**Ali Abbas – What a load of garbage**

>> Welcome to the podcast series of "Raising the Bar Sydney," raising the bar in 2017 so 20 University of Sydney academics take their research out of the lecture theatre, and into bars across Sydney, all on one night. In this podcast you'll hear Ali Abbas' talk, "What a Load of Garbage." Enjoy the talk.

[ Background Talking ]

[ Applause ]

>> Thank you, Finn. Good evening. It's fantastic to be here tonight, and thank you all for coming out. I'm here to talk about rubbish. And the one thing I'd like you to take home tonight is something called the "circular economy." But before I get to that, let me tell you a little story about my grandmother. She lived in Lebanon up on the hills in a village where she gave birth to 21 children. Sadly, six of them passed away when they were babies; and she raised 15 kids. That's a large family. We don't see that anymore these days. God bless her soul. I remember the happy feelings when I used to visit my grandparents' house. I remember watching my grandma how she managed the household. She never threw away anything. She'd get things from the garden, from the field, it goes on the table. Whatever's not eaten is returned to the garden, to the animals, to the chickens, to the cows. She'd make a nice product on the cow poo. She'd collect the cow poo, form it into these round discs, slap it on the rock wall out in the sun to dry, and when the smell is gone, she'd collect them, store them for later use in the kitchen, or for heating in the winter. So they say there is a happy -- there is a memory from every smell of it. From every smell we get a memory. For me the happy memory is actually smelling the cow poo. Whenever I do that, it kind of inspires me, as I remember my childhood happy days. My grandmother had a concept of circulation. She had a concept of the circular economy at the household level. So I guess how many of you have heard about the circular economy? Okay, that's great. That grandma approach to circulation of materials stuck in my mind. And throughout my life and career as a chemical engineer, I realised how much that approach can be scaled up at large in our society to solve this grand problem of waste. We can learn from her approach, and your grandma's too, perhaps, how we can be more resourceful in terms of utilising materials. Australia, without a doubt, has a massive waste problem. We generate waste at about six times the rate of our national population growth. As individuals on a per capita basis, we are one of the most wasteful nations. The latest National Waste Report 2016 reported that we generated some 64 million tonnes of waste in 2014 alone. That's a lot of waste. And according to my rough back of the envelope calculations, that's enough waste to fill about 600 Olympic-sized swimming pools every single day.

[ Background Talking ]

So waste is an important national issue, and we've seen it discussed recently on TV in shows like "The War On Waste," which exposed how much of a throwaway society we really are. But that means also that we are conscious of this; and that's a good thing. And there are plenty of good stories out there like my grandma's. Tonight I want to tell you how in our society we are dealing with waste. I'd like to touch on the complexities surrounding the waste issue. I also would like to explain why it is inevitable that we will -- technically speaking, we will end up with waste being generated in our current linear economic growth model, or system. I would also like to rethink about sustainability in terms of waste, because waste can be an opportunity, rather than a problem. And we can move towards a circular economy. If we adopt innovative solutions, we can become masters of our own waste. So why is waste a big problem in Australia? When I talk to industry experts, they tell me that we are challenged because we have plenty of resources. We have a lot of space to have those landfills. I used to live in Singapore. Singapore ships all its waste across to its neighbours. They pay for it for them deal with. So that plentiful of resources and space distracts us from being innovative in resource utilisation efficiency, and in reusing materials and recovering resources. We also are a small population scattered across vast distances, and that means it will dilute waste. And we also have a high consumption rate. We have a small manufacturing base, small industry base, which translates into no economies of scale to deal with waste, and that means that waste management is a very expensive exercise. And to make things worse, we have inconsistent policy, from the federal to the states, to local councils, it's all over the place. You can call it a "dog's breakfast." And what is the current technology that we are using to deal with waste? What do we do with waste? I've mentioned landfills. We rely on landfills as a key workhorse technology for dealing with waste at the moment. But landfills are not a sustainable way forward. They have long-term impacts on the environment, they can contaminate soil and groundwater, and they have got a lot of public opposition. Nobody frankly wants to have them in their backyard. They're too smelly, too noisy, the trucks going in and out. And they can contaminate the ground, as I mentioned. These contaminants can end up in our food. Plus, landfills generate greenhouse gases that can escape. They are generated from the fermented kitchen waste, the greens, the organic waste, and they can escape into the atmosphere contributing to the global warming problem. But there's been good developments, good technology developments in the area of landfills nowadays. Landfills have good liner technologies that keeps that liquid leachate from seeping away into the ground; it's pretty good. And we have gas capture systems that capture the methane, combust that, and turn it into energy and to electricity for household use. But landfills is not the way forward, and quite frankly, it's not the best way that is for us to deal with this valuable resource, the waste.

