COMMONWEALTH OF PENNSYLVANIA
HOUSE OF REPRESENTATIVES

STATE GOVERNMENT
HOUSE ENVIRONMENTAL RESOURCES & ENERGY COMMITTEE
PUBLIC HEARING

STATE CAPITOL
HARRISBURG, PA

IRVIS OFFICE BUILDING
ROOM G-50

MONDAY, JANUARY 10, 2022
9:30 A.M.

PUBLIC HEARING ON RARE EARTH MINERALS
STAKEHOLDER TESTIMONY

SUBCOMMITTEE MEMBERS PRESENT:

HONORABLE DARLY METCALFE, COMMITTEE MAJORITY CHAIRMAN
HONORABLE MIKE ARMANINI
HONORABLE STEPHANIE BOROWICZ
HONORABLE DONALD COOK
HONORABLE JOSEPH HAMM
HONORABLE KATHY RAPP
HONORABLE PAUL SCHEMEL

HONORABLE GREG VITALI, COMMITTEE MINORITY CHAIRMAN
HONORABLE JOSEPH HOHENSTEIN
HONORABLE MARY ISAACSON

MEMBERS PRESENT VIRTUALLY:

HONORABLE RYAN MACKENZIE
HONORABLE TOMMY SANKEY

HONORABLE DIANNE HERRIN
HONORABLE RICK KRAJEWSKI

MEMBERS PRESENT VIRTUALLY (CONTINUED):

HONORABLE DANIELLE FRIEL OTTEN

STAFF MEMBERS PRESENT:

GLENDON KING, MAJORITY EXECUTIVE DIRECTOR
GRIFFIN CARUSO, RESEARCH ANALYST
ALEX SLOAD, RESEARCH ANALYST
PAM NEUGARD, ADMINISTRATIVE ASSISTANT

SARAH IVERSEN, MINORITY EXECUTIVE DIRECTOR
BILL JORDAN, RESEARCH ANALYST

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Pennsylvania House of Representatives
Commonwealth of Pennsylvania

I N D E X

TESTIFIERS

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SUBMITTED WRITTEN TESTIMONY

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(See submitted written testimony and handouts online.)

P R O C E E D I N G S

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MAJORITY CHAIRMAN METCALFE: The House Environmental Resource and Energy Committee is called to order. And before we take the role, if I could ask everybody to please rise. And, Representative Bud Cook, would you lead us in the Pledge, please?

REPRESENTATIVE COOK: [inaudible].

MAJORITY CHAIRMAN METCALFE: Thank you, Representative Bud Cook. Our member secretary is not present with us today to take the role, so I'll ask my administrative assistant, Pam, to take the role for the members that are here.

MS. NEUGARD: Chairman Metcalfe?

MAJORITY CHAIRMAN METCALFE: Here.

MS. NEUGARD: Representative Armanini?

REPRESENTATIVE ARMANINI: Here.

MS. NEUGARD: Representative Borowicz? Representative Cook?

REPRESENTATIVE COOK: Here.

MS. NEUGARD: Representative Hamm? Representative James, on --

MAJORITY CHAIRMAN METCALFE: He's on --

MS. NEUGARD: -- leave. Representative Kail? Representative Mackenzie? I believe he's virtual.

REPRESENTATIVE MACKENZIE: Here.

MS. NEUGARD: Okay. Representative O'Neal on leave. Representative Ortitay on leave. Representative Rapp? Representative Sankey I believe is virtual.

REPRESENTATIVE SANKEY: Virtual, here.

MS. NEUGARD: Representative Schemel?

REPRESENTATIVE SCHEMEL: Here.

MS. NEUGARD: Representative Stambaugh on leave. Representative Warner? Chairman Vitali?

MINORITY CHAIRMAN VITALI: Here.

MS. NEUGARD: Representative Fiedler?

MINORITY CHAIRMAN VITALI: Leave.

MS. NEUGARD: Representative Guzman?

MINORITY CHAIRMAN VITALI: He -- leave.

MS. NEUGARD: Representative Herrin? Virtual, I believe.

REPRESENTATIVE HERRIN: Yes, I'm here virtually. Thank you.

MS. NEUGARD: Okay. Representative Hohenstein?

REPRESENTATIVE HOHENSTEIN: Here.

MS. NEUGARD: Representative Isaacson?

REPRESENTATIVE ISAACSON: Here.

MS. NEUGARD: Representative Krajewski?

MINORITY CHAIRMAN VITALI: I think he's virtual.

REPRESENTATIVE KRAJEWSKI: Here.

1 MS. NEUGARD: Okay. Representative Krueger?
2 MINORITY CHAIRMAN VITALI: Leave.
3 MS. NEUGARD: Representative Otten?
4 REPRESENTATIVE OTTEN: I'm here virtually.
5 MS. NEUGARD: Okay. And Representative Snyder?
6 MINORITY CHAIRMAN VITALI: Leave.
7 MAJORITY CHAIRMAN METCALFE: Thank you, Pam. And
8 this morning's hearing is on rare Earth minerals. And we
9 had had a hearing on Representative Rapp's bill in December
10 related to solar and wind technology, and was talking with
11 some experts on the use of those rare minerals and the
12 solar wind technologies, also about the use of those rare
13 Earth minerals in our national defense systems, and the
14 fact that it seems like we're relying heavily on China for
15 many of their rare Earth minerals. So I think that's --
16 should be of importance to all Pennsylvanians on where
17 those rare Earth minerals are coming from, and we might be
18 able to supply them for ourselves in the future rather than
19 relying on another country that might not have friendly
20 intentions, as we've seen in the past. But, we do have
21 Ms. Gale Blackmer, Ph.D., Director, Bureau of Geological
22 Survey, Department of Conservation and Natural Resources
23 with us today. And, ma'am, before we hear your
24 presentation today, if I could ask you to please rise and
25 raise your right hand? Do you swear or affirm that the

1 testimony you are about to give is true to the best of your
2 knowledge, information and belief? If so, please indicate
3 by saying I do. Thank you, ma'am.
4 MS. BLACKMER: Uh-huh.
5 MAJORITY CHAIRMAN METCALFE: Thank you for being
6 with us today. We appreciate you taking time and sharing
7 your expertise with us today. You can begin when you are
8 ready, ma'am.
9 MS. BLACKMER: [inaudible].
10 MAJORITY CHAIRMAN METCALFE: Little green light
11 pops up when it does turn on. Maybe we should use the
12 other one. Glendon, can you get the other one for our
13 presenter -- testifier? Thank you. In the future,
14 Griffin, you should just cut the wires on the one that's
15 not working.
16 MS. BLACKMER: There we go.
17 MAJORITY CHAIRMAN METCALFE: No. Better yet,
18 don't do that. I think that will get you in trouble, and
19 me for telling you to do that. Glendon, could you move
20 that one that isn't working off to the -- like under the
21 table, around the -- in the chair or something, somewhere
22 where we won't be tempted to use it? Thank you. Thank
23 you, ma'am.
24 MS. BLACKMER: All right. Good morning,
25 Chairman Metcalfe, committee members, Chairman Vitali, and

1 thank you for having me here to speak today. I'm
2 Gale Blackmer. I'm the state geologist and Director of the
3 Bureau of Geological Survey in DCNR. I'm going to talk a
4 little bit about rare Earth minerals in general, some of
5 the opportunities and challenges here in Pennsylvania, and
6 a little bit about the research that the Bureau of
7 Geological Survey is engaged in. Next slide, please.
8 The rare Earth elements are a group of 17
9 metallic elements. They're similar, chemically, to each
10 other, but they have some physical structures and some
11 chemical differences that make each element useful in
12 different ways. You can see some of the uses here. I'm
13 sure you know a lot of these. Catalytic converters,
14 magnets, batteries, fuel cells, flat-panel displays,
15 steelmaking, glass. So -- next slide, please. Sorry about
16 the -- oh, okay. The footers were not supposed to be seen
17 on all the slides.
18 So, rare Earth elements are not technically rare
19 in terms of their concentration in the Earth's crust, but
20 they are widely dispersed, and they occur in low
21 concentrations in Earth material. So, concentrated,
22 economically mineable deposits are rare. Potential sources
23 in the United States are regions where geologic processes
24 have concentrated these minerals. We'll focus on the
25 sources that are marked in red that may be the most

1 economical sources available within Pennsylvania.
2 So, placer deposits are places where heavy
3 minerals are concentrated by gravity settling in water. So
4 that would be river and beach sediments or glacial
5 deposits. Heavy elements can also be concentrated by human
6 processes. A lot of this is waste products: coal, fly ash,
7 slag, nuclear waste, acid mine waste. And they are alco
8 concentrated in coal underclays. Underclays are layers
9 that are found underneath coal seams, and they may have
10 been the soil horizons in which the coal forming plants
11 were rooted.
12 So, it's unclear what geological process exactly
13 control the occurrence in the underclay, but it's probably
14 some kind of absorption to clay. Next slide, please. So
15 we'll look at each one of these now.
16 UNK: Griffin? Griffin, the slides are not
17 changing for the people virtually. They haven't changed
18 since the title page.
19 MS. BLACKMER: All right. So, looking at the
20 placer deposits, the rare Earth elements in stream bed
21 sediments in Pennsylvania, streams concentrate heavy
22 minerals. And those probably come -- can you go -- okay,
23 good. They probably come from igneous rocks in the source
24 regions. Each dot on this map represents a sample of
25 stream bed sediment that was taken in previous studies.

