

The Great Simplification

Nate Hagens (00:00:02):

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

(00:00:33):

Returning to The Great Simplification is author and low tech enthusiast Kris De Decker. Kris joins us from Barcelona, Spain, where he is the author of Low-tech Magazine and No-tech Magazine publications, which explore appropriate technology solutions to future lower resource material energy human futures.

(00:01:03):

Kris is back today to give examples of five categories of appropriate technology. For instance, hot water bottles that provide energy services to humans. Cooling, heating, transportation. He's been researching prior civilizations and their use of appropriate technology. He knows a lot about this topic. This is a fascinating conversation to me because I think our culture just assumes that we're headed towards some George Jetson, more gadgets, more things, more stuff. But energy underpins all that stuff, so we are going to need technology, but maybe not the type of technology that we expect. Please welcome Kris De Decker.

(00:02:06):

Hello, Kris.

Kris De Decker (00:02:09):

Hello, Nate. Good afternoon.

Nate Hagens (00:02:12):

It's morning here. Afternoon in Barcelona.

Kris De Decker (00:02:15):

Exactly.

Nate Hagens (00:02:16):

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I am happy to have you back on the podcast. I have your books and magazines here on a Low-tech Magazine, and I wanted to have you back for a little bit deeper dive on some of the intermediate low tech examples that are out there, and here's why.

(00:02:43):

I think our cultural narrative is fighting to maintain economic growth, high technology, globalization, just in time supply chains. And the things that you and I talk about and the topics on this podcast conceptually make sense, but we're not emotionally getting the signals that these things are going to be in a reality.

(00:03:07):

Yesterday, I had a podcast with a woman who's working on sustainable packaging from locally grown materials like potatoes and algae in Lebanon. Lebanon has had a 50% drop in GDP, and she's living the low tech lifestyle. And so I know you are a world expert on all the variety of the type of more available, less complex technologies we might use in the future. So I thought today, you might just choose five or six of those and give us a story and some outlines on how those might be appropriate in a resource and energy, and complexity constrained future. That was a big bite.

Kris De Decker (00:03:59):

All right, sounds good. I'm not living in Lebanon though.

Nate Hagens (00:04:05):

It's hard though, right? Because her point was that they're forced to do it now.

Kris De Decker (00:04:17):

Exactly.

Nate Hagens (00:04:17):

We can imagine that these days might come, but we're not forced to do it yet. So you as a human being have forced yourself to do these things and learn about them as a vocation. So that's why your knowledge is an important bridge, I think, for more people to understand these things.

Kris De Decker (00:04:40):

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Yeah, you could say that in a way, I'm imagining living in Lebanon. Although I'm living in Spain where everything still works. But yeah, that's a good summary.

Nate Hagens (00:04:50):

Yeah. Excellent. So we've had a few emails. Where would you like to start? I think one thing that you have written on and talked about is, solar power is great. Solar power is not going to power a 19-terawatt global growing system. But it could in combination with human power, provide energy and brain services, which is ultimately what we want from technology anyways. So can you explain what the combination of solar power and human power might look like and give us some examples?

Kris De Decker (00:05:40):

Yeah. First of all, I think that when we discuss energy sources, we tend to forget one of the most important ones, and that's human power. Historically, humans were the main source of mechanical energy. So for heat, we used fire of course, and biomass. But when it came to mechanical energy, we had some help from windmills, from animals, and from water mills. But most of the work we did ourselves.

(00:06:15):

And if you see the cities that we still live in, like medieval centers of cities, they were built by hand. Canals were dock by hand. Even the Panama Canal was dug by guys with shovels. And all tools were human operated, the washing of clothes, making products. It was all dependent on human power.

(00:06:43):

And if you look at today's situation, then we have mechanized every single physical effort. We don't even open the doors anymore. I've seen battery powered pepper mills. So we went from one extreme to the other.

(00:07:06):

And when you compare human power with solar power, it's a very interesting comparison, because one human can generate more or less the same amount of power as one square meter solar panel on a sunny day. And on a cloudy day, it's comparable to a much bigger solar panel. We can produce much more power than a solar panel.

(00:07:35):

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The big difference between human power and solar power is that obviously, solar power depends on the weather, it depends on the time of the day, it depends on the seasons. While humans are just like fossil fuels, they can produce power whenever it's necessary.

Nate Hagens (00:07:52):

Humans are base load.

Kris De Decker (00:07:56):

Exactly. That is why they make such a good combination. But there's more advantages. Yeah, solar panels don't grow on trees. They don't fall out of the sky. You have to produce them in factories, and humans don't need to be produced in factories. We kind of self-replicate by means of human power. And it's also the only power source that increases as the human population grows. So everything else needs to be shared among a growing population.

(00:08:33):

And in practical terms, it's a very all round energy source. So you can produce mechanical power obviously, but that can be converted to electricity. But when we're active, we are also producing a lot of heat, which is very useful. And human waste can be converted into fertilizer and biogas for cooking, for example.

(00:08:58):

But I think what's the biggest advantage of human power is that when you have to produce your own power, first of all, you're going to think twice about how much power you need. And that is what's missing now in the whole discussion about renewable energy. We try to make the supply sustainable, but we're not talking about reducing energy demand.

(00:09:25):

But say you want to watch a movie and you have to provide the power for that. Then probably you're not going to watch it on a flat screen television by yourself. You're either going to watch it on your smartphone alone, or you're going to power the flat screen, but make it into a cinema, and project the movie for the whole neighborhood.

Nate Hagens (00:09:51):

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So people that watch this podcast sometimes come away with the impression that I am anti-renewable energy, and I'm not. I think that in tandem with declining flammable fossils and declining economic growth, that renewables can contribute to a meaningful human culture and civilization.

(00:10:20):

But I had a couple weeks ago, someone come out to the office here, to give us an estimate on solar. And they wanted 30 of those panels that you said are equivalent on a sunny day of one human.

(00:10:37):

So this is the conversation that's being had is we want to continue our robust, convenient, richer than kings or queens of old energy lifestyle by adding lots of mechanized helpers. And the conversation about using less and still getting the rewards of living a life of meaning is not yet in the public discussions. Maybe I could get five or eight solar panels that would really help my life. I don't need 30 of them. So can you dive in a little deeper on human labor in combination with some solar inputs, some solar panels, etc.? What can we accomplish and what are some examples there?

