, or I offer— When I first started as a young engineer in 1961 in Montreal, one of the industries I was peripherally involved in—not very close to, but I knew people who were—was a mining industry in Quebec that relied on severance taxes to support the legislature. Sound familiar? Very little in terms of regulatory coverage of it, although it was beginning to emerge, until scientists and health officials began to realize that as a material out in the open with the public, it's very, very dangerous to human beings, the miners, the workers, all of us, and so on. What was the material? By the way, that industry died—that mining industry—died in less than 10 years, because we realized there were more economical alternatives that were safe, that were clean, would do the same job, and not cause problems. There is a town in Quebec named after that mineral, and the name of the town is Asbestos. And I have looked at this, and I see the parallels between coal for power generation and asbestos. There is a movement as Ontario has shown and other jurisdictions are showing where, get rid of the coal. It's against the law—it has been for as long as I can remember—to have coal-fired power plants in California. They've never had a coal-fired—well, I should say never. I don't know if they ever did before. But about 10 or 15 years ago, they even outlawed power from coal-fired power plants out of state, which was a political hassle because there's a couple of coal-fired power plants on Indian reservations in, I think, Utah or Nevada or somewhere, and they were literally cut off from being able to sell power in California.

0:31:02.0 So I mean, there are jurisdictions who aren't bought and paid for by the coal industry around the world and around the country who are moving away from coal and finding it economically sound policy to do so. I've even told Bill Rainey he ought to take his pension and run with it and invest it somewhere else.

MK: What did he say to that?

AT: Oh, he laughed, "Oh Allan!" You know, just laughed. I said that to him many years ago. It's—we've got to stop killing the planet, and that's what we're doing. We're approaching 400 parts per million of greenhouse gases in the upper atmosphere. It has been 275 plus or minus 25 for, I want to say, 12 million years, some long period of time. It's spiked up and down. A volcano can kick it out, cause problems. But man started polluting the air with greenhouse gases in the middle of the 19th century when the Industrial Revolution took off. And one of the earliest scientists warning of this— and I meant to look up his name—one of the earliest scientists warning us of the pollution of greenhouse gases from coal was a scientist in England in the 1800s. So it's not as if it's a new discovery. And whether you read his works or you come all the way up to—what's his name?—Hansen at NASA or whatever—

CK: James Hansen?

AT: Huh?

CK: James?

AT: Yeah. James Hansen, who's brilliant. He really knows his stuff. And I have a friend I've gotten to know who's retired now from my alma mater, a former professor of I guess geology.

I'm not sure of that. But he's a professor emeritus from Ann Arbor who's written a book called *A World Without Ice*. Now this is a man who, his entire career, has studied ice. And his name is Henry Pollack, and he's just so knowledgeable and so terrific. You get up and hear a lecture from him, and you want to get up and scream, "Why are we doing what we're doing to the planet?" He has studied icebergs. He's studied the ice on the Arctic, the Antarctic. He's studied the ice coming off of mountains—what do you call it—that slowly creep down the side of a mountain—

MK: Glaciers.

AT: **0:34:16.3** Glaciers, yeah. And how they're receding and raising the levels of the ocean. You know, the Arctic north of us here has already come close to going through a complete summer without any ice. And it looks like it's going to get worse this year. And that melting of that ice is killing the polar bears, because they can only swim so far looking for food. There's many an observation of a mother with cubs trying to swim to the next floe, and the cubs don't make it because the floes are so far apart, and the food's disappearing. There's no word in the Inuit language for robin. They had to invent a word for robin, because up until about 15 years ago, they'd never seen a robin in the Arctic. Robins are now found in the Arctic. There are some —and I've heard a couple of numbers, but let's—there's some 1300 little tiny Inuit villages all around the coast of Alaska, which is the longest coast—well, it is the longest coast of any state—that are going to have to be moved because the ocean's creeping up on them. And these are villages that have existed, they think some of them, for 10,000 years. These natives have lived there and fished those waters throughout history, and now the erosion and the damage to their villages is such we're going to have to move them. Some of those villages are going to cost $1 or $2 million each to move them to higher ground. Well, who's going to pay for that? Should we send the bill to the coal industry? Because it's happening because of climate change. Now, there's one item. I have friends in Alaska, and I track Alaska through—there's an environmental Alaska organization that I track. I had the lady here come and speak to several people. The governor didn't have time for her, so they pushed her off on a bureaucrat who was a waste of time. The lady had come all the way from Anchorage, but she was incredibly knowledgeable about what's going on up there.

Now, as I say, we're creeping up. We've gone from 275 parts per million, we're creeping up on 400 parts per million. Over 400 has actually shown up in some areas. We're worried that it's going to get to 450 and maybe even 500. If it gets to 500, we're really in serious trouble. Well, a 1- or 2-degree Celsius increase in the temperature of the atmosphere also has the risk of thawing the tundra, and the tundra has frozen locked in it 1500 parts per million methane. And methane is —and CO_2. Methane is multiple times worse than CO_2, so a lot of scientists are worried that that's going to be released. In fact, a recent voyage by scientists in the Arctic, they saw bubbling in the ocean like the ocean was boiling. This was in an Arctic that's barely over 32 degrees. Well, why is the ocean boiling? And they were able to sample it and found out it was methane being released from the bottom of the ocean. Never been seen before. And it's because the temperature gradient of just a couple degrees is enough to trigger those kinds of things. I mean, the environment around the earth is so fragile, one astronaut used to describe it. Think about the globe as a peach. The skin of a peach is how thick our environment is. So why are we messing with it? But, I don't know.