1 The USGS conducted some studies, and DOE
2 conducted some studies around 2014, looking at stream bed
3 sediments. So, each dot on the map represents a sample of
4 stream bed sediments. And you can see that the highest
5 concentrations are in Southeastern Pennsylvania, and that's
6 where there are actually metamorphosed igneous rocks at the
7 surface. It's the only part in the state where that
8 happens.
9 So, there are some stream beds in Southeast
10 Pennsylvania that contain elevated rare Earth element
11 concentrations, but the yield from these streams is very
12 low. Next slide, please.
13 If we look at the coal underclays, the area in
14 blue on the map represent areas where there are underclays.
15 Again, DOE did some research into this in Pennsylvania and
16 neighboring states, and they found some pretty high
17 concentrations or rare Earth elements, especially in the
18 lower Kittanning coal and its underclays in Clearfield
19 County. And those contain up to 650 parts per million of
20 rare Earth elements, so that's a pretty good concentration.
21 Now, not all underclays have those concentrations
22 of rare Earth elements. There are others besides the lower
23 Kittanning that have them. It's unclear how those deposits
24 form. Like I said before --
25 UNK: Gentlemen --

1 MS. BLACKMER: So --
2 UNL: -- we are -- and ladies, we are not hearing
3 anything at this point. If we're hearing -- if we're
4 virtual.
5 MAJORITY CHAIRMAN METCALFE: Thank you for
6 letting us know. We're going to need to continue on
7 because of our time constraints. And we do have our man
8 here working on trying to provide that information. Can
9 you hear me?
10 MS. BLACKMER: Apparently not.
11 MAJORITY CHAIRMAN METCALFE: We are going to
12 continue on with the presentation. Thank you for letting
13 us know that you are not seeing or hearing. Hopefully
14 we'll have that resolved here shortly. Sorry for the
15 interruption.
16 MS. BLACKMER: So, basically we need to do some
17 more work to understand how those deposits form and their
18 distribution. Next slide, please?
19 All right, so what are some of the challenges to
20 mining rare earth elements in Pennsylvania? So, if we look
21 at the stream deposits, those samples that were collected
22 for study are from small streams, and they have a small
23 amount of material. So, even though the concentrations are
24 elevated, based on the current information we have, there
25 is probably not a sufficient source there to make it worth

1 going in to mine.
2 If we look at the underclays, those are probably
3 a good prospect. We don't really understand the enrichment
4 process that controls the rare Earth element content in
5 these rocks, so it's difficult to predict what the best
6 layers may be without further surveying. So, we need to do
7 some more work on this.
8 These are widespread deposits. They're kind of
9 thin in most places, and some have been completely
10 destroyed during coal mining operations. So we need to do
11 also some mapping to understand that distribution better of
12 those deposits.
13 Now igneous rocks, especially a very specialized
14 kind of igneous rock called carbonatite, is a really good
15 source of rare Earth elements, rare Earth minerals, but we
16 don't really have those here in Pennsylvania in ways that
17 are accessible. So, we know that there are igneous rocks
18 below all the sedimentary rocks, but they're a mile down,
19 10,000 feet. They're very deep, so exploring for the right
20 kind of rock would be prohibitively expensive, and also
21 extraction would be very expensive. So, igneous rocks are
22 probably not a viable source in Pennsylvania. There are
23 some metamorphosed igneous rocks and metamorphic rocks at
24 the surface in Southeastern Pennsylvania, but with all the
25 urban development, you know, you're not going to mine.

1 We're not going to put in big mines in Southeastern
2 Pennsylvania. It's just not practical. Next slide,
3 please.
4 So, I'd like to talk a little bit about some of
5 the research that the Bureau of Geological Survey is
6 engaged in. We are participating in the USGS Earth Mapping
7 Resources Initiative, which is called Earth MRI. This
8 program -- the goal of this program is to improve our
9 knowledge of the geologic framework of the United States,
10 and identify the areas that have the potential to contain
11 critical mineral resources, including rare Earth elements.
12 So, this project that we are engaged in is the
13 High-Alumina Underclay Team Project. The other members of
14 the team are the West Virginia Geologic and Economic
15 Survey, the Maryland Geological Survey and the Ohio
16 Geological Survey. And, what we're doing is essentially a
17 geochemical survey to look for the potential for rare Earth
18 elements, lithium and other critical minerals. We've taken
19 samples from places that were accessible in mines and in
20 surface exposures, and those -- the samples have all been
21 collected for this study. The analysis is in progress, and
22 we hope to have the results sometime in 2022.
23 So, this study will address the potential for
24 beneficial reuse of mine waste and waste streams. And
25 also, if good sources are found, it would provide help for

1 coal mining districts in economic crisis. Next slide,
2 please.
3 A second project that we have proposed under
4 Earth MRI is an aerial geophysical survey. This is a $4
5 million study. We just put in the proposal. We should
6 have a decision sometime in the spring. The idea is to
7 look at the areas that are outlined in red on the map, so
8 exploring some of the Pennsylvanian aged underclays, and
9 also the stream placers in Southeastern Pennsylvania.
10 These aerial surveys can indicate where rare Earth elements
11 and other metal ore bodies are located in the subsurface.
12 Next slide.
13 Q We're also participating with a DOE project.
14 So, they have a -- they call it the CORE-CM Initiative.
15 That's Carbon Ore, Rare Earth and Critical Minerals
16 Initiative. And we are part of the mid-Appalachian Carbon
17 Ore, Rare Earth and Critical Minerals Initiative, or
18 MAPP-CORE. So, the area that's covered is outlined in the
19 red circle, or the red oval on the map. The map shows all
20 of the other projects also that DOE is funding.
21 So the objective, as you can see, is to identify
22 key barriers and opportunities in connecting these
23 materials and resources to end-users and manufacturers.
24 The team is very large. They are listed on the slide, too.
25 Our survey's work is to do basin resource assessment, and

1 to locate spoil piles in ponded areas that might be
2 potential sources in Pennsylvania. Next slide, please.
3 Just a couple of slides to finish up with about
4 ongoing work at the geological survey that also will inform
5 rare Earth element studies. Geologic mapping is a core
6 business function of the Bureau of Geological Survey.
7 Where mapping detailed geology throughout the state, there
8 are a couple of examples on the slide. Some of this is
9 funded by Federal grant programs from the USGS. And
10 everything we do is available to a variety of customers.
11 It's available to everyone at no charge, all of our maps
12 and publications.
13 We're also mapping hydrography in Pennsylvania.
14 So, that streams and drainage, and we're doing
15 elevation-derived hydrography. We're using the new LIDAR
16 elevation data as the base. So you can see some examples
17 of that on the bottom of the slide. The -- our work, which
18 is shown in the magenta, is more accurate at a smaller
19 scale than the Federal researchers have done in the past.
20 So, all of that better mapping can better inform
21 our geochemical sampling for suitable rare Earth element
22 sources. Next slide. We also do in-house geochemistry.
23 So, we have a brand new scanning electron microscope that
24 we're very excited about replacing the old one. And so we
25 do geochemistry studies in support of geologic mapping,

1 mineral identification, coal work, oil and gas work;
2 studies that are performed by our staff and by over
3 government agencies and researchers across the state.
4 We have a number of specialized report series.
5 One of them, the mineral resources report, are focused on
6 economic mineral interests. So, we're well positioned to
7 do further geochemical studies that are needed. To look at
8 the variety -- the variability in rare Earth
9 concentrations, especially in underclays.
10 And I just want to say in closing that if
11 Pennsylvania is serious about looking at these resources,
12 there is some support that's needed for this work; Federal
13 support, state support, university and industry support.
14 And, you can see some of the states that have provided
15 their own funding for these projects listed in the slide.
16 We're already getting Federal dollars to help with our
17 reconnaissance mapping. So, that's all I have. Thank you.
18 Be happy to take questions.
19 MAJORITY CHAIRMAN METCALFE: Thank you. Members
20 with questions? Representative Hohenstein.
21 REPRESENTATIVE HOHENSTEIN: Yeah. Thank you.
22 And, thank you for the thorough presentation. I -- this is
23 really more of a comment, because I don't think it's going
24 to be something within your area. But, I was struck by the
25 fact that 75% of these minerals are used in automobile

1 catalytic converters. And, we have a problem in
2 Philadelphia with illegal mining of those by the cutting
3 off of those converters. I guess my question, if there is
4 one, to you --
5 MS. BLACKMER: That's not just Philadelphia.
6 REPRESENTATIVE HOHENSTEIN: Yeah. But my
7 question to you is, what other efforts are being made to
8 reclaim and reuse what's already out there in the market in
9 an appropriate way? Because like I said, we see it in
10 Philadelphia in a way that really is destructive. But
11 I -- is there --
12 MS. BLACKMER: Yeah.
13 REPRESENTATIVE HOHENSTEIN: What do you know
14 about that?
15 MS. BLACKMER: So, I don't know a lot about the
16 recycling efforts, which is really, I think, what you're
17 asking about. But, DOE has a number of programs doing
18 research into rare Earth elements in -- a variety of
19 aspects of rare Earth elements, and I believe that
20 recycling and reuse is part of that. I don't pay as much
21 attention to that, because we're not going to get in on
22 that end of it. There was more money for rare Earth
23 elements, as I'm sure you know, in the bipartisan
24 infrastructure bill, so there are probably some new
25 programs that will start up that way.