Kris De Decker (00:11:32):

Yeah, so I've set up a system in my own apartment here that is a combined solar human powered system. So it uses a hybrid charge controller that's actually hybrid solar wind, because human power... I have a bike generator. It's very similar to wind turbines, so you need a different type of controller.

(00:11:57):

The biggest cost of any off grid solar system, but also the same happens on a large scale. The whole power grid, you can consider it off grid situation too, is that the main problem is energy storage.

(00:12:16):

So if you look at the costs, for example, about 80% of the costs of an off-grid system are the batteries and the charge controller, but mainly the batteries. And also in terms of the energy that you invest in a system, 70, 80%, it's the batteries.

(00:12:33):

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And the great thing about combining a solar system with a human power generator is that you can make your battery storage much smaller, because the bike can always take care of extra energy source. Humans, we are power sources, but also, we can be considered batteries.

(00:12:57):

And so what I do here is that basically during the summer, I have enough solar energy, and I don't need to bike generator. Also, it gets too hot to use it anyway. But in winter, I don't need that much battery storage. Because on low power days, I can go sit on the bike for an hour and I have lights for the whole evening.

(00:13:22):

So that's also a reason why human power production, these days it's more interesting than say 50 years ago because we have for example, LED lights which consume very little energy. And just an hour on the bike is enough to light up my apartment for the rest of the evening. And also the bike generator itself, it's like an early 20th century technology that didn't have that in the Middle Ages. So we can do much more with human power than now than we could 100 years ago.

(00:13:57):

And so in winter, it's not just that I can say, top up the battery and... I become the battery. But at the same time, it also keeps me warm. Because when you're sitting on this bike for 10 minutes even and you're pedaling hard, you're not cold anymore. So you actually save much more with heating costs and with electricity even.

(00:14:26):

So it's a beautiful combination in that sense. And for the Human Power Plant, this art project that I'm doing in the Netherlands, we actually envisioned a whole neighborhood that works in that way. So it's a utopian vision, but the whole society is run on human power. But from the moment there is solar power available or wind power available, well, humans don't have to do anything anymore. It's just the wind and the sun take over. But combining them allows you to use solar and wind without the enormous energy storage infrastructure you would otherwise need.

Nate Hagens (00:15:11):

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I heard stories that back in the day, 200 years ago, 300 years ago, when in Holland there were all the windmills, that when the wind was blowing, then people went out and did work. But when there was no wind, then they had siestas or cooked, did other things. Is that true, that the work schedule was based on the flows of the sun and the wind, contrary to now where everything is 24/7 access to electricity?

Kris De Decker (00:15:50):

Yes, exactly. I did a lot of research on that. And indeed, windmills were only working when the wind blew, and that fact was just accepted. And it was not just a windmill here. You had huge industrial areas with thousands of windmills together.

(00:16:10):

And it was not just windmills, also sailboats working that way. I mean, a sailboat does not move when there is no wind. So there was no other choice but to wait and do other stuff meanwhile.

Nate Hagens (00:16:23):

Was the economy centered around that intermittence?

Kris De Decker (00:16:31):

Yeah, so indeed. Of course the Netherlands is a very windy country, just like Barcelona is a very sunny city. But even then in the Netherlands, so say the common approach was to use wind when it's available. But when, for example, there was a period say of a week or two weeks when there was no wind... It even happens in the Netherlands. It's rare, but it does happen. Then they had a backup power source, and that was animals.

(00:17:01):

So for example, for very important industrial processes like milling the grain, they used horses and other animals to keep the production going. But that was much more expensive. Animals were much more expensive to use than wind, so it was only used for production processes that were really crucial, like food production. You could not really wait three weeks, because then everybody dies. So it was already there, this combination of winds, and an intermittent power source, and a more reliable, say living power source,

Nate Hagens (00:17:43):

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What you just described is a 200-year-old microcosm of what we face today. Our backups are going to be more expensive and maybe triaged towards the really important industrial processes if there are energy disruptions, etc. in the future.

(00:18:06):

Second question on what you just shared is the issue of time. So, many of the things that you're talking about are easy technically. But, it requires you in this case to get on your bike and do something when in our culture, time is money. And if we optimize for energy efficiency and energy availability, we have to input more of our human time. And that's a big cultural shift. Do you have any thoughts on that?

Kris De Decker (00:18:41):

Yeah. Well up to a certain extent, of course, when I'm on the bike, I can keep working. I mean, I can work on my laptop while I'm pedaling. So that's not really an excuse.

(00:18:53):

But of course you're right, that especially when you want to rely on wind and solar... And I think that we're not going to rely only on human power because then we're going to enter quite dystopian future scenarios I'm afraid. But if you want to switch to intermittent power sources to run your economy on, then yes, you're going to have to adjust the economy and daily rhythms to the weather, and the seasons, and the time of the day.

(00:19:28):

And there's a lot of things you can do with a solar panel during the day that you don't need energy storage for. So for example, if you want to use a power drill, you can do that entirely without batteries. You just connect the wires of the solar panel to a power drill and you can drill as much as you want as long as the sun shines.

(00:19:50):

And of course, there are other things that... Say a refrigerator needs 24 hours a day electricity. But even that you can solve with solar panels without batteries in the sense that if you use a very well insulated fridge, and the solar panel cools it during the day, and the temperature stays the same during the night because of the very good insulation. So there's many technologies that can be adapted to use renewable power when it's available, without having to use chemical batteries.

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Nate Hagens (00:20:31):

My colleague DJ White, who I wrote three college textbooks with, he uses solar panels in Hawaii, and he lines his freezer with milk jugs filled with salt water as kind of a buffer. There's all kinds of ideas like that, I imagine.

Kris De Decker (00:20:50):

Yes.

Nate Hagens (00:20:51):

Have you tried things like that?

Kris De Decker (00:20:55):

I am building one of these fridges as we speak, but I recently also discovered some people in the US who are building a similar technology for cooking. So it's basically a kind of fireless cooker, but then with a heating element inside. So you connect it directly to the solar panel, and it's like a slow cooker. It just with very low power, with a 100 wat solar panel, you can cook a meal. And it takes seven, eight hours depending on where you live of course. And if you add a bigger solar panel, it just goes faster. So even cooking, you can do with a very low power solar panel if you are prepared to change your routine, in the sense that you're going to have to start cooking in the morning if you want to have dinner at night.

