



Episode Title: What is Green Chemistry? -- A Conversation with Joel A. Tickner, Ph.D.

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LLB: Hello, and welcome to *All Things Chemical*, a podcast produced by Bergeson & Campbell, P.C. (B&C[®]), a Washington, D.C., law firm focusing on chemical law, business, and litigation matters. I'm Lynn Bergeson.

This week I had the pleasure of speaking with Joel Tickner, Professor, Department of Public Health, University of Massachusetts at Lowell, and Executive Director of Change Chemistry, to discuss green chemistry and Joel's important work at Change Chemistry. We all appreciate that chemicals are absolutely essential to society. Green chemistry is all about engineering chemicals to diminish their adverse effects and ensure chemicals, materials, and products are safe, efficacious, and sustainable. We discuss Joel's pioneering work in this field, his leadership of Change Chemistry, implementation of the Sustainable Chemistry Research and Development (R&D) Act, and the U.S. Environmental Protection Agency's (EPA) implementation of amendments to the Toxic Substances Control Act (TSCA) addressing new chemical review, and much more. Now here is my conversation with Dr. Joel Tickner.

Joel, thank you so much for being here today. I'm just delighted that you're in the studio and having this conversation.

Joel A. Tickner (JAT): Thank you so much, Lynn, for inviting me today. I'm excited to be doing this with you.

LLB: Joel, I have known you for a long time and admired your work in green sustainable chemistry for many years. But some of our listeners may be less familiar with your extraordinary background and accomplishments. Just give us a little rundown of yourself.

JAT: Yes. I've been -- I'm a professor of public health at the University of Massachusetts at Lowell, where I've been for almost 25 years. I did my Ph.D. at Lowell. I'm trained as a health scientist, spent much of my early career studying and then advocating for policy to

address chemicals of concern, and realized that through policy alone, we were making not fast enough progress on these chemistries.

Let me give you an example. Last week, EPA, or two weeks ago, EPA announced their final regulation on methylene chloride, a chemical we've known that is toxic for 40 years. If we'd just spent the time finding better solutions that were a win-win for health and environment and for industry, we wouldn't have spent 40 years debating the nuances of the mechanisms of toxicity of methylene chloride and really driven solutions that would have benefited everybody. I think early in my career, I realized that unless we focus on the solutions, we get stuck debating the problems *ad nauseum*, and that doesn't solve anyone's problem.

LLB: True that. God knows we discuss a lot.

You are and have been for a long time, Joel, a very passionate and, I might add, effective advocate and promoter of sustainable chemistry. Maybe you could share with our listeners when and how you developed this passion for sustainable chemistry. Was it something in particular, a postdoc project, you worked on? What is the source of all of this passion?

JAT: Yes. Starting during my master's work, I worked with, Professor Mary O'Brien. Mary wrote a book back, published in about 2000, called *Making Better Environmental Decisions: An Alternative to Risk Assessment*. Mary was trained in risk assessment. She had been on the board of several organizations, had been on government committees. I think what she saw was the approach to just studying whether it's bad doesn't give hope. It doesn't give solutions, and alternatives of assessment gave a path forward.

Fast forward. During my Ph.D., I worked with Dr. Ken Geiser, who is one of the fathers of the Toxics Movement, has been on the boards of many environmental groups, has been on many government panels, and founded an institute at UMass Lowell called the Toxics Use Reduction Institute. He was one of the key instigators -- writers of a bill called the Toxics Use Reduction Act, which is arguably one of the most successful chemicals policies in the world, really, again, focused on looking at solutions, weighing those solutions, and then creating an infrastructure to support companies to evaluate and adopt those solutions.

During the '90s, during my Ph.D. studies, we formed at UMass Lowell a program in cleaner production. At the global level, the pollution prevention movement, which came out in the '90s. The 1990 Pollution Prevention Act was really focused on moving from treating waste, addressing problems, to preventing pollution at its source. What is the best way to do that for chemicals is really thinking about green chemistry and sustainable design. Ken had already engaged with some of the leaders in green chemistry in the late '90s, early 2000s, Paul Anastas and John Warner, sort of linking that back to this area of alternatives assessment, saw that many times we don't have better alternatives, and we have to design them.