Now, methane brings us back down to gas extraction. Why are we not toughening the regulations for the extraction of gas? There are now scientific reports coming out about methane releases in the drilling and extraction of mining for natural gas. And while with some of my work as an engineer in California and a piece of work I put together for FedEx and AQMD and EPA, I put together a whole group of people, and we studied the potential for alternative fuels in their fleet of trucks. They have one of the largest fleet of trucks in the world. They buy sometimes 20,000 trucks a year around the world, so it's a big fleet. And Mr. Smith was concerned with the regulations coming and different fuels coming, and he cut a deal with—what was his name?—doctor—can't remember—the head of AQMD in Southern California.

MK: AQMD.

AT: **0:40:06.1** AQMD. Air Quality Management District. There's 9 AQMDs in California, okay? There's one California Air Resources Board that covers the whole state, and CARB covers mobile devices. The AQMDs cover stationary sources of air. I mean, South Coast —just South Coast —which is essentially Los Angeles area, parts of Riverside and Orange County, and that's all. Because there's one in San Diego. There's one in Santa Barbara. That South Coast Air Quality Management District's building, this DEP would be a wing of it. It's a huge organization, and I'll tell you a little sidebar. It's up to you whether you want to keep it or not.

When I was doing this, putting this project together, which was a lot of fun. I got to really know the people at Fred Smith's firm, and he's a character. He's unbelievably dynamic, resourceful, thought-provoking, demanding individual. But he founded 35, 37 years ago, still CEO, and I remember him saying to me, "Allan, I like this study you're putting together, but I don't want to ever hear of 1 single package being late because of this project. Do I make myself clear?" (laughs) "Yes, Mr. Smith." So we got into it, and we studied in great detail from an environmental standpoint, from an operational standpoint, maintenance, cost, employee attitudes —Barbara was involved in the employee attitudes—a whole bunch of parameters. Battelle Memorial Institute in Columbus wound up being the scientific organization that conducted the data. I was overall above the project. And we put 120 new trucks on the road in Los Angeles operating on 5 different alternative fuels. Natural gas came out to be the best of the 5. From an environmental standpoint because the emissions are so low from a gasoline engine, but particularly a diesel engine operating on natural gas is—well, I'm not sure what the numbers are today. Back then, a diesel engine would be 80% cleaner than diesel fuel. Now, diesel fuel is a lot cleaner today, so I don't know what the numbers are, but I believe it's still about 40 or 50% better than diesel fuel and half the price.

MK: Natural gas?

AT: Yeah, natural gas. So natural gas is a logical interim fuel, especially for long-haul, over-the-road trucks, big diesel engines. But it also can work in gasoline engines, not as efficiently because natural gas requires high compression. A diesel has about 24 to 1 compression, gasoline engines are only about 9 or 10 to 1. So if you—the way to do a gasoline engine is to put a head on the engine that increases the compression ratio. You'll get much more out of a fuel. But if you take a diesel engine apart at 100,000 miles that's been operating on natural gas, on the top end of

the engine, you look at it. It looks brand new. Shiny. No oil deposits. No carbon. Nothing. You can get twice the life on the upper end of a diesel engine if it's operating on natural gas. And as I said, the emissions are lower than diesel fuel, and the price is so low. The South Coast—part of the results came out of our study, I believe—I'm not entirely sure of this, but the study we did for FedEx, which was in the mid-'80s—sort of mid-to-late-'80s. Out of that, the South Coast Rapid Transit District, which is the largest municipal bus operator in North America, switched over time all their diesel engines over to natural gas. So they've been operating around Los Angeles on natural gas all these years. You may have seen this on television ads citing that, showing a lady riding in a bus with a green thing, so on and so forth. And it makes sense. My only concern about this—so I would be supportive of more natural gas in our vehicles as an interim step towards electric, because natural gas is so clean. And its current pricing is such that it—well, I haven't looked at a price recently, but the last price I saw in Los Angeles, they were paying something like $1.60 a gallon equivalent when gasoline was $3.50 a gallon or diesel fuel was $4.00 a gallon.

0:45:08.7 So, but it takes money to convert. A big truck like that, it costs about $20,000 to convert it to natural gas. Smaller vehicles, you can probably do it for $10,000. I'm looking forward to going to the auto show, because General Motors is going to show for the first time a pickup truck there that runs on natural gas. I'm going to have a look at it and see what the price differential is between a gasoline truck or a diesel truck and a natural gas truck. So, its emissions —much lower emission level—is desirable.

But what I'm worried about is we're being—we're not being as careful about the emissions coming from the drilling, both polluted water and polluting the air, because one of the emissions that comes out of drilling is methane, as I mentioned earlier. It is many times more lethal in the upper atmosphere than CO_2. I hesitate to quote what the ratio is, because I can't remember the right number. The number that keeps coming into my head is 100 to 1. I mean, it's that dramatic. It may only be 20 to 1, but it's a dramatic ratio, significant ratio. So, the drilling industry ought to be regulated a lot more tightly to make sure they are not allowing what we engineers call fugitive emissions around an operation like that. And that's going to cost more, but hey, that gas isn't going anywhere. They can't ship those jobs overseas. Those jobs are here. They can't go anywhere else. So tightening up, and our gas—our natural gas—is still the cheapest in the world. So we can actually export our natural gas. That's already going on. They're building liquefaction tankers and ports so that we can take the natural gas out, liquefy it, and export it. So it has real serious potential as an alternative fossil fuel.

MK: What about the industry's assertion that there's very little of these kinds of—what did you call—

AT: Fugitive emissions.

MK: —fugitive emissions, because it costs—it's a valuable resource. They don't want to let any of it escape. Do you buy that assertion from part of the industry?

