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## *Session 4: Markets and Allocation*

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Thank you for the chance to share a vision about what could happen in this country. I was just thinking as I was writing through my notes whether or not, in 10 or 20 years time, you would find a water utility in Mexico deciding intentionally to invest in shares in the Colorado system in Idaho, Nevada, and Colorado as an investment strategy to manage risk. In Australia that now happens.

Let me backtrack and talk about water and what I think is important in the vision that I hold. I think it's best captured when I was flying here and I was transferring from one airport to another in New York, sitting next to a young American family with a young child. They said, "Why are you going to Kansas City?" I said, "I'm going to talk to Americans about how they might build a new water management system." They looked at me and said, "Oh, I had heard that Beijing was sinking because the Chinese were taking too much groundwater out of Beijing." I said, "You don't have to go to Beijing to find that problem, you can find it in California. In fact, last year there were some areas and some towns that sank more than the height of your young son." And they were shocked and said, "How do you fix it?" I said, "It's easy. You define, first of all, you set a limit on the amount of water that can be taken so that the groundwater no longer, or the ground stops sinking. You issue shares in the amount of water that's allocated each year, and give everybody a water account that's just like your bank account, and imagine an ATM for water." And they said, "Why don't you do it? That's simple, that's obvious." And the thing I wanted to convey to you first of all is the importance of thinking very simply about what really needs to happen.

There's a famous diamond paradox that really says nothing is more useful than water, but doesn't really purchase much. And Adam Smith had made this observation back in the

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1700s. I wonder if somebody will say at some stage in the future that water may be the jewel in the crown held by the farmers in western USA that is awaiting discovery. I want you to think about things quite differently than the way it's talked about so far.

Paul Keating famously said back in the 1980s that he was worried, and at this stage he was our treasurer. He was in charge of what really runs the Federal Reserve here or the equivalent of it. He said he was concerned that Australia might be becoming a banana republic or at least at risk of becoming one. When he became Prime Minister, he set up a national competition policy that made some observations, which I think could be made about the United States today. If you brought him over here, he would probably be puzzled by the arrangements and the complexity of the whole regimes used to manage water. He really pointed to the fact that water trading didn't really work, and that water was used in low value industries when it could be used in much higher value industries. And this went through and was adopted by COAG, the equivalent of your Western Governors Association. The great insight that came out of that back in 1994 was that you don't talk about markets, you don't even waste your time trying to set them up. What you do is you design, you fix up your allocation entitlement arrangements so that markets emerge naturally. The more you get governance right, the more markets emerge, and the more efficient water use becomes. So the vision and the journey that Australia started in the 1980s flowed through into the 90s, through into the 2000s, and now 2016, it's still wrong, but it's on the right journey.

Let me make four I think very important observations before I go further into this talk. The focus needs to be on trading, and the language needs to improve. This conference has been about water markets; it should be about water trading. In some systems you'll get to have markets, but markets involve lots of players, lots of people acting, trading continuously, but the focus needs to be on getting to systems where water trades naturally, quickly at low cost. In Australia, as people like Tom Rooney will tell you, it's now possible to trade water from one region to another, from the start of the deal to completing the deal to

paying for it and having the water moving on to the new farm in 40 minutes. Why isn't that possible throughout most of western USA?

There needs to be two types of trades, not one, two markets if you like. One is about trading volumes of water that are available for use now, and the other is about long term investment-type things and well-defined systems have two types of trades and often many more types of trades, but at least two. As I said markets emerge naturally when the institutional conditions are right. So focus on building the institutional conditions and be thrilled and excited when suddenly you have a broking industry. The US broking industry is run by the law firms who seem to take 5 years to do a trade, not 40 minutes. There's something wrong.

Finally, language, narratives and process really matter. I think one of the greatest steps forward came in about 2003-2004 when those responsible for water reform in Australia met actually in Adelaide, and I was there at the meeting when they agreed to do it. And they agreed to write a glossary and amongst them all agreed never again, for a period of time—they now use it again—but they agreed collectively not to use the word “water right” because they found when they went into rooms that were talking about something that was totally new, it was about entitlements, new government arrangements, allocations, and compulsory meeting, statutory plans, etc., and they were using the old language to describe something that was new. When you talk about something that's new using old language, people still think you're talking about the old system. Changing the narrative, changing the paradigm, writing a glossary ended up being I think one of the most important steps in the reform process and journey that Australia went on. We discovered that some of the terms used in one state meant exactly the opposite in another state. If you're running a system like the Colorado we were talking about arrangements in Queensland and South Wales and South Australia. The word “entitlement” meant the reverse in one state to another. So a lot of things had to be cleaned up. Having consistent language and having a consistent narrative is really

important.

When I was talking yesterday, Ellen Hanak asked me to tell you about some of the things that Australia's still got wrong. Some time ago I wrote a report that really upset the Australian government that said Australia made at least 18 horrible, very expensive disastrous mistakes. When I presented talks about the list of 18 up here, and asked everybody to put up their hand if they're not making all of them, nobody put their hand up. I don't have time to give that talk. But I urge you not to make the mistakes that Australia made. The narrative which is most important I think is one that realizes that the waters are based at the moment as it's cast in the United States is really cast as a zero sum game. Everybody is very protective; everybody wants to protect their rights.

Remember though that the value of rights, whatever they are, is determined by the quality of the asset you have. If you have an old broken down car, it's not worth very much. If you have a brand new Cadillac with a GPS and all the rest in it, then people are interested in buying it and will pay a lot for it.

When I went into Nevada last year to help people in the Diamond Valley solve the mess they're in, it took me about 15 minutes to get them to say let's go to a new system. I think the thing that most underscored how bad their system was, was when we went through the process and say, "Okay, now I'm going to recommend to you that you validate who owns what," and the State Department official said, "Well, it's easy, we've got a register." I said, "Well, let's just send a letter to every registered owner to find out and let them know we're about to fix up the water rights system." A month later, 30% of the letters came back from U.S. post, "no one at this address." We went back into the room and sat down in a room like this with everybody in it and said, "Who owns this water right? Who owns this one?" It was a fascinating process. The community realized that they didn't have a clue what was going on. I can assure you that throughout much of western USA, there are some exceptions, that is the state of your knowledge of who owns what. Systems that have integrity

build good markets. When you don't know who owns what, you hit very complicated legal processes that take forever, and even after you think they're finished, you still don't know if you really own what you've paid for. There is an opportunity to fix things up, and essentially to do what I've just shown you, build a cake which is much more valuable. The narrative needs to be about increasing opportunity, increasing wealth.

The framework for this is set out in a blueprint that we released last year for all of the west. It talks about setting limits and enforcing those limits. There needs to be much more talk about enforcing limits. In most of the states that I've been looking at, and I'm now working at the moment in California, the limits haven't been set and rapid depletion is occurring in much of what's going on. The plans put in place need to be statutory, need to have standing that stops legal argument. You need unbundling structures and I'll come back and talk about them more. And you need efficient trusted governance. I can't emphasize how important it is to have trust. You in the corporate world know how important it is that, for example, the Reserve Bank speaks with solidarity. If you had members of the Reserve Bank or actually your Federal Reserve who went out and said, "We've just set the wrong interest rate," you'd have a disaster. You need systems that are not based on representative governance. You need low cost administrative processes, and you need to consider, as Australia now does, giving the environment a legal share.