Really with that focus on cleaner production and really thinking about new forms of manufacturing that are more sustainable and products that are more sustainable, healthier for people and the planet *and* drive economic value was really the best way to deal with our chemicals challenges. Starting in the early 2000s, we were doing a lot of work around alternatives assessment. We hosted the first International Symposium on Alternatives Assessment in 2004, but also, a lot of my dissertation work revolved around a concept called the precautionary principle. The precautionary principle is very embedded in European policy, the idea that look before you leap, or where there is scientific evidence of

harm from an activity or chemical, we should be acting before we have perfect evidence of proof of harm.

Part of the work we did was organize, in 1998, the Wingspread Conference on the Precautionary Principle, where we brought together scientists and others from around the world to define what the precautionary principle meant in practice and then how to implement it. But then in 2001, actually a week after 9/11, we brought together 50 scientists from around the world to define what precaution meant for science. Part of what we said was that for science, particularly when looking at chemicals, precaution really means designing out the harm in the first place, which is where sustainable chemistry comes in. It was really these threads of the science, the policy, and the markets that led to that interest in sustainable chemistry.

Then, about 2003-4 my university, UMass Lowell, brought John Warner as a faculty member and Amy Cannon as faculty members into our university. Really, that sparked a lot of the interest that I had in sustainable chemistry, which then led to the formation of the Green Chemistry and Commerce Council in 2005. A lot of sort of intersecting concepts coming together to say we need to focus on innovation in solutions and then getting those solutions adopted in the marketplace.

LLB: Truly visionary, Joel. I mean, and having Doctor Warner there must have been, as you suggest, that spark that just -- boom -- sent you guys off into -- on a fast track to developing the organization that you now lead, Change Chemistry. I'd mentioned this in the intro, formerly the Green Chemistry and Commerce Council, or to many of us GC3. As I understand it, Joel, and in the interest of full disclosure, B&C is a member, because we believe passionately that this is the way to go to ensure sustainable green chemicals are marketed. As best as I can tell, we're looking at a mix of both companies and NGOs [non-governmental organization] and nonprofit organizations. When you created the organization, what was your vision for it, and how would you define success, for the organization and its members?

JAT: Yes, I've found in most of my career that a lot of ideas, a lot of organizations that happen, a lot of pivots happen in a very serendipitous way. How we formed GC3 -- now Change Chemistry -- was really with a meeting we held in 2005 at the Darden School of Business at the University of Virginia. That came out of a set of activities we had, trying to understand European chemicals policy. In 2001 and 2002, Ken Geiser and I went and studied what was happening in Europe on the ground around comprehensive chemicals policy, the development of the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), what was happening at the member states. What we learned was there was a lot happening.

What was interesting in that was we wanted to spark some discussion in the States, and we put together a group of ten European experts on chemicals from government, industry, non-profits, academia. We brought them to the states. One of them, in 2003, sparked a lot of the state-level discussions around chemicals policy reform. One of those people was the German Deputy Minister of Environment, Dr. Uwe Lahl.

This was the Bush Administration. The West was heavily -- as the government was, along with the Chemical Manufacturers Association, now the American Chemistry Council -- heavily lobbying against REACH. What Dr. Lahl wanted to know was whether that's the way companies actually felt about European chemicals policy. She said, "Can you put together a meeting of companies across sectors, the value chain, to understand how this

might impact them?" We had an interest in understanding how to drive better chemistry in these companies, and I said, "Sure. Let's do a meeting."

So we had that meeting. What was interesting in that meeting was companies across the value chain, across sectors, were all challenged with similar issues: lack of information on chemicals throughout the value chain, lack of incentives for investment in green chemistry or sustainable chemistry, pushback from the value chain, different parts of the value chain. At one point in the meeting, one of the participants from SC Johnson got up and said, "This is the most valuable discussion I've had in a long time. We should do something." I took advantage of that moment and said, "Let's form an advisory committee and figure out what to do next." So rather than writing a business case, we said, "Let's do something," and --

LLB: Let's do it. Just follow the Nike advice. Let's just do it.