1 MAJORITY CHAIRMAN METCALFE: Thank you very much.
2 Have a good day.
3 MS. BLACKMER: Thank you.
4 MAJORITY CHAIRMAN METCALFE: Our next presenter
5 is the Chief Executive Officer of Synergos Holdings,
6 Zeke Moskowitz.
7 MR. MOSKOWITZ: Good morning, Chairman, and thank
8 you for giving me this honor to be here today.
9 MAJORITY CHAIRMAN METCALFE: And we have to -- we
10 have to swear you in, if you don't mind, there. If you
11 could raise your right hand. Do you swear or affirm that
12 the testimony you are about to give is true to the best of
13 your knowledge, information and belief? If so, please
14 indicate by saying, I do.
15 MR. MOSKOWITZ: I affirm.
16 MAJORITY CHAIRMAN METCALFE: Thank you, sir. You
17 can begin when you're ready, sir.
18 MR. MOSKOWITZ: So, just as a quick introduction,
19 if you could please put up Slide #1? So, my name is Rabbi
20 Yechezkel Moskowitz. I am the founder of Synergos
21 Holdings, a company based out of New York that is
22 developing and commercializing cutting edge American
23 projects. In this line of vision, Synergos is employing
24 the market ingenuity and expertise to build prosperity for
25 future generations. With our patriotic capitalism model,

1 Synergos is pursuing opportunities that bring better
2 economic outcomes for all Americans, but most importantly
3 those in the most depressed communities in our country.
4 Of our projects, Materia USA, a critical mineral
5 and rare Earth project development venture, is one of our
6 most important. This is because Materia is focused on the
7 revitalization of our nation's rare Earth and critical
8 mineral supply chains through a focus on secondary and
9 nonconventional recovery means, with a prime focus in the
10 Northern Appalachian Regions of the Commonwealth of
11 Pennsylvania.
12 Over the last two years or so, Materia has
13 collaborated with local stakeholders in the Northern
14 Appalachian Basin, including but not limited to Penn State
15 University, Larson Enterprise in Clearfield County, and
16 Carlson {phonetic] Engineering Group out of Pittsburgh.
17 Together, we have produced a conceptual plant and a design
18 with initial feasibility study and partnership with
19 Department of Energy's Office of Fossil Energy and the
20 National Energy Technology Lab for the recovery of a wide
21 variety of commodities, from coal underclays, including but
22 not limited to smelted-grade alumina, coal-based carbon
23 products, commercial-grade lithium, and an assortment of
24 other rare Earth and critical minerals.
25 So, these prospects can be reclaimed from the

1 coal underclays in Central West Pennsylvania, including but
2 not limited to lower Kittanning, the Mercer and the Clarion
3 seams in that region. Our most recent work included a
4 hydrometallurgical circuit to produce a rare Earth
5 concentrate for the market.
6 While perhaps viewed as a pipedream to some, our
7 proposed facility is in fact commercially viable and offers
8 an opportunity to kickstart industry without any new mining
9 projects across the Commonwealth, using abandoned mine
10 lands and waste dumps as a feedstock. The facility can run
11 for the foreseeable future, and from local estimates we
12 have been able to say approximately 20 or so years of
13 feedstock is readily available from abandoned mine lands.
14 We also had a -- it also has -- the facility also
15 has a high technology readiness level. This is because the
16 facility is integrating commercially available technologies
17 from mineral and solid material concentration and physical
18 separation methods. If you go to the -- I guess you guys
19 have already -- your slides.
20 But, it goes without saying that some of the most
21 depressed communities in the Northern and the Southeast
22 portions of the United States are old mining towns that
23 were once offered prosperity to the locals by the mining
24 operations, but have in present times become synonymous
25 with depression and opioid abuse. It is clear beyond a

1 shadow of a doubt that investing in technologies and
2 methods that will generate new jobs in the region, both in
3 the short term and the long term are critical for a
4 sustainable future.
5 As is well documented, Appalachian poverty is a
6 major problem, and has been a challenge that goes largely
7 unnoticed by the rest of the country. The Appalachian
8 Regional Commission, the ARC, reports on Appalachian
9 statistics such as poverty, income and employment.
10 According to their reports, poverty rates across the US are
11 currently at approximately 15.6%, in contrast to 19.7% in
12 the combined Appalachian Regions. There is no question
13 that this poverty can be attributed to a significant
14 decline in mining jobs across the nation, with coal being
15 replaced with cleaner alternatives. This transformation in
16 recent years has shown a clear and distinct production
17 decrease, and the relevant outcomes are known to the local
18 communities.
19 Per local estimates, there has been a steep
20 decline in local mineral production, case in point in
21 Clearfield County which has seen approximately double the
22 percentage of the decline of production compared to the
23 rest of the state. While there has been a robust increase
24 in gas production over the last decade, natural gas
25 utilization, as far as the pipelines, does not employ as

1 many people on a per BTU basis. With coal production in
2 accelerated decline, natural gas has perhaps filled the BTU
3 needs of the powerplants, but it has not created a
4 financial windfall due to the inability to offer
5 long-term-sustaining jobs. This is because most jobs are
6 confined to the drilling surfaces that are needed upfront
7 with little opportunities on the downstream. As such,
8 local mining communities like in Clearfield are in
9 immediate need of new mining jobs to replace those that are
10 being lost. Bituminous coal, mining jobs in Clearfield
11 County alone decreased from 683 in 2011 to 138 in 2019. In
12 the same timeframe, bituminous coal production decreased
13 from -- within the county from 4 million to approximately
14 877,000 metric tons. Clearfield County ranks 61st out of
15 the 67 PA counties of -- for a per capita income, lagging
16 in the state. A 2019 average occupational wage for all
17 employees in Clearfield was 41,000, compared to the
18 Commonwealth average of 57,500.
19 Meanwhile, the mineral wealth under the feet of
20 these communities can amount to the millions, if not
21 billions, and there is no reason why these communities
22 should not be empowered to tap into these amazing
23 prospects. With that said, there is obviously a lot of
24 work that still needs to be done. And without the
25 state -- the support of the state and the Federal

1 government, the risk is just too great for most investors.
2 The end of the day, it's just much easier to just go and
3 get your critical minerals from China where they are
4 readily available at a cheap rate. To mitigate such risks,
5 the Commonwealth should work together with project
6 developers, local communities, as well as neighboring
7 states to increase collaboration for a common goal, lifting
8 the region out of poverty, and paving the road to a better
9 and brighter future.
10 One thing is clear, God didn't distribute mineral
11 wealth according to state lines, and neither should
12 legislators. To that point, Materia in partnership with
13 Penn State is also investing in other reclamation and
14 restoration opportunities and currently in the research
15 phase, such as reclamation of rare Earth elements and
16 critical mineral contents from acid mine drainage, as well
17 ask fracking sludges and waste waters. Legislators should
18 work with project developers to find humanitarian and
19 holistic pathways to exploration and commercialization
20 without burdensome and nonsensical regulations.
21 One such example is our proposed mining through
22 reclamation concept, where core drilling and further
23 exploration as well as characterization can be done under
24 an exploration permit, and actual mining can be done under
25 a reclamation permit. Such a pathway with a common-sense

1 framework can alleviate the burden on those investing time
2 and money to bring back jobs to the region without forcing
3 them to take unnecessary risks such as cumbersome bonds.
4 With that in mind, Materia with the success of the projects
5 envisions a collaborative future where Materia and other
6 project developers collaborate with local communities to
7 bring about a reality where they empowered to be the center
8 of the next industrial revolution.
9 I would be remiss if I didn't say that many old
10 workings of the Lower Kittanning coal and Mercer clay
11 contribute a significant amount of acid mine drainage to
12 the watershed of the West Branch of the Susquehanna River.
13 Remining and reclaiming these lands present, in addition to
14 domestic critical mineral production, an opportunity to
15 eliminate -- significant source of pollution in the region,
16 and solving an unclaimed abandoned mine land issue that has
17 existed for decades. Such a 180-degree win is exciting for
18 our team and showcases the prospects for a clean and
19 sustainable future. However again, without collaboration
20 with the legislature, the road ahead is cumbersome and
21 remains uncertain.
22 The vision is -- which is not exclusive to
23 Materia, is one that will create new opportunities for
24 prosperity that could not be realized before. With new
25 jobs being offered, these new realities for depressed

1 communities should be unequivocally classified as clean
2 energy jobs. Moreover, and as was indicated in a
3 greenhouse gas and life cycle analysis study that was
4 conducted by Materia with Penn State and Columbia
5 University over the last year, secondary recovery methods
6 for supply chain buildup are at the minimum environmentally
7 benign and very possible, with the correct reclamation
8 partner and plan, in fact negative-emission projects.
9 With such ideas, it is truly amazing what
10 possibilities are -- lie ahead of us that are truly
11 transformative for the communities and for the industry,
12 and that can offer the Commonwealth a second chance, very
13 true out-of-the-box way of leading the next generation of
14 industrial greatness. What we need however is the
15 legislatures to seize this opportunity, and let the tide
16 rise with all of the ships in the process. Thank you for
17 taking the time to hear my testimony today.
18 MAJORITY CHAIRMAN METCALFE: Thank you, sir. Our
19 Representative Bud Cook would like to ask you a question.
20 REPRESENTATIVE COOK: Thank you very much for
21 your presentation and your information. Of course,
22 Southwestern Pennsylvania -- coal mining, you know, has
23 been historically, in the past, huge and continues to
24 contribute to our economy. The question is, is how has the
25 existing coal mine community been receptive to these rare

1 Earth prospects of going after? If you could give us an
2 idea.
3 MR. MOSKOWITZ: Well, with Penn State University,
4 we partnered with Larson Enterprises, which is a local
5 family; I believe a third or fourth-generation mining
6 family in the region. They are one of the largest
7 landowners in Clearfield of surface mining prospects and
8 mineral rights, and they have been very receptive and very
9 excited, and we have been working directly with them on
10 creating the mine plan.
11 Now, if you saw in the slide, the first and the
12 last picture of the slide are actually abandoned --
13 or -- sorry -- are surface mines that have been reclaimed.
14 They have developed the methodology where they
15 basically -- after the mining is done, the overburden is
16 put back, and they replant the region, and -- either for
17 pasture, or for solar panels, or with forests. And that's
18 why our LC -- our life cycle analysis and greenhouse gas
19 emission report came back that the projects are
20 environmentally benign, if not negative, because of those
21 prospects.
22 The -- every -- this is the bottom line. When
23 you work with locals, they care about their environment.
24 They care about their future. They're going to do whatever
25 they can to prevent future acid mine drainage, and to