Ten opportunities, and I need to be very, very quick, as I go forward because time is short. One of the first things Australia did was to build centralized water right registers of guaranteed integrity, and we took a process of, rather than doing what you do here which is adjudicating rights, it's simply validating a right, and inviting people who had an old system right to convert it into a new system right, which was recorded on a central register. And the only way you could own that right was if it as in the central register. This is done throughout most of the world now for property, and why wouldn't you do it for water. And why wouldn't you bring in a framework that says, if you want to trade, you have to have a new system

right. We'll stop trading of old system rights, so people start to convert over quickly. And why wouldn't you make those rights mortgageable, and go to the banking industry, and we're now building a water right system that you can bank on and that you can mortgage for dollars and actually execute the mortgage in ten minutes. It's not hard. When you do that, as Australia found, a lot of people become very interested in lending against the value of water, and the more they do that, the more innovation you get, and the more they become concerned about having credibility in the governance systems you put in place.

The second big opportunity, which adds to the value of the water system and grows the cake is to unbundle the water right and split it out, and to establish a long term share and manage those shares separately from the allocations that are made time by time. So you don't have complicated leasing processes, you just have a very simple structure. And this is what Australia did. In 1994, we did what America is just now starting to do, talking about setting limits, talking about making water rights, we called them licenses, or tradable, and as China is doing, getting the price right. You actually need to do the two and the architecture around that is very important. That happened back in 1993-94 in a process that went through. We then unbundled the structure further, issued people shares just like shares in a company, and we went through the difficult process of working out how you would have a fungible share structure. We required everybody to have what we now describe as a water account, just like your bank account. When allocations are made, just like dividends are made to shares in a company, the second allocations are made, they're recorded in a water account. And as you use water, it's dedicated off their account. If you want to trade water, why can't you just log into your water account and transfer the water from one account to another account. Why can't a water manager do as a bank manager does, sum up all of the accounts and see how much water is left in the system? Why don't you do these things? And as part of this process then, you issue permits to use water separately, and the beneficial use requirements which tangle up so much of what happens, are only about how you use water.

Yes, water has to be put to a beneficial use and not cause harm, but if somebody wants to save water and leave it in the account, what's wrong with doing that?

One of the big mistakes Australia made early on which cost us millions, in fact billions, was to not allow people to carry water forward from year to year. We discovered as we introduced markets and we had a use it or lose it program, you need to have a use it, lose it, or save it. We concluded that saving was often the most beneficial use you could do. So why don't you build structures that do that? And having mechanisms that separate shares from allocations from use builds opportunities for people to get development approval essentially and do an entire irrigation industry, and then buy the water down the track. In fact, we're now finding many farm businesses have very, very valuable irrigation structures but don't even own their water. They don't need to because, just like electricity, you can buy it.

The third important experience that's come out of Australia is you need to give the plans that are written statutory integrity. So what we'll do is we'll end up taking them right back up into the legislator after they've been approved and get our legislator to improve them so they have the same standing as all other legislation. This is important because it reduces all the legal contests about what's going on. The plans are short. They are legal documents that say this is how decisions must be made. If the rule of trading water from zone A to zone B is an exchange rate of 0.9, you say it's 0.9. You don't put in the plan 20 pages of documentation of the science and knowledge and the hydrology so the lawyers can have a fight about whether or not you've got the science right. You just say as your Federal Reserve does, the answer is 0.9, and if there's a third party appeal, the third party appeal can run a process to change the plan, but in the meantime the trades continue at 0.9. This is a very, very important building clause. And as part of the process, and this is difficult, and I've been working on it this last year in Nevada and have some equations to do it, and I'm now trying to do the same thing in California, you convert all of the complex rights systems

through into a simple sharing system. Most of you here know enough about the corporate world to know that you can merge companies. Think of a process where you equably work out how to convert all of the rights, which were all different in the prior appropriations system, every single right is different, through into a simple one that has several classes of shares and put it all together so that you know what's tradable, and you know the value of shares, and the markets, and you know what things are worth. Then brokers and others can report on what's happening.

And then thinking about giving the environment an entitlement just like other shareholders. We now have the environment as a significant shareholder in Australia. Every time water is allocated on the first, the day after the 1st and the 15th of each month, the first working day after the 1st and 15th of each month, allocations are announced, and the environment receives a share of those allocations. We now have environmental water managers who are selling water back into the market because I'd like to use the money to buy more shares or invest in other things. They're now part of the system, and we've had a revolution in environmental water management.

This conference has talked a lot about irrigation water use efficiency. Why haven't you talked about environmental water use efficiency? Australia is discovering when you give environmental water managers the capacity to manage environmental flows, determine when releases are made and where water is put, that they can get much more environmental gain to a drop of water allocated to them. Think about the total rather than half of the cake. Sharing systems we put in place look like this, where you have some bits managed under rules, you put conveyance systems in place, you have normally no more than three classes of shares, and three different markets, and that allows people to manage risk. If you have medium, high, and low security shares then everybody can work out what sort of supply risk they ought to take depending on the investment. Towns want high security, rice growers might want less security, this is something which can be worked out in the market. And

with shares, you can manage risk. They're called shares for good reason. They used to be volumetric entitlements. We discovered that you can't guarantee that it's going to rain; you can't guarantee water supplies. The best you can do as the corporate world worked out several hundred years ago is give people a share of what's the profit, but you cannot guarantee there's a profit, and you need incentives for every single investor to manage and understand that scarcity exists.

The next important opportunity is to build trusted governance arrangements. You need to realize if you have representative governments, you'll end up with insider trading problems. Don't do that. Instead, build independent expertise by governance structures. Have a nested planning hierarchy to pull everything together. One of the mistakes Australia made was not to manage ground and surface water resources as one; you need integrated structures to pull the plans together. Adopt simple gross accounting systems. We used to worry about return flows; we now have a system that says allocations across the whole system get reduced as water use efficiency increases. That's much more efficient and saves a lot of administrative costs. Think about tag trading arrangements, so that Mexico could invest in Colorado or Idaho with confidence, and not be worried about what's going on, rather than having to move rights from one state to another or one region to another. And lastly, make sure you allocate rights to individuals. One of the big things Australia did with a lot of controversy was to transfer the right of ownership from districts down to individuals, and require each district to allow water trade between districts. That generated probably an increase in value of 20-30 percent. The cost benefit analysis work that needs to be done on this is really important. There needs to be much better methods in place. Looking at opportunities over here has identified there's a really big opportunity to move to an Australian type system. It will have, they actually see losses from where you are now. You need to document the many things that come. Talk about innovation, talk about community resilience. Understand as people in Nevada are now realizing in the Diamond

Valley that social coherence is something that people value. It comes out of trust; it comes out of integrity; it comes out of having bankable water management systems and positive environmental outcomes.