[ Background Talking ]

Let's go back to some basic fundamentals. Let's go back to the physical laws of conservation, and specifically to the law of mass conservation, which implies that mass in a given system is conserved. So if I put one gramme in of any material into a system, I'm expecting to get one gramme out. Mass is conserved. We teach this in the first year of our chemical engineering degree discipline, what we call the "mass balance," or, "material balance." Under the same conservation principle, energy is also conserved, and we also call that something else, it's called the "energy balance." That's Chemical Engineering 101 or Chem. Eng. 101. Let's put this in a little bit of a context. If we extract raw resources from the environment and bring it into this system, that's the manufacturing system. Raw resources like crude oil, like sand, like wood, like iron ore and so on, all these resources are brought into the manufacturing process, converted, manufactured into products such as plastics, paper, metal, and so on. And so in this context of the mass balance, we expect that the mass of those raw materials in the system will be conserved into these products that we manufacture and use everyday, products like this piece of paper in my hand. Such products we use a lot every day. However, we also add things into this system. We add water along the way. Remember, we are extracting the raw resource. We are transporting it. We are then converting this reaction, these chemical engineering processes. We are then packaging it, transporting it again, and then delivering it to the consumer. A lot of materials are inputted into that system; I mentioned water. But there are other chemicals that are added as well. So then we end up with other streams that are being formed around this system. So let's imagine a virtual box with an arrow going in from the right into the box, representing the feedstock raw materials, and an arrow exiting from the box being the products that we have manufactured. One gramme in we expect to have one gramme out. But that's not that case. That gramme of raw resource doesn't all end up in the product. And we've added water and other chemicals. So we're going to eventually end up with a waste stream. And let's draw an arrow down from that box representing the liquid and solid waste that we may generate. What else is there? We've got emissions. Let's put another arrow in that box upwards, gaseous emissions, the carbon emissions from all these depths of the manufacturing. So the yield of that product is not really 100%. And we inevitably ended up with a waste stream. And that's for any product we have. Take a shopping plastic bag, for example, or that piece of paper, that's the same case. So the summary for that is that mass in -- whatever that mass is in coming into that system is going to balance with the mass coming out of that system, whether that's a product, or a waste. So you are all now chemical engineers; well almost. Energy balance, remember I mentioned that. What about energy? So we talk about products and waste. Let's talk about energy in this discussion as well, because along the way, we've extracted, we've converted, we've reacted, we've separated, we've purified, we've packaged, we've transported. All those steps require energy. And energy is an important player in the waste business. But it's often not discussed. And it's very much this nexus between energy and materials, so the energy balance and the mass balance, they're very much linked with each other. So we have for every product around us an energy footprint. In the same way I mentioned the emissions, we will have an emissions footprint, a carbon footprint for any product. And we also will have a water footprint. Water is important in the manufacturing process, it's used up. In some countries, the water is polluted in those rivers because of the manufacturing processes. So we have these KPIs, performance indicators, the energy footprint, the carbon footprint, and the water footprint, that are the performance indicators of any product; they are the environmental indicators. And so this means that we will inevitably end up with some waste, and some impact on the environment from our current manufacturing systems. And where does that energy come from? So if we were in Australia, or in China, that energy would come mainly from coal power stations; and that has another burden on the environment emissions. And so I've described to you a manufacturing system, which is what we have currently today that extracts resources from the cradle origins in a linear direction towards their grave fate, which is the landfill. So remember, once we get the product in our hands, we use it, and often it's a single-use product, which we chuck out, and it ends up in the landfill. And these resources, remember, are finite; we all know that. Nature has what it has. We will use that up, and there's no more ultimately. So we need to be clever how we utilise these natural resources. And so we have this linear economy that we have today. And in fact, that's very good for business. Businesses require the linear economy to make more money, more single-use products. They can sell you more. You use it once only, you chuck it out and buy some more. So it's good for profit, it's good for business. Unfortunately, that's the case. So we must think about resource utilisation efficiency, and we must refresh our thinking about every product around us.