1 prevent problems to the local fishery and lakes, et cetera,
2 because these -- this is their home. They want to protect
3 their home. So, we see a future where Materia USA and
4 perhaps TMRC and other stakeholders can partner with local
5 mining communities and actually develop these kind of plans
6 where we can do this reclamation work.
7 Just in Clearfield County alone, based on our
8 prospects, we're looking at a -- 20 to 25-year, very
9 easily, of minerals that are available in the -- somewhere
10 -- could be between 3,000 metric tons to 10,000 metric ton
11 feed per day. So we're talking about a tremendous amount
12 of mineral wealth. The entire mineral wealth -- the entire
13 mineral demand of the United States, if I remember
14 correctly, as far as rare Earth mineral concentrate is
15 presently at 15 million.
16 So, when it comes to a lot of the research that
17 is being done that focuses on, so to speak, acid mine
18 drainage and stuff like that, that's not really where it's
19 at. As your geologic survey said, the underclays are
20 really where there is to be a lot of -- place to be
21 focused. And I'm hopeful that we can do additional
22 characterization and hopefully partner with Penn State in
23 the future, and with the Commonwealth of Pennsylvania's
24 geologic survey to really get the good characterization of
25 these opportunities, so we could use our conceptual design

1 for our facility that we've did the feasibility study
2 together with the DOE, and partner with the state and with
3 the local communities to build several such facilities, so
4 we could start remining these abandoned mine lands and
5 extract the mineral wealth. But, so far the reception has
6 been very positive.
7 REPRESENTATIVE COOK: Very good. Thank you very
8 much.
9 MAJORITY CHAIRMAN METCALFE: Any other members?
10 Representative Armanini?
11 REPRESENTATIVE ARMANINI: Thank you, Chairman.
12 Yes, thank you for the presentation. With -- being a
13 representative from the Clearfield County, I applaud you
14 for the efforts in working with the locals, as you stated.
15 For sure, when you bring it to the local level, we do have
16 our hearts into it.
17 And my question is, with the abundance of these
18 minerals that lay beneath us -- just looking for a global
19 perspective. As we know, most of these elements are coming
20 in from China and countries that really do not care about
21 our environment. What would you say, if we were able to
22 actually get into production, what it will do to our
23 worldwide economics for our country, but also for the
24 environment? We -- you know, we're hearing of this global
25 CO2 and so forth. Could we, by producing in Pennsylvania,

1 help the world?
2 MR. MOSKOWITZ: Well, that is a great question.
3 And [inaudible] to answer your question, indeed, yes. So
4 first of all, just based on our life cycle analysis and our
5 greenhouse gas emission, our projects would be
6 environmentally benign, if not net-negative. So that means
7 that yes, mining in Pennsylvania will actually save the
8 planet, because that the Chinese are renown, and so are the
9 -- and also, so is the case for cobalt extraction in the
10 Congo and the lithium brine pools in South America. All of
11 these mining opportunities are done with egregious
12 environmental terrorism and at the same time human right
13 violations. At the same time, mining in Pennsylvania and
14 here in the United States would be done in a responsible
15 and -- ethically responsible and environmentally
16 responsible manner that would truly create -- give the
17 Commonwealth of Pennsylvania an edge in this
18 nonconventional and secondary recovery methods.
19 I also believe that as far as the economic
20 impact, each one of these facilities -- besides for the
21 mining jobs, just the actual facility alone, would create
22 at least 50 high-paying jobs, as well as a downstream
23 economy. And there was a study from the -- from -- I
24 believe it was the IEA that usually it's 80% downstream job
25 creation for the community. So in other words, in -- each

one of these facilities as they are currently designed can process 3,000 metric tons, I believe, a day.

So, what we -- how we envision it is a much more -- a localized type of structure where you would take these facilities, and you would spread them out across the Commonwealth, and hopefully the Commonwealth in partnership with West Virginia and others in the region, and then you basically would start doing this abandoned mine land reclamation. And that way you could give local communities the opportunity to reclaim their lands, to clean up the acid mine drainage, which would help the wildlife in their local areas, as well as start producing rare Earth and critical mineral opportunities.

MAJORITY CHAIRMAN METCALFE: Any other members? Thank you, sir, for testifying before our committee today. Appreciate you --

MR. MOSKOWITZ: Thank you very much.

MAJORITY CHAIRMAN METCALFE: -- sharing your expertise today. Thank you. Our next testifier is Mr. Anthony Marchese, Chairman, Texas Mineral Resources Corporation. Thank you, sir, for being with us.

MR. MARCHESE: Thank you. I'm sharing my screen. Do you see that?

MAJORITY CHAIRMAN METCALFE: Yes, sir.

MR. MARCHESE: Great. Wonderful. You want --

1 MAJORITY CHAIRMAN METCALFE: And we -- we'll need
2 to --
3 MR. MARCHESE: -- to swear me in?
4 MAJORITY CHAIRMAN METCALFE: -- swear you in.
5 MR. MARCHESE: Okay.
6 MAJORITY CHAIRMAN METCALFE: If you could raise
7 your right hand. Do you swear or affirm that the testimony
8 you are about to give is true to the best of your
9 knowledge, information and belief? If so, please indicate
10 by saying, I do.
11 MR. MARCHESE: I do.
12 MAJORITY CHAIRMAN METCALFE: Thank you, sir.
13 MR. MARCHESE: May I address one of the questions
14 earlier I believe that they had for Gale in terms of -- I
15 don't think it was ever answered -- in terms of the
16 reclamation of rare Earth minerals?
17 MAJORITY CHAIRMAN METCALFE: If you would save
18 that until the Q-and-A portion of your time --
19 MR. MARCHESE: Okay.
20 MAJORITY CHAIRMAN METCALFE: -- that would be
21 great.
22 MR. MARCHESE: No problem.
23 MAJORITY CHAIRMAN METCALFE: And -- but if -- you
24 could certainly address that once you are done with your
25 presentation, if you wouldn't mind.

1 MR. MARCHESE: Great. No problem. Thank you
2 very much for allowing me to appear. My name is
3 Anthony Marchese. I'm the Chairman of Texas Mineral
4 Resources, a publicly traded company whose principal focus
5 has been, along with our joint venture partner, USA Rare
6 Earth, the development of the round top, heavy rare Earth
7 and critical mineral project about 60 miles southeast of El
8 Paso, Texas.
9 Texas Mineral Resources has successfully
10 partnered with Penn State University on three projects
11 funded by the DOE related to the extraction of rare Earth
12 and critical minerals from coal overburden. And, don't
13 want to take Sarma Pisupati's under. In the future he'll,
14 I'm sure, describe it. We look forward to working not only
15 with Penn State, but with others in the state with projects
16 to further these goals.
17 I'd like to take the opportunity today to give
18 everyone an overview of the rare Earth and critical mineral
19 industry through a slide presentation of our round top
20 project in Texas. It's not to meant to be a marketing
21 tool, but simply, because of what we are doing, I think
22 would give everybody a good view of the industry as it
23 stands today; very specific.
24 So, obviously you have the slide -- next slide.
25 Gale went through a very good explanation of what the rare

1 Earth elements are. This slide -- I'm just going to give
2 takeaways from each slide. These slides are available to
3 you. There's plenty more where that came from if you want
4 even more information. My contact information is on the
5 front page of this presentation.
6 But, on the left you will see heavy rare Earth
7 elements, light rare Earth elements, magnet rare Earth
8 elements. As you can see, there is an intersection. Some
9 heavy rare Earth elements and light rare elements go into
10 the manufacture of magnets. And actually, those are the
11 principal uses of rare Earth elements today, in magnets
12 that go into anything that generates power.
13 If you look on the right-hand side, the
14 applications of these rare Earth elements, you can see,
15 sort of, the compound annual growth rate that they
16 anticipate over the next five years. And people always
17 think of these as, you know, electric vehicle specific, but
18 you can see things like fuel cells are just as significant
19 as electric vehicles. Drones for our military on the
20 bottom, jet airplanes. There isn't a product that, today,
21 doesn't generate power that doesn't have any rare Earth
22 elements in it. It just doesn't exist. The defense
23 industry uses rare Earth elements in virtually everything
24 it produces; every weapon system, every airplane. So, they
25 are ubiquitous, we just don't -- or the average person,

1 rather, just doesn't realize that.

2 Supply chain security: takeaway from this slide

3 is -- and people might not be aware. China produces only

4 about 62% of the world's rare Earths. The rest of it comes

5 from, you know, neighboring countries. North Korea is a

6 major producer, except we don't acknowledge it. They send

7 it to China for processing. But you have Australia that

8 produces rare Earth elements. One company in the United

9 States, MP Materials, produces it, but they send it to

10 China to process.

11 On the right side you can see, China on the other

12 hand is responsible for about 85% of the world's

13 processing, and that is a major problem, given the fact

14 that even if you mine it today, you still have to send it

15 there to process. And of course from there it has to leave

16 China, and that's where they potential bottlenecks can

17 occur.

18 If you go to the bottom of that slide, you will

19 see that the USA sources about 80% of its material from

20 China. On the other hand, the EU, to the right of the

21 bottom part of the slide, is almost 98%. So, they have a

22 significantly more dire need for rare Earth independence

23 than we do.

