Today on the Library Channel-- Selling Sunshine, ASU Solar Energy Research, 1951 to 1981. I'm your host Fred McIlvain. Today, I'm joined by ASU archivist Rob Spindler.

Hi Fred.

Professor Charles Backus.

Hi. Glad to be here.

And professor Harvey Bryan.

Thank you for having me.

In the fall of 2013, ASU libraries is hosting the exhibit Selling Sunshine, showcasing solar energy research beginning in the 1950s, and the marketing campaign to make Arizona a national player in solar energy research. Rob is going to talk with professors Bryan and Backus about their research.

Thanks, Fred. I'm really excited to bring everybody together to talk a bit about our solar energy history here at Arizona State University. I'm especially grateful to our two guests today for their assistance in helping us compile this great exhibit on the fourth floor of Hayden Library. So why don't we begin with Professor Bryan. Sir, what did you begin working at ASU? And what was your role in solar energy research and development here?

I came as a student. I didn't work here for a number of years. I mean, in 1968 I came here. Got exposed to several people that I thought were doing some very exciting research. And obviously as a student, I try to attract myself to that area. And that led me on to a career in that field that has been very positive for those years. It led me to graduate school later at the University of California Berkeley.

I worked for the Department of Energy in the energy and renewable program. And then, teaching at several institutions in this field, and returning to ASU in 1999. So it was sort of coming home after a number of years away. So most of the my active period a issue as a researcher happened after 1981. But I was here during the late '60s, early '70s. I worked with, I think, some key figures who were at that time moving the program forward.

Thank you. Doctor Backus, when did you begin working here? And what was your role?

I came here as an assistant professor of engineering in 1968. I had previously been at the University of Arizona getting my doctorate a few years before that. Oddly enough, it was in nuclear engineering. But my specialty was in space power, and I worked while I was in graduate school and for three years afterwards in space power, using nuclear sources. But when I came here, we were losing a lot of contracts to the solar guys. So I decided to become a solar expert at ASU.

OK. Professor Bryan, when you arrived here, who were the ASU leaders in solar energy? And what did they do?

Well, the two people I was closest to that were in my department were Professor Jeffrey Cook and Professor John Yellott. And both being somewhat of a lost voices. It was an essential part of my program at the time. That was that when we had a college of architecture. But they were trying to move the field to think about buildings that actually would become a passive device that actually could absorb and store energy and reduce its load. And then later on, particularly John Yellott's work, was to look at active solar thermal systems. And he did some of the pioneering work in that field.

Doctor Backus, perhaps you were aware of other leaders in solar energy and could tell us a little about what they did on the engineering side?

I would like to, but there weren't any. At '68, that was just 10 years after it became a university. And the whole university was in transition, trying to become a university instead of a teachers college. So my first reaction was that there are no laboratories to do research. And really, in those days, no encouragement to do research. So I decided to develop a short course for working engineers.

And so, I organized within that first year a five-day short course for engineers across the country, and what I called-- at the time-- direct energy conversion. It's advanced energy concepts of various kinds. And I taught that with outside speakers through the years. But I taught that course every year for 16 or 17 years. And I think that's sort of what was a national visibility of advertising, and people coming to campus-- from all over the country, and outside-- that started associating advanced energy with Arizona State.

Hard to imagine a young university struggling to develop its laboratory and research capabilities in the late '60s and early '70s when you look around the campus today, and see what our research-intensive

institution ASU has become.

OK, for Professor Bryan. Did you see these solar energy devices on display? The exhibit features a number of photographs of devices that were, at the time, called exhibits.

Well, John Yellott in particular. He was actually a part time faculty member. He had a couple other jobs. He was headmaster of the Phoenix Country Day school. And he also had a solar consulting company called Yellot's Solar Laboratories. Part of it was at his house in his back yard. And some of it was at a small yard he rented in Sunny Slope. We had a lot of testing apparatus. Solar calorimeter, and a few other devices like that. And it was actually not part of ASU, but he would invite students there-- particularly on weekends, Saturdays-- to go up and see the lab.