This story I think summarizes the Australian experience better than anything else. When Australia started the journey back in the 1990s, and committed to fixing up its water allocation system, the profits, the return on investment sat around 20 percent per annum, never went under 15 percent per annum, outperformed the Australian share market for the first decade. I would like you all to think about designing a system in America and the West, which can outperform the rest of the U.S. economy for a decade. It's doable and it's feasible. At a state level, the focus to do it, this is on building institution arrangements that are robust, and transitioning to new water systems. The federal government I think they are providing assistance for pilot demonstrations, early investments, and doing things like funding the installation of meters throughout the whole system, demonstrating a willingness itself to support a transition and not having departments of reclamation, interior, whoever they are saying, "No, no, this is our water; it's not state water; it's separate." You must have one system that has integrity. And being prepared to restrict its role so that statutory plans are respected rather than having ongoing legal contests, and a lot of that comes out of the federal legislation and resolve.

If I had more time, I'd talk more, but I want the paper to draw you to a checklist that's at the back of the paper which sets out 14 checks. I think if you read through that, you'll discover that most of the systems used in the United States file the most basic of robustness tests. The vision I'd leave you is one of which says, focus on the institutional arrangements, and be excited in 20 years time when you have vibrant water markets, and irrigation in communities that are prosperous, and environments that are healthy because you focused on getting the design detail right rather than talking about markets, and talking about markets, and talking about markets, but not doing or making the changes that need to happen. Thank you very much.

*Discussant: Nicholas Brozovic*  
*Director of Policy, Water for Food Institute*  
*University of Nebraska-Lincoln*

Thank you very much. It's a pleasure to be here. Mike is a tough act to follow. Let me start by saying I greatly enjoyed his paper. I am a huge fan of the Australian water system. I think there is a lot of learning to be had there. That said, I think it's important to acknowledge that markets are part of a larger water management tool kit, they exist within a specific institutional context, and they're not the only solution to water management and allocation problems. So think, there is an enormous path dependency in water resources. A lot of the history is very localized, and so it's important to understand what the local context is, and what the applicability is. So that said, I'm going to lay out some of the key findings from Mike's paper that I think we can all agree on. I'm going to mention some points of disagreement, and then give you a little bit more context about the U.S. setting of water markets, water transfers, water transactions—there is actually a lot of work being done there formally and informally—and talk about some of the innovations that we have. I will mention that within this room we have a large proportion of U.S. expertise in water transfers and water markets. And so for those of you in the rest of the audience, it's important to understand that, and I'd encourage those of you—you know who you are—to come forward and ask questions.

So let me start by trying to frame the conversation in terms of much of our audience who represent growers and their interests, who represent agricultural lending and investing perspectives. Why should you care about water markets? Why should you care about any of this discussion that you've heard so far? First of all, it's important to recognize, and I think we all know this, across much of the U.S. and globally, access to water is critical to crop productivity and farm income. As a result, access to water translates directly into rental

rates, land market prices, and profits at the field level and farm level. Similarly, risks to water availability, whether those are physical risks from depletion, regulatory risks, legal risks, or risks from climate change, mean that there is investment risk. So if you are interested and work in agricultural investment, you need to understand water risk. Because of this, understanding the value of water in agriculture is very key. I will also argue that in general understanding the value of water in agriculture, and particularly how water is capitalized into land market prices and water rights values is generally not well understood. So those of you that work actively in water management or in investment, I would urge you to take a moment and think about how you value water risk in your enterprises. You know it's there, but I think that at least in the conversations that I've had with people about the ag lending community, sometimes those approaches are not very sophisticated. Speaking as an academic, I also know that we struggle to value water risk because of data issues.

Why do we care about water markets? Well, first of all, water markets can provide enormous clarity on the value of water. So they serve an important purpose there. They provide a different kind of risk management opportunity, and therefore a different kind of investment opportunity. They can also provide an incentive for innovation as they monetize on-farm savings. So they provide a different way for growers that are innovative, new technologies, to provide an income stream.

Now, let me then come back to what I think really comes through in Mike's paper. First of all, water markets provide strong agriculture risk management. Second of all, there is an important need to provide registries, and markets function only as well as the institutions and regulations that underlie their function. So monitoring and enforcement are incredibly important within markets and market-like systems. This is something that often gets lost in the debate. In order to have the market that functions well, the underlying institutions have to function well. I also really appreciate the focus on trust and the importance of trust in water markets. This is something that I've personally found in my work, and I think many

others that have worked on the ground will emphasize that too. Finally, the role of markets from an environmental protection, I think markets can have a very, very important role in environmental protection. That's a very controversial topic, and I would defer to Chris on that one. He's someone that works at the forefront of that field. But if done correctly, markets can provide a lot of environmental protection and that's a very worthy goal.

Now, to come to things in the paper that are perhaps debatable or contentious within the U.S. community, first of all, the paper argues that the U.S. water rights system, which is primarily based on prior appropriation, is an inefficient way to structure water markets. So I guess there are several issues to clarify here. First of all, prior appropriation is one system that exists within the U.S. There are many, many other systems operating for water rights allocation within the U.S. These include riparian rights, correlative rights, tribal rights, adjudicated rights, mining rights, and in some cases all of these coexist at the same time. Now that's perhaps an argument for simplification, but it's important to understand that it's not just a prior appropriation system.

Second of all, there is active water transfers and water trading throughout much of the U.S., and many of the highest value and volume systems are in prior appropriation systems now. Therefore, I don't think ex ante that we can say that prior appropriation does not create good market outcomes. Now, we can argue as to whether that is in itself an efficient outcome or you might do better going to another system; however, I will note that when you have an entitlement system with different classes of reliability, that doesn't look that much different theoretically from a prior appropriation system with different vintages of water rights. Third of all, there is the concept of beneficial use and that this is problematic in reallocating water. I think that we all agree that theoretically beneficial use doctrine is a problem in western water allocation. My own sense has been that people are generally very hesitant to use beneficial use doctrine to take back water rights. And so it's there on the books, but beneficial use doctrine doesn't really get applied. So we talk about use it or lose it a lot, but

the number of people that have lost it is very, very small. And again, I'd reach out to the audience here if I'm wrong on that one.

Second of all is the idea here, and I think many of us, we'd like this idea to be true, that moving to a formal water market will increase the value of water. There is a very, very important caveat here. If you start with a regulated constrained system in place, then moving to a water market will increase the value of water because it increases investment opportunities. If you start in a system like we have in California that has been unconstrained for over 100 years where you have very, very high value agriculture, no restrictions on pumping, no restrictions on drilling, then in order to move to a place where a market can exist, that will involve a very, very large reduction in pump water. That will reduce farm level profits. So markets and market-like systems are a way to blunt the impact of regulations. They're a way to provide new investment opportunities, but by themselves it's not clear that they will, they don't exist without other restrictions in place too. So it's not clear to me that in the case where you introduce both restrictions in a market at the same time, whether the value of water rights will increase or decrease.

Next, we need to acknowledge the role of transaction costs in moving to a market. Administratively, changes, monitoring, and enforcement are very, very costly. So large institutional changes cost money. Within the Australian context, I don't know the final value, but I know around \$8 billion U.S. dollars was spent on environmental buy-backs. I know that cost share subsidies for technology adoption was several billion U.S. dollars. In addition, there were payments for state governments to make the changes acceptable. There were grand water buyouts and so on. These are tens of billions of dollars in a system that is in order of magnitude less than what we have in the U.S. And so I think it's important to acknowledge that moving to systems that may in the end be much, much more efficient is very costly and that requires a level of political willpower that it's important to acknowledge.