24 This next slide will -- really expands on

25 the -- several slides ago. You can look at, for example,

1 you know, on the left-hand side, all the material that goes
2 into various devices; biomedical devices. Again, people
3 are not aware just how ubiquitous these materials are. And
4 they are used for a reason, because they -- you use them in
5 small quantities, extremely small quantities, but they have
6 an outsize benefit for even the cost and quantity. You can
7 double, triple the cost of the rare Earth elements, and it
8 would still add very little incremental expense to
9 products, given the benefits.
10 The other thing most people aren't aware of, that
11 most rare Earth mines, including those potentially in
12 Pennsylvania from -- for example in our projects in which
13 we are looking at coal overburdens, there are additional
14 material that come out of those projects. So, in our case,
15 you can see on the right-hand side, we have things like
16 industrial sulfates that go into the various products that
17 you see below. So, point being that we always think about
18 rare Earth elements as the most important product of these
19 mines, but keep in mind that there are always benefits to
20 mining these materials, because you have other products
21 that can be used in many other applications.
22 This one really -- this slide really focuses on
23 the two areas that people constantly think about when they
24 think about, you know, rare Earth elements, critical
25 materials, electric vehicle production and renewable

energy. There is no question, without these rare Earth minerals and critical minerals like lithium that you are not going to get the electric vehicle revolution that we all anticipate. So for example, California has a very ambitious electric vehicle mandate, and we are not going to get there without figuring out how we can securely source a lot of these materials.

So that slide on the left -- bottom left shows you sort of the growth of EV sales. On the right, things like solar, wind, those also require a lot of the rare Earths, and even things like silver. Silver is a major -- even though it's not considered a critical material, silver is a very essential part of a solar panel. And as a result, we need all these materials to adopt any type of green energy adoption.

Next slide just, once again, illustrates the scarcity. Not just the scarcity of the material, the scarcity of the material in this country. Very -- just -- I'll point out, very -- there are, outside of China, very few real producers. You have the Australians and Lynas Corp which is a major producer in that part of the world. Most of their output goes to Japan which help them finance their mine. So that material for the most part is not coming to the EU or the United States, unless somehow it gets out of Japan. But for the most part it's

1 for the Japanese.

2 In our case, we'll be one of only two currently

3 planned mines in this country. And as I said, the current

4 mine pulls material out of the ground and sends it to

5 China. They are hoping to process it at some point in the

6 United States. Our company would also be creating a magnet

7 plant. Again, most magnet plants, outside of the country,

8 primarily in Southeast Asia: China, Vietnam, Myanmar,

9 places like that, and Korea. Move on to the next slide.

10 Oh, I'm sorry. I'm going the wrong way.

11 This is something that most people talk about and

12 never really understand. There is really very little

13 substitution. You may read in the paper, gee, we've

14 developed this, you know, rare Earth free motor. Let's

15 differentiate between developing something and actually

16 using it. There are -- and as one of the members earlier

17 mentioned, catalytic converters. I think 20, 30 years ago

18 they were talking about replacing platinum in catalytic

19 converters because it was so expensive and so on. Guess

20 what we're still using today: platinum.

21 So, the point being that these are materials that

22 at some point will have some alternate sources, or rather,

23 you know, alternate uses. But at the end of the day it's,

24 do they work as efficiently? And, before I answer the

25 question about reclaiming, even if you reclaim these

1 materials, reclaimed material is not as effective as new
2 material. The point being that we should not count on
3 industrial substitution to pull us out of this need for
4 local domestic mining of rare Earth material. First of
5 all, companies have expended billions of dollars in
6 industrial processes to change raw material mix. To change
7 the way you produce something takes significantly longer
8 and significantly more expense than we might otherwise
9 think. And this slide just really goes to the heart of the
10 matter.
11 The US Government is trying, as I am sure the
12 State of Pennsylvania will try, to provide significant
13 support. The DOE, the DOD, but we should not expect
14 another Solyndra, which unfortunately ruined it for our
15 rare Earth and critical mineral projects today. We see
16 nothing -- and we are in close contact with the US
17 Government. We see no effort to actually finance a mine.
18 They've tried. I think the DOE has tried to provide loan
19 guarantees, but again, in a way that has not provided any
20 kind of support for the industry.
21 So, most of the support has come with, you know,
22 smaller projects, which in my opinion do very little. You
23 know, when you're providing 150 to $250,000 for research,
24 all that does is guarantee, in my opinion, a waste of time,
25 you know, and effort. I think if you're going to go,

1 you've got to go big, and actually try and provide some
2 type of assistance that gets you to a finished product, not
3 just research that gets you, typically, even more research.
4 And finally, you can see the demand for magnets.
5 As I said, magnets are the typical landing point for most
6 of these materials. You can see, there's a tremendous
7 amount of demand for magnets, moving forward, lithium
8 especially as it relates primarily to the electric vehicle
9 industry. And, both lithium and magnets are the primary
10 drivers of a good part of what we see today in trying to
11 free ourselves from, you know, Chinese dependence on these
12 materials.
13 That is the end of my presentation. Again, I
14 appreciate the opportunity to speak to you. And again, I
15 encourage you to reach out to me. Always available, and
16 always happy to help. We have a commitment to
17 Pennsylvania, and we will continue with that commitment.
18 Any questions?
19 MAJORITY CHAIRMAN METCALFE: Thank you, sir. Did
20 you want to want to answer the question that was from a
21 previous testifier that you were going to answer during the
22 Q and A?
23 MR. MARCHESE: Yes, that would be great. It's
24 extremely expensive to reclaim rare Earth minerals,
25 typically because so little is used in a product, and

1 getting to it is a -- an intense -- requires an intense
2 amount of labor. So, it's not as though you have an
3 airplane where you say, gee, I'm going to reclaim the
4 aluminum. I can get the aluminum. It's easy to reach.
5 When you look in your iPhone, it's not as though when you
6 open that iPhone you see the rare Earth elements right
7 there. I'm going to extract -- no. These rare Earth
8 elements go into smaller components which are composed many
9 times of hundreds of other material. So, getting to them
10 is extremely expensive.
11 And in the case of, for example, lithium from
12 electric vehicle batteries, these batteries have been
13 designed to last for ten years or more, and we've just
14 began to scratch the surface of the electric vehicle
15 industry. So realistically, those are easy to get at, the
16 lithium from these batteries, but again, you're looking at
17 life cycles that in all likelihood -- they may say they're
18 ten years. They probably will last longer than that. So
19 again, getting to those batteries or the lithium
20 content -- that's only one aspect. Lithium is only one of
21 the critical materials that we have. The rest of them are
22 extremely expensive.
23 To the best of our -- and by the way, the Chinese
24 have been at this for 30 years, and there is little to no
25 reclamation of rare Earth materials in China, so that tells

1 you something about the ability to successfully or
2 profitably extract these materials after the fact. And as
3 I said earlier, even if you get to them, the -- if you want
4 to call it -- the strength of the material is diminished.
5 So, you have to upgrade the material once you get to it
6 which adds expense.
7 But at the end of the day, it's just not
8 something that right now anybody has been able to
9 successfully address. Apple Computer suggests that in some
10 of their newer iPhones they use recycled material. What
11 Apple fails to tell you is they never explain how expensive
12 it is to get to it. They have robots doing these things,
13 and I suspect it's as much of a marketing effort as
14 anything else rather than an expense effort. So anyway,
15 sorry to belabor it, but there's a reason why we have no
16 reclamation.
17 MAJORITY CHAIRMAN METCALFE: I appreciate that,
18 and appreciate your expounding on that question that was
19 asked earlier. So, I think the citizens at large across
20 the United States were shocked last year to find out that
21 we were so dependent upon China for ingredients in our
22 pharmaceutical drugs that we then became dependent on
23 throughout this pandemic.
24 And I -- likewise, I think the average citizen
25 across the state would be shocked that China produces --

1 processes so much of what is used in our nation and in the
2 EU for the rare Earth minerals, especially when it comes to
3 our national defense systems. And, as you pointed out
4 through the various products and services that we depend on
5 throughout the day, that we're -- that are using these rare
6 Earth minerals.
7 And, you had mentioned that you really didn't see
8 a commitment from the Federal Government as far as funding
9 to try and achieve the objective of helping the United
10 States to become more independent related to rare Earth
11 minerals, is what I got out of your -- what you mentioned.
12 If I am misstating that, please correct me. But, do you --
13 MR. MARCHESE: No, what I'm saying is I don't see
14 the -- I don't see a desire to fund in a big way. I --
15 what I am seeing is drips and drabs; you know, 100,000
16 here, 200,000 there, 1 million here. This is a drop in the
17 bucket compared to what it takes to, for example, open a
18 mine. Our cap ex, capital expenditures for the mine that
19 we have in Texas, is approximately 300 million. And that,
20 by the way, would rank as one of the lowest cost projects
21 in the world. So, it's -- it takes a fair amount of money,
22 and I guess my concern is that continuing to throw 100,000,
23 200,000 at something -- all that's done -- and I think I
24 have other speakers after me that can attest to this. All
25 that leads to is more research.

1 MAJORITY CHAIRMAN METCALFE: Right.

2 MR. MARCHESE: And at some point we have to just
3 say, look, enough with the research. We need to actually
4 have the potential, you know, if you had a good project, to
5 actually help fund it.

6 MAJORITY CHAIRMAN METCALFE: So, let me kind of
7 wrap up my question, and then we're going to go to
8 Representative Schemel for a question. The profitability
9 of mining rare Earth minerals -- actually, China is
10 probably making a bundle off of the rest of the world for
11 the processing of those. But, being as though they have
12 been known to use slave labor, and the way that they
13 undercut so many of our industries, I assume that's why we
14 don't see the profitability within our own market that
15 would enable a venture capitalist, say, to take on a
16 significant project that would help to start to cut into
17 their market share.