And he'd run basically informal classes. Not part of getting credit, but people who were interested, and students that he took under his wings, he would tend to encourage them to come up, visit him at the lab. And possibly do some simple projects. And that was a great opportunity. But again, it was before we had, as you mentioned, a lot of the formalness that we have today in a modern research university. So we can do these things in a more fluid way. Back then, anyway. And they're great educational experiences because you don't usually have those opportunities to work with someone like that in a kind of casual way.

I thought I read somewhere that there was a second installation of devices on top of one of the engineering buildings later. But you don't recall that?

No. Because actually, some of those engineering buildings didn't exist until the middle '60s. We started a long term contract to look at concentrators in conjunction with photovoltaics to lower the cost. We started in '73. And that contract-- which at the time was the largest contract ASU had ever received outside of the Department of Education. That continued for 17 years of continuous funding, looking at concentrators and developing all of the technology associated with solar cells under concentration and so forth.

And so, that started in '73. And so, by '76 or so, we had all kinds of devices and stuff there we were researching with, but not a good laboratory. And so the dean of research committed to building a solar platform on the F wing of engineering. And so, that was '77, as I recall. And then when we moved all the experimental things up on top.

It's one of the challenges of doing projects like this and working through the archival collections. We get pieces of the stories. But it's one of the great things of having you here today to help us fill in the blanks between the documents that we're able to find. Tell us about the broader support. Was industry interested in what we were doing here? Were the presidents interested in what we were doing here? Was the legislature interested in what we were doing here?

The first international solid conference was held jointly between the U of A and ASU. But again, that was started actually by the business community. The head of the Valley National Bank, the head of APS, and the head of one of the premiere law firms in the state actually incorporated what is now International Solar Energy Society, ISES. And it originally started here as a conference that moved between Tucson and Phoenix, over a long weekend I guess.

And you have some of the photographs of the outdoor exhibit, which had a lot of solar-thermal, crop drying, solar pumps, solar cookers. Those are the kind of things in the '50s that were attracting a lot of attention. And again, we had quite a larger international group at that conference. Because I think a lot of people saw some of these devices having international applications, particularly in developing parts of the world. And that organization was started here by the business community, not necessarily by the university. And later, they hired John Yellott to become the executive director. But that was about a year or two after the organization actually got going.

And when I came in '68, that was in the process of-- the International Solar Energy Association, it was called at the time, was in the process of moving to Australia, because of the lack of interest and activities in all of America at the time. And in my view, some of us were interested in, in my case, photovoltaics was a space phenomenon. And cells were only made for space. And so, that was an interest. Except when I came to ASU, I wanted to start to looking into terrestrial applications.

But there were orders of magnitude, several orders of magnitude, too expensive for terrestrial applications. And it really wasn't until the Arab embargo that it got national attention, that gee, we should be looking at something other than oil. And that's when, like the National Science Foundation, they only did scientific kinds of university support projects. What's the curvature of the back leg of a cricket in North Africa, or something like that. Which is important, but not that it impacts society very much.

And so the National Science Foundation established research applied to national needs as it ran. That's

when I decided to go after that money. And we had no capability to do semiconductor research here, which is odd because the semiconductor industry was blossoming in Phoenix by the time. And so I started going to the Photovoltaic Specialists Conference, which was a meeting in 1970. And in those days, those were only space people. Are there were only two companies in the United States that made solar cells for space.

But I found the president, one of them, was very interested in terrestrial applications. And so he and I collaborated on how can ASU, with no research capability, become involved? And so we decided on a proposal to the RAN program that we could lead, because they were product partial to universities instead of industry. But we would propose looking at the use of concentrators with photovoltaics, knowing that the lenses are cheap compared with these diamonds they make for cells.

And so the company would look at, how do you make cells differently for that? And we would look at the total system. We have mechanical engineers and traditional people that could address those things, and then set up a laboratory. We obviously had a better place than LA, where that company was located, to do solar testing. And so that was the collaboration that we were able to get into it with no semiconductor research capability at that time.

I think what it shows you there's two thrusts. One was solar thermal, one was photovoltaic. They matured a little bit differently, and the applications obviously were different. But again, they all are a strong part of our history.