Nate Hagens (00:21:53):

Yeah. In the summer here, we have a solar oven, which is just a small rectangle with plastic on top. And you can put a pan of rice or chicken or whatever in there. And it takes six hours sometimes, but it works quite well, and it's free once I bought the oven.

Kris De Decker (00:22:13):

Yes.

Nate Hagens (00:22:14):

So couple other questions. By the way, in this podcast I did yesterday with Lebanon, the only reason she was able to do the podcast was because her office had solar panels that they had bought a few years earlier, because there's power outages all the

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time there. Electricity is only on 10% of the time. So this is another example of let's scale solar. Not to replace our current economy, but maybe as a hybrid.

(00:22:49):

So another question, Kris, is the type of things you're talking about, with the exception of the actual complicated polysilicon wafers made in China, etc. A lot of the things you're talking about, can they be made in local and regional economy like Spain and Portugal and France supply chain with materials, or does this still require a globalized just in time system?

Kris De Decker (00:23:26):

Yeah, the solar panel itself is obviously quite problematic. There may be ways to build solar panels that are say kind of more... Which require more low tech production processes. I did an article on that a while ago, but that remains to be seen.

(00:23:47):

So if you're talking about using wind power, there's different ways to do that. And the best is of course to use the old-fashioned way. And that's to direct to not produce electricity, but have a mechanical... You can do that with a windmill. It's very obvious, you have a mechanical connection between the blades and the machine that you are powering.

(00:24:14):

And with solar, it's a bit more complicated, but you can do it with a heat engine. Like early 20th century, there was a lot of work done on that. And those things are say much more resilient in that sense, that you can build them anywhere.

(00:24:32):

And the solar cooker that I was talking about, the one you mentioned is of course the most low tech version. So you just need a piece of glass, basically, a pane of glass.

(00:24:49):

But also the electric cooker that I was talking about, you don't need really much materials. It's actually easier, what I learned from these studies, to get this done in Africa than to get it done here. Because for instance, there, you have aluminum foundries in many towns where they can build a pot that is exactly suited for using such a machine. And here, you cannot get it.

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Nate Hagens (00:25:19):

My friend Simon Michaux is going to be in Brussels in a couple weeks talking to government officials working on renewable energy things. And his belief is that we won't be able to scale renewable technology to the decarbonized goals that are set out due to limitations on copper and nickel. But, that we can scale this technology using more simple minerals like sodium, fluoride, zinc, etc. And that's where the real innovations in a post growth civilization will have to go. Do you have any thoughts on that?

Kris De Decker (00:26:06):

I didn't really look into that. But obviously, there is not enough material available to address the energy demand with solar panels and wind turbines. There's too many rare materials that you need for that. So it's definitely one thing that we should be looking into. But at the same time, I think that it should not distract us from the real challenge. And it is how to live a modern, comfortable, happy life without that much energy.

Nate Hagens (00:26:43):

Well let's move on to the second category. The first category was human power in combination with some solar power. The second category is we talk about the HVAC systems. Heating, ventilation, and air conditioning to heat and cool buildings and spaces. But in this appropriate lower tech future, your work focuses on heating and cooling people instead of spaces. Can you expand on that?

Kris De Decker (00:27:26):

Yes. So let me start with heating, because cooling is pretty similar, but it's handier to keep it apart. So modern heating systems and cooling systems are pretty peculiar things. What we do is we heat the entire volume of air in a space in order to make people comfortable. Well, with cooling it's the same. You're going to cool the whole volume with the air conditioning system. And there's maybe a few people in that space, and it's extremely energy inefficient. It's comparable to cars actually, where 95% of the energy goes into moving the vehicle instead of moving the passenger. And our modern heating and cooling systems are very similar in that sense.

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Nate Hagens (00:28:18):

Yeah. I'm right now in a eight room building that the whole thing is being cooled, but I'm the only person in the building right now. I'm just sitting here doing this with you. So it's just like driving a car. But go on, sorry.

Kris De Decker (00:28:36):

Yes. So if you look at how people were finding thermal comfort before the industrial revolution... Or actually, you don't have to call that far back. Before the 1950s, there was no central heating systems. There was not this ample supply of fossil fuels that made it possible. And so the strategy was totally different. They were heating people instead of spaces. And there were different ways to do that.

(00:29:08):

The first is to use a radiant heat source. And that is of course originally the fireplace, but then later it became the stove. And that is a different type of heating. So the share of radiation is much higher than the share of convection. And that means that you're not creating an equal temperature in the whole space. The closer you get to the heating system, the warmer it gets. And the further away you get from it, the cooler it gets.

(00:29:39):

So what people did was actually creating a microclimate of thermal comforts in a rather cold space, and people could choose where they would sit or stand. So if you were too hot, you moved away from the stove. And if you were too cold, you were coming closer or you were going to sit on top of it.

(00:30:00):

And that's of course much more energy efficient in the sense that the energy use is independent of the size of the room, and you can be comfortable at lower air temperatures. Because you increase the share of radiation in the heat transfer, and you can be comfortable at a lower energy temperature.

(00:30:23):

Radiant heat is comparable to the heat you get from the sun. And we all know this effect. If you are, say in winter, you are sitting in the sun, it can be quite comfortable even if it's only say 10 degrees Celsius. But if then someone comes to stand in front of

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you, the air temperature remains the same, but suddenly you're cold because this person takes away your radiant heat source.

(00:30:53):

And the second thing was that people made use of personal heating devices that worked through conduction. And conduction is another type of heat transfer that is actually physical contact between a heat source and a human.

(00:31:14):

So of course, the temperature needs to be lower or you get burned. If you touch the cooking fire, you're going to get burned. But if you have a lower heat, lower temperature heat, like a hot water bottle, you can directly transfer heat from the heating device to your body. And that's of course the max in thermal efficiency. You need very little energy to keep yourself comfortable.

(00:31:44):

And so originally, these personal heating devices, they were based on steenkools from the fire. So people just took glowing coals from the fire, put it in a ceramic pot, put that in a wooden box, and then put it under their feet, for example. And the clothes from those times, they were kind of working together with that. So they were draped over the heat source. And literally, the heat was rising into your clothes, across your body. And again, you can be comfortable in a room that has low air temperature, because you created a microclimate that heats yourself.

Nate Hagens (00:32:27):

How long ago were thermal hot water bottles a thing in culture? Was that several hundred years ago? And secondary question. You would heat that up before you go to bed and you sleep with this bottle. But then at 3:00 in the morning, I would assume all the heated dissipated, do you go refill it then? Can you tell us a little bit more about that?