AT: No. Have you ever heard of an industry that said, "I need to be regulated more?"

MK: They are few and far between.

CK: What Michael is saying is it's to their advantage to not lose their resource.

AT: **0:48:07.6** Well, I'd say that too if I was them. Prove it. But let's make sure you don't. Let's put in place regulations that don't allow those fugitive emissions. Okay, so we put in caps or capture vessels or whatever, well, we'll get more product for you. But don't fight regulating the fugitive emissions. I've been there before and done this. I mean, in South Coast Air Quality Management District, we dealt with fugitive emissions in every damn industry you can think of. And I can remember one project I did for South Coast with (laughs) the chief scientist there. He was wonderful, Alan Lloyd—Dr. Alan Lloyd. He went on to be head of CARB at one point. He's now retired and lives in Nevada somewhere. A Welshman. His boss, they were under pressure to control fugitive emissions from coatings. VOCs, as it's called in the industry—volatile organic compounds—are a common emission in a lot of chemicals and a lot of processes. In fact, you, I guarantee, have experienced it, because have you ever painted anything? You smell the paint? That's a VOC. By the way, toxic.

So, Dr. Young and I put together—not Dr. Young—Lloyd and I put together a project. He asked me to do an economic and technical analysis of the impact of a rule that they were going to implement at South Coast Air Quality Management District requiring that the furniture industry in Southern California which, by the way, happens to be the second largest concentration of furniture manufacturers in the country. Most people don't realize that. It's not the good stuff. It's the cheap stuff, really cheap, but good stuff's in North Carolina, Michigan, so on. They were going to require within 5 years that that furniture industry was not allowed to use any coating that emitted any VOCs at all. Well, the industry rose up, "You're going to kill us. It will never happen. We can't do it. There's no such coating available." And it was turmoil from the beginning of it. I went through many a hearing in which they said, "Where are we going to get this?" And the chairman of the meeting said, "Gentleman, you've got 5 years. Work on it. Don't tell me. I'm telling you within 5 years, we will outlaw emissions of VOCs from coating furniture. Period. So get your scientists, your engineers working, and fix it."

See, that's the difference. This agency never, never does anything like that, this DEP in West Virginia. Never takes a leadership role. Never steps out and says, "We ought to do this. We've got to fix this. This is not acceptable." It's only when something like this happens. Well, the inspections are not acceptable. We'd better inspect it more. Why haven't you been inspecting it all these years? South Coast is a tough agency. It's one of the largest air quality agencies in the world, and it's made tremendous progress. With the Air Resources Board, it brought us the catalytic converter for cars. It—they made a lot of progress. I'll get back to the furniture thing, and the Air Resources Board and the districts in California at one point said to the car manufacturers, "You've got to clean up the emissions. And here's the emission level we're going to accept each year going down, down, down, down. You figure out how to do it. But here's where we're going." This was in California, because under the Clean Air Act passed by Nixon, California can write tougher regulations than the Clean Air Act. And by the way, not to lay all the blame on DEP. Here the legislature won't let the DEP do anything more than the Clean Air Act or the Clean Water Act. So, from that standpoint, they can't do anything probably missionary or visionary. Anyway, that's what they stated you're going to do. You're going to get

to this level on emissions. The automobile industry screamed bloody murder. "It's not going to happen. We can't get there. Nobody will buy cars." Et cetera, et cetera.

Well, I'll cut this long story short by saying, I remember my father had a Cadillac product back in the 1950s, I guess it was. We were lucky if we got 11 miles to the gallon on that car. And it pumped out exhaust fumes like crazy, like all the other cars. And it had a 4000-mile or 3-month warranty. Barbara's Cadillac is sitting out here. Not only gets 27 miles to the gallon on the highway, it has 100,000-mile warranty. Now, we've come a long way, and the emissions on that car are 98% less than my father's car. But it was AQMD and the Air Resources Board pushing the technology, pushing the envelope. Don't tell me it can't be done. Go do it.

0:54:08.3 In the case of the VOCs on the furniture, the industry screamed bloody murder. A couple of the firms moved to Mexico, because most of the firms were making furniture for Mexican citizens and Mexicans living in Southern California with Mexican employees. Now, a couple of firms moved to Mexico to get away from South Coast. Lo and behold, somewhere in the middle of the third year, a small chemical company in northern California figured out how to make a zero VOC coating. And by the time the fifth year arrived and the rule went into place, those coatings were available. So, when the government agencies push the envelope, good things happen. That's what so pisses me off, pardon my French, about this whole Tea Party Republican crowd who are—and the coal industry and our attorney general and everybody here—fighting the EPA to prevent them from trying to control our air emissions and our water quality when all you've got to do is demand that they push the technology. Give them a reasonable amount of time to do it, and they'll do it.

I've got many an example of where that's happened. I use the example of a car from my father's car to my wife's car. Look at the differential. When they first did that, by the way, in the cars, and they got these emissions lowered in the cars, they raised the warranty to about 10,000 miles. And then CARB suddenly realized, wait a minute. We don't want zero emissions in these cars for the first 5000 miles. We want zero emissions at 100,000 miles. So we want you to improve your car to the point that you can get up to 100,000 miles and not be emitting more than this certain level. And that's why today we've got a car that's got a 100,000-mile warranty on it, because the automobile companies now know, they're protecting themselves with a warranty, and it's covered. So again, it's good, sound engineers and scientists pushing the envelope, constantly pushing it. And we must continue to do it in spite of the lawyers and the lobbyists and the industry—polluting industries—that are pushing back. There's more of us than there are of them. It's just that they're much better funded and organized. And that's part of our problem.

