

Welcome to 30 Brave Minutes, a podcast of the College of Arts and Sciences at the University of North Carolina at Pembroke. In 30 Brave Minutes we'll give you something interesting to think about. Joining the Dean of the College of Arts and Sciences, Jeff Frederick, are Jay Blausler, Director of Campus Sustainability, Nathan Phillippi, Senior Lecturer in Geography, Andy Ash, Professor from the Department of Biology and Rachel Smith, Professor of chemistry. Their topic: sustainability.

FREDERICK: One of the words that has crawled deeper into our daily lexicon in the last decade is *sustainability*. Sustainable agriculture. Sustainable architecture. Sustainable and renewable energy. Carbon footprint reduction strategies. Sustainable eco-systems. Environmental and ecological impact studies. Clean air and water. Sustainable business practices. A sustainable global society. In its depth, sustainability integrates social sciences and environmental science and history with numerous physical and natural sciences, engineering, and certainly technological applications. It is a changing intellectual discipline and an important contemporary issue. Our children and their children will inherit the world we leave for them. We better leave them something sustainable.

It's also a practical matter. How do you manage wetlands? What about various species in decline? How do you arrest deforestation? What about building neighborhoods that are energy efficient, economically resilient, and able to endure the human and environmental factors of a rapidly changing world?

Across the world today, over a billion people lack access to electricity. How will we produce and distribute electrical current so that light and heat and cooling and refrigeration and medicine and internet can blanket the earth. In addition to upgrading the quality of life and extending the duration of life, delivering electricity to the world would create a huge number of jobs and bring tangible economic and educational benefits across underdeveloped areas.

In some ways, progress on sustainability has been halting. Henry Ford's Model T, introduced about 100 years ago, or so, got 25 miles per gallon. The average full-size SUV today gets about 20; admittedly, the truck I drove to campus today, 17.

Last year, our electricity came primarily from these four sources: Natural gas, 34%; Coal, 30%; Nuclear, around 20%; and Renewables, around 15%. Even so, the number of workers in solar has doubled since 2012 to around 260,000, and the total amount of solar energy capacity increased nearly 50% last year alone.

Sustainability, then, has a significant economic impact. It also has a practical impact. By 2050, the world's population will be about 9 billion and that will necessitate a

massive increase in the amount of available food. Already, 51% of the world's population lives on about 2% of the planet. Let's think just about the food issues alone, although clearly there will be other related issues of energy, architecture, living space, and dozens of other concerns if the population gets to 9 billion. All right, let's work on food. Easy enough. Let's add more land under cultivation and increase the amount of fertilizer so we increase the yield. Except that effects the water supply and some land will need to be allocated for living space for all the additional people. Well let's just increase the animal supply through systematic breeding. Except more livestock can produce more emissions which causes other problems. Ok, let's just expand genetically modified crops to fill the void. Great! Except those foods might have a detrimental effect on your health.

The long and short of sustainability is that it is sort of perfectly Newtonian. Newton's third law crudely stated suggests that for **every action**, there is an **equal and opposite reaction**. Every time you fix some element related to sustainability, you might unleash another set of forces at the same time that growth and changes in organic beings are already taking place and are affected by. And these issues are creating global, national, corporate, and community impact. A growing number of firms are now listing water scarcity as an issue that could change profitability as well as the way they do business.

So, many different matters have an impact on sustainability. Air conditioning, for example, makes a clear and noted improvement in our lives. Who would disagree with that as we sweat uncontrollably doing this broadcast in August in the South? A recent study concluded that the world consumes about 1 trillion kilowatt hours (kWh) of electricity for AC annually; more than twice the total energy consumption of Africa for all purposes [20]. It is also estimated that energy for cooling could increase tenfold by 2050. [1] At what price will our comfort come? Our topic today, sustainability, a matter of critical importance with each passing year. Joining us are Rachel Smith, Nathan Phillippi, Jay Blausser, and Andy Ash.

Let's start by saying, from the most basic perspective, how each of your disciplines and areas of specialization defines sustainability.

SMITH: Within the area of the chemical industry and the pharmaceutical industry, we really refer to sustainable chemistry as green chemistry and the emphasis is on trying to decrease the total amount of waste products that are produced, particularly hazardous waste, make the most efficient yield of the starting materials that we use in order to make pharmaceuticals and other products. We are also trying to increase the efficiency of, for instance, heating methods. More direct heating methods, for instance microwave heating, where you are not actually heating a material that is

then used to heat the chemicals undergoing the reaction, but more directly heating them. Those kinds of emphases are what the chemical industry is trying to do in order to be more responsible about the way that we are producing chemicals in today's environment.