JAT: And we got together over the next year and said, "Let's form an organization." That led to the formation of the Green Chemistry and Commerce Council, which is now, you know, 20 years later -- almost 20 years later -- still together, and growing, and expanding. I think you take advantage of a moment where there are pain points for companies and say, "How do we solve this together? How do we connect dots to solve that together?" Which is what we're pretty good at, is really making those connections and finding ways to create an ecosystem for change.

LLB: Mm-hmm. As a member, Joel, I just want to compliment you and your fabulous team for putting together such excellent programs. The content, the educational value, the energy, and the innovation you bring to a complicated area is really outstanding.

JAT: Thank you. I think the value for us is we do a lot of listening. One of my principles of strategy is listen a lot, digest it, and then out comes a pearl. You get those pieces of wisdom by really doing a lot of listening, and building understanding, and challenging, and that's what the sort of dialog and engagement we've tried to understand -- build within the organization. I think we've been successful.

We did one of our first engagements early on. Well, it was a little bit later on. It was early 2012-13 after we formed a group of retailers now called the Retailer Leadership Council. We have 17 major retailers -- big ones -- Walmart, Amazon, Best Buy, Home Depot, CVS. In Europe, Kingfisher, H&M. I think what we learned was we pulled together these retailers with a group of chemical suppliers and realized that they were talking right past each other. Chemical suppliers thought that they could just -- all you had to do is tell customers that it's safe and it's okay. The retailers were thinking that you could snap your fingers and get alternative chemistries in a couple of years at the same cost. Really building that understanding through listening and engagement has been very powerful, I think, to shifting supply chains. We see a much more engaged chemical sector, particularly those that are closer to customers, than we did five to ten years ago.

LLB: Without that basis, there's very little reason for even supply chain partners to trust one another, so the greater the education, the learnings, and the exchange of information, the more likely there will be a smoother and more transparent supply chain network. Great work.

I'm very interested in the law that passed several years ago, or Congress enacted, the Sustainable Chemistry R&D Act. As you know well, Senator Chris Coons from Delaware was a lead sponsor of the legislation and a long, long-time advocate and supporter of

sustainable chemistry. GC3, as it was known then, played a very significant role in the legislation. Maybe you can tell our listeners a little bit about what that law seeks to accomplish. I think it tends to be kind of outshadowed by TSCA and Lautenberg [the Frank R. Lautenberg Chemical Safety for the 21st Century Act], but the Sustainable Chemistry R&D act is really important. Maybe help explain it to our listeners.

JAT: Sure. Yes. Let me give a two-second history. This is a bill that was first introduced in 2004 as the Green Chemistry R&D Act by Representative Phil Gingrey from Louisiana -- a conservative Republican, by the way -- introduced the act for the first time. It passed the House three times over various Congresses, never passed for the Senate. It sort of slowed down. There was a lot -- there was a frustration, but -- and the act hasn't changed a ton since its original introduction in 2004. But it was really Senator Chris Coons (D-DE) picking it up in 2012-13. The name change was really the reflection of not a change of approach, but more language that would work in a bipartisan way. Green sounded a little too green, and sustainable was more bipartisan friendly. But the bill finally -- in 2021, with the National Defense Authorization Act -- passed.

It has really two parts, or three parts, and a goal. The goal was really to coordinate federal investments, strategy, and actions around sustainable chemistry to grow sustainable chemistry. Model might be, for example, the National Nanotechnology Initiative. How do we bring together a whole-of-government approach to advance a specific technology or field? What the act does, it says first, White House Office of Science and Technology Policy (OSTP) convenes agencies involved in sustainable chemistry across the federal landscape, build both public and private partnerships to scale sustainable chemistry. And specific actions are: one, do a landscape of sustainable chemistry across the federal government, which the OSTP published last August. Second is create a strategy document to grow federal investment leadership coordination around sustainable chemistry, both public and private sector. That report is supposed to come out in, sometime this year. And then third, there's a part of it that says every federal government agency should undertake activities to support sustainable chemistry to the extent resources, and funding, and mandates allow.