Kris De Decker (00:32:59):

Yeah. So hot water bottles, they show up in the records around 1600s. And then like I said, they were kind of used with glowing coal, so it was quite dangerous. You also had the bedpan so it was like glowing coals under your mattress.

(00:33:19):

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And then when the water supply came in the 19th century, then people switched to water as a heat storage medium, which of course it's better and safer. And first, these hot water bottles were made out of ceramics and out of metal. And then in 1900 and something, the first rubber hot water bottle was invented.

(00:33:48):

And concerning your second question, indeed, people always think that these hot water bottles are meant for using the beds, and they are very useful there. And actually, in winter, if you put a hot water bottle there, in the morning it's still hot because the blanket is very well insulating the heat.

(00:34:10):

But they're also especially useful outside the beds. For me, it's my only heating system. And in winter when I'm sitting here, I have a hot water bottle on my lap. I have one if necessary behind my back. And if it's really cold, I have another one below my feet. And every two hours or one two hours, I get up, I refill them, and I come back. I mean, you have to move now and then. It's not healthy to sit on your laptop without interruption for so long. So yeah, it involves some human labor also.

Nate Hagens (00:34:46):

Do people on your street there in Barcelona refer to you as that Belgian MacGyver mad scientist guy, or do they have any idea what you do?

Kris De Decker (00:34:59):

I managed to hide it for a very long time, but less and less. And actually, I live above a bar, the typical Spanish bar here. And I'm quite often there writing. And in winter, when I meet my friends here and it's cold, I come down with four or five hot water bottles. And people of the bar got so interested, and they actually want to do it next winter. They want to set up a whole infrastructure with hot water kettle and then a rack of hot water bottles and blankets so that they don't have to pay for their gas terrace heaters anymore, which is very expensive.

Nate Hagens (00:35:39):

It might be even more expensive next winter with the whole Russia Ukraine thing. We don't know what's going to happen there.

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Kris De Decker (00:35:47):

Yeah. So that's made it even... Before it's probably like, "Yeah, this guy is a clown." But now people start realizing that it actually saves them a lot of money. I don't even need to start about the environment or the future of our children, but it's just much cheaper.

Nate Hagens (00:36:08):

Well, for the record, over 15 years ago, I knew you were not a clown when I started following your work when we ran the oil drum.

Kris De Decker (00:36:18):

That's true.

Nate Hagens (00:36:19):

These hot water bottles, they be made simply regionally, locally, or is it still petroleum based things that create the fake rubber? Or are there different ways to do it?

Kris De Decker (00:36:34):

Yeah, you don't need to use rubber. I mean, the only advantage of rubber is that it's kind of flexible, so it's more comfortable. But also, I have used metal containers. I have used plastic pet bottles. It's just a container you need that doesn't leak, and that's it. So that's not really the problem.

Nate Hagens (00:36:59):

So again, at more of a philosophical, higher lens on these things, the mind shift that needs to happen is heating and cooling humans instead of heating and cooling spaces. And can you imagine... Here's the thing. So you're very familiar with Jevons paradox, and as we invent more technology that is more energy efficient, we actually globally end up using more energy. So as we're growing, Jevons paradox acts as a positive feedback.

(00:37:41):

But once we're declining in total aggregate throughput, then I think efficiency will cut the other direction. Efficiency and these little ideas that you've been suggesting today are going to be really important. I think Jevons would flip once we're in the down slope of the carbon pulse. Do you agree with that?

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Kris De Decker (00:38:08):

Yeah, totally agree with that. If you combine efficiency and sufficiency, you have a winner. And it's much better than just going for sufficiency, because then that's not so attractive. You're going to have to give in a lot of things.

(00:38:25):

But actually, like I said earlier, the fact that I can power lights the whole evening in my apartment with just one hour on the bike, it's thanks to energy efficiency. And what do you see with LED lights in the world we are living now? They did not lower energy use. They just gave us much more lights. They gave us digital billboards and everything.

(00:38:49):

But in another context, in a context of sufficiency of limits, then LEDs our fantastic things, of course. Because with old-fashioned light bulbs, I would not be able to power my own apartment, not with solar and not with human power.

Nate Hagens (00:39:09):

That's why I think it's so important to be having these conversations, so that we differentiate a smaller economy from a disaster and focus on the energy services that humans need, decoupled from how much GDP is growing. And there are ample responses out there for some intermediate energy and material future. And so I'm very grateful for your continued work on these things.

(00:39:44):

Let's move on to another category, which I've learned from reading your magazine and your articles. This is the concept where we just talked about heating and cooling people instead of spaces. Well, if we extrapolate that to apartment complexes where lots of people live... And today's cultural narrative is everyone needs all of the things. But you've written about historical communal services, like kitchenless apartments, I think you mentioned in New York City. Can you talk about this concept a little bit?

Kris De Decker (00:40:30):

Yes, but I now realize that we forgot to say anything about cooling. Maybe I should add that.

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Nate Hagens (00:40:35):

Oh sure. Please, please. No, go for it.

Kris De Decker (00:40:40):

For cooling, it's basically the same. It's like you can cool people instead of spaces. And the main technology for that is the fan. The fan does not lower the air temperature in a space, but it cools down the person.

(00:40:55):

And the second is the cold water bottle. So what I do, in summer, I enter the bed with a bottle full of ice instead of a bottle with hot water. And it works great. And of course, the problem with cooling, it's more challenging than heating. Because above a certain temperature, the fan, for example, is not working anymore. 32 degrees or something and it stops. I mean, it still operates, but it does not cool down anymore.

(00:41:25):

So you can still use it in a very interesting way, in combination with air conditioning. Say if assume we're going to have temperatures of 40 degrees or 50 degrees, a fan will not do it. But you could still say, the air con, you can put it on 30 degrees or 28 degrees Celsius, and then cool down the people with fans and cold water bottles. So you can find a compromise there.

Nate Hagens (00:41:55):

Well, that that's going to be, in my opinion, globally much more important than heating given a higher wet bulb temperatures and population on the Indian subcontinent, and lack of affordability, we're going to need to keep people cool. So what you're saying is not 24/7, super cold, expensive air conditioning. But air conditioning to a certain threshold, combined with a fan, combined with water bottles with ice or something, could be some path?