18 MR. MARCHESE: Well, okay. I'm going to disagree
19 with you somewhat. The Chinese actually are profitable
20 because they are able to sell their product at a good
21 price. And actually, the Chinese labor costs have gone up
22 significantly, as has their environmental costs, which is
23 one of the reasons why prices have risen, actually doubled
24 in the last several years.

25 So, the -- China is actually paying what is

1 standard for local rates. Now, obviously that may differ
2 from what we have in Pennsylvania or Texas, but China
3 is -- in -- from as much as we can tell, not using slave
4 labor. They're actually paying market prices for their
5 labor.
6 I can only speak to our project. Our
7 assumptions -- and we project profitability. Our
8 assumptions are that we use, you know, local wages. And by
9 the way, mining in this country pays significantly above
10 average for any type of labor. Miners make a very good
11 wage, and that's one of the attractions of mining. And,
12 you know, it -- I believe as time goes on, more people
13 will, you know, re-find, if there is such a word, mining as
14 a profession.
15 MAJORITY CHAIRMAN METCALFE: So where is that
16 reported, the labor cost from the Chinese? It's the
17 Chinese Communist Party that's reporting to the US that
18 they're paying their laborers that much?
19 MR. MARCHESE: No, it's just anecdotal evidence
20 we have from -- you know, from China. There's nothing
21 that, you know, I can look to that is -- you know, the
22 Chinese Government isn't about to give you their labor
23 rates. But, we know for a fact that the Chinese middle
24 class has been rising dramatically. Wages have been rising
25 dramatically. We know that as of -- for a fact that

1 environmental costs have led to -- I mean, that they
2 publish -- that have led to rise in prices, simply because
3 the cost of their material is going up.
4 MAJORITY CHAIRMAN METCALFE: So still, even
5 though --
6 MR. MARCHESE: [inaudible].
7 MAJORITY CHAIRMAN METCALFE: -- even though --
8 MR. MARCHESE: So, we can infer from that, that
9 labor rates have gone up.
10 MAJORITY CHAIRMAN METCALFE: Even though they're
11 paying more, supposedly, according to their own analysis,
12 or their own information that they would give out of China,
13 we still have a disparity between what we pay in the United
14 States and what --
15 MR. MARCHESE: Absolutely.
16 MAJORITY CHAIRMAN METCALFE: -- they pay, which
17 causes us not to be able to find the profitability to
18 actually see somebody pursue these projects that we need to
19 actually produce the rare Earth minerals like we need to
20 have them produced to have independence from China?
21 MR. MARCHESE: The answer is yes, but I would
22 argue -- I would differ in one respect from what you said.
23 I believe that any project that is slated to come onto
24 production in the United States cannot move forward without
25 showing profitability. So, whether it's funded by the US

1 Government or by venture capital or by private capital,
2 unless you are able to show profitability, the project is
3 not moving forward.
4 MAJORITY CHAIRMAN METCALFE: Yeah, I didn't -- I
5 don't think we disagree on that. Representative Schemel?
6 MR. MARCHESE: Yeah.
7 REPRESENTATIVE SCHEMEL: Thank you. And, you
8 sort of hinted at this in your last response, but, you
9 know, what would it take for the United States and,
10 consequently, Pennsylvania to become competitive in this
11 space? And how much -- from what we know geologically, how
12 much rare Earth material do we have? Can we really be a
13 competitor, or are we just able to, you know, sort of
14 produce a little bit on the margins?
15 MR. MARCHESE: Okay. First of all, anything that
16 we produce within the United States with respect to rare
17 Earth or critical material will be purchased. We have
18 domestic content -- most people forget, we have domestic
19 content laws in the United States that if, for example, we
20 go into production and produce dysprosium which is a magnet
21 material, the United States Department of Defense, or any
22 US Government agency that purchases products that have
23 dysprosium in it would be required to source domestically.
24 And as far as I can tell, any project or projects that are
25 slated to come on board in the United States would be able

1 to sell 100% of what they sell, just domestically. And
2 understand, I once worked at General Motors. If you're
3 General Motors, you're looking for a second and third
4 source of material. If you think that somehow the, you
5 know, Fortune 500 or 100 are happy that they're sourcing
6 from China, they are not. If there were, you know, a
7 second and third source, especially if it's domestic, even
8 if they have to pay more, which they probably would,
9 somewhat, they would use that -- and remember what I said.
10 This is -- these are products which are priced in the
11 last -- you can literally double the price. It would add
12 very little to the incremental cost of your ultimate
13 product.
14 Now, to your question specifically about
15 Pennsylvania, to the best of my knowledge Pennsylvania does
16 not have, you know, mountains of rare Earth mineral, for
17 example, as we do in Texas or even California. But, the
18 potential for Pennsylvania is to extract rare Earth
19 elements and critical materials from things, you know, like
20 Zeke said earlier, from underclays, from acid mine drainage
21 and so on. What I think people need to understand is that
22 sourcing these materials, or the projects that would result
23 from sourcing these materials for an investor is venture
24 capital. In my opinion, the minute that the first project
25 is able to show profitability, you'll have plenty of

1 private capital flowing into the sector. But again, you
2 need to, in my opinion, kickstart these projects. And in
3 order to kickstart the project, somebody has to put up, in
4 essence, the venture capital money in order to make that
5 happen. And I think that's where, potentially, the state
6 may be able to help. You know, I think a little bit of
7 capital with a successful project would lead to the state
8 basically moving away from having to put any capital in,
9 and having private capital replace the state capital. And
10 how much? It really depends on the project. I can't tell
11 you what, you know, each project costs, but I do think that
12 Pennsylvania has the potential to kickstart some of these
13 projects. But it would take more money than just, you
14 know, one or 200,000 to do research.
15 MAJORITY CHAIRMAN METCALFE: Thank you, sir.
16 Appreciate the time that you gave us today and your sharing
17 your expertise with us. Thank you very much.
18 MR. MARCHESE: My pleasure.
19 MAJORITY CHAIRMAN METCALFE: Our next testifier
20 is Mr. James Taylor, President from the Heartland
21 Institute, and Linnea Lueken, Research Fellow, the
22 Heartland Institute. And you're both with us live. Thank
23 you for joining us today. And if I could keep you standing
24 until I swear you both in. Sorry, we only have one
25 microphone to share back and forth there. Do you swear or

1 affirm that the testimony you are about to give is true to
2 the best of your knowledge, information and belief? If so,
3 please indicate by saying I do. Thank you, both. You can
4 have a seat, and you can begin when you're ready.
5 MR. TAYLOR: Okay, thank you [inaudible]. Thank
6 you, Mr. Chairman and members of the committee. I am James
7 Taylor. I'm President of the Heartland Institute. The
8 Heartland Institute is a nonprofit, nonpartisan public
9 policy organization. Our job is to discover, develop and
10 promote free-market solutions to the problems that confront
11 society. We spend most of our space in the states at the
12 state level throughout the country, in all 50 states, and
13 we certainly welcome and appreciate the opportunity to
14 present some information on this topic today. I hope it
15 will be helpful. My colleague, Linnea, is a research
16 fellow at the Heartland Institute, and she is also one of
17 our scientists on staff. And, she will be able to add
18 scientific information as requested and necessary.
19 But first as an overview, it's a very good thing
20 that we're paying attention to the issue of rare Earth
21 production and where it's coming from. 57% of the rare
22 Earth production in the world comes from China. 15% is
23 here in the United States, and it comes from a single mine
24 in California. You know, we import 80% of the rare Earths
25 here in the United States that we use.

1 Now, why is China so dominant? Well, one of the
2 reasons is that China does not impose the environmental
3 standards that people in Western democracies justly require
4 for mining, and especially of rare Earth minerals mining.
5 Rare Earth mining is not like mining coal or silver or
6 copper. Rare Earth elements, as mentioned earlier by
7 Dr. Blackmer, they are spread out throughout the Earth's
8 crust. They don't really run in veins. You don't just tap
9 into one place and get them.
10 So, you have to excavate a tremendous amount of
11 soil, of minerals, et cetera, to pull out a little bit of
12 rare earth materials, and even then you have to separate
13 the rare Earth elements from the other materials that they
14 are embedded in. That usually requires a great deal of
15 separation by water, by acid, et cetera. As a result you
16 get a runoff of often toxic materials that create
17 tremendous environmental harms. This has been reported
18 throughout the media, throughout academic institutions, et
19 cetera, that rare Earth mining is one of the most
20 environmentally destructive practices that occurs on the
21 planet.
22 So in China, basically they are allowed to
23 produce rare Earth minerals without the environmental
24 standards that we would require, again justly so, here in
25 the United States, and that means they can produce rare

1 Earth minerals at a much lower cost. In addition, yes,
2 their wages that they pay their workers, when they do pay
3 their workers, is significantly lower than here in the
4 United States. So, we have a number of factors that enable
5 China to dominate rare Earth production.
6 Here in the United States, if we were to want to
7 ramp up rare Earth production, it would be very difficult
8 to do so through conventional mining. And this has been
9 pointed out by previous speakers, that if we were to
10 attempt a separate route, which is to extract rare Earth
11 minerals, whether it's from coal waste, whether it's coal
12 sludge, coal ash, whatever, or from other materials, it is
13 far, far, far more expensive than the mining that occurs in
14 China in that format. So basically what it means is that
15 as the market stands, China is and will continue to
16 dominate rare Earth production.
17 Now, as has been pointed out earlier by other
18 speakers, we have an economy that is growing
19 increasingly -- is -- it is gaining increasing demand for
20 rare Earth minerals. Much of that demand is in the defense
21 industry, but a far greater amount just through consumer
22 goods and, more recently, through renewable energy
23 equipment: wind power, solar power.
24 According to the International Energy Agency,
25 meeting what is projected to be wind and solar power goals