But it really is a coordinating act. It doesn't have any specific funding or mandate beyond coordinate federal chemistry -- sustainable chemistry across the federal government. This interagency committee has a ten-year lifespan, so it has time to do that. It is a coordination bill. There's no money attached. There are similar bills that do this in other technologies. But really, it is an impetus to say sustainable chemistry is critical to achieving federal technology innovation goals. That was much of what we tried to do is really shift the narrative from this being a science bill to a technology innovation, jobs, and manufacturing bill, and I think that is what finally got it across the finish line was shifting that narrative, that this is critical for jobs, innovation, domestic manufacturing.

LLB: Maybe you can offer a few words about how GC3/Change Chemistry members can and are taking a really active role in advocacy to promote new and sustainable chemistries.

JAT: Yes. Clearly, we know that chemistry innovation costs a lot of money. Capital expenditures and administrative are high. R&D expenditures in the industry are shrinking. There is this need to both grow new innovations, new technologies, and then be able to scale them, but also provide the incentives for adoption. If there is no particular regulatory mandate or demand pull -- I mean, there is a demand pull from the marketplace, clearly. The challenge is it costs more, and the incumbent chemistry is well capitalized and integrated, cost effective, it works. It's not regulated. There's not a lot of incentive to switch. So how do we create both the investments and the incentivization structures to really scale those

technologies, and get them adopted in the marketplace? We formed back in 2017 an alliance called the Sustainable Chemistry Alliance to get the R&D Act across the finish line, which we successfully did in partnership with other organizations. But now really focusing on how do we leverage some of the new investments that come out of the bipartisan infrastructure law, the Inflation Reduction Act (IRA), chips and science, which are investing billions of dollars into -- tens of billions and hundreds of billions of dollars into -- the economy to decarbonize the economy and grow new sectors, like -- not new sectors, but reinvigorate sectors -- like the semiconductor industry -- and grow new sectors like renewable energy, renewable chemistry.

How do we make sure that sustainable chemistry is key to those investments? Because ultimately chemistry is an enabling technology. So we can leverage chemistry effectively, for example, to drive decarbonization. The chemical sector is the most energy-intensive and carbon-emitting industrial sector. How do we achieve a chemical industry that is both sustainable -- or decarbonized -- and safer? Because the marketplace is really pushing for safer chemistry. We see this in -- particularly in parts of the -- sectors that are what you might call “in me, on me, around me” sectors. Consumer products.

LLB: That’s a good expression. That’s a very apt description of those demographics that I know drive the most intense scrutiny from regulatory bodies, any type of consumer application. It’s just an expression I hadn’t heard before.

JAT: Yes. That’s used a lot in the consumer products industry, where they see the best opportunity for growth. And you see this in -- we’ve done some analyses that show that products in specific product categories that have either claims or certifications of sustainable chemistry, like Safer Choice -- they’re growing multiple-fold in that product category compared to incumbents. That is why you see companies like SC Johnson, Unilever, others buying these niche, I would say, smaller brands that are green, because that’s where the growth is happening.

But there is -- going back to where we see key needs for advocating for sustainable chemistry. Certainly there’s a coalition of organizations really working to expand EPA’s Safer Choice program. It’s one of the few programs that I’ve ever seen where you can get chemical manufacturers aligned with NGOs pushing a similar agenda. It’s a win-win, right? It works. It’s successful. Everyone sees a value in it. How do we expand programs like that to grow the marketplace for better chemistry? Understanding that -- at least in this country -- maybe state policy will be a key push driver. But given the pace of regulations under law -- the Lautenberg Act and TSCA -- it’s going to take a while to get through that chemicals universe. It’s really going to take the U.S. market forces more, which is a benefit. Because one thing where I see us much more ahead of the Europeans is really on the investments around solutions, whether it be investment in decarbonization through the IRA, or programs like Safer Choice, or market pushes, like for sustainable chemistry really solving problems rather than just pushing out problems.