MK: I love your examples and models you have discussed. There was one other model when I talked to you at the Concerned Scientists Gathering a couple of months ago in Charleston. You mentioned a—it sounded like a vacuum pipe—an inner pipe and an outer pipe for the vacuum industry.

AT: Oh yeah, you're talking about a CSP system.

MK: CSP, it is.

AT: Concentrated solar power. When I was a partner in Theodore Barry in Los Angeles, we were involved in a development that was taking place after the Carter—remember the oil crisis? —in the Carter Administration. There was an emphasis to try and get to better power systems.

MK: So he wants to turn on the microwave. We get the better—

AT: **0:58:03.5** —better power systems that were not emitting any pollution. And Southern Cal Edison at that time was looking at peak demands that were requiring them to think about building new power plants. Well, there was a firm in Israel that had come up with an idea of what's called a concentrated solar power collector. What it is is if you can imagine a trough that is 8 feet wide at the mouth and 43 feet long—43 feet because it's got to fit on a truck, and 8 feet because you can't exceed 8 feet on a truck. So they designed this mirror in the shape of a parabola. Well, if you remember your geometry, a parabola is such that any light going towards the mirror reflects to the focus of the parabola. So in the focus of the parabola, we had 2 pipes, one inside the other with a vacuum between the two. And that has some engineering technology reasons. It doesn't matter right now. In the center pipe, you ran a fluid. It could be a salt or liquid. It could be a bunch of fluids. Because when you concentrate the sun in this collector, you can get up to 800 degrees in that fluid. So that fluid then goes into a heat exchanger or water than then creates steam to drive a steam turbine to generate power. Well, there are 9 of those plants in the desert—the Mohave Desert in California. And at the time, the "nayslayers," as I call them—

MK: The nayslayers.

AT: —said, "Oh, this CSP nonsense will never pay for itself until oil gets to be at least $14 a barrel." Hello, $14 a barrel? Where is it today? A hundred dollars a barrel?

MK: $114.

AT: Those power plants have been operating all that time since the mid-'80s with no fuel requirement at all, no emissions at all, generating power every day.

MK: There are 9 of them?

AT: There are 9 of them.

MK: How big an area do they serve?

AT: Oh, hundreds of acres. They're huge. They're in the desert.

MK: No, but I mean, how big of a population or how big a—

AT: Well, I don't know.

MK: —can 9 of these provide? How many would you need for say southwest Virginia?

AT: Well, I don't know. I'd have to sit down and calculate that. I don't know. I couldn't answer that.

MK: But it's significant?

AT: It's significant. Oh yeah. But those particular plants that were built though are peaking plants. They're not demand plants. Do you know the difference?

MK: No.

AT: **1:00:58.9** A demand plant is, I turn on the electricity in the middle of the night, I'm going to get electricity because the coal-fired power plant is running all day long. If I turn on my plant and I have solar cells on my roof in the middle of the night, I'm not going to get any energy because the sun isn't shining on the solar cells. So a peaking plant is a plant that takes advantage of the sun during the daytime. Well, one of the advantages there is when do we need the most power? It's during the day, particularly on hot days when the air conditioners are all running. So those plants see the most sunlight during the middle of the day to late afternoon when they can add to the grid power that the fossil fuel plants don't have to produce. So that's—they're called peaking plants when the peak of power demand goes up. Now, if those plants had energy storage such as taking that fluid and putting it in a tank that's insulated and keeping it hot and continuing to feed it, then you could, in fact, during the night be able to pull hot fluid out and still generate electricity. Then you could have a solar plant like that as a demand plant. And while our plants and technologies were back in the '80s, that's now being done with CSP plants because energy storage techniques have been developed. And as I said, I don't know the one I mentioned earlier at Sault Ste. Marie in northern Ontario, I don't know if it's a peaking plant or a demand plant. I don't know. I don't know if it's got storage or not. But anyway, we've covered an awful lot. I don't know if I—

MK: Yes, you have.

CK: So what's the path from here to there? From sitting here in Charleston, West Virginia?

AT: We ought to be doing everything we can to transition to renewable energy, because there's been many economic studies that show that the renewable energy is going to create a lot more jobs than the coal—than the dying coal industry is going to generate. And while coal isn't going to go away overnight, and this all isn't going to happen overnight, we ought to have the policies in place to generate it and create jobs for these miners when—don't you think they'd rather have a job that's above the ground and safe than going into a mine and not knowing if they're going to come out?

CK: What would those jobs look like?

AT: Oh, they're everything from manufacturing of solar cells and manufacturing of the equipment to installing it to maintaining it. I mean, these are—well, there's another concept we haven't talked about. The idea of having a central power plant and then a bunch of wires pushing the electricity all over the countryside is actually a Neanderthal approach. The most logical

approach is to generate the power where you need it, because the line losses can be significant. You can lose 60, 80% of your power in line losses. So you generate 100 kilowatts at John Amos and pump it all the way across the state, you may only get 20 or 30 kilowatts at that end because of line losses. But if you generated—which I'm going to do with our plant in Canada when we build it—if you generate the power on the plant, I use it in the plant. And any excess, I feed back into the grid. That's called distributed power meaning instead of a central generating plant, you have distributed the generation of power across the countryside, and you generate it where it's needed. If you connect all of those sites—why, if every home in Kanawha County had solar cells on a south-facing roof and were connected to the grid, then you could monitor that. You could measure it. The grid takes it back. You get a credit against the power you draw a night. It's an economically more attractive thing for us but not for the power companies.