FREDERICK: What about the rest of you all?

PHILLIPPI: Within geography we emphasize the idea of human and environmental impacts, and what is the role of humans and their responsibility towards the environment and the idea of stewardship with the idea of land-use change and land-use development and mapping out these processes, and trying to create a more realistic picture and idea of how the land and resources are being used so we can come to a better understanding of using scarce resources and hopefully keeping them around longer for a few generations.

FREDERICK: That reminds me, I went camping a couple of weeks ago and when I checked in with the ranger, the last thing she said to me was something I have heard many times: Leave no trace. Whenever you are done, make it like you weren't even here.

ASH: Ecologically, I think sustainability amounts to two things. First, keeping the human requirement for biosphere resources below the ability of the biosphere to provide those resources, and secondly, a human extraction, where resources should not impair the structure and function of natural systems such that they cannot provide those resources.

FREDERICK: So, in some sense it is a math problem. What is the capacity and how do we stay under it?

ASH: Yeah. It's a math problem and a structural problem. If you compare, for instance, an agricultural field, with a natural community, the difference in the number of species is obvious, and that structure provides stability, at least that is what ecological theory says. So, when we modify natural systems to human use, we usually diminish structure, which then impairs stability and longevity. You know, there are problems more than just math. It is configuration and resilience.

FREDERICK: Jay, talk about it from your perspective.

BLAUSER: Sure. All of this is in line with the way our committee here on campus, the sustainability defines this. We actually endorse the Environmental Protection Agency's definition, as well as the Association for the Advancement of Sustainable and Higher

Education. It is exactly what has already been said, but is based on simple principle, everything that we need for our survival and well-being depends, either directly or indirectly on our natural environment. Therefore sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony that permit fulfilling the social, economic, and other requirements of present, and future generations. That is the EPAs version.

FREDERICK: That is a mouthful!

BLAUSER: It is. A shorter version that we also agree with is that from AASHE. They define sustainability in an inclusive way, encompassing human and ecological health, social justice, secure livelihoods and a better world for all generations.

FREDERICK: So let's talk a little bit maybe about the last decade, where it appears, at least from a layman's perspective, that there has been a lot of energy released about the issue of sustainability and attacking it. In what ways have we made progress over the last decade or so in terms of understanding sustainability and taking some action toward making a more sustainable world?

PHILLIPPI: A lot of people have recognized that cutting carbon emissions that is one of the most important aspects of environmental sustainability. On top of that, there is the idea of urban growth sustainability with development as cities become larger and the majority of the population of the world starts moving into urban centers. Where can these people be placed in not only a sustainable way so they don't have a negative impact on the environment, but how can they live comfortably? How can they sustain a way of life that is good? And be able to make a living that gives them respect and doesn't degrade them? And have a shelter that is safe and solid. So in respects of developing countries, a lot of governments are starting to step forward, particularly within Asia to be more prudent about, particularly again, about carbon and cutting the carbon footprint, and not allowing automobiles into the downtown urban centers, but force them to use mass transit in general. Even in Europe, where there has been a huge push for this, and also pushing for more green. Not just areas in general, but green buildings where they will put plants on the rooftops or plant more trees within the boulevards, and, or use interchange areas to offset the carbon footprint of vehicles.

FREDERICK: And Jay, we have been doing some of that on our own campus, right?

BLAUSER: Absolutely. We incorporate those kinds of technologies in our projects where it is feasible and practical. To piggy-back off of what Nathan was saying, what is also encouraging to me on a global scale is where the United Nations is coming

together. We have many countries in the world that are coming together and have been for many years. I guess it started way back in 1992, with the Rio Earth Summit. Since then, you have the Kyoto Protocol, and most recently, you have the Paris agreement, which actually went into effect back in November of 2016. This is now encouraging because a lot of countries in our world are actually working on trying to reduce and mitigate these issues that are causing all of this climate change.

FREDERICK: Let's break it down one step further. Why are carbon emissions at an excess volume bad for the environment, bad for the globe in such a way, or how significant is the problem?