Next of all, I actually very much like the Australian system of water rights. The

pragmatic part of me says that it's going to be very, very difficult to convince people that have senior water rights to give them up. Now, within the U.S., I'm aware of two prior appropriation systems of groundwater where this has been tried. The first is the Sheridan 6 Local Enhanced Management District in Kansas that a few years ago petitioned the state to move from a prior appropriation system and flatten its water rights to a correlative system so that they could reduce everybody's pumping by 20 percent below baseline. That is a phenomenal experiment that many, many of us in this room are watching very, very carefully. Now in the last two years, it's been wet, so they haven't come anywhere near that cap. I will also say that that system has a little over 100 farmers in it. That's a very small system. The second system which has been attempted is the Diamond Valley system. They have not yet gone all the way through to changing their water rights to a shared base system. I think they're closer and I'm hopeful that it will happen. That system is about 60 farmers. So these systems are very, very small, where social bonds really matter. What I'm less clear on is when you move to a system where you have millions of acres, thousands of farmers, institutional investments, and billions or tens of billions of dollars are water rights, whether people will rely on those same social mechanisms to allow a change in water rights. I fear that there will be major legal challenges.

Let me talk a little bit about the U.S. context of irrigated agriculture now. So, the U.S. has about 54 million irrigated acres; that's roughly ten times more than Australia. Several states within the U.S. have more irrigated acreage than Australia, and several others have more irrigated acreage than the Murray-Darling Basin. So for example, Nebraska, lots of people talk about Nebraska. I love to talk about Nebraska. I'm going to try not to talk about it too much. We have 8.5 million irrigated acres. Australia has 6.4; Murray-Darling Basin is around 3.5. Within that is enormous complexity.

I now want to come to the value of water in irrigated agriculture. This is, of course, an issue of a lot of interest. First of all, right now within the U.S., in most cases, the value

of water rights is partially or fully capitalized into land values. So if you're in an area that irrigates, you're paying for the water right through your leasing contract or through your purchasing of that land. What are those values? Well, they vary enormously. California, of course, is on one end. The value of water rights in California is much, much more than it is anywhere else. Spot market prices in the drought have exceeded urban water use values for lease arrangements. I should also say, and this is something that I don't have a good answer for, but I just found out within the last few months, when you look at Australian water prices, they're about an order of magnitude less than the water prices we have in the U.S. Now, that's a mystery to me. I've been told that some of that is a result of the high regulatory costs and labor market constraints within Australia. But when for example, you look at Murray-Darling Basin spot market prices, or I guess allocation entitlement prices, you compare them to what's happening in California, there's an order of magnitude difference. Corn in Nebraska, irrigation water rights are worth two or three times more than they are in Murray-Darling Basin for similar amounts of water. So this is something that is a mystery to me, but I really want to emphasize that it's not the case that the value of water in the U.S. is underappreciated.

So when we look at the United States, there's an incredibly varied water management, water rights system across the U.S. The federal system we have puts a lot of control over water at the state level, and as a result of that, we've had a very large variety of different kinds of policies put into place. I like to think of it as a grand water management experiment. So across the United States, there's enormous innovation in groundwater management. Across Nebraska we have just about as much variation in water management as across the rest of the United States because of the local management system we have there, the Natural Resources Districts. There are many, many both formal and informal water markets operating, so Chris has talked a lot about the value of informal water markets. My suspicion is that informal water markets right now have a higher volume and value of water

transacted. They're not called water markets; they're often called pooling arrangements. There's enormous value generated for agriculture there that we don't really know about because we're not asking the right questions. So I'd say that there the key is that there is enormous local innovation, and our challenge is to collect and synthesize that information, move it from anecdote, to rigorous statistical testing, to impact stories, and then to a narrative as to how lessons learned from one area can move to another. I'm a big believer in pilot programs. I think pilot programs are a great way to kick the tires and see what works, but we need to acknowledge that pilot programs will often fail, and we need to talk about those failures and understand that that will happen, too.

So with that, I'm going to summarize in my remaining six seconds. First of all, when we talk about markets and incentives, it's important to think about things from an ag investment and grower perspective. Water is a production input, and its value is either partially or fully capitalized whether you have water markets or not. There are many markets and market-like transactions operating right now within the U.S. that represent investment opportunities. In general, I'm very optimistic. You know, I think that we will see an increase in market transactions. I think approaches like we see in Australia are very useful. I hesitate to suggest that large-scale reform of water rights is the only way to get there, but in general as I said, I'm very optimistic. Thank you very much.

*Discussion with Mike Young and Nicholas Brozovic*

*Moderator: Troy Davig*

*Senior Vice President and Director of Research  
Federal Reserve Bank of Kansas City*

**Troy Davig:** Mike, why don't you take a few minutes if you have any thoughts or want to respond in any way to Nic. And while Mike is commenting, if you have any questions for either Nic or Mike, please make your way to the microphones.

**Mike Young:** Yeah, I think I agree with almost all of Nic's insight. So very little actually disagreement. I don't think if we really talk through we're very far apart. I could spend a lot of time talking about why actually prices in Australia are different, but I don't think that's useful. The point is that we have prices. We have systems where the price of water allocations changes with the weather forecast. So if irrigators see a forecast that says it's going to rain, they know they're not going to irrigate, and that water then can be sold to somebody else. And those sorts of systems is the sorts of systems I would expect to find. To get there, you need great simplicity.

The journey Australia started on back in the 1980s, and went through with increasing clarity was messy. We never expected to end up where we ended up. We're very lucky we got there. The main message is work on getting the structures simple. The obvious first steps, which I think you'd agree with, building a new system of registers so that people know what they've got, and can trade with confidence as a permanent thing, and then getting the short term allocation market. People in Australia are puzzled by the fact that you need fallowing programs where people are paid not to farm a whole area. If you have a proper allocation market, or temporary market whatever you call it, you don't have to pay people to fallow. They might want to use one acre-foot, two acre-foot, or three acre-foot, whatever it is, they just make that decision and it's much more efficient. I mean, importantly, when water is scarce, every single water use with exception looks for opportunities to save water.

In Australia now, virtually every single water user in the Murray-Darling Basin has traded water within the last three or four years. The trading is just part of the things you do in business. I could go on talking, but I think it's more important to have discussion. So I think I agree with all the detail and yes it is possible to go part the way through without going to the fully fledged, unbundled simple system, but its clarity and vision and the new language is very important. When you get the simple structures and you go from all the different prior appropriation type systems, all the other water systems, converting them all into a standard structure, and having one type of water right, then you have one market with clarity and tradeoffs. Whenever you have separate different systems as Australia used to have, you have an uncontrollable mess.

**John Ambroson, John Deere Financial:** There's a lot of lenders in the room here, Mike, and I'd just be curious of what the role or how the financial community was integrated into the process in Australia and if there were any learnings or any thoughts or advice or comments around how that worked and what we could learn from that in the financial side?