It seems that the Solar Energy Research Institute, the drive to land that institute, might have been a turning point in our development here. I was speaking a little bit with Dr. Backus about that earlier. Could you talk a little more about the development, and the attempts to land that institute? And how that came out?

Yes. After the embargo got national attention of the feds and President Carter came in to the White House, he decided-- primarily as an individual decision, I think-- that we need a national lab devoted to solar energy. And so you put out word to all the governors saying, I want to solicit proposals for a national research institute in solar energy. And I want to no more than one proposal from each state. And I want an independent, not-for-profit research established industry organization to run it.

And so, there was a Solar Energy Commission in Arizona. It was set up in that-- I don't know, '73, '74

time frame. And I was on that commission. It was an amazing thing for the state of Arizona to do, I thought at the time. And in retrospect, even more so. We had knowledgeable people on the commission, but we were given like $500,000 a year to invest in developing solar for Arizona. And so we had all kinds of proposals that we would decide and award. And then went on for several years. And that was a lot of money at the time.

Anyway, the governor came to the commission to say, OK. This is your baby, put a proposal together. And we talked to the big national research independent institutes-- SRI, Stanford Research Institute, to Battelle Memorial Institute, Midwest Research Labs. And there were some others on the east coast that we didn't talk to. And we put a proposal together.

And actually, we proposed that this be put at the ASU experimental agriculture farm at Elliot and Price. At the time, we had 320 acres there. And it was just our farm, which was in the College of Engineering.

Another location of the ASU research park.

Yes. That's a whole different story. And I was very involved with that. Anyway, so we talked to all these people. And we put in a proposal with Battelle Memorial Institute with an ASU location-- the institute out of Columbus-- running it. And we proposed, as our director of that institute, Paul Rappaport, who was one of my mentors. He was at our CA research lab. He was one of the early experimenters PV.

Anyway, we proposed him. And actually, I can't remember the year. But I proposed him, and he received an honorary doctorate degree from ASU sometime in that period. And he was the first lecturer at my short course, which I started in '69. Anyway, we proposed him as the director. And it got down to the winner of that competition was Colorado. They had also proposed Paul Rappaport as their director. And they told us that we were an extremely close second in competition, which doesn't get you anything.

So anyway, it's an interesting turning point. But I wouldn't say it was a turning point away from ASU's activities. It would've been a huge boost to us had they chosen Arizona for that, but it went to Colorado.

Now, during '75 was that competition. And during that time, the state put a lot of effort in the community, put a lot of effort in promoting Arizona and putting out booklets and whole Arizona highways was devoted to-- and they hired space artist McCall to come in and do all kinds of futuristic for that article. And from my point of view, it was sort of a lot of misinformation. But it was a PR piece, it wasn't a

reporting piece.

And so, we made a big effort, and we were not successful. But we received, after that, an awful lot of funding from the Solar Research Institute in Colorado and from Sandia National Laboratories, and other government entities. So we were ramping up our involvement through that whole period.

And It may be that we will come up with a phase two of this exhibit that will really bring out much more of history from 1980 forward, where so much of that research was ramped up. For Professor Bryan, one of the things we tried to feature in the exhibit were the solar demonstration houses that were built at different times and in different places. And one of those can actually be seen today at the northwest corner of Rural and University. And I'm told another one is still standing in Paradise Valley. But tell us what you know about the houses, and that work.

I think the first house came out of a competition that came from the International Solar Energy Society's organization here. I think there was some money from somebody. And I know Gary Herberger, who actually was a student at the time, actually helped administer the competition. So I think there may have been some money from his family in about. I'm not quite sure.

But they owned a lot of property in that part of Phoenix, and there may have been some interest of looking at solar development at some time. Gary at that time, form what I've heard-- even as a student-- a very visionary type person. So he's continued it throughout his career. And have also been a great philanthropist in our community here.

And it was a national competition that was announced in various architectural journals for a residential home in Phoenix. I don't know how many square feet. Probably around 1800 square feet, something like that. And pretty much all the technology we had at the time was solar thermal, which is not necessarily what the load on a house is in Arizona. It's cooling, and we really didn't have solar thermal at that time.