ASH: Carbon dioxide is greenhouse gas and it absorbs infrared radiation, which is a form of heat. So the more carbon is in the atmosphere, the warmer the atmosphere gets. We're on track to have for the fourth decade in a row the warmest decade in which people kept records. There are a lot of aspects to it, but I think the bottom line is if there is something we can do about that we ought to, regardless of who caused the problem for starters. The analogy I use in my ecology class is if you are going down a hill and your breaks fail on your car, and you are about to go over the edge, does it really matter whether somebody did that to you or your car just failed? I think we have pursued the wrong argument in a lot of cases. We worry too much about how much of this is caused by human beings, how much global warming due to excess carbon in the atmosphere is caused by people, but the simple fact of the matter is that if carbon concentrations are going up we need to figure out strategies to reduce them and not get bound up in these arguments about whose fault it is or why it happened.

FREDERICK: Yeah, I agree. Focusing on blame doesn't do much to address the problem. It just sort of isolates one group or another. What about in the chemical industry? What sort of progress has been made in the last decade there?

SMITH: So I'd say one of the main ways in which we have progressed, at least in our emphasis and our strategy for making our processes more sustainable is trying to use fewer solvents that are volatile organic compounds and increasing the number of reactions that can be performed in water rather than in toxic solvent. There was a noble prize given in 2005 to a team that developed a catalyst that is able to do a reaction that was previously a very toxic reaction and can now be done under much more marine conditions. So there is a renewed emphasis and a greater emphasis on even in the pedagogical sense. Even in the labs we do our experiments on small scale so that we are producing fewer waste products, but at every level we are trying to decrease the amount of waste that we are generating.

FREDERICK: Because that waste is not easily disposed of?

SMITH: Exactly. So, even here at the university, we have to pay a company to come and take away all of the waste products from all of our reactions that we do here. The same is true but even to a greater scale for those chemical manufacturers.

FREDERICK: Well, that is all very optimistic, some progress here or there... Let's flip the side of the coin to the other viewpoint. What are our challenges? What are the areas where we haven't made as much progress? Where are the places where sustainability needs to become a bigger emphasis?

ASH: From an ecological point of view I think one great area where we can work harder is in an area that is called ecosystem services. That is assigning value to functions that natural systems provide that have in past business models not been taken into account. For instance, if we had to build machines to supply oxygen to the atmosphere, which green plants do for free, how much would it cost? Basically it would break the budget of every nation on earth. First of all, we don't have machines that work at that capacity. We don't assign value to that, and it is a critically important function. Historically, political and economic systems have not done a very good job of assigning value to these functions that natural systems provide us for free. When we talk about taking out ten acres of land for a Walmart and a parking lot, that is all good. There are jobs created. There is stimulus to local economy, but there is no factoring in of what was lost in terms of the services that the natural community that was there provided to us. And I think we have got a lot of work to do in that area.

FREDERICK: So it goes back to what you were saying earlier. There is this reaction. Every time you make some alteration of the ecology of an area, there is a consequence even if it is not immediately identifiable in the minds of the ordinary person.

ASH: And there are consequences that don't get factored into the economic system. In a lot of ways economics has been based in many cases on acquiring natural resources cheaply and then selling them at a higher price to somebody else, or transporting them somewhere. That is where a lot of the very wealthy people came from. There is not a good connection between ecological principles and economic principles.

*\*\*We'll return to Thirty Brave Minutes in a moment, but first thank you for listening and for your financial support of the College of Arts and Sciences. The Dean's fund exists to help students and faculty to make meaningful connections to the community, the state and beyond through intellectual inquiry, scholarships, and*

*research in the humanities, social sciences and STEM fields. Consider a contribution today. Mark your envelope: The Deans Fund, College of Arts and Sciences, UNC Pembroke, Hickory Hall, Pembroke, NC 28372 or call the College of Arts and Sciences at 910-521-6198. You can also find us on the Web. Now, back to Thirty Brave Minutes and your host, Jeff Frederick...*

FREDERICK: What about other challenges? Other ways in which sustainability is still kind of in its infancy?