**Mike Young:** Engaging with the financial sector was critically important, particularly as we went through the unbundling process because a lot of banks used to have mortgages over land, which reflected the value of the water rights held with that land. When we separated the two, time had to be given for the banks to renegotiate all the mortgages. That became very interesting in ensuring the integrity of the system. We've now got to the stage where to put it bluntly banks love lending against mortgage, or mortgage water shares. Imagine somebody walks in and says, "Look, I've got half a million worth of water rights, I want to borrow \$300,000." As a banker, you can look at what the value of the rights are. It's very easy to do. You can go to one of the water broker exchanges to see what it's worth, you know exactly what it's worth. If they have half a million and they want to borrow \$300,000 worth against that, it's an easy do. Moreover, 12 months down the track, if somebody can't pay, you ring them up and say, "Look, you haven't made your payment. We could put you in the

courts, but alternatively you can sell five or six shares and pay us and you as the mortgagee will get the money.” So the banks actually love this new system, those that understand it. There’s been a real challenge in actually conveying this new system to the banks; the idea of lending against shares that are mortgageable is something that’s strange to them. So there’s a whole education process that’s gone through. But once you get the banking industry banking on the integrity of the system, the governors, presidents, the people involved in the Federal Reserve start to understand that this system better work.

***Panelist: Richard Sandor  
Chairman and Chief Executive Officer  
Environmental Financial Products***

If we look at wealth creation in the United States in the post World War II period, if you go from '45 to '70, it was manufacturing. In the '70s to 80s, it was with the Russian crops failing and the Chinese crops failing, and [inaudible] anchovies across the Peruvian coast, grain prices exploded, and wealth became, and value occurred in the commoditization. If we go to the 80s, we had a different kind of commoditization. We had a commoditization of financial markets. We created this thing called derivatives and brought in asset liability management which was held in low repute by the banking community. The regulators borrow overnight, lend for 30 years, curve will never invert, and you'll be in terrific shape. Jump on's-another pejorative. Or, you know, some crazy got it in Atlanta, he thought there should be a 24-hour news network. You know? Turner, and he was thrown away, and a guy came up with something called the cell phone. All of this stuff financed by junk. Basically, MCI taking on AT&T, also garbage.

Then in the 90s, we had a different kind of wealth creation. It was the commoditization of technology, information, etc. In '86, Microsoft went public, stupid idea, a geek, young kid, dropped out of a university. In '90, Cisco; in 1995 Mark Andreessen came up with something called Mosaic and it ultimately caused the birth of the web and it was a \$10 an hour research project by a kid who didn't use it for health, but decided to find a way to date women, and that came into the browser. And then we go into the turn of the 20th century, and it was the birth of social media—Twitter, you know, no great social cases, no academic arguments. They arose organically because they satisfied a need.

Hypothesis: The great value proposition in the 21st century will be the commoditization of air and water. That's where value is. The question is, how do you

capitalize on that and how do you deal with it? Why do we say, all anybody has to do is look at water. There's three continents that are long water: North America, South America, Europe. The rest of the world is short—Africa, the Middle East, India, China. You know, we're blessed, 5 percent of the population of the world, if that, and 15-20 percent of the water, Great Lakes, etc. It's in the wrong places, it's in the wrong way.

What do we do in this country well? We create organized markets for the production and distribution of goods and services. No better area than agriculture. Nothing better. You don't see it, you don't hear it, you put a price for corn, and all of a sudden there's elevators that emerge and finance it; there are people who come about, great public firms, no big to do. The price is what is critical. Set the price in a fair and clear way, and you will find the proper allocation of capital.

I want to speak about having been a professional inventor, getting it wrong a lot of times, and sometimes getting it right. The first thing that you need is education. I think Mike put it right, Nic put it right. Tom and I have spoken. Whether it's governors or it's anybody like that, you have to understand water is a hot button issue. But the hot button issue is when we're talking about water trading, we are speaking about the excess, the excess beyond hydration and hygiene. We need 25 to 30 gallons of water in the world. The United States uses 150 gallons a day for hygiene and hydration, as opposed to the Europeans in 75 and the Chinese at 25. It doesn't work. Two hour recreational showers in Scottsdale isn't on. It doesn't work. Leaky bathtubs don't work. If you would try to approach it with command and control, not the way Mike said or Nic, you're going to get a legislative result, and let's talk about the legislative results. You know, the U.S. Constitution was 6 pages. Federal Reserve established in what 25 pages? Sarbanes-Oxley: 165 pages. Dodd-Frank: 2300 pages, longer than the New Testament, the Old Testament, and the Koran combined. Is that an efficient use? And what does it cost? Waxman-Markey, the climate bill, 1400 pages; greater than all of the religious testaments in the world that govern the morality. So, I'm going to come

back, and I have two minutes, so I'm going to just suggest a couple of things that might be worthwhile.

Number one, we started a climate exchange 15 years ago, and we did it on a voluntary basis, and everybody said, "That's the dumbest thing in the world. Go back to Chicago. Nobody in the United States is going to take on mandatory reductions without a law." The fact is, we ultimately signed up as pilot members: Ford, IBM, Honeywell, American Electric Power, 128 corporations with no federal law, and it was in effect the size of Germany, and it worked. It got practices, it got what Mike and Nic talked about. We had monitoring, we had verification, etc. Listen carefully. We monitored 128 corporations, which were the size of Germany, and the registry monitoring and verification cost a million and a half dollars a year. Not what Nic was saying or Mike. It's really pretty simple. It's not at all complex. So these things can be done.

So, one voice from the audience is go around the political process, engage the private sector, the users, develop a cap and trade system that has reductions, they can't be politically toyed with, and they go on like the acid rain program in the United States, and make sure they can't be fiddled with. And as an economist, you don't want the rent seekers getting a hold of it—K Street, the lobbyists. All they do is increase transaction costs.

The second bold contract is bypass, which we did in Europe, the spot market. This is totally out of the box thinking, but set up a futures market where you get twice the transparency, regulation, and make that the first step and not worry about spot water trading, because 99 percent of futures don't get settled by delivery. So you can go down a low cost regulatory path, get a buy-in from industry about how you deliver because I think as Mike said, if you put the price up, behavior changes. You don't have to swap the water. You only need to swap the water to make the market at delivery be honest. But if you want price transparency, regulation, regulatory clarity, you can bypass the existing one and design a delivery system to price a certain amount of water in a certain way which will give you

95 percent of the benefits. I'm very optimistic. We can't go on like this. We can't have 1800 gallons for a one pound steak. We can't have 500 gallons for a pound of chicken. Water trading exists today. It is called the international grain trade. And it's just inefficient to buy water and have to buy it simultaneously with food if you can unbundle it.

So I would say, what does the future look like? Stick my neck out, and I'm often wrong, but I'll stick it out here. You'll see water index trading in the United States in another year or two or three. We trade temperatures, we trade rain, all of these markets are potential and you can get through with what looks like a terribly difficult situation with inventive activity, and assembling a team of willing users. So by and large, the creativity in this room, the advocacies, behind Nic, behind Mike, saying it doesn't bite, it saved what? \$370 million I think, Mike, in New South Wales. The water markets, a couple hundred million, in Australian GDP. You have them, and don't worry about adjudication, less appropriation, more appropriation. Adjudication is just like having junk bonds. They get priced if they're not adjudicated well, and they become inferior goods. So don't try to make it perfect. Use existing exchanges and I think we can solve a problem that the world needs to pay serious attention to. Thank you.