1 and incentives or requirements imposed by governments
2 around the world, we can expect anywhere from a three to
3 30-fold increase in demand for rare Earth elements in the
4 next couple decades. We're not talking 10%, 20%, 50%.
5 We're talking threefold to 30-fold increase, and it's being
6 driven largely by wind and solar power equipment. It's not
7 being driven by the defense industry or by any other
8 industry except for the wind and solar power industry.
9 Now, here in the United States there is no way
10 that we are going to have a company that is going to
11 compete with China with our current environmental laws,
12 with the wages we pay, et cetera. Indeed, the Federal
13 Government has been subsidizing research to try to get us
14 to a point where people can produce at an economic rate
15 rare Earth elements basically from, again, pulling them out
16 of -- whether it be coal waste or other formats.
17 But even with those subsidies, just as last year
18 the Federal Government announced $20 million in
19 subsidies -- even with those subsidies, even with that
20 research, the fact of the matter is it's always going to be
21 much more expensive to produce rare Earth elements by
22 recycling them than from mining them. So the question then
23 becomes, is it worth it? How much do we have to pay, and
24 is it worth it?
25 And, one thing that's also -- that needs to be

1 addressed is that even if -- I mean, technically,
2 scientifically we can do this, it's just going to cost a
3 lot more money. Now, if a company is subsidized
4 sufficiently that it can produce these elements, it's still
5 not going to be able to sell its product except to the
6 defense department. We already have a mine in California
7 that's mining rare Earth elements that's producing 15% of
8 global supply.
9 Anything that we are doing to try to increase
10 that demand, especially at the state level -- excuse me --
11 to increase that production especially at that state level
12 -- even if you get to a point where you subsidize the
13 company enough that it's going to produce rare Earth
14 elements, it's not going to have a market unless we require
15 such a market. Because companies, whether it's GE, whether
16 it's General Motors, whoever it may be, they are not going
17 to want to pay three, four, five, ten times the price for
18 rare Earth elements that they would otherwise.
19 It's been mentioned also -- Dr. Blackmer
20 mentioned earlier that it's not just the Federal Government
21 that is providing money for research, it's various states.
22 With all these state subsidies as well as Federal
23 subsidies, we still don't have any companies, any private
24 companies that can make money on this technology.
25 In the State of Pennsylvania, if -- certainly you

1 have the option to do so. Certainly there are benefits to
2 have more domestic rare Earth production. But if the goal
3 is -- or the expectation is that it's going to create jobs
4 or create economic growth, now you're competing with all of
5 these other states that are similarly already subsidizing
6 or giving money to this research. Eventually you will have
7 to outcompete those states if you are going to have that
8 production here.
9 Regarding -- there was a question mentioned
10 earlier that was very insightful. How is this going to
11 impact coal production or coal jobs, particularly in
12 Southwest Pennsylvania? And the thing is, is that if you
13 are going to be recycling rare Earth elements from coal
14 that has already been produced, you are not going to have
15 any more coal production or coal jobs. The coal has always
16 been produced.
17 In fact, the present Federal administration touts
18 these types of programs as justification for shutting down
19 conventional energy production and use, including coal
20 power. The messaging is that by extracting renewable Earth
21 elements -- or -- excuse me -- rare Earth elements from the
22 coal that's already been mined, they are creating renewable
23 energy jobs. See, we're creating these renewable energy
24 jobs. That's the reason why we need to, again, force more
25 renewable energy and less conventional energy. So it's not

1 going to do anything to help coal mining or coal
2 production.
3 So, putting all this in perspective and
4 summarizing, we do have a problem that's a very difficult
5 problem, and that is China is dominating the global
6 production and the global economy in rare Earth elements.
7 It certainly can be argued that it would be good for the
8 United States Government to the extent that governments
9 sometimes intervene with markets to do something on this
10 front to encourage and promote rare Earth production here
11 in the United States.
12 It's going to be difficult for Pennsylvania at
13 the state level to make much of a difference. It certainly
14 won't help Pennsylvania economically. It may help the
15 nation as a whole as far as our security goes, but that's a
16 problem that I think if it needs to be addressed probably
17 would be better addressed at the Federal level. But again,
18 certainly there is very good reason and rationale to be
19 looking into this, because we're not just Pennsylvanians.
20 We're not just Illinoisians or Floridians. We're
21 Americans. We just need to understand all that goes into
22 wanting to do something good, wanting to help out our
23 country, and how we can make sure that we take steps that
24 do more than make us feel good. And more than make us feel
25 good. I mean, we're being patriotic to try to enhance our

1 domestic production, but will actually make a difference
2 that matters. And those are the pros and cons and all the
3 elements for the state legislature to consider them as best
4 as I can present them, from my opinion. And, Linnea may
5 have a thought or two as well.
6 MS. LUEKEN: Sure.
7 MR. TAYLOR: Thank you.
8 MS. LUEKEN: Mentioning what was discussed
9 earlier about the reclamation and recycling of some of
10 these devices, one of the major hurdles that makes it so
11 expensive is that a lot of these companies, you take a
12 Samsung or an Apple phone, they're sourcing all of their
13 materials, all of their individual components from other
14 companies. Those companies are producing their chips,
15 their wiring, all of that from materials bought from other
16 companies and so on.
17 So if you go to Apple, and you ask them how much
18 of one material or another is in their phone, they might
19 not necessarily know how to answer that question. And when
20 it comes to recycling that afterwards -- sorry -- catch my
21 breath -- they -- the chemical processes that you need to
22 invent in order to separate these minerals out are going to
23 change depending on which materials are there. And if they
24 don't necessarily know which materials in what amount are
25 in there, it significantly increases the cost, because they

1 have to do all of this R&D trying to figure out what the
2 phone is made of in the first place. They basically have
3 to reverse engineer everything that they look at in order
4 to work through to figure out the chemical engineering
5 solutions to the recycling problem. But, that's what I
6 have to add.
7 MAJORITY CHAIRMAN METCALFE: Thank you, both.
8 Appreciate your presentation and testifying before us
9 today. Members? Representative Bud Cook.
10 REPRESENTATIVE COOK: Yeah, I just want to go
11 back to Southwestern Pennsylvania for a moment and discuss
12 what I think I heard in your testimony. The current
13 Federal administration wouldn't be so much looking at
14 enhancing coal-producing jobs, but replacing coal-producing
15 jobs and have them pursue rare Earth elements. Did I
16 understand that correctly?
17 MR. TAYLOR: Yes. Mr. Chairman and
18 Representative, thank you for that question and comment.
19 Yes, indeed, and that's really a problem here. We've had
20 essentially a 50% reduction in coal jobs here in
21 Pennsylvania, and we're told that by recycling some of this
22 material, if we ever throw enough money at this issue to
23 create a company or an enterprise whether that's
24 public/private partnership, whatever, that would then be
25 extracting the rare Earth elements from the coal residue

1 and creating renewable -- or -- excuse me -- and creating a
2 rare Earth element production from that, it's not going to
3 be coal miners. It's not going to be coal businesses, and
4 the number of jobs would pale in comparison to the number
5 of jobs that have already been destroyed.
6 And what bothers me the most is when I hear
7 messaging from the Federal Government that this shows that
8 renewable energy mandates, promotions, et cetera create
9 jobs. Well, you might create a few afterwards, after
10 you've killed many thousands. It's not going to help the
11 coal economy at all. It's being used as an excuse to
12 further shut down and punish production and coal
13 businesses.
14 REPRESENTATIVE COOK: Thank you. Very troubling,
15 indeed.
16 MAJORITY CHAIRMAN METCALFE: So as we -- from
17 your summary of your testimony and some of the testimony we
18 heard previously, which again, I don't think the average
19 citizen understands that we are so dependent on China for
20 the rare Earth minerals, just like they weren't -- we
21 weren't aware of our dependence on pharmaceutical
22 ingredients.
23 Likewise, I don't think that the majority
24 understand that these rare Earth minerals are needed for
25 the solar and wind technologies, and that our -- are a

1 requirement. The supply that we're going to need for what
2 some want to increase the use of that technology to is
3 going to increase, I think you said, three to 30 times fold
4 from where it's at. So, 300% to 3000% of where we're
5 currently at, which is going to drive up cost and drive up,
6 I think more importantly from a national security
7 perspective for all citizens that are Americans, that is
8 going to increase our dependence on China for our power
9 along with our pharmaceuticals. Would that be accurate?
10 MR. TAYLOR: Yes. Thank you, Mr. Chairman. And
11 by the way, that's a concern. It's a bipartisan concern.
12 The Trump Administration initially began looking into more
13 rare Earth production here in the United States, and the
14 Biden Administration has continued it. It's a concern that
15 is tough to get at, because -- again, because of the
16 environmental advantages for lack of a better word, for
17 lack of the environmental protections in China that cost a
18 lot of money here, for lower wages in China, et cetera.
19 It's a very difficult problem, and it's one that
20 we do need to take seriously. We don't want to be
21 dependent on China for the rare Earth elements that are
22 critical to our energy production and usage if we do have a
23 wind and solar based economy. For our military,
24 fortunately we do produce some rare Earths here in the
25 United States, but again our military depends on it. This

1 is something that is a very serious problem, and the
2 question is, how do we best go about it?
3 At the state level here in Pennsylvania, I would
4 argue that the best way to go about it would be to make
5 sure that we streamline our regulations, that we don't have
6 impediments for processing, for production if and when
7 there is production that can be economical. It's really
8 not going to be economical unless government subsidizes it,
9 and it's really going to require -- the amount of money,
10 government money, would have to be at the Federal level to
11 make a difference. You know, there's just not enough at
12 the state level.
13 But I think here in Pennsylvania, because there
14 is a good amount of the rare Earth elements in, you know,
15 coal that has been mined and the coal residue, there is an
16 opportunity for that. If the Federal Government wants to
17 say -- not as a jobs creator, not as an economy boon. They
18 sold Solyndra on that messaging and marketing, and if it's
19 being sold as some type of jobs creator or economy builder,
20 it's going to fail like Solyndra. But on the other hand,
21 for our national security interests, if we continue to push
22 our energy in this direction, where we're going to be
23 reliant on China to keep our lights on, then we may need to
24 do something. I think the best thing to do also would be
25 to take a closer look at programs at the state and Federal

level where we are encouraging or even mandating use of or generation of power from sources that require such rare Earth elements and are driving up our requirements for rare Earth elements. That's specifically wind and solar power.