Kris De Decker (00:42:33):

Yeah. And of course, on a larger scale, what needs to be done is to plant trees and make more green zones in cities, because that is also why cities are so unbearable to live in summers now. And the countryside is more or less okay.

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Nate Hagens (00:42:53):

Right. Because the larger trees are dissipating the heat and keeping it away from you, which is why shade is cooler. Yeah. I have a version of a hot water bottle in my bed. It's called a golden retriever. But she doesn't keep me cool in summer. She has to get down because she's also very hot. Yeah.

Kris De Decker (00:43:22):

But indeed, humans and animals are the original hot water bottles. And if you look into history before the 1600s, how did people keep warm? Well, they were huddling together. They all slept together in one bed. The pigs and the cows were in the living room, or just below it. And even the visitors slept in the bed. There were all these kinds of rules to where a visitor should sleep when he stayed overnight. So the original hot water bottle is the human and its animals.

Nate Hagens (00:43:58):

That's hard for me to imagine, because the last few visitors I had to my house, I just can't imagine all of us in the same bed together. I would have to have my golden retriever between me and my visitor.

Kris De Decker (00:44:12):

Yes.

Nate Hagens (00:44:13):

Okay. So thank you for bringing up the cooling. I think that's very important. Now, what about the communal services? Where not everyone has to have a kitchen stacked next to each other, but they might share the energy to provide human needs. What are your thoughts on that?

Kris De Decker (00:44:36):

Yeah. So a kind of hype of recent years was the tiny house, and it's kind of to downsize everything individually. You have a very small washing machine, a very small kitchen. But it's super individual. And it's what you see. Our households are getting smaller and smaller. Throughout the 20th century, you see in the Netherlands for example, it went from five people to two people in just 100 years. And everybody

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needs their own washing machine, kitchen, cooking stove, refrigerator, shower. And that's great for the economy because you have to sell all these appliances, but it's not so great for energy use of course.

Nate Hagens (00:45:23):

And it's also not so good for social capital, right? You just cook by yourself.

Kris De Decker (00:45:31):

Yes. So I have a lot of data from the Netherlands, because I actually did this research in the context of the Netherlands. So there's research saying that 40% of Dutch people regularly feels lonely. And then there we are, sitting in our own apartments with our own devices, feeling miserable basically.

(00:45:58):

And if you look to the past, it was obviously not like that. I just gave the example of sleeping all together in one bed. It's quite an extreme example, and I'm not sure if we should bring that back.

(00:46:11):

But you had a lot of... Say the kitchen, the dining room, the bathroom, the washing room. Those were very often community services, and they were not happening in the privacy of the home.

(00:46:26):

And the most famous example is of course, the Roman bathing house. Actually, also the Greeks had it. And in other parts of the world, you have very similar things. Like in the Islamic world, you have the hammam. In Japan, you have the sentō, you have a very important culture of communal bathing. In Finland, you also still have it, but it's about the only place in western part of Europe.

(00:46:56):

Because what happened, Europe was in the Middle Ages after the Roman Empire fell, quite an exception in the sense that people stopped washing themselves because of religious beliefs that the soul is more important than the body. So we kind of showed that by just not washing ourself and stinking hours in the wind.

(00:47:20):

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So we kind of find it a pretty weird idea. But in many other cultures, the concept of communal bathing is not that weird. Although it's also under pressure, because of western ideals and technologies and values spreading.

Nate Hagens (00:47:36):

It just seems that energy surplus has really fueled individualism as opposed to communal activities. And by the way, we're nearing the peak of energy surplus.

Kris De Decker (00:47:57):

Yeah. So we should also kind of question this individuality that has also lots of other disadvantages, like you say. I think many people would be... I don't know. It's quite a culture shock maybe to go wash your body in public. But if you look into how these things were and are organized, they're also kind of different ways to do it.

(00:48:24):

Like in some bathing houses, people were naked completely. In others, they were only half naked. Sometimes there was more privacy. So these things are quite flexible also.

(00:48:37):

And also, communal services, kitchens, bathing houses are often associated with poverty. And that's another problem. But if you look at the Roman bathing house, and the hammam, and the Finnish, and the Japanese, nothing reeks of poverty. On the contrary. It was a pretty luxurious experience, and much more than what we have... We don't have the luxury in our private bathrooms that the Romans had in their bathing houses.

Nate Hagens (00:49:13):

As you were speaking, I was visualizing me in a public bathhouse in Japan, and people running and screaming like a Godzilla movie. But it's morning here and I just had my coffee. So go on to the kitchen.

Kris De Decker (00:49:29):

Yeah. So the kitchen is interesting also, but also very much tied to the role of the woman in the household. So it's a totally different story. And in the US, you had these

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trends towards the end of the 19th century, like 1880s. And it lasted until 1920, more or less, of building kitchen-less apartments in so-called apartment hotels.

(00:49:59):

So it was mainly in New York, but also elsewhere, where people had apartment units without kitchen or with a very reduced kitchen, like a kitchenette kind of thing. And you had a communal kitchen and dining room on the ground floor, but not where people joined to cook together. But where there was actually a professional cook. It was like a restaurant in your apartment building, and you could go eat there every day, or you could even order the meals up to your room if you didn't want to face the other residents.

(00:50:37):

And this was very much an idea that came out of feminism. So what we call now the material feminists, they wanted to reduce the housework for women. And they kind of promoted this kitchen-less apartment. So these buildings also had childcare, communal children in the building, for example. And it became pretty successful, also after 1900s. There were many of these buildings. There's a whole list of names of these apartment buildings. But then what happened in 1917 with the Russian Revolution is that basically, the Soviets stole the idea and they introduced the concept of the communal apartment. And it became totally associated with communism. Yeah.

Nate Hagens (00:51:32):

So it was a good idea. It was a good idea, but then it got associated with a different political ideology, and so it kind of went out of favor?

Kris De Decker (00:51:43):

Yes. So that was one of the reasons. Another reason is that it kind of formed a threat to the idea of the nuclear family and the economy. Because what happened after the economic crisis in late 1920s, so women had entered the working force during the war, and then became an economic crisis. And there was a push for women to get back to their cooking stove so that the jobs would be free for men again. So it was also economical reasons for that.

(00:52:18):

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But yes, this association with communism was of course... I mean in the US it's a pretty sensitive thing. Still today, I think. And also, it worked different in the Soviet Union. So it was not restaurants. People actually had to share the kitchen and the bathroom. There was no professional cook or something. And it was not the luxury of the Roman bath house either.