***Panelist: Tom Iseman***  
***Deputy Assistant Secretary for Water and Science***  
***United States Department of the Interior***

I appreciate the opportunity to be here. Again, I'm Tom Iseman. I'm the Deputy Assistant Secretary for Water and Science at the Department of the Interior. My introduction described a bit about what Water and Science and the Department of the Interior do, but I did want to discuss that as a starting point to explain why we have an interest and a role in water markets, and to put some sideboards on the rest of my comments this morning.

Our primary interest in water and western water is through the Bureau of Reclamation, which owns and operates water supply projects in 17 western states. We have over 300 dams, almost 250 million acre feet of storage. We provide water to one in five farmers in the western states, and irrigated water for 10 million farmland acres. So, we work with a lot of the states here in this district, and other states in the western U.S., and we work a lot generally on water management issues in the western U.S. because of this infrastructure and our responsibility to manage these assets. We also have the U.S. Geological Survey, which plays an important role in monitoring water flows, groundwater aquifers, subsidence as Mike discussed earlier. And I think they can play an important role in providing data to help track and monitor trends in water use in a way that can inform markets. And it's not a part of what Water and Science does, but we also have the Fish and Wildlife Service in the Department of the Interior. We've talked a lot about environmental flows, and certainly they play an important role in describing the need for ecosystem flows and trying to protect flows for habitat and wildlife.

So the Department has an important role in water resources, and I'm going to focus on that role today as I talk about some of the opportunities I see here along the lines of this discussion. One of the starting points I would say though is that even, notwithstanding our

important role, we've clearly acknowledged that the states control the administration of water. So, we work with our local water user partners and the states to administer water. We I think are very cautious and respectful of the state's role, and I think that helps to inform the ways that we see potential contributions from the Department of the Interior in this conversation.

So I do want to start with some points of agreement that I see with Professor Young and some of the other discussants today. First, there are clearly benefits to using markets in trading, that they can allocate water to higher value uses, and address issues of shortage or scarcity. They can help to incentivize efficiency in water use. When you put a price on the asset, it will make people value it and conserve it differently. They can provide flexibility for climate adaptation or in drought conditions. Mike talked about how in Australia they've allocated the risk for climate adaptation to private water users, and to me markets are one of the best tools that we can give to private users to help deal with this risk. And I think they're in a better position frankly than the government to make those decisions. Certainly, that's one of the things that to me is an advantage for enabling local water users to participate in markets, is that it avoids the risk of the federal government having to do, I think in Mike's paper, what it called a claw-back of water, or trying to make decisions about how to allocate water. We'd much rather see local water users in the state doing that than having to interject a federal role in those cases.

One of the points also that is not my expertise but I thought might be best suited to the people in this audience, and given that we've got a lot of farmers, and in particular, bankers and lenders. As I said, reclamation has a lot of water supply infrastructure—dams and canals, pipelines. A lot of it was built in the early to mid-1900s. We need to reinvest in those assets. To the extent we can start to treat water rights more as bankable assets, I think is a term that was used in Mike's paper, that can be used effectively in the process of reinvesting in our infrastructure, providing collateral essentially to get loans. It's certainly a

challenge right now for the federal government to make these investments. We work closely with our water user partners. One of the things we've seen is the need for some collateral. There are difficulties using our infrastructure as collateral, but to the extent that we can treat these water rights as bankable assets, it will really provide a benefit.

I agree with Mike that we need to focus on the institutional conditions, thinking about registries and monitoring. I mentioned some of the resources that we have that can help to do that both in terms of data, infrastructure, water management and governance. Also, I agree with Mike that water resource planning can help to inform markets and to drive markets, and that's something that we're doing through something we call the Basin Studies. We talked a little bit yesterday about the Colorado River Basin Study which covers seven states, and looks at water supplies and demands. We've Basin studies in 22 Basins in the western U.S. They bring people together, start to look at the challenges, and identify solutions, and that's one way that we can start to structure and incentivize markets.

So what are we currently doing, what the federal government doing? One of the points that I wanted to highlight is the Reclamation Water Smart program. We've made significant investments in water conservation and efficiency. I know there's been some debate about the merits of that. We've conserved over one million acre feet. Some of it consumptive, some of it more along the lines of water efficiency. We have limited the expansion of use in those cases, but I think there's still a question about what happens systematically to that water, and it's a question that bears further investigation. More importantly though, I think we have a long history actually of supporting water markets and exchanges and trading, really maybe trading isn't the best term for it. It was discussed by Nic and others that there are several cases. It was discussed yesterday. I did want to flag a few just to describe some of the history that we've seen at Interior. As early as 1988, Interior had principles that recognized that water transfers could be beneficial and that we should try to accommodate them and reduce the transaction costs associated with using

our infrastructure to do transactions. In the Central Valley Project, as early as the 70s, congress has given us authority to look at water banking programs and drought. In the recent drought in California, we've averaged approximately 350,000 acre-feet transferred each year, most of it being ag to ag, and I think it demonstrates Mike's point about how markets can be a tool for adaptation. The Colorado Big Thompson Project in Colorado, there's an ongoing market with functional and low cost institutions. You see a lot of year to year trading among farmers. The Idaho Snake River, we have longstanding state sanctioned rental pools for water supply. And another role for markets, and we talked a little bit about environmental protection, but there are several places where reclamation is actually a market participant. We are acquiring water for environmental protections. We see that in places like the Klamath Basin in Oregon, the middle Rio Grande in New Mexico, and the Snake River as well in Idaho. Yesterday, Les mentioned the system conservation program. I think that's a great example of an innovative model. It's not really a trading process, but we are using market mechanisms to acquire more water, to bolster this water supply system in the Colorado River Basin.

So, this time went faster than I expected, but I'm going to close with a few comments looking at what we can do going forward, and maybe some observations about what I think might be the best strategies for how we approach this. I think it's been discussed there are clear distinctions between Australia and the United States, one important one being the state/federal relationship and the leadership role of states in administering water; another one being the availability or lack of availability of federal funding that the federal government can't just come in and make or decree these markets or make significant new investments to acquire water.

With that said, there are things we can do. I mentioned the Water Smart grants. This year, we are going to carve off I think three million dollars that would be to support the development of institutions for water markets or trading. I would encourage anyone

who's interested in establishing or pursuing markets to look at that program. Again, it's Water Smart. There will be information available online that describes that program, and establishes criteria that you can see kind of what kinds of practices we're trying to promote. I think we can play a role in trust and governance, and that might sound laughable to some people when you see what's happening with the current election. But despite I think some of the concerns about the federal government, some of which may be merited, what I've seen when I've been out working with Reclamation and with our local water user partners is that they do trust their on-the-ground Reclamation staff, the people who are operating the facilities, the people that they work with day to day. And Reclamation can play an important role in governance. We can provide the incentives, in particular the use of our infrastructure and targeted investments in water. And we can also I think do more work along the lines of the cost benefit analysis; or as Nic I think described it, developing the narrative for why there's an important reason to pursue trading and markets. I think, as I said, I don't think there's enough awareness of how much activity there is in markets, and that there are real benefits to be had to the extent that we can help promote trading.

So finally, I would just say in Australia it seems like we saw wholesale reform. In America, I think we're going to see incremental change; we're going to see it locally and geographically, and I think that's the right way to do it is to support some of those local innovations. I as well as some of these other panelists, I'm an optimist about this, and the federal government, I can say confidently, will be there to support some of those local innovations in this direction.