[ Background Talking ]

So this linear economic growth meant that you will inevitably have waste, as I mentioned. And so these -- as populations grew, these big rubbish bins that we call the landfills, or the tips, they also grew. But we came up with other solutions, recycling. And that's been a good successful story. Today we recycle more than 50% of waste, so we divert that from the landfills. But recycling to me is a very large band-aid solution to the big problem. It's good, there are some things, yes, we need to recycle and we will continue to do that, it makes sense. But landfills is not a sustainable way forward, and recycling really is not as sustainable as we think. And the reason is remember, whenever we recycle a product, we have to reprocess them. We have to expend energy in the reprocessing of that material. And remember I introduced the energy discussion into the waste discussion. And this is why, because we need energy to do the recycling, and often that's quite a lot. So take coffee cups, for example. Who had a coffee today? I think I lost count how many I had today, raising the bar I guess on my coffee intake. But coffee cups also has been mentioned in the war on waste as an issue. We generate something like 30 billion coffee cups a year in this country. Coffee cups are made from a composite material that's got plastic, as well as paper in them. That's difficult to separate if you want to recycle them, the plastic from the paper, which distracts companies, recycling companies from actually doing the separation. But it's not impossible. So if you've made a good gesture to throw the coffee -- the takeaway coffee cup in the yellow bin, that's great. If you've thrown it in the red bin, it's just as good because it's going to end up -- or just as bad, I should say, because it's going to end up in the landfill anyway. It gets sorted and all of it goes to the landfill. So we all have this guilty feeling about coffee cups, takeaway coffee cups. But I want to say tonight that maybe that guilty feeling should be transferred also to the businesses where instead of giving us non-recyclable coffee cups, they should be giving us biodegradable coffee cups, coffee cups that we can all throw in the yellow bin and they all end up recycled. And there are also other wastes out there that are not recycled, food we throw away more than 50% of the food that we have. So that's quite frankly not acceptable. We are a developed country, and so we need to rethink that situation. Glass is another issue. So we also have problem with recycling glass, because again, recycling glass requires energy, and it's sometimes cheaper to bring in the glass from overseas. And so we end up with these large piles of non-recyclable glass just piling up in places on farms and in warehouses around the country. So what are you doing about this? What can we all do about this? How can we rethink this system? How can we introduce a new structural change to solve this problem?