(00:52:49):

There's great information online, some research done by American scientists actually, where they show these apartments. It's pretty weird. There's the kitchen. The kitchen is shared, but you have every family has its own dining table, its own gas burner. And these apartments, they still exist. But throughout the 20th century, this was the default way to live in the Soviet Union. You had a communal kitchen and bathroom.

Nate Hagens (00:53:23):

I have a question on that. But regarding communism, just a quick comment. Even the word socialism in the United States is akin to devil worship. And yet, people don't understand that we are living socialism now in many ways. But it's socialism for the rich, because our central bank continues to guarantee the whole endeavor with artificial stimulus and low interest rates and things like that. We're debasing the dollar. Most people don't have any investments, so their \$50,000 in savings is going down in value because of the dollar debasement. But those people that are closer to the financial spigot are doing better. So we have socialism now. It's a managed market. And yet that term is so pejorative in my culture. I don't think so much in your culture.

Kris De Decker (00:54:26):

Not that much, no.

Nate Hagens (00:54:30):

Yeah, go ahead.

Kris De Decker (00:54:32):

You could call it communism, but you could just as well sell the communal kitchen as an anarchist idea. Because when people organize their own things bottom up, you can also come out with a communal kitchen.

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Nate Hagens (00:54:47):

Well, I would like to sell it not as anything political at all, but a way to conserve energy, which is about to be more precious. And to build social capital, which is about to be more needed.

Kris De Decker (00:55:03):

Yes, exactly. And also in the US with these kitchen-less apartments, sustainability was not the drive behind that movement. And of course, there were things in the Soviet system. Like for instance, people were put randomly together. It's not that you could choose with whom you would be sharing the kitchen and the bathroom. So I'm not really arguing to copy the system. It's just that from a sustainability viewpoint, from energy use, but also social interaction, social cohesion, it makes a lot of sense to do more of these things together. Or at least give people the opportunity to do it. You don't have to force them to do that.

Nate Hagens (00:55:48):

So let me put you on the spot here. I know that you're a tech expert on exploring different low energy technologies, and you're not a policy person. But let's just say that people in your country, in Spain, politicians recognize that we are headed for an energy and growth constrained future. And they want to provide decent, basic needs for humans. And they were to design some new apartment complexes in Madrid or Barcelona. What would you recommend, if you had a drawing board? And knowing the things you do about our energy and sustainability issues, how would you merge sufficiency and efficiency in a brand new apartment building that would house several hundred humans? Do you have any broad brush ideas?

Kris De Decker (00:56:54):

Yes, and I would even say they're not that original, because these things are actually happening. So in Finland, I visited one of these communities where they share a lot of things. Not just the kitchen bath shower facilities, but also guest rooms, and workshop room, and playgrounds.

(00:57:22):

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I mean, there's so many things we could share. Here in my apartment building, there's 18 apartments and we have 17 vacuum cleaners. We are the only ones not having it. But why do we need 17 vacuum cleaners? So also, these things could be shared.

(00:57:41):

And I would definitely go for a restaurant kind of facility. But also, what would be very useful is a shared laundry space, which is also happening in Scandinavian countries. Pretty common. And it saves a lot of space. If you take out these household activities out of the private apartments, and you make it into a shared space, you win a lot of space in your apartment. And that can be either translated into bigger apartments for all or just more apartment units in a residential building.

(00:58:17):

And if you look at the history of these kitchen-less apartments in the US, it was actually not more expensive to have restaurants with professional cooks on your ground floor than to have your own kitchen. And that was exactly because of that. Because if developers could make smaller units and move the kitchen to a communal space, they could provide more units and still earn the same. So it's quite a win-win situation for even developers of buildings. They don't have to lose money with such an approach.

Nate Hagens (00:59:00):

I think the key would be that a developer would announce that that's what they're building, and that people choose. "I want to go and live in that environment." I think that's the big thing that would need to happen. Right?

Kris De Decker (00:59:14):

I mean, it's happening here and there. With this whole kind of idea of the sharing economy, this is kind of part of it. It's just, of course, there's always apps involved, which is not necessary.

(00:59:30):

But also, I think the easiest thing to move would be the laundry also. It's not just taking a lot of space inside a home. It's also unhealthy to do your laundry at home. You can also actually argue that from a kitchen, we are polluting our indoor

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environment every time we cook. It doesn't matter which kind of stove you use, it's that the food is burning. And the laundry-

Nate Hagens (00:59:56):

This entire... go ahead.

Kris De Decker (01:00:03):

Whether you use a tumble dryer or you're drying your clothes at home, if you're in a humid environment, it's not very good for the indoor environment. You're going to create mold and everything. So why can't we reserve?

(01:00:18):

I've seen some great examples. The top floor of an apartment building that is kind of half open, and everybody can hang their laundry to dry. And in less than a day it's dry, because there's a lot of wind coming through. You solve a lot of problems in terms of air quality indoors, energy use, and so on.

Nate Hagens (01:00:42):

So this entire conversation, Kris, so far, reminds me of a phrase I've been using for a long time, which is we don't face a shortage of energy, but a long edge of expectations. There's so much waste in our system that could be improved, which is why barring nuclear war or a Carrington Event of a solar pulse or something like that, I don't think we're going to collapse. There's going to be a great simplification, and that's why I'm talking to people like you. You in particular, because you're envisioning what a more energy and resource constrained lifestyle might look like.

(01:01:29):

So let's move on to another category. We talked about kitchen-less apartments, maybe a restaurant on the lower level within a city. We talked about heating and cooling people instead of rooms. But within a city, how could we make our cities more walkable with trolley buses, and bikes, and just to make transportation less a person in a car by themselves getting around within a city?

Kris De Decker (01:02:02):

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Fundamentally, it's not rocket science of course. You have to get free of cars. And as long as you don't do that, you cannot really give the alternatives the space they need. So I've seen in many cities, that they try to push everything into one street. So you have cars, you have public transport, and you have a cycle path that is usually on the sidewalk. And so instead of taking space away from the cars-

Nate Hagens (01:02:32):

A cycle path on the sidewalk?

Kris De Decker (01:02:34):

Yes, like in Belgium where I'm from, that's very common. So instead of taking away space from the cars, they take away space from the pedestrians, and they put the cycle path on the sidewalk. Which obviously creates a lot of friction between cyclists and pedestrians, while the car drivers happily continue.