LLB: I take it, based on your comment that the EU might not have as many of the member company or member state financial incentives that we have here in this country, because I would agree with you. A lot of the federal legislation that has been enacted over the last several years has provided tremendous opportunities for investment in new technologies that will help further a sustainable economy.

JAT: I think that’s right. I think, though, we’re seeing from some of the work we’re doing with European companies, agencies, and some of the member states, there’s now a recognition

that the push through regulation isn't enough. There needs to be the pull side attached to it. We've been doing projects with the European Chemicals Agency, the European Commission for a number of years, really bringing that message of the innovation side. You need both. One of my mentors, Nick Ashford at MIT [Massachusetts Institute of Technology], who's a Ph.D. chemist and a lawyer, would talk about innovation policy in that really well-developed innovation policy has both willingness, but then capacity and opportunity. Willingness is often driven by either regulation or market forces. But then you have to preface that with both capacity and opportunity, you need to create the space and the incentives to innovate as well, not just -- we know that regulation is definitely a driver of innovation, but the pull side is often just as important or more important than the push side.

LLB: Yes, I'm with you, Joel. I think it's probably a little more important than the pull side. But you are a frequent lecturer, Joel; you are an avid writer. One of your recent articles in the winter issue of *Issues in Science and Technology*, you wrote an article with your colleague Ben Dunham titled "A Road Map for Sustainable Chemistry." Excellent article. I very much enjoyed reading it. One passage in particular caught my eye, and I quote: "Any federal strategy on sustainable chemistry will need clear leadership and coordination to be successful in achieving its goals." End quote. Having spoken a little bit about the Sustainable Chemistry R&D Act and the fact that it is a blueprint or a coordinating, overarching road map for dealing with federal issues pertinent to green chemistry, how would you assess at this stage, given the fact that it was signed into law a number of years ago, the coordination efforts that are underway since passage of the Sustainable Chemistry R&D Act? Are we on track? Are we losing ground? What's your take?

JAT: Yes. I'm a bit worried at this point. I'm optimistic, but worried at the same time. What I will say is there was an attempt to engage federal interagency collaboration around sustainable chemistry back in about 2013. That effort imploded because of turf wars. You know, "I do sustainable chemistry." "You don't do sustainable chemistry." What I see right now is a much better and well aligned effort. You've got multiple agencies, I think 14 agencies, engaged in this interagency committee, some very good leadership coming from OSTP, and NIST [the National Institute of Standards and Technology], and NSF [the National Science Foundation]. However, my concern revolves around a very deep focus on bench science and not on what the pain points are for industry around innovation, and scaling, and adoption. Those are going to be key. At this point, I'm not as worried about the technology side. Certainly, there are technology needs, but the scaling, that's half the puzzle. The scaling, the adoption, the incentives are the other half.

Actually, at our Change Chemistry forum -- or roundtable -- last year, in October, John Warner and Paul Anastas gave a little 25th anniversary retrospective of their pioneering book, *Green Chemistry: Theory and Practice*. I asked John, "What was your biggest failure?" And he said, "You know, I thought when we did this, that if we built it, they'd come, that this is so amazing, everyone would just do it. We realized that that's only half the game. The economics have to work. And if the economics don't work, if it's not scalable, it dies on the vine." So if we don't have a federal strategy that addresses that, we're going to be stuck. Or if it doesn't address the pain points of companies. We brought companies along the value chain to meet with the committee. They're struggling with finding better alternatives tomorrow. How do we do this? How do we link our regulatory agenda or our key priorities around chemistry to what the innovation needs -- or what the adoption needs are -- in industry?