PHILLIPPI: Culturally, the idea of the foods that are consumed and that demonstrate wealth or success. For instance, western countries have largely banned wheat and meat based types of diets, and so as these developing countries that were largely based off of vegetarian diets, shift to show that they have been successful. That puts more stress not only on the byproducts that these animals create, which do have an effect on climate change, but also on the economies. What is the cost for meats and chickens now? Not only that but the taboos that are put into place for what is consumed even of these animals. Even going back fifty years ago, there is much more parts of the animal that were consumed on a regular basis, or would show up on a table, like the tongue, or the kidneys, or the sweet meats, or what-not. It was something that could just be consumed and was affordable to lower income families. Whereas today, it is very difficult to find any of those products. People make icky-faces when thinking about that. One of the things that, particularly in the Western world, as populations do increase and a lot of these food types become scarce. Maybe the idea of how we approach how other countries do eat different types of tubers or vegetables or even bugs, might be something that should be embraced, just to stretch out and make consumption of foods more affordable and available.

FREDERICK: Other challenges?

BLAUSER: I think in terms of energy production, that is a large industry and a large area that is contributing to some of our climate change. We have a lot of technologies that are in development currently, with solar, wind turbines, and different things. One of the main issues that is limiting us from really passing with these technologies is the intermittency of technology and the capacity to be able to store that energy. As long as the wind is blowing and the sun is shining, you can produce that power. But what happens at night when the wind is not blowing. The ability to capture that when it is produced, store and then use it when it is at night or wind is not blowing. That is the area where we are still improving. During the process while this is improving there is going to be some intermittent technologies and sources of power. Coal is sort of losing its focus and that intermittent fuel currently is natural gas. There is pros and cons with that as well, but during this period of development, until the intermittency

is worked out with our technology, we are going to have to do a little give and take, I guess is a good way to put it.

FREDERICK: So we are okay at producing renewable energy, maybe even distributing it, but storing it and keeping some excess is a place where we need to make some progress.

BLAUSER: Absolutely.

FREDERICK: Let's talk just a little bit about the science. There are some that are skeptical about matters related to sustainability. How clear is the science on sustainability and its relationship to all of us?

ASH: I think if you go back to basics, the science is pretty clear. There is a finite amount of mass on the planet and the human population is going to exceed the mass off the planet at some point. There will be limits to growth at some point, okay? So, if you are going to have a sustainable society, you are going to have to recognize where those limits are and how do we keep the human population below that limit. Another thing that we sort of danced around a little bit, but you know what? Sustainability has a subjective component to it. You can live sustainably at all sorts of different levels, depending on what your ecological footprint or your requirements for the environment are. The universal conception is that the industrialized society is where we ought to be. We maximize use of resources and there are lots of other societies on earth that live sustainably at much lower levels of energy and resource use than we do. So the question is where is the balance? I think the science and even the political leadership on those sorts of questions has a long way to go. So, the generalities, I think, are clear, but with the specifics I think we have a long, long way to go.

FREDERICK: Well, to that end, what is the next area of research or what is the next breakthrough that is likely to come in each of your different disciplines?

SMITH: I think Jay already mentioned the major breakthrough that really needs to happen in chemistry, which has to do with batteries and finding batteries that can hold a charge for a longer time. Obviously, think about your electric car. We are now limited to how far you can drive just by the batteries. So, if we could have more efficient batteries we could overcome that problem.

FREDERICK: And the market for a battery that would charge faster and last longer for virtually any device that you would use has got to be unlimited, right? We are still limited in some sense by a kind of cord, the kind of cord that we have to plug in to charge the battery. What about other breakthroughs that you all would anticipate?

PHILLIPPI: There was a paper that was just put out. It was being able to visualize and to create a real representation without necessarily using satellite imagery of an area or region that would be used for some form of farming. The article was specifically talking about bioenergy plants, like sweet potatoes and things like that, that would be used for bioenergy, and what would be its impact on the environment. The interest of it was that it was trying to predict without actually having a plan that this is the impact that we would see within this area.

FREDERICK: Predictive analytics on sustainability issues?

PHILLIPPI: So without having to have to go through the process and seeing, ooo, this was bad! How can we go back and fix this? Try and predict if we do this kind of crop in this area, this is the type of effect it will have on...

FREDERICK: In some sense there has been this reality for a century or so about urban planning, right? We have to make our cities work, and lay them out in a grid, and make sure things are connected. We have also had varying levels of rural planning. Crop rotation, how to maximize yields, what kind of crops can replenish the soil? How do we make sure there is an environment for livestock? But, we are at the point now, with sustainability, where we have to integrate urban and rural planning together into more of a network of how a holistic approach would function for everybody's benefit. I think that is kind of an area that more and more people are beginning to study. As opposed to we have an urban area and we have a rural area, and they don't connect. Kind of realizing that they have to connect at this point.