In fact, professor Yellott was working on some solar absorption systems at that time. But there was nothing ready for application. And so, it was an interesting house. A very contemporary styled house, as pictured in the exhibit. But again, it had active solar thermal collectors that you really don't need if you do a fairly good passive house in Arizona. With good orientation and some thermal mass, you can probably bring down that the load on that-- at least the heating load on that-- to pretty much nothing in

Arizona. You don't have to heat many of your homes if they're well-designed in Arizona.

So it went through several. It won an award, and again had some press in the architectural magazines at the time, and it went through several owners. And now the house actually still exists, though in a very, very different form. And probably even the owner currently doesn't know the history of it, I don't know.

But I think we've come a long way from those early experiments. And again, we did so on campus. We also teamed up with APS to do several APS demonstration houses. So it's part of that learning experience that went on in during that period. And not always successful, but again. A lot of times the students who worked on those projects, and some of the professionals, worked and learned a lot. And it certainly did have some carry over.

We were very early in curriculum-- and development of curriculum-- around solar energy, and also workshops for the public to learn about solar energy applications they could actually install in their homes. Did you have any experience with that? How did your research influence your teaching in the classroom?

Well in my case in engineering-- partly because of my philosophy, I suppose-- that solar energy in general, and certainly in photovoltaics, does not deserve to have a degree. Again, in my opinion. It draws on all kinds of other technologies, and certainly in photovoltaics the semiconductor is the basis of the device which is the basis of the conversion to electricity.

And so your degree should be in an established field of some sort. And my years of teaching has taught me, as well as my own career, that people end up where they don't get their degree oftentimes. And they need a good solid education that prepares them and gives them flexibility to go in the directions that their career leads. I'm a nuclear engineer that became one of the national leaders in solar energy, which most people at the time thought that was anti-nuclear, that the nuclear people were anti-solar and so forth.

And I had done a lot of advising-- in Saudi Arabia, of all places. But it had a lot of sun in Saudi Arabia, and a lot of money because of what's under the sun and under the ground. But they were going to start out with a solar energy curriculum, a four year undergraduate program. And I just said, I don't think that makes any sense at all. These people need to be grounded in all kinds of basic technology, not just

specialized.

And so anyway, I taught courses starting that first year in direct energy conversion, and in the mechanical engineering department I was in at the time. And I think that my view was that solar needs to be pursued in a graduate thesis, like a master's thesis or a Ph.D. thesis. That is a very specialty topic that is the nature of a thesis, or a dissertation. And that you need all kinds of basic technological courses to prepare you to do that specialized investigation.

And I have taught courses in photovoltaics, but I think we only had one course per se in photovoltaics. And of course, direct energy conversion included that, but a lot of other advanced energy things. So I did not push for a curriculum.

Well it was poured in again by our faculty members. Again, since I was in the architecture program, a lot of our focus was on design and obviously the applications. And Jeff Cook was a pioneer in the whole concept of passive solar design, which he actually used the building as an envelope. Orient it properly, include enough mass and other features, that the building is a collector in a way. And he was very successful at pioneering those ideas. And they still have, I think, a lot of residents in the design community.

John Yellott, on the other hand, would like to bring in projects from his testing lab. And use them in a creative way in the classroom. And actually, when I was about to leave they had just got awarded a large National Science Foundation contract to actually do workshops for community, to actually build solar collectors.

Solar hot water, solar collectors. And every Saturday, they would have workshops on the roof of our building and actually build them. And then the homeowners would take them home. And they worked, though iffy. We have very bad water in Arizona. The mineral would clog those things up pretty easily.

But it was, again, an experiment of trying to get this out to customers, the consumers, in a proactive way. And it was actually a very fun project. I still have the workbook from that course. And I have some photographs. Probably if I had more time I could dig them up and share them with you. Because it was, I think, a time when we were really linking and embedding ourselves in a very fundamental way in trying to get the technology out of the lab and into people's homes or on top of their rooftops. And I thought that was a very interesting feature, and one that I still think of has a lot of merit.