Take per- and polyfluoroalkyl substances (PFAS), for example. Why do we not have a federal PFAS innovation strategy? It needs to be linked. And one of the most important -- Europe doesn't have that either.

LLB: Sadly, no one does.

JAT: But how are we going to find solutions to this highly effective and useful chemistry if we don't have them?

LLB: No. It's an excellent point, one that I ask myself often, because there seems to be a lot of irrationality embedded in many of the regulatory initiatives globally pertinent to PFAS. It's probably for a much longer, different conversation.

JAT: Yes, but going back to the committee and the work, one of my worries is that it's not reaching the highest levels of government. It's sort of hidden in this subcommittee at OSTP that isn't even the innovation side of the house at OSTP. It's a committee that's dealing with emerging contaminants and PFAS. Are the people on the committee the right people? is one [question]. Even their interim report was a little -- and we mentioned this in our article -- it was hidden on the OSTP website. There was no fanfare. There was no release. Actually, the report didn't even go to the congressional sponsors. We shared it with congressional sponsors.

LLB: Oh, dear.

JAT: There were challenges of it. You compare that to the Bold Goals for the Bioeconomy report [Bold Goals for U.S. Biotechnology and Biomanufacturing], which was this fancy, White House-driven, big, big PR and, and well-written and well-defined report. This is not getting that. I think this goes back to somewhat -- chemistry was never sexy. Everyone hated chemistry in college. We need to make this as critical and connected to all these other moving trains, so it's clear that you can't achieve the bold goals for the bioeconomy without sustainable chemistry. You can't achieve goals for environmental justice without sustainable chemistry. You can't achieve decarbonization goals without sustainable chemistry. I don't see that happening right now in this report. The bold goals for sustainable chemistry. That's not there yet, and I think it has to be there if this is going to be successful.

LLB: It's remarkable. We've been chatting now for about 30 minutes, and I've not asked you to define sustainable chemistry, as that term is used by stakeholders across the board. As a lawyer, I see it from a number of perspectives. I see it in marketing and in promoting products, but it's more than that. How do you define sustainable chemistry, and is there a way to harmonize the disparate definitions that are out there?

JAT: Yes, we ran a whole project called the Expert Committee on Sustainable Chemistry to try and do that. We brought together 20 experts from academia, industry, nonprofit world, environmental justice, and governments to create a consensus definition and criteria for sustainable chemistry. We had about an eight-month process, brought in stakeholders from outside to review it, provide input. What we wanted to do was find an actionable definition that could be used in policy, investment, and business decision-making that was flexible, but then had a set of criteria for defining the directionality.

Our definition was "Sustainable chemistry is chemistry that meets the -- and this is paraphrased, but short -- chemistry that meets the needs of current and future generations without causing harm to health and the environment." Then we have a set of criteria around

transparency, justice and equity, human health, ecosystem health, and circularity that helps define what is sustainable chemistry, and understanding that there's really very little chemistry today that meets this North Star. The committee was very clear, "We need to have a North Star, and say, 'This is where we want to go, understanding that we're not there today, but we need to get there. Here are the criteria on which to measure progress toward that North Star.'" There are different definitions.

As part of this project, we went through and reviewed different definitions of sustainable chemistry. There's a lot of overlaps in the definitions. Much like -- I've heard for years, "Green chemistry isn't well-defined." Well, that actually is pretty well defined by Warner and Anastas and EPA. The definitions are pretty clear, similar to sustainable chemistry. But as you say, Lynn, there has to be something clear and measurable for investment, for government to be able to weigh against. The definition that the OSTP committee came up with is a bit long. It has some contradictions in it, and it was definitely a definition by committee.

LLB: I was just going to say that!

JAT: What we tried to do was come up with one that is -- and that was the purpose of our project -- was to hand OSTP a curated definition that came from multiple stakeholder groups, including the chemical industry, so that they could leverage that. Unfortunately, it wasn't used, but it is the definition we're using within Change Chemistry, to do it and say, "This is where we're going, and these are the aspects that have to be looked at." The criteria haven't been -- there are very good criteria out there for defining "safer." We worked out with the Organization for Economic Co-operation and Development (OECD) on that. It's the *other* areas that don't have really clear criteria metrics. It's fairly all over the map how companies measure different sustainability attributes. We do need to get some level of consistency across those.