*General Discussion*

*Moderator: Troy Davig*

*Senior Vice President and Director of Research*

*Federal Reserve Bank of Kansas City*

**John Tracy, Texas Water Resources Institute:** One of the discussions that struck me through this whole meeting is that we're predominately talking about water or the ag economy from sort of one part of the hydra services perspective when we're looking at managing river systems, and that is water supply either for the environment, agriculture, or communities. But when we're talking about markets, there seems to be this presumption that water will always have some positive value, and when we look at river system management, there is a hydra service where water actually has a negative value, and that is with flooding. And in many of the large regulated river systems in the western United States, when you look at the positive value associated with managing the river for water supply, you also have it run into conflict with if you do too much towards water supply you can create a negative value with increased flooding. So the question becomes, how would you price that in a water market, and is that something Australia started dealing with? And if no, thinking about this, that it's not always storing water reduces flooding risk; there's many circumstances with western reservoirs where storing water increases flooding risk, and how would that be priced into a water market that isn't just looking at a water supply market, but rather a hydra services market, looking more comprehensively at why we manage river systems?

**Mike Young:** The Australian approach, or the approach that I put up a sketch that looked like a tank. You won't notice, the bottom bit of the tank, the conveyance water is managed according to rules, not in a market process. Similarly, the bit at the very top of the tank, which is called flood water, actually I price under rules management. The shares bit, the bit in the middle, sorts out itself through a market process. So you're right, you need to have

clear separation, and with issues like flood, nobody wants to own flood water. Because if you own flood water, you're liable for what it does. When you have water that you own, and you start applying it to a field or whatever you do with it, you're liable for all the consequences that result from that use. Flood waters have to be managed through regulations, and the high level systems plans that are in place have to be very careful with issues like actually carry-forward, for example, when you start filling up a dam. There has to always be enough space left in the top of the dam so you can control flood risk. We in Australia made some very serious mistakes, one which was up in Brisbane where people essentially over-zealously kept too much water in the dam, concerned about the importance of having water available for use, and forgot to leave enough air space in the top and we had a big flood, actually a huge rainfall event that caused a disaster because they actually mismanagement of the dams. So you need first of all to have the rules in place to deal with all of these issues and manage that through very careful governance at the top, and then letting the market work within that overall framework. So your point is very important. You have to have the two managed separately and enough instruments to do both.

**Audience Question:** I guess this is the point of the question, is that we're talking about moving away from rules managing water for one segment of the hydra services and moving to market based approaches. So why wouldn't we look at creating a market based approach for all of the hydra services? Why would we separate them? This is a real situation in Idaho where there is this real discussion, I guess I'd say controversy around certain reservoirs where there is a feeling on the people using it for water supply that there's too much benefit being accrued to the people that are using it for flood prevention, and that if there was a market there that in essence allowed the water supply users to take on the risk associated with the flooding and bring it all into the market rather than just part of the hydra services.

**Mike Young:** You can design it. There's been work in Australia that suggested essentially you pay and trade opportunities for people who invest, [inaudible], that actually allow a

flood risk. So you can pay people to build storage, etc., that actually lower risk. Those sorts of things are being played with and explored. But essentially, what you're saying I think is there's a need for people who specialize in designing systems, and we haven't got the skills anywhere in the world nearly enough in terms of knowing how you design systems and the system data, how people who understand hydrology economics, markets, governance, the whole lot. We're into very uncharted fields. And that's the frontier in all of this. And while I'm there, I'll make a quick comment that I think you need to be very careful in thinking through the sequence of reforms; where you start and where you end up is very important. The biggest opportunity I think in America at the moment is to convert your existing water rights through into new registers, but having systems which are like a tolerance title type system. It's the only way you can own something is if your name is in the register, and you don't have complex paper trails. Designing that transition is the holy grail in terms of starting the journey. If you get that wrong, you'll lock yourself into designs that will make it impossible to step forward. That includes dealing with flood. The greatest insight that Australia did was to set up new systems that became defined as shares, not as rights to volumes.

**Richard Sandor:** If we take, and I think the Australian situation is terrific because it deals with all of these levels. But in theory, if you go back to the work of Ronald Koes, and deal with externalities, as long as you have unambiguous property rights, and they are transferable. It doesn't matter if you give the rights to people who are being flooded or you give them to people as rights to use. So, almost any of these systems we know can be dealt with at least theoretically, and have been dealt with, whether it's sales or auctioning of bandwidth, other sorts of things. If you get that bit right, a tradable solution is not a very hard one. The problem is if you want buy-in, then you're in a political process. And there's two things. And the second thing, keeping in mind that the allocation of these rights, be they on the polluted or the polluter, is irrelevant as long as you have low transaction costs

and unambiguous property rights. So what we know in economics and what virtually any economics class will tell you, these are all doable problems and then when you start to fiddle with them, then you increase the transaction costs, and then David Ricardo's gains from trade disappear, and you've got to carefully balance. Australia's done it, but it doesn't mean that it couldn't be done, or you could take the rights and price them negatively. Oh my God, you might say. Well, there's \$40 trillion of sovereign debt out there, and \$12 trillion trades below zero interest rate. So negative prices are something that we're living with right here. So none of these, I don't think there's a magic pill. If you take a look at the Coasian framework, and you follow the line of reasoning that Mike and Nic talked about, make it transparent, get registries, allocate them, set limits, and then provide a regulated market that gives you price discovery and price transparency, whether it's for spot or future prices, you'll get there. And the debate often falls down, as it's falling down with climate change, and just to make a point, which I do think is very important, it's not whether we are or are not running out of water. It's not whether the Ogallala will last for 10,000 years or 10 years. The question is, is there an institutional framework that can be designed where the benefits exceed the costs, and you will have no macro effect? And if you lower water use from 150 gallons per capita, and you don't subsidize the growth of cotton in Arizona, and do some very simple things, the problems are tenable.

**Mike Young:** I think you know you're getting close to a solution when you have brokers who are charging for an outcome. In things like land sales, brokers take a percentage of the final sale, and basically deliver the whole thing for that. At the moment when you do a water trade in the United States, you employ a lawyer who charges by the hour, or actually every 5-minute block. Because they don't know how long it's going to take, how complicated it's going to get. So part of the design framework is to build, as you said, unambiguous rights so that people can complete, to work out how to complete the transaction at the lowest cost. And it's getting the certainty around the right enables then you to get competition

around how you deliver brokering services and get the markets to operate. While you have such huge regulatory confusion, right confusion, you don't go forward. Convincing water users that they will profit from having meters in place is really hard. When they start to understand what happens at the moment is people are allowed to steal from each other, and they have a product that if they weren't allowed to steal from each other, they could sell, then they start to understand the benefits of going to metering. But step one is to get registries of the long term rights, and defining them as Australia did with shares, and saying, in this water system there will be no more shares ever issued, and making governments honor that is a very important step. The second building block is to have monitoring of allocations, and have water accounting systems that have the same integrity as your financial systems, where if somebody goes into negative, and if their water account goes into negative, they have to make good very, very quickly. If they don't make good, it's going to cost them so much, that it's in their interest to go back into the market to solve the problem rather than to say, "Oh, whoops, sorry, forgive me, I might fix it up next time."