Today at ASU, we talk a lot about intellectual fusion and bridging the gaps between disciplines and scientific research. And as I've read through all these documents and thought a bit about all of this, I've wondered whether a more interdisciplinary approach might have helped us advance our research. We mentioned before the there was uneven development between the design side and perhaps the engineering side. And it seems like there was a heyday in the design side, and then it might have faded a little bit. And then more of a heyday in the engineering side a little later. Do you have any thoughts about bridging the disciplines, and whether that would have been beneficial at an earlier time at ASU?

There's always been a friction between the solar thermal and solar electric community. I seem as one, and I don't like any of that separation at all. And some of the principles underlying solar should be understood in all those applications. And they have to be understood, all those applications, to make it work. But there's still some of that. And some of that is reflected in the research, the R and D. Monies that are available, very little money for solar thermal work. Most of the research money is moved towards the photoelectric types of devices. And that's where the market is also today.

It's funny because you hear people say, oh yeah. I had a solar collector, and it all got clogged up. And then it wouldn't work anymore. And yet, they didn't make the connection. That's electricity we're seeing today on the rooftop, not a solar thermal collector. And they don't understand the fundamental differences, which are profound differences in the devices.

But they still have this attitude about, oh, it never worked. And we still have to overcome that, and we have to overcome that with education. And I agree. A blended approach is the best way. I agree with Professor Backus. I would say a fundamental good four-year engineering degree, and then you specialize and take that forward in a graduate program. And that's actually how we've designed the graduate program that I direct, which is actually in the form of schools.

And it's basically an applied project. It's actually part funded by the National Science Foundation, at least initially. Because they realized there wasn't enough design engineers out there to feed the marketplace. There's a lot of people that can work in the labs, but not that many people work as sign engineers. So we focus on applications of commercialization component to this program.

But most of the people coming in are coming with EE or mechanical degrees from good solid engineering programs. And then we give them policy. We give them economics. We give them business skills. We give them entrepreneurial skills, as well as some of the advanced solar courses. And we hope

to blend them into a program that they can come out with skills that can actually allow them to be a project manager for a large solar project. Or work for a company doing commercial installation, or something like that.

And they could work even in the solar electric field or in the solar thermal field. Some of the underlying skills they may need as far as how to get something contracted and built are fundamental to both systems.

Dr. Backus?

In my case, I guess, I've never thought of there being competition or friction between. They were just different entities. And there is some overlap. And some of the early research done-- our activity, like at the University of Delaware in particular. They've built solar-heated houses with photovoltaics, and cooled them with glass, or something where they could pass air through. And like a lot of combination things, they don't-- either one-- work very well as a result of a combination thing.

And it turns out that photovoltaics, based on the semiconductor character of the material, its efficiency goes down with temperature going up. And then if you expose it to water and other kinds of things, it usually deteriorates the photovoltaics. So it's hard to come up with a practical application that incorporates both of them. Home designs these days will have solar collectors that are thermal collectors for heating water or the heating of the house, and then a separate photovoltaic one.

So I don't know if there's so much competition. But for a university who does more the research part of development, the research is more into the details. And so, they get separated even more in a university setting. So it's always good to collaborate. And my industrial experience is, if you work in an industry and you have a project to complete, you bring in people who are really experts in all of the aspects of what you're trying to do. And then use their join talent with their individual expertise to attack the common problem.

And that's a needed part in an industry, but not necessarily at a university. If you want to do research on some topic in order to get funding, you have to be specific and detailed, and so forth. So the nature of the beast make them different. In industry, you have to integrate them for a common good. At a university, we separate it in little spires of expertise, and try to get finding in our little spire.

Any final thoughts from either of you about this history or this exhibit that you'd like to share?

One of the things that helped us over the early stages in solar energy and research was, of all places, the Corporation Commission. They gave me a little bit of money and asked me to put together a task force to say, what should Arizona be doing? And in particular, what should the utilities be doing towards the future in solar? This was sometime in the '70s. And so I put together a task force. It involved utility people and National Laboratory people like at Sandia and SERI, Solar Energy Research Institute.