LLB: I for one would support that. In the remaining time that we have, Joel -- because it is quickly going by -- I wanted to pivot and talk a little bit about the 2016 amendments to TSCA under Lautenberg.

You alluded to the progress that EPA is making with regard to the chemicals that it has identified for high-priority risk evaluation and risk management. You noted the recent final rule on methylene chloride. It has been a difficult, tortured eight years, but progress is being made. But how would you characterize where we are with TSCA reform and implementation of the Lautenberg amendments?

JAT: Yes, it's been slow. I think what happened, we certainly saw -- let me take a step back. Three of us wrote back in 2011 an article really saying -- and this was a shot to the design of the Lautenberg amendments saying, "Don't forget about implementation," because implementation is where the rubber hits the road. Even with the Sustainable Chemistry R&D Act, we saw companies saying, "Hey, we got it passed! We're done." And I was like, that's the starting line.

LLB: No implementation.

JAT: Implementation matters, and I don't think the crafters thought as much about the implementation as they should have, because in studying TSCA 1 -- we'll call it TSCA 1 -- that was one of the key barriers was the implementation and the hurdles to implement. I think we saw very little progress during the previous administration and this administration.

I think what people realized was we have this very set in stone regulatory structure through the Administrative Procedures Act (APA) to actually do stuff, and you can't go much faster than this. I think they're doing the best they can with the implementation, given the cards dealt. I think, though -- and I understand that we probably lost an opportunity to do something much bolder. We see we're now doing what we did with Europe 20 years ago, looking at the Green Deal and the Chemicals Strategy for Sustainability. I would say that Europe, at least in a policy sense around chemicals and materials, is a decade to two decades ahead of us in some ways, in other ways, if you think about the incentives, behind us. But on the regulatory side, I think it's Europe and the states that are going to define the regulatory framework and not our federal policy, unfortunately.

I do think, as we've discussed, that there are some challenges in the implementation that you're certainly working on, and we've been working on around, if we're only going to be able to tackle so many risk management rules a year. It's going to take, at this pace, how many years? A hundred to get through. Let's say we have 3,000 chemicals that need regulation. That's going to take decades --

LLB: Yes, generations.

JAT: -- to be able to enable the better chemistry to fill those gaps. Certainly, that was definitely one of the rationales behind the Safer Choice program: leverage the marketplace to drive better chemistry. But the challenge of getting those new, safer, more sustainable chemistries faster into the marketplace in a prioritized fashion is -- has been a challenge, and certainly a challenge for many of our members who have -- including Green Chemistry award winners -- that are challenged in getting -- we already have all of these other incumbency barriers to green chemistry or sustainable chemistry that relate to cost, performance, integration into the value chain. Having one more barrier, which is a regulatory hurdle that the incumbent chemistries don't have further disadvantages the sustainable chemistry solutions. It's something where we're struggling with trying to find a way to address that problem.

LLB: You correctly note, Joel, that we have an organization that our firm has worked on now for the last three years, the Coalition for Chemical Innovations. We so applaud the innovation going on in the United States and globally right now and try to find safer, more sustainable alternatives to chemicals that are no longer serving society's interests well. We have developed a number of videos that are available at chemicalinnovations.org. We use these to help educate members of the Hill and other stakeholders that may be less familiar with some of the challenges of the regulatory program that EPA invite, for lack of a better word, and trying to diminish those barriers to getting products on the market as fast as possible. Not short-circuiting review, but not imposing challenges that will make it much more difficult to thrive commercially, if not even get on the market.