BLAUSER: Exactly. We touched on this earlier, but I think that availability of food and also water, are going to become more of a focus as we continue moving forward. With more people on the planet and less farmers, less land to produce crops, we are going to have to develop better ways to be able to meet the demand for the food we are going to need, as well as the water. Both. Those are going to become more critical as we move along.

FREDERICK: Let's break it down to an even more basic level. What are common sense, easy to adopt habits and strategies that ordinary people can employ to make their own communities and neighborhoods a little more sustainable?

BLAUSER: Small behavioral changes make a difference. For example, just daily habits and the decisions you make. Take an example from our students on our campus here. Do I drive from parking lot A to my next class or do I just walk to my next class? It is so simple. When I'm done with this, do I recycle it or do I throw it in the trash. If you throw it in the trash it goes to the landfill. All of that adds up. Do I have to use plastic

bags every time I go to the store? Can I just use the same bag over and over? Turning off lights. It is so many little things that seem like no brainers, but it adds up. Just on our campus alone, we have got 6,500 students and almost 1,000 employees. If everybody thinks about it that way, the simple things that you can control day to day, it makes an impact.

ASH: In urban areas I think we have made real progress with green belts, and green belt organization park systems. I think that helps. It is important to note here that much of what we are saying here is what sorts of human systems can we develop that work better? One of the big make, or many people make, is thinking that food comes from a grocery store. Or gas comes from a pump. Virtually, there is almost nothing in New York City that helps New York City work the way it does. All of the resources, the concrete, the wood, the food, the gas, whatever, comes from somewhere else on earth and often from natural or quasi-natural systems that provide those things. So, it is not just a matter of organizing and running our human-based systems better, we are going to have to ultimately be concerned about how much natural area is left to provide the resources that we all want to see in our lives and maintaining those. It gets harder and harder to convince people of that because I think it was in 2007, for the first time in history, over half of the human population lived in cities or urban environments. So it gets harder to educate people about natural systems when most of us don't live in those sorts of systems.

FREDERICK: Fascinating. What do you all see, as a wrap up, from your students when issues of sustainability come up in discussions or in lectures? Do they seem to be a little bit more attuned to the topic or are they just like the rest of us, needing to be brought along?

SMITH: I get the sense that our students are digital natives, and I think they are also sustainability natives. They don't remember a time when these issues weren't discussed. If they have the energy to walk the two extra feet to recycle their soda bottle or not, that might be a different conversation. They are certainly aware of these issues and are having these discussions. It is not a new topic for them and they are discussing among themselves issues of environmental awareness and sustainability.

PHILLIPPI: Yeah, the students are much more aware than you and I are now, I hate to admit it, about being sustainable within their daily lives. I often ask questions about things that they might do, such as brushing their teeth, how many of you keep the water running while you brush your teeth? Very few of them do. I will freely admit that it is something that I do, just because that is what I grew up doing. Or, I noticed

many students will, instead of buying bottled water, have water bottles so they don't have the impact of needing to recycle or throw that bottle out.

FREDERICK: Some of the little things that Jay was talking about. How the little things add up and they become big things.

BLAUSER: And I interact from time to time with a student group call THE GREENER COALITION here on our campus. That is a student club that is promoting sustainability and doing various events, outreach and whatnot. Most of them are very passionate about local food, sustainable local food. So much so that they have partnered with our student government association and over the summer, they drafted a resolution, where I think they are scheduling to meet ultimately with our chancellor to discuss it, but what they are wanting to do is have our chancellor commit to what is called the real food commitment. What that means is basically, by the year 2020, 20% of the food that you are serving in the campus dining is what is considered real food. Real food being sustainably produced food. It is local, people involved are paid a fair wage, it is either organic or close to it, free of man-made chemicals, and things that we don't necessarily want to put in our bodies. Those kinds of things. And if the protein wasn't humanely produced. But 20% of the food that we are buying and consuming will be that. That is encouraging and that is our students.

FREDERICK: Congratulations to our students and thank you to our panel for a great discussion on a real important topic. If you have enjoyed this pass along *Thirty Brave Minutes* to a friend and we will see you next time for another thoughtful discussion on a topic of interest.

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**Thanks for listening to 30 Brave Minutes, and Go Braves!**

1] Karin Lundgren 1,\* and Tord Kjellstrom ,“Sustainability Challenges from Climate Change and Air Conditioning Use in Urban Areas,” *Sustainability*, Vol 5, issue 7.