1:05:43.9 But there is an interesting case in point. In Sacramento, there's an organization called SMUD, S-M-U-D, capital S-M-U-D. All caps. Stands for Sacramento Municipal Utility District. It's totally captured by the city. They can't go outside the city. So if their plants are such that they're not providing enough power for Sacramento, they've got to buy power on the market. Well, way back in the '90s, they made the decision to make their customers their partners, and they came up with a program whereby if you would agree, whether you owned a church or a grocery store or a supermarket or a home—they started with churches because churches are so idle during the week, they don't have a big power demand during the week. They started putting solar cells on all of these buildings and buying the power out of those cells, and in so doing they avoided having to buy power from outside the state or building any new power plants to deal with the growth of Sacramento. And I believe that program, making your customers your partner, I think it was over 10 or 15 years that it was in place. Now I haven't checked it for at least 5 or 7 years. I don't know where it stands today, but I know for many years it was very successful and an obvious example of how distributed power can help a utility if the utility has the right attitude about it. And there's a similar program—did I talk about F.I.T.? F-I-T?

MK: Yes.

AT: I did, yeah. Well, you know, we could have a F.I.T. program here. Our incentives for solar in West Virginia are terrible, and in fact—

MK: Our incentives are terrible?

AT: Incentives are terrible. They're minimal. You can only be so many people. And in fact, some of the tax benefits that were put into the legislative process and passed so that people who put solar panels on their roofs would get a tax break, well the West Virginia Tax Department is denying them even though it's in the law.

MK: Even though it's in the law?

AT: Even though it's in the law they're denying them.

CK: It's in the state law or federal law?

AT: State. State law.

MK: State law, and the State Tax Department is—

AT: Yeah, is denying them. Yeah, now I don't know if they still are, but I heard about this a couple of months ago. I mean, Don Garvin would know or the guys at CAG would know more about the status of that. But that's the sort of incentive program that you could have to incentivize people to do solar. Now, there's a wonderful case history—I started to tell you about it, and I got off track—of this guy Jigar Shaw that wrote this book *Creating Climate Wealth*. He started a company called Sun Edison, and he sold it for several hundred million dollars. He did very well. Started it on his own, built it up, and what it is is a company that if you will agree to put solar cells on your roof, and he's done this on Walmart stores and major buildings all over the country, none in West Virginia, he cuts a deal with you that he will pay your utility bill. You pay him, he'll put the solar cells there on the roof at his expense, and how does he get his money back? Because the price of utilities is continuing to rise, and as it goes up, he is—your paying him, and he's getting the differential back on feeding energy back into the grid to pay for those cells. And he's doing this all over the country, and he's been very, very successful.

CK: Why not here?

AT: Pardon?

CK: Why not here?

AT: Well, because of the artificial low price of coal-fired power. You can't make it work in West Virginia, because we don't attribute—you know—our coal power is so damn cheap, which it really isn't.

MK: **1:10:26.6** Which it isn't. That's right.

AT: So, Sun Edison is an interesting case history. I've just started to read his book, and it's an interesting model. He's started another model I've got to look into that Rolls Royce doesn't sell their engines. They have a program they call "Power by Hour." They get the airline to pay for the use of the engine on an hourly use basis, and that avoids the capital cost. You know, I'd love to put solar on here, but I can't afford it. If there was some program that we could jointly work a deal where the utility price would help pay for the power, why not?

CK: And how effective would it be—to ask the Governor Manchin question—how much sun do we have? How much would people gain in these neighborhoods?

AT: Well, you know, he's—

CK: I'm asking that, because I don't know the answer really.

AT: Yeah, he—see Sun Edison offers you a fixed utility rate for 20 years, which is attractive to business. Anyway.

CK: But solar would work here then? How does it work? Can you do a little simple layman feel for how it would work?

AT: Yeah, he would benefit from the feedback of power, selling of power, back to the utility, the excess power. If you—say you needed 10 megawatts for your home, so he'd put on a 15-megawatt system. So he'd have 5 megawatts minimum potential to sell back. But if you didn't use your 10, you were only using 2, he could sell all that power back as well. But he guarantees you you won't pay for more electricity than you use right now at the rates right now.

CK: I guess what I'm asking is how close are we to having successful solar energy. If the legislature were to be more hospitable, are we ready? I mean, is the signs—what sort of infrastructure? Can you sort of lay the path?

AT: **1:12:55.3** We're into the third or fourth generation of solar cells. This is not new stuff. I mean, I was involved in designing just that CSP plant, but other photovoltaic cells in California in the '70s. Solar cells have been—the technology itself goes way, way back. We knew about solar technology in 1880. We knew we could generate electricity with it. And what's sad is right here in West Virginia, we have silicon mined up the river in Montgomery. There's a plant north of—up river from Montgomery—called Alloy, and they mine silicon and they ship it out of state so people can make solar cells elsewhere. Well, why aren't we building a manufacturing plant in West Virginia and capturing those jobs and making solar cells? Why? Oh! That's a threat to coal. I've been more or less told that. On the Public Energy Authority, I wanted to put together a project, and I had the president of Alloy Chemical, we met with him in Ohio, we talked to him. He was open to the idea. Silicon is a difficult material to handle, very difficult. It comes in blocks. If you can imagine, it's sort of like a block of gouda cheese, okay? And it's got to be free of impurities, so when it's shipped, it's got to be carefully handled because if it has any impurities in it, then you get a whole load rejected. And silicon is used in computer chips, memory devices for our computers, as well as solar cells. So the silicon that's being mined in West Virginia is going to—maybe it's going to Intel in California to build computer chips or what used to be BP Solar in Maryland. They've moved that offshore.

CK: And is that difficult to mine as well, or what are the dangers involved in mining silicon?