(01:02:57):

So Belgian always scores very high in the best cycle cities in the world, but I know better. I mean, it's a very lazy way to try to solve the... "Here you have your cycle paths. Are you happy now?" Well, not really, because we are endangering pedestrians the whole time. Especially now with all these fast e-bikes and scooters who are now going at 40 kilometer per hour next to people walking at five kilometer per hour. So that's really a very bad idea.

(01:03:28):

And I see here in Barcelona, it's better. When they put the cycle path, they take away space from the cars, and that's how you have to do it. And people of course complain. That's the people who drive cars and who want to keep driving cars. But in general, these cycle paths pretty quickly fill up with cyclists.

(01:03:50):

And when I came to live here 15 years ago, nobody was cycling for practical reasons. I mean, they went cycling for sports, and now people are cycling everywhere. So it's as simple as that. You just take space away from the cars, give it to the bikes, and people will do the rest.

Nate Hagens (01:04:11):

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I actually just got a new e-bike two weeks ago. And I'm going to use it to go into town, which is 10 miles away with a backpack, to get groceries. I'm not going to really use it for exercise. I have another bike for that. But I just think it would be fun to try that. So I'm going to actually try that later today. What else on appropriate lower energy tech would make cities more transportable? You've researched trolley buses, right? What are those?

Kris De Decker (01:04:49):

Yeah. So a trolley bus is basically an electric bus, but it has no battery. It is connected to the overhead lines, just like a tram or an electric train. And that makes them extremely interesting in the sense that-

Nate Hagens (01:05:06):

Is that like the cable cars in San Francisco?

Kris De Decker (01:05:10):

I think San Francisco has trolley buses. I don't know, maybe you call them cable cars. They have rubber wheels or is it on rails?

Nate Hagens (01:05:20):

I'm not sure. I think they're on rails.

Kris De Decker (01:05:23):

Yeah. Then it's not a trolley bus. So the great advantage of a trolley bus is compared to say electric buses with batteries, you have all the advantages of electric transportation. So you have more efficient engines. You can power them with renewable energy, you have no exhaust fumes. But you have none of the disadvantages of using batteries.

(01:05:51):

So batteries take a lot of space. They take a lot of energy to produce, they add a lot of weight to the vehicle. And they cause peaks in the energy demand, because the bus is not using energy continuously but in peaks. So you need to extend your power grid.

(01:06:16):

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And if you compare it to a railed vehicle like a tram, it's way more cheaper to build. You don't have to have the whole rail infrastructure. You can build a trolley bus line much quicker. It combines much better with cyclists. Because another problem in my home country, Belgium, is that when you bike, you see people falling on the ground everywhere because their bike gets stuck in the tram rails. So it is in many ways, ideal in between technology that is super efficient and works really well. And we had 900 systems beginning of 20th century worldwide.

Nate Hagens (01:07:05):

How is it without batteries? How is it powered then?

Kris De Decker (01:07:11):

Yeah, it's like an electric train or a tram. It has this kind of pantograph, and it's connected to an overhead line. So it's constantly fed with electricity by the network.

Nate Hagens (01:07:28):

I mean, you just listed all the advantages. What are the disadvantages?

Kris De Decker (01:07:33):

Well, they're associated with poverty and the Soviet Union. Here we are again.

Nate Hagens (01:07:42):

This is a viable path then for sustainable sufficiency and efficiency in the future, trolley buses in cities?

Kris De Decker (01:07:50):

Yes. And some cities have understood that, and that includes very rich cities like Lyon in France. I went to visit that system and document it. I mean, Lyon is a very chic city. The buildings are amazing and people have a lot of money, but it's full of trolley buses there. Nobody complains about them on the contrary, because it's a wonderful public transport medium.

(01:08:21):

But the problem is that the majority of trolley bus systems that are still in working order are in former Soviet Union countries, in Latin American countries. So in basically

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the rather poorer regions of the world. But they used to be anywhere. Just that in most western countries in the '60s and '70s, they were replaced by diesel buses or just by cars. I mean, public transportation kind of took a dive

Nate Hagens (01:08:54):

Because we had a lot of diesel and gasoline at that time.

Kris De Decker (01:08:58):

Voila.

Nate Hagens (01:09:02):

Okay. Moving on to another area of technology, energy, and human benefits. The last two podcasts that have been released with Robert Lustig and this morning with former governor of Oregon, John Kitzhaber, were on human health and our healthcare system. In the United States, we use 20% of our GDP in the healthcare. And our benefits are very low compared to countries like Spain that spend less and have better healthcare benefits. So from the perspective of the carbon pulse, how can we get in the future decades, 80% of our healthcare benefits with 20% of the resources? Can you speak to that? Have you done research, do you have suggestions in that direction?

Kris De Decker (01:10:06):

Yeah, I did an article on that. And indeed, I was very much surprised by the environmental footprint of the healthcare system. So it's quite a young research domain. But still, the information that is there is quite revealing.

(01:10:23):

So the US, I think it's 10% of national emissions, the US healthcare system. And I calculated if you would extend that to the whole world, then the total emissions would be 16 gigatons, which is half of global emissions worldwide. So just imagine that the whole world follows the American example. Then that's already half of all emissions we now emit in all sectors of economy.

(01:10:55):

So obviously, that is not sustainable. And more so, it's counterproductive, because such a big footprint is coming down to curing people at the expense of making other

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people sick. And other people, that's younger generations and future generations who will suffer because of the healthcare we provide now to ourselves. So it's a big moral dilemma.

(01:11:25):

And it's also very difficult of course, because it's easy to say for a person like me, I'm not going to use a heating system, and I'm going to wear a sweater. And I'm not driving the car, I'm cycling everywhere. But when it comes to healthcare, it kind of comes down to, "Well, I'm going to live a shorter life or I'm going to suffer more pain."

(01:11:47):

So it's a very difficult topic to talk about. But there are actually a lot of solutions in the sense that our healthcare system in general and in the US in particular is totally messed up because of the focus on curative medicine, and the fact that it's designed for profits. I mean it's run by medical companies, the providers of medical machines, pharmaceuticals, and all other medical products that actually... It's them designing our healthcare system. Yeah.

(01:12:33):

The challenge is to kind of move from a curative healthcare to a more preventive healthcare system that first of all does not make people sick. Because industrial society has given us a lot of effective medical treatments, but it's also making us sick. And if you see who is in the hospital, many people are there because of so-called welfare diseases. It's excessive nutrition, low quality nutrition, lack of movement, stress, substance abuse. There is a lot of reasons why people are in a hospital that should not be in the hospital to begin with.