In that regard, one of the things that we've been pushing -- and I would like your views on it -- is whether EPA can or should give preferential treatment or somehow affirmatively support sustainable chemistries when evaluating new chemicals. It may be considered a risk factor, for example. That's one of the reasons the Coalition for Chemical Innovations exists: to help promote sustainable chemistries, because, as we say in our group, "SNURs tend to not spur innovation," but a significant new use rule (SNUR) can be a decided commercial detriment for a new chemical. That may be changing, but it's going to take many, many years to get out from under the somewhat adverse inferences in the business community that a significant new use restriction attaches to a new chemical innovation. What are your thoughts on that?

JAT: Yes, and this is very much related to the system we've created and inherited. With original TSCA in 1976, we assumed everything on the market was safe until EPA regulated it. The narrative that chemicals come to the market without any testing -- which is the narrative that some of the authors of the Lautenberg Act used -- I think this is the wrong narrative. It wasn't that chemicals -- the newer chemicals that came to the market, actually, if you look at the analyses, they're generally better replacements to this stuff on the market.

There have certainly been mistakes. We have made mistakes. We know that, and we will always make mistakes, by the way. But the narrative of -- we want to solve the problems of the previous system by letting everything on the market without regulation or letting it be there and shifting it onto EPA to regulate, by making sure that we review things that come into the market, have good data, they're safer. We don't want to undermine that system, but we've got to understand that the system puts those chemistries at a disadvantage, too.

How do we -- there is a precedent for EPA recognizing better chemistry. They've had several programs, like the Sustainable Futures Program, where they work with companies to make sure when they're designing chemistry, because the vast majority of the chemicals on the market today, it's -- about 90-something percent of chemicals on the market today by volume were grandfathered under TSCA. They are mostly older chemistries. They weren't designed with health, safety, and environment in mind. That wasn't what we thought about 50 years ago. We want to make sure those newer chemistries are, but that *is* the way industry is thinking. Programs like Sustainable Futures bring those tools to industry to design better from the start. Most responsible companies will not bring something that sniffs of a carcinogen through the EPA process anymore. It goes to the --

LLB: Absolutely.

JAT: -- it's cut out right away. So how do we then do that? EPA's had other programs like -- in the New Chemicals Program, something like the -- it was called the Pollution Prevention Recognition Program. Give some kind of credit, some kind of recognition to new entrants that are better than the incumbents.

In other sectors, for example, in the renewable energy sector, EPA has sort of a prioritized special process for those chemistries, where they have a team that specifically reviews those chemistries as solving -- renewable fuels, I think, is one of them. EPA *can* do that. What we've been talking about within our own organization, and with other organizations, if there *were* some kind of third-party verification of better, at the entrance -- like using the Safer Chemical Ingredient list criteria -- could those get a prioritized passage through the process? That they go to the top of the heap, they get a prioritization. If there is a need -- we know that some of the alternatives do have potential health and safety concerns. There's no safe chemistry. How do those get addressed in a way that doesn't unnecessarily burden innovators versus the incumbents that have no requirements?

LLB: Exactly. That's a good suggestion, the prioritization. I'm glad we share a common goal and making sure that better and more sustainable chemicals are not thwarted through an unnecessarily burdensome regulatory process, when EPA could perhaps do things a little bit differently to hasten their appearance on the market.

Joel, I know we're running out of time. I want to thank you for your wonderful commentary and remarks. Is there a way our listeners can learn a little bit more about Change Chemistry? Do you have a website you can direct them to?

JAT: Yes, definitely. You can either go to changechemistry.org, or member.changechemistry.org. We're a growing organization, over 100 members, \$3 trillion of manufacturing power. We're building our base in Europe, and we're a well-connected and trusted organization from every group, from environmental, environmental justice groups to the chemical sector. What we've done is really created -- tried to create -- an ecosystem for change around solutions. That's been really powerful to our success to date.

LLB: Indeed, we're a proud member of Change Chemistry, Joel. Thanks for all the great work you do and for chatting with us today.

JAT: Thank you so much, Lynn, I appreciate it.

LLB: My thanks again to Joel for speaking with me today about green chemistry, Change Chemistry, and the urgent and growing quest to make chemicals greener and more sustainable.

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