AT: I don't really know, but nothing like coal. I mean, there's no explosion possibilities. It's not a volatile material at all.

CK: You think of the term silicosis. Is that related?

AT: I don't think so. I'm not sure. I don't really know. That came from handling of sand and that sort of material, but silicon is—it is silicon. But maybe prior to it coming out as a cake, it is difficult. I don't really know. I never got into it. I wanted to, but there was no interest in the Public Energy Authority.

CK: I guess that ought to be an issue with fracking at some level. I mean, there's a lot of sand involved with that, is there not?

AT: I believe so, yeah. They're disturbing the sand way down, and they're pumping sand in, but I don't really know. I'm not close to that industry. I—most of my time as an engineer was spent on natural gas in vehicles, not long after it came out of the well. But you know, this Marcellus and the other deposit, they're very important in the economics of West Virginia. And I applaud Kessler, who's picked up on—

MK: President of the—

AT: **1:16:24.5** Senate, yeah.

MK: Senate, yeah.

CK: Who's he then?

AT: Kessler. Senator Kessler has picked up an idea that I think came from—oh dear, what's his name?—Economic Development Organization—well, he's here but also in—

CK: **1:16:47.8** (???) (inaudible)

AT: He used to be on the lobby team with me. I'm ashamed I can't remember his name. Don't put that in the record please. (laughs) Anyway talking about putting a set-aside every year as part of the extraction severance taxes. You should have been doing that in coal for the last hundred years. Alaska has done it on oil. Alaskans get a check every year from the government. (laughs) They're the stockholders of the oil reserves in Alaska. I mean, they've had as much as $2500-$3000 check come from the state government as a dividend for the year—every individual.

MK: How nice.

AT: Yeah, we should have been doing that with coal all these years.

MK: We didn't get any severance tax from **1:17:38.9** (???) (inaudible) way up in the '60s.

AT: And look at where the—look at where the—where is the poorest part of the state? In the coal country.

MK: That's the legacy.

AT: It's sad. It really is. All my years, I'll tell you guys. All my years of working with industry, and I've been an engineer—well, class of '61—so I'm over 50 years in industry whether it's aerospace or the food industry or the film industry or automobiles—all the industries I've worked with, I have never seen an industry that is so—

1:18:12.8 (end of audio 1)

0:00:00.9 (start of audio 2)

AT: Careless.

CK: I'm sorry?

AT: So careless is the coal industry. I mean, it's just terrible what they do. I mean, when—I don't know if you recall, but 80—I think I remember the numbers right—80% of the miners killed in the Upper Big Branch explosion—those 27 miners—80% of them including one of the youngest that died had black lung disease on an autopsy. What? I thought we had a law against that (laughs) that was passed decades ago, I think by Senator Byrd. But no, we're still causing lung disease among miners. That's really, really sad.

CK: **0:01:01.4** I started a new track. Okay.

AT: I remember having an interesting conversation outside of one of the committee rooms at the legislature with a lawyer who will remain nameless. His wife's involved up there as a lobbyist. He's a powerhouse of a lawyer, and they have children, and in the conversation talking to him, he represents the coal industry. I said, "How can you do what you're doing?" I said, "What are you thinking about as far as protecting your own children?" He said, "You leave my children out of this." I said, "I'm sorry, they're not left out of it. They're here and exposed to it." "You leave my children out of it." And I said, "Now that's really sad. Shall we tell your children that?" And he walked away. He was furious. I mean, I'm worried about my grandchildren, and they're not in West Virginia. They're in Virginia. They're downstream of West Virginia. You know? We've just lost our sense of balance and proportion in this state.

MK: If we ever had it.

AT: If we ever had it, yeah. Because the industry's been dominant since the 1800s—1880s or '90s or '60s or whatever—since before the state was a state. But, in all my work in California with industry, every time I had a project in which I had to tackle some sort of a pollution scenario in a manufacturing process in which we were trying to figure out what to do, in every case, no exception, improving the environmental scenario of that process or that equipment or that plant improved the bottom line. And if you look at companies—pick an industry, any industry. If you do as some of the Harvard Business School and other business schools have done, you look at an industry and you look at the leaders in that industry, you'll find they are the cleanest, most non-polluting companies in their industry, and they're also financially better off than the others.

CK: How and why?

AT: Because pollution costs money.

CK: But they're not asked to pay it usually here.

AT: Oh yeah, but they pay it in terms of worker turnover, machinery deterioration, and all sorts of things. There's all sorts of ways it can come back to haunt them. And not in the short term,

intermediate, but I mean long term. If you do things cleanly, you'll be financially better off. There's a marvelous example. There's a company in Atlanta called Interface. Interface is in the carpet business. Interface used to be a very minor player in the carpet business. I don't know, number 25 or something. The industry is dominated by Milliken and a couple of other big houses. The founder of Interface, a chap named Ray Anderson, read—oh dear, what's his name? I've got the book out there. I'll get you the name—*The Ecology of Commerce*, and after reading it a couple of times, he called a meeting with his executives, and he gave every one of them a copy of the book. He said, "In 1 month, I want you all back in this room to give me a plan for this company to achieve a zero carbon footprint by 2020." Well, they all went out of the room thinking, "What? Has he lost his mind? How the hell are we going to do that? Our raw material is petroleum. How are we going to do that?" To make a long story short, they're on track to achieve it by 2017. I happen to know one of the officers of the company very well.

MK: The secret being?