(01:13:18):

And of course, the medical industry has nothing to win with more focus on preventive medicine, because you cannot sell it. There's nothing to sell there. And if you see the enormous power they have, the marketing budgets they have, the influence they have over medical scientists, then it's pretty obvious why we are here. We are going to the hospital to make the economy grow, but not necessarily to get better.

Nate Hagens (01:13:48):

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So what are some low tech responses to that? Other than the kitchen-less apartments, and the communal cooking areas, and sharing vacuum cleaners, and spending time with other humans, and riding a bike to generate your own electricity.

Kris De Decker (01:14:09):

I think many of these things are actually already the solution. So human power, walking, cycling, that is already solving the lack of physical activity. There's now more people in the world who are overweight than underweight. That's kind of quite a change.

(01:14:28):

And the same for stress and social isolation, which some studies say feeling lonely is just as unhealthy as smoking a pack of cigarettes a day. There you have your shared kitchens, and bathing houses, and so on. But there's also a lot to learn from say, developing countries that do not have the access to this modern healthcare system. And India has some great examples.

(01:14:57):

So I found a study of the same treatment, which is a cataract surgery. So cataracts are the main cause of blindness. And the scientists made a comparison between the energy use, and emissions, and waste production between India and the UK.

(01:15:17):

And so in India, they do the same procedure for only 5% of the emissions and the energy use and the waste, than they do in the UK. And they manage to get better outcomes. So they have less infection rates than in the UK.

(01:15:34):

And so what are they doing? They are basically flouting every rule of medicine in the first world about infection control. They reuse all supplies on different patients. So one of the main reasons why our healthcare system is such a disaster in environmental terms is because everything is single use and then disposed of. That includes you have some anesthetics, a bottle. And then you use part of that bottle to anesthetize one person, and you throw the bottle away.

(01:16:12):

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That's not what they do in India. They keep using the same bottle for different patients. Also, while they are operating on one patient, the next patient is right next to the other patient being prepared for the operation. All things that we cannot do in the US or in Europe.

(01:16:32):

But when you read that report, you kind of start wondering, why do we have such strict infection rules in the Western world? Is it because of health considerations, or is it to make more money? Because apparently, if they manage to do this with less infections, then what is the use of spending so much waste and energy to do it in a different way?

(01:17:00):

So these are things that show that there is a lot of potential, just like in other sectors, to really lower the footprint of healthcare, without reducing health or longevity. We don't need to die at 40, because we do things a bit differently. If you combine that with lifestyle changes, I think we get a long way. We may even arrive at results where we even live longer than today.

Nate Hagens (01:17:35):

So an overarching theme in everything that you've discussed today is, I think those that follow this podcast can cognitively imagine the necessity of some of the things that you're talking about. And not only the necessity, but maybe in many cases, the desirability of a more local, more communal, more socially active future.

(01:18:01):

And yet, you and I both know that society in aggregate with politicians and media and everything, are not likely to change en masse until we're forced to, like my friend Jocelyn in Lebanon and other places.

(01:18:22):

So for people listening to this show, what sort of recommendations do you have? Other than reading your website, reading some of your articles, becoming educated on these things. How to start a mind shift where you can simplify first and beat the rush as it were, on starting some of these things? What sort of tips or pathway to

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making some changes ahead of when this is going to be necessary? Do you have any ideas on that?

Kris De Decker (01:18:55):

Yeah, I think it would help to imagine you're already living in Lebanon, and you kind of prepare for what's coming, because it's a lot of work. Even if disaster would strike tomorrow here in Barcelona, I'm not ready either. I have done some things, but I don't produce my own food, for example. So I won't last much longer than other people, and I could not even do it by myself. So yes, it's also cooperating with others.

(01:19:36):

But yes, you look around and everything is working, the power is always on, there's water coming out of the faucet, there's food in the supermarkets. It's easy to get to think, "Okay, it will always be there," but actually, you can argue for sure it's not always going to be there. We just don't know when it's going to be gone. But it's going to be gone one day, and it may be sooner than you think.

(01:20:05):

So as an individual, as a family, as a community, I would start preparing for that. And it can actually be a lot of fun, and it's very rewarding to learn things to do, to learn to do them in a different way. And to learn about these low technologies, older technologies. And not just technologies, but also just ways of doing things.

(01:20:30):

Like the whole idea of communal household tasks is not really a technological solution. It's just the opposites. It's social innovation instead of technological innovation. And that is more what we need.

(01:20:45):

After all, we invented everything we need. This electric cooker I was talking about, you can consider it a new technology, but there's not any new components involved. It's just a different mindset using what we have, and reconfiguring it into something that fits a world where energy is not always available and not in unlimited quantities.

Nate Hagens (01:21:15):

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Well, we should continue this series. I think it's really important to share these ideas, and your work is unparalleled, I think, in these topics. I have to say that if there were a new apartment building that had communal restaurant, and laundry, and maybe bathhouse or something like that, and there was a poster that said, "Kris De Decker lives here." I would sign up to live there as long as they allowed dogs.

Kris De Decker (01:21:50):

Looking forward.

Nate Hagens (01:21:52):

So if you come back again on the show in six months or so, is there any one topic that you would like to take a really deep dive on that you're personally very interested in and passionate about? Or is it all of the above?

Kris De Decker (01:22:14):

Yeah. Well, I'm working on a lot of new articles. So in another six months, I hope there's five new topics that show up.

Nate Hagens (01:22:25):

Can you give us an idea? What are those topics? Just one or two sentences.

Kris De Decker (01:22:32):

I'm doing one on the steel production, history of steel production. And how to kind of escape from the Iron Age, which is not that easy. Because lots of so-called sustainable technologies, the high-tech solutions require a lot of steel.

(01:22:52):

I'm also doing some updates on the system here, like the use of solar energy and human power. And then I have a whole list. I have always, a couple of dozen articles in preparation. So I never really know which one will be the next that is published. I mean, mostly it takes a few years from start to publishing, so it's hard to predict.

Nate Hagens (01:23:18):

Thank you so much for your continued work on lower tech, more appropriate tech futures. And to be continued, my friend.

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Kris De Decker (01:23:29):

Thank you very much.

Nate Hagens (01:23:31):

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