And we had several meetings over a year's time, reported back to them with several suggestions of what they could be doing. Including that the utility should set up a laboratory to get experience with the incorporation of solar kinds of technology in a utility operation. And we proposed that APS a course, which is under Corporation Commission and the biggest one in Arizona, utility. They should establish a special laboratory to just look at utility interface with solar technology.

And they indeed did establish out at the corner of McClintock and University a major solar laboratory looking at utility interfaces with that technology. And lasted for 20 years. And they gained a lot of experience, and became very well established in the national community for their utility knowledge of how to incorporate, what are the problems, and what do we need to be concerned about, and so forth.

So that came from a political group called Corporation Commission, which is a utility regulation. And there's been a lot of things over the years that people from government, or the governor, but until President Crow came and started a lot of real initiatives-- broad-based, he's a very talented person. An untypical university president that has really jumped in and made ASU a broad-based research institution. All kinds of integrated topics, and so forth.

But the previous university presidents that I served under, I guess, never took that kind of an approach. And they were sort of aloof and didn't want to interfere with faculty pursuits, or tell them what to do or something. And not that they were bad people, but just not on their screen to pursue agendas and have major impacts by driving the university in certain directions.

Crow's done an amazing job in 10 years. He's been here redirecting and making ASU visible. Oftentimes, our development in solar energy at ASU has been in spite of legislators or even presidents-- or lack thereof-- of interest in the pursuit of those kind of topics.

Certainly the Corporation Commission is very actively engaged at this moment regarding the rate

metering controversy in residential applications. Final thoughts from Professor Bryan?

Hey, well, again. I reinforce that. We are sort of like it's "Dj vu all over again" in some cases. We have a governor who sets up the Solar Energy Commission. A governor or two later, the first thing he does is get rid of it. Because he saw it as, I don't know what. A threat, or something. But when we started to put these kind of ideological lenses on, people see these various technologies in threatening ways. When, in fact, that should never have been the case. And we're still seeing that. In fact, that's current again as you mentioned. We're seeing a big push back on net metering. That can really hurt a maturing industry like solar energy, especially in the residential sector in this state if we back off from some of these are programs.

I think what we're seeing if you look at a lot of the subsidies that have gone to the solar industry in the last years, most of them have been reducing in size. So in fact, at one time you used to get several dollars per watt installed. Today, residential, you get $0.10 per watt. So that's good. They're all going to be off the books very soon.

And that's how a new industry should start. It should not be a perpetual thing. But just because it is taking advantage of them now, we shouldn't try to tie the hands of this new technology by saying you can't participate in these systems. When, in fact, some older industries still benefit from. They have not been sunsetted in the oil industry and the gas industry and a couple other industries.

But I think the solar industry is accepting that they will be sunsetted. But let's have that time frame and be realistic, and not collapse a whole industry at this point-- which is, I'm afraid, on the agenda of some people right now, which would really hurt our state, I think, economically.

Thank you, Professor Bryan. Thank you, Professor Backus. Very enjoyable.

Well thank you for inviting us. It was enjoyable for us to reminisce and think about our past lives, and the past experiences at ASU. So we appreciate that revisit.

And your exhibit, and all the work you put in, it just shows you how we all have to build on the shoulders of our predecessors and the tremendous work they've done. And I hope every time-- one of the things a lot of students do, when they see these wonderful apparatuses on campus now, generating all this energy from the sun. They can appreciate that it's taken a while. It's not just something that's happened overnight.

Thank you. It's really, I think, important to remember the tireless efforts of President Grady Gammage, all of these scientists, all of these design folks who worked so hard over so many years to try to place us in a position of prominence in solar energy. So I think it's valuable to remember those efforts, and to honor those individuals that have worked so hard for all of us.

Be sure and stop in and check out the exhibit Selling Sunshine in the Luhrs Gallery on the fourth floor of the Hayden Library.

The Library Channel is produced by Jennifer Duvernay. Directed and edited by Matthew Harp. Thanks for listening, I'm Fred McIlvain and we'll see you next time.