AT: **0:05:36.8** Commitment in everything they do—everything. What are we doing that is waste? What are we doing that is emitting? What can we do to recycle? So one of the very first things they did to a customer, when you went in and bought their carpeting—which by the way, they don't sell rolls of broadloom. They sell carpet tiles. And he was the first to develop carpet tiles per se. And the reason he developed them, he said, "Think about it. When you put broadloom in a room, you walk in this door and you sit in those chairs and you walk back and forth and so on, the broadloom that's behind the sofa or behind the chairs never gets walked on, never gets worn out. But when it becomes so threadbare at the entry hall that you want to throw it out, you're throwing out perfectly good carpet around the room. And broadloom, by the way, is one of the biggest things in landfills. It's a major element in landfills. So he developed tiles that you could move. You switch. So you pick up the tile behind the soft and move it to the front door and take the front door and put it behind the sofa. And they structure it in such a way, it's incredible to see. I mean, you describe it that way, and you say, "Well, wait a minute. Is that going to work? Won't they slip? Won't they peel up?" No. They've gone through and they've engineered this so beautifully. And you look at the floor, and you won't know it's tiles. Now they're heavy into industrial and commercial buildings, not so much in residential. But they also say to you, "If you are buying our carpet, we want you to sign this agreement that when you're through with it, you'll return it to us so we can recycle it. Don't put it in the landfill. We will recycle our own carpet." That's the way they started. They have subsequently added, "We'll recycle anybody's carpet." They are now recycling fishing nets that fisherman are discarding all over the world. These people have plants in South America, Canada, all over the United States, Europe. It's a big company now. By the way, it happens to be like number 3 or 4 of carpet companies. It has risen to the top from being a minor company, and it's an incredible success story. But it took commitment at the top for him to say, "This is what we're going to do. Tell me why we can't." And they are accomplishing it.

Now Ray Anderson tragically died of cancer last year, but his company is carrying on. And by the way, (laughs) he proved his point by trading his Bentley in on a Prius (laughs) which was just a little bit of an aside. I don't think I would have done that, but anyway.

CK: The scary thing about hybrids around here is you're burning coal, I guess, right?

AT: Well no, you don't have to. You could put a solar cell charger up. Let's see, where did I read that story?

CK: Back up and tell us what we're talking about here.

AT: **0:09:21.1** Well, the Chevrolet dealer in Cincinnati just opened a solar charging station for any plug-in hybrid car or electric car. Chevrolet, of course, has the Volt, which is an electric car with an onboard—it's not a hybrid—it has an onboard gasoline engine that runs a generator that regenerates that power to the battery. The gasoline engine does not drive the car ever. It's a pure electric car with an onboard generator. So that's how they get 400 miles or 500 miles out of a tank of gas. And the car runs the first 60 miles without that little generator running. And of course, there's the Tesla out of California, which is not an inexpensive car. I think the sedan is at $65,000, and the sports car's about a hundred and a quarter. It's pure electric. Well Tesla is installing Tesla Turbo charging stations all over the country. So you can stop and while you're having lunch, if it's near one of these stations, plug your car in, go and have lunch. An hour later you come back, the car's all charged up. I intend to get some sort of an electric car here. I'm going to trade in my dear old Land Rover out there that gets, if I'm lucky, 12 miles a gallon. I'll get something that is a plug-in electric, and I intend to put a charging station in here.

MK: A solar charging station?

AT: Yeah, I've already got it designed in my head, a little gazebo that will look pretty and flowerpots on it and so on, and on the south roof, it will have solar cells. And so when I come home at night or during the day and the car is sitting there, we don't commute to work anywhere, we could have the car plugged in. Now what's happening also is there's a movement now for cars that have full battery power to plug them in to feed back into the house. So you use your car as a source of power for your house, particularly in a power failure. Now, you've got to be careful of that because you want to drive the car when you go out there. You don't want to drain it down to zero. And they've got technology to prevent that and so on. But this Chevrolet dealer in Cincinnati has built a charging station, and anybody can come and plug their car in, and I don't think he's charging yet. I mean, I'm sure they will some day.

Going back to South Coast Air Quality Management District, when I was doing that work on the FedEx vehicles, General Motors had produced a wonderful car called the EV1 and then the EV2. The EV1 had lead acid batteries, and the EV2 had—not lithium ion batteries. Those came later—I had the interim battery to lithium ion. It was a little 2-door coupe. It was a hot rod. You could peel rubber with it. It was a marvelous little car. If you want to read an interesting book, read *Who Killed the Electric Car?* Because General Motors was way ahead of Prius. I mean, it was a pure electric car, battery powered. The original lead acid cars would only go about 60 miles and they were out of juice. But when they switched to the other batteries—nickel hydride—nickel hydride batteries—they were getting 160 miles.

MK: Nickel hydride?

AT: Yeah.

MK: H-Y-D-R-I-D-E?

AT: Yeah, yeah. Now when you think about it, how many miles a day do you drive on average? If we lived here in Charleston, just running around Charleston, am I going to put 100 miles on the car? I doubt it. If you're commuting to work anywhere in this area, you might drive 15, 20, even 40 miles to work. Well, you could plug it in at work. You could plug it in at a restaurant. And what was happening in Southern California when that EV2 was running around, and General Motors would only lease them. They wouldn't sell them. And eventually—are you ready for this?—called them all back and crushed them. And there was nothing wrong with those cars. They crushed them because they were considered internally in General Motors—this was in the book—to be unfair competition to the gasoline cars.

MK: And their other cars?

AT: **0:13:48.8** To their other cars, yeah. And the president of General Motors since has said it was the worst decision he ever made while he was president at General Motors to kill that car, because he would have been so far ahead of Prius, although it was only, as I say, a 2-seater, and so on. But you look it up, and it was called an EV1 and an EV2. Cute little thing. As a matter of fact, the little Honda hybrid—that little 2-door coupe they've got—is a bad copy of the GM body. The GM body was a much prettier looking little thing. So I think long term, beyond natural gas, electric cars are going to take over, and I'll gladly get one. I mean, I was studying the Tesla the other day. Well, they only get about 250 miles on a charge, and they're $65,000. I don't want to pay that for a car.