**Richard Sandor:** I want to add one thing which I think is worth bearing in mind. We're talking abstractly about the gains from trade, and the benefits, and I think Mike, Nic, Tom have all talked about it. But we did a study for the state of New Mexico. And let me in very simple terms tell you what the gains from trade are like. If you take a square mile, take 640 acre-feet of water. In New Mexico, that produces an alfalfa crop that's worth \$250,000. That same amount of water is what Intel uses in its fabrication plant, and has a local payroll of \$500 million, and it can't double the plant site because the water rights can't be transferred. So you have water being used here, \$250,000; use here \$500 million for the exact amount of water, and the farmer would be a lot better off just turning it into a recreational property and have people out there, and that doesn't go to the subsidized gas that goes into drawing it; it doesn't speak to ag subsidies. And that's the magnitude of the problem we're talking about. Do you produce \$250,000 or do you produce 6,000 jobs? One farmer who wouldn't lose

his property just by unbundling the water and making the rights separable from the land ownership will unlock 5,000 new jobs that are sustainable. And that's what you need to be thinking of, not water trading per se, but what happens when you don't allow it?

**Nicholas Brozovic:** I'm going to follow up quickly to Mike's observation that when you see brokers in the room that it means there's value to be made, and money to be made in water trading. I think that's very fair. I don't think it's correct to characterize the U.S. system of trading and transfers as run by lawyers. The brokerage system is what's used in Australia. That does exist very actively within the U.S., both specific water brokers and real estate brokers do trade water. But there are also a number of other institutional arrangements that are not brokered that are used in water markets. That's part of a larger discussion, but I just wanted to ... I think, I don't know. There are some water lawyers in the room perhaps. We want to speak carefully about them. But just again to clarify that.

**Mike Young:** I was going to observe that when we unbundled in Australia, one of the things that really delighted me was to see how many people in agriculture who were trapped in agriculture because they were poor, retired, sold their land to their sons or daughters, minus the land, and they then used their water rights as a source of income. We were amazed to see how much structural adjustment and innovation occurred and how quickly areas that were depressed became vibrant again. I used to spend a lot of time in a town, which used to be a rundown, decrepit, old, struggling community. All the shops were unpainted, dusty, struggling. You go there today and there are vibrant shops, new cars. The prosperity that came back into this area, that also had a massive salinity problem, and nobody could see the solution to, is amazing. And it came because the community had the opportunity to suddenly trade their water out of the district, the water lift, and everybody said this is going to be a disaster. The people then had cash, and they themselves found a solution to the salinity problem that government consultant after government consultant never could see. They brought the water back in again, and now it's a prosperous community without

the environmental problems that used to be there, and confidence and pride. I find it tremendous to go back there 20 years later and just see the change and the transition. And I might add while I've got the microphone, that keeping it simple is very important. There's a great game among scientists to build very complex models. At the moment, in Diamond Valley, the management plan or the draft management plan says, if the average depth of water table monitored at four wells on the first of February each year drops, then the management board must reduce allocations per share by between 3 and 6 percent. That gives everybody confidence. It's very, very simple. It takes one person on the first of February to go out and see how deep the water is in four wells, and come back and report it. There were proposals from consultants to build very, very complicated models, and what they really know is that managing its depth to groundwater, and as it goes down, pumping costs go up. So why not keep it simple? Build it approximately right, rather than comprehensively wrong, but not inordinately expensive to run.

**Ellen Hanak, Public Policy Institute of California:** Thanks, this has been such a great discussion all of you. A couple of quick observations on how to lower transactions costs. Mike, I agree getting the registry right is key. But I think the other thing that you mentioned, but you haven't come back to and highlighting as an essential thing for reducing the role of lawyers in the process here in the U.S. is that exchange rate thing that you guys worked out, where you figured out how much water ... my water right here is tradable locally or further along depending on kind of the environmental requirements of water that needs to stay in the river. And that's the really tough part of a lot of surface water trading in the U.S. So that's a job that we really need to do in order for guys like Tom Rooney to be able to really have a good business here. So that's one observation. And then the second one, this is a request really to Tom. You mentioned that the Bureau has a lot of infrastructure, and that is a really useful way of moving water around, not just for folks who have contracts with the Bureau, but more generally in the system. And you guys are not especially nimble at making

that easy for people. I think there are a lot of simple things that could be done like waiving some of the reviews that have to be done every year if you show that there's not a cultural significance to transferring water from point A to point B in year one; it could be the same in year five. So those are just a couple of thoughts on making this all work better, guys.

**Mike Young:** And certainly I would agree in terms of setting the exchange rates, and also how you manage return flow issues which is something that was talked about a lot yesterday. Most of the systems in Australia rely on what I would call a simple gross accounting system, where there's no concern about return flows on a trade by trade basis. In theory, what's supposed to happen is that as the system becomes more efficient, actually allocations per share across the system go down. So there are incentives for people to move ahead of the game, and actually costs for those who move more slowly. The transaction costs are much less because you don't have to do case by case assessments. In practice, we have a mixed approach where if you trade water out of the region or if you're using it for some urban purposes, sometimes return flows are actually managed. So it's a design issue that can be adaptively managed as you're going forward. But going to a gross rather than a net accounting system can save a lot of transaction costs.

**Richard Sandor:** One punctuation here which I think adds. If you take a look at costs of transaction and do it in a Coasian framework, you have legislative costs; that is to implement anything. You have regulatory costs. You have the costs of building the institution; that is the exchange. And you have the costs that come up with the designing of the contract per se. And if we take a look at trends today in America, the exchanges disintermediate the lawyers because they have rules books and conflict resolution, which is outside the court system. The exchanges are now disintermediating the brokers. So you can take transaction costs by 10-20 percent down dramatically which could make a trade worthwhile, but wouldn't in the institutional. So, we have the most efficient markets that you have. You don't even think twice about corn, and what goes on there and the world allocation price is done with

almost no transaction costs. You know, they are fractions of a tenth of a cent of a bushel. So there's lots of things that I would say, if you looked at organized exchanges, disintermediate the brokers, get rid of the lawyers, and develop a governance system which is efficient and works well where the government is not the active, but the oversight that exchanges enforce their rules, rather than having it there. All you need to look at corn, wheat, beans, crude oil, cocoa, sugar, cotton, and you'll see a system that has these low transaction costs. But you will find that brokers won't be amused by disintermediation; the lawyers won't be amused by disintermediation; K Street will not be amused by disintermediation; but you have to design a system and an exchange in an electronic platform, no voice brokerage. You have to do a lot of things that will ultimately make costs cheap and competitive. I speak from what I know because we started with an exchange, and it's not to be self promotion, which was an idea for carbon trading. We built the technology, we had no brokers allowed on the exchange, we had no lawyers, and it is the predominant system in Europe, and we started with a couple of million dollars and sold the exchange for \$650 million to somebody because the design was very cost effective. So you have to really pay attention. Your question was fantastic. That is the key, and the key is if you had a blank board, you'd get rid of, and weren't subject to lobbying, you'd get rid of all of these external service providers who get rents, and you'd make it an enclosed system. And that's ended up with the most efficient food system in the world.