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>> Let's talk about circulation, and the circular economy. So under the circular economy model, we would use less resources, we would throw out less waste, and the engine here is in the circulation. But the keyword here is "reuse," it's not "recycle." So we try as much as we can to reuse materials, and we try as much as we can -- or use products as many times as we can. Under this particular -- I mean this makes a lot of sense, right? And in fact, it makes too much sense to the Europeans who have put this in policy already. It is also legislation in China now in their Environmental Protection Legislation. It's yet to be here. So there's something there that needs to be discussed. In my mind, there are multiple fronts to tackle the waste problem. So we've talked about the individual level, multiple levels. We also need to discuss the business or the retail level. We also need to talk about the industrial level, and policy. So it can't be a single individual's initiative here, it's got to be the collective. But even the collective individuals cannot make that big a difference because we are dictated by this linear economy system that provides us with all these products that we have today. Let me give you a couple of examples, as Finn mentioned, of introducing some technological solutions to some of these problems. But I'll give them at the industrial scale, because that's where I think coming from the large scale can start to have these bigger impacts. One example is in the construction industry. So we are building a lot of buildings around the place. We need concrete, we need bricks, we need construction materials of all different properties and sorts. That comes from natural resources as well. So we extract sand, and cement, and so on from nature that also the cement business is quite a high emissions intensity business. So how can we think about a circular economy in the construction industry? So we are cooperating with power stations, with local councils, with the construction industry, with construction materials manufacturers together to try and build this circular economy for the construction industry, where we can use waste from one industry, and this waste becomes the feedstock to another industry. So rather than working alone, these industries would be working and collaborating together to build these materials circulations. And that means at the end of the day, we would be circulating materials, reusing them in new buildings, and reducing, you know, the magnitude of that right arrow going in, and the left arrow exiting out of the box. The resources are reduced and the rubbish for the waste is also reduced. So our work at the moment is looking at how we can generate these nice blends of waste construction materials where we are bringing in the fly ash from the power station. We are bringing in non-recyclable glass, grinding that and bending that into the mix. We are bringing in waste from mines, waste from the steel industry, the steel slag, and even agricultural residues like from the rice industry. So those wastes and blending them in different proportions we're looking to build materials that have specific strength, specific water resistance, and also other properties like acoustics for the construction and building buildings. That's one example, so the circulation of those materials. And these are large extremes. So those non-recyclable glass, the flay ash, at times it's been used, but they do end up ultimately in the landfill if we don't do the circular economy approach. Another example is wastewater treatment. So we are working with companies that use algae to do this wastewater bioremediation. And algae is a wonderful thing. It can clean the water, it consumes carbon dioxide, and with sunlight it grows and makes more algae. We feed that algae to aquaculture to produce fish and prawns so that food is being produced. And the wastewater from the aquaculture is taken back, where, to the algae. And the circle goes around. While at the same time we are producing valuable products out of the algae, we are helping these companies to develop processes that extract valuable compounds from the algae, such as nutriceuticals or healthcare products. These are very valuable products. So these circulation approaches at the industrial scale give you an idea what can be achieved there. And what about the business retail scale, or level of their approach? And this is where the circular economy drives home. You know, typically, we would buy things in our normal business as usual linear economy. We buy a washing machine, we buy a telephone, we buy a light bulb. We buy products. We own those products when we buy them. Well, in the circular economy approach, the business model has to turn around on its head. Circular economy requires the vendor of the phone, of the light bulb, of the washing machine, to own the product, and to own all the materials in that product. So for the washing machine, it's all the plastic, it's all the metal in there. All the materials in that washing machine will remain owned by the vendor. That's a different approach. You would be leasing that washing machine for, say, a three-year contract. At the end of that contract, you would return that washing machine, they would come and pick it up, and they would give you a new washing machine, a new model. Let's think about that for a moment. And that's the same with the phones as well. Imagine you could actually return your phone every year to the manufacturer, to Apple, or to Samsung, and they will give you the new model at the end of the year. And that's the same for other products, even cars. We buy cars, we own cars. But under the circular economy, it means we would be buying the performance from the cars, renting the cars. I need to get from A to B, I'm renting the car to get that performance. So under the circular economy model, ownership is transferred to the vendor. So what does it mean for waste? It means now that the vendor owns all the materials. It's in the interest of the vendor now to create a product, to design a product that has excellent performance, lasts longer, and that business model now is -- incentivizes those companies, the manufacturers and the business retailers, to only source products that are reusable, products that can be easily opened up and their parts reused. Not recycled; we don't want to do much reprocessing of materials because of the energy issue. That's what the circular economy says about the business end of -- or the business level of attacking the waste problem. It makes sense to buy a product that gains in value. You buy a house because you're going to own it, but also you know it's going to increase in value. It doesn't make sense to buy a product that doesn't gain value, and then you throw it away. So that's what the circular economy is saying. So the key message out of this circular economy business level discussion is that we must revisit product design. And product design is the first and foundational step in the circular economy. That means we have to rethink about every single product in our everyday lives. And the manufacturing processes have to spend thoughtful energy in designing products for us that are reusable. Let's review my grandma's poop product. It made sense for her to design these round discs, to recycle or to reuse the energy out of that from the cow poo. So I understand now. I've been reading about a larger-scale implementation of this particular recirculation. In Northern Kenya there is a town of about 180,000 people who have closed the loop on poop. They basically recycle the poop. They designed a product out of that that's mixed with charcoal. So they don't have a lot of trees there, they need energy, right? And they recycle and reuse. They've got a fresh way to think about poop. So I have failed to convince my kids to drop their iPads and go out and have a whiff of cow poo and get inspired. But I keep telling them about the recirculations that my grandma used to do. I educate them about the circular economy now. Perhaps later they can have a future where waste is a thing of the past. And of course, you and we all can contribute to this through our purchasing power. We can demand products and only products that are circular economy certified, once the circular economy policy and legislation is in place here. So we need to raise the bar in waste. And to make that change, we all need to revive that grandma approach to recirculation of materials. We all need to demand a circular economy policy in Australia. Thank you very much.

[ Applause ]

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