MK: But if the technology takes hold, it will come down in price.

AT: Oh it will, yeah. They've actually taken the Volt technology—Chevrolet Volt technology—and they have a prototype Cadillac Coupe with the same technology. So yeah, GM's going to spread that throughout the industry. Now, I could have a solar station out here that charges the car free. Now, on the natural gas side, did you know that there are people—if you—I don't know where you guys live or—

MK: Elkin.

AT: Do you have mineral rights to your property?

MK: We live in town.

AT: Okay, so you don't have mineral rights on your property.

MK: No.

AT: People who have mineral rights to their property on which there's a gas well have a deal that they get free gas. I'm sure you've heard of that. Some people get free gas. Honda makes a natural gas powered Honda Civic. They only sell it in California. But people have been able to

acquire them who live in West Virginia and Ohio and other states, and then you buy a little thing that's called a fuel maker. And it's not even as big as that cabinet. It's a little thing with a footprint of maybe a foot and a half by a foot, and it stands about 4 feet tall. And you connect it to your gas line in your house, or you have your plumber do it, please. You connect it to your gas line in your house, so when you come home at night with your natural gas powered car, you just plug the car in overnight. It takes it 4 hours to fuel up. But you know, that's okay.

MK: It converts house gas into car—

AT: **0:16:34.2** It doesn't convert it. No, it doesn't convert it. It just pumps it in.

MK: Same.

AT: Same gas.

MK: Same gas.

AT: Yeah, but see, the problem is that the gas in our gas lines in our street and our furnaces and everything is only about—I don't know—7 or 8 or maybe 12 pounds per square inch. You need 300-400 pounds per square inch in the tank and in the car or the trucks. So this little fuel maker sits there and pumps away all night pumping gas in, taking the gas out of the low pressure line, and filling up your tank. So there are people all over West Virginia that have this deal, and they're driving free. The gas company took them to court several years ago and said, "Well, when we cut that deal with you, it had nothing to do with cars."

MK: House gas.

AT: And they said, "Really? Where does it say in the contract we can't use it for cars?" And the court agreed. So, anybody who has a deal like that, I'm sure the contracts today probably rule out a car or vehicle. But I have a friend who just bought a new Ford truck, a beautiful, big Ford 250 with a double cab, and he's so proud of it and so on. And I said—and I know he lives on a farm and he has natural gas—he owns the mineral rights and he gets free gas. I said, "Well, why don't you have that thing converted to natural gas." He said, "What would I want to do that for?" I said, "Well, what are you paying for diesel fuel?" He said, "I don't know, $4.50 a gallon or $4.20 a gallon." I said, "Well, what's wrong with free?" He had no idea. He's out there looking at it. It will cost him about 10 or 12 grand to convert the engine—I mentioned that before—because natural gas requires spark plugs and diesel fuel doesn't. And there's a bunch of other things you have to do to make the vehicle—

MK: But you'd soon pay for that.

AT: Oh, free fuel? (laughs) You know. So, and by the way, from a political standpoint, that's a real problem. This state is having a problem, this one and other states. The fact that the mileage on cars is improving constantly, it means cars are using less gasoline per mile so the tax revenue to the states is going down. It's dropping. Even though more cars are being sold as a growth rate in car sales, when you've got cars now that are getting 35 miles to the gallon— I mean, that

Cadillac I did a bit of a test coming back from Toronto on one of my trips. I kept it at 55, 60 miles an hour all the way through Ontario, which is flat—that part of Ontario. And then on the New York Thruway it's flat all the way to Pennsylvania. I got 35.7 miles to the gallon on a Cadillac. Now, the minute you get it in the hills and the mountains, it dropped back down to 27. But the point is, those kind of mileages in vehicles were never thought of 15, 20 years ago, never imagined. And the tax structure for the state collecting road tax to repair the roads and build the roads, I mean it's totally dependent on those taxes. Well, even though you've got increased cars and you're going to alternative fuels or if you go to electric or solar power, you've lost that revenue. So they're—right now, many states and some national organizations are trying to figure out what's the alternative. Well, they've come up with, you've got to get your odometer read every year, and they'll tax you on so much per mile that you've driven during the last year regardless of what your car is. I mean, we're already paying 50 cents a gallon for taxes. Every gallon of gas you pay now is roughly 50, 51 cents taxes. So I mean, the state needs the money to repair the roads and maintain them and so on, although around here you'd think they must have stopped repairing them or maintaining the roads, but that's another issue. So it's a challenge for the politicians to come up with an alternative. As we improve the mileage or the energy consumption of vehicles, we make them more efficient, and they haven't fixed it yet. They're wrestling with it. I don't know where it will go.

But you know, these are all examples of pushing the technology to cut pollution. Every one of these technologies I've talked about is pushing the technology to cut pollution, because we can't keep poisoning the planet. We don't have a backup. This is the only one we've got. And as I've said in some of my talks, life is not a rehearsal. If it was, you would have been given a script. So we can't keep doing this. And we know enough to fix it. The technology is out there to fix it. It's just, you've got to get the industry and the politicians the hell out of the way or educate the politicians to realize there's more of us as voters. But you've got to educate the voter force. The voters don't understand climate change.

MK: Thank you.

AT: My pleasure.

MK: Phenomenal— phenomenal. Wow! I knew it was going to be good. (laughs)

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