REPRESENTATIVE COOK: Thank you.

MR. TAYLOR: Thank you.

MAJORITY CHAIRMAN METCALFE: Thank you, both, for making the trip here today, and for testifying before our committee. Any other members? Thank you, both.

MR. TAYLOR: Thank you.

MS. LUEKEN: Thank you.

MAJORITY CHAIRMAN METCALFE: Have a great day. Our next testifier is Sarma Pisupati, Ph.D., Professor of Energy and Mineral and Chemical Engineering, Penn State University, Director, Center for Critical Minerals. Thank you, sir, for joining us today.

MR. PISUPATI: Thank you.

MAJORITY CHAIRMAN METCALFE: Do you swear or affirm -- if you could raise your right hand, please. You were kind of heading that way. I --

MR. PISUPATI: Yes.

MAJORITY CHAIRMAN METCALFE: -- kind of jumped ahead of you. Do you swear or affirm that the testimony you are about to give is true to the best of your knowledge, information and belief? If so, please indicate

1 by saying, I do.
2 MR. PISUPATI: I do.
3 MAJORITY CHAIRMAN METCALFE: Thank you very much,
4 sir. You can begin when you are ready.
5 MR. PISUPATI: Thank you. I am ready.
6 Chairman Metcalfe and Chairman Vitali and members of the
7 Environmental Resources and Energy Committee, thank you
8 very much for giving me this opportunity to offer testimony
9 and answer your questions regarding the benefits and
10 challenges of extracting and utilizing critical minerals
11 found in Pennsylvania and the United States, and other
12 issues related to this topic.
13 I am a professor of energy and mineral
14 engineering and chemical engineering, and the Director of
15 the Center for Critical Minerals in the College of Earth
16 and Mineral Sciences at the Pennsylvania State University.
17 The goals of the Center for Critical Minerals are to
18 develop the science and technology required to establish
19 additional rare Earth and critical mineral production
20 capacity and reserve base in the Commonwealth of
21 Pennsylvania and the United States, reducing the reliance
22 on imports from other countries, provide support to
23 industrial partners to commercialize the science and
24 technology for sources of revenue and economic development
25 of the United States.

1 The third one is mitigate environmental concerns
2 from energy and mineral industry waste, and the production
3 of value-add critical minerals for national security. And
4 the last one and most important for us as a university is,
5 create, engage scholarship opportunities for our students,
6 train well trained workforce and broaden the employment
7 opportunities for graduates.
8 The United States and world have seen an
9 exponential growth in the use of critical minerals for a
10 variety of applications, ranging from sustainable energy
11 and national defense to modern electronic and medical
12 applications. These minerals are used for touchscreens and
13 long-lasting batteries in smartphones and computer
14 applications. All the materials that we see today and use
15 today need to be smaller, lighter and stronger, and this
16 requires critical minerals.
17 Sustainable wind energy development requires
18 stronger magnets made from neodymium, boron, iron and other
19 metals. Similarly, arsenic, gallium, germanium, indium,
20 titanium are essential for solar energy panels. Electric
21 vehicles are heavily dependent on battery materials such as
22 lithium, cobalt, nickel, iron, phosphorus and manganese.
23 On the defense front, each F-35 fighter aircraft
24 incorporates about half a ton of rare Earth elements. The
25 demand for these elements is expected to grow by a factor

1 of between three and 14 in the next ten years.
2 Unfortunately, the United States is 100% import reliant on
3 17 of the 35 critical elements identified by the United
4 States Department of Interior, and 14 have net import
5 reliance greater than 50% of consumption.
6 According to the International Energy Agency
7 data, most of the world's copper, nickel, cobalt, rare
8 Earth elements and lithium are produced abroad and, as we
9 have seen, mostly processed in China. Penn State has a
10 long history of conducting research and supporting industry
11 for efficient recovery of rare Earths and other critical
12 minerals.
13 Dr. Edward Steidle, former Dean of the College of
14 Earth and Mineral Sciences in 1952 wrote, quote, "By the
15 year 2000 we will not be wasting our coal ash in which
16 geochemists have shown that there is notable concentration
17 of rare Earth elements such as germanium and rare Earths,"
18 end quote. And he also wrote, American industry will be
19 faced not only with a lack of raw materials at home, but
20 also with difficulty of obtaining supplies abroad, end
21 quote.
22 The case of collaborative work and
23 government -- with government and industry followed. Today
24 for example, Penn State's Center for Critical Minerals is
25 working with several industrial partners, such as Texas

1 Mineral Resources Corporation, Materia USA, Energy Fuels,
2 Inc. and other industries in evaluating various feedstocks
3 from Pennsylvania for designing a multi-metal extraction
4 plant. There are four main challenges in developing
5 domestic rare Earth production capabilities. They are,
6 one, finding the highest assay feedstock which has a lot of
7 rare Earth. Second, characterizing these materials for
8 rare Earth extraction. And three, developing processing
9 options that are efficient and minimize environmental
10 impact. And fourth, financial modeling to ensure that the
11 processes will be competitive in a global rare Earth
12 market.
13 A multidisciplinary approach is needed to
14 overcome these challenges involving geosciences, mining
15 engineering, mineral processing, hydrometallurgy,
16 pyrometallurgy, material science, plan design and
17 simulation and financial modeling. Penn State is uniquely
18 poised to address these challenges with over 25 faculty
19 members currently actively involved in research, education
20 and outreach across these disciplines.
21 Historically, as a coal mining state,
22 Pennsylvania has abandoned mine lands, coal refuse piles,
23 metallurgical waste dumps and acidic drainage from
24 abandoned coal mines. Billions of gallons of acid mine
25 drainage impair over 5,500 miles of streams in the

1 Commonwealth. In addition to primary ores, Penn State's
2 Center for Critical Minerals is concentrating on these
3 secondary resources: overburden and underclays, acid mine
4 drainage and sludge, precious metals from US Department of
5 Defense electronic waste materials, fly ash and power
6 industry waste and mine tailings, some of which may have
7 lower concentration than traditional ores.
8 The analysis of three acid mine drainage sites
9 and sludge samples that we obtained is shown in Table 1.
10 The samples are highly enriched in rare Earths and offer
11 enormous environmental benefits, such as remining and
12 reclamation of abandoned mine lands, and remediation of
13 acid mine drainage while providing critical elements from
14 domestic sources.
15 Of note is that the high heavy to rare Earth --
16 heavy to light rare Earth element ratio in these acid mine
17 drainage sites is higher than the other ores that we depend
18 on, creating an especially strong niche for these deposits
19 for sought after heavy rare Earth elements. Because of
20 lower concentration, larger amounts must be processed,
21 therefore a multi-metal recovery approach is more
22 desirable. Fortunately, Pennsylvania's primary and
23 secondary enriched ores have high assays of not only the
24 rare Earths but also lithium, aluminum and a number of
25 other critical minerals.

The current AMD treatment methods use hydroxide-based chemicals for neutralization, resulting in the precipitation of minerals from the solution. Using the methods, up to only 70% of the rare Earth elements precipitate at the target treatment pH of AMD, and the rest is discharged with water.

Our group has recently developed a two-stage process shown in Figure 2 using environmentally friendly carbon dioxide, utilizing carbon dioxide mineralization process. Through this novel patent, application pending of course, process, 90% of aluminum and over 85% of the rare Earths elements can be recovered at pH values around 7.0; below 7.0, suppressing the precipitation of most of the iron that would otherwise dilute the target metal concentration.

Although the coal associated waste and AMD provide the most compelling feedstock for critical minerals in Appalachia, given the added benefit of environmental remediation, primary ore concentrates do exist in coal and coal associated sedimentary units.

In a recently completely geological study, lithium contents that exceed 1,000 parts per million, and alumina contents ranging from 32 to 34 weight percent were found in clay deposits underlying in Mercer coal.

Subsequently, along with our industrial partners,

1 Materia USA and a local mining company, coal mining
2 company, Penn State has further characterized the Mercer
3 underclay as a viable feedstock for lithium as a battery
4 material, rare Earth elements and aluminum. Pennsylvania's
5 critical mineral resources extend beyond the rare Earth
6 elements, lithium and aluminum.
7 Our center has published a report on the
8 assessment of cobalt and manganese resources from
9 Pennsylvania just a month ago, as shown in Figure 3 of the
10 title page. Main findings are, the preliminary estimate is
11 that coal refuse in Pennsylvania contains approximately
12 52,000 metric tons of cobalt, over half a million metric
13 tons of manganese are contained in these accumulations.
14 The preliminary estimate is that 60 metric tons of cobalt
15 and over 5,500 metric tons of manganese are being
16 discharged with acid mine drainage into Commonwealth of
17 Pennsylvania's water waste every year.
18 The sale of cobalt and manganese commodities
19 recovered from these materials could help offset the cost
20 of mine reclamation and stream restoration in Pennsylvania.
21 The results of the initial process development have been
22 presented for the integration of cobalt and manganese from
23 secondary materials into lithium battery supply chain.
24 One thing that I want to point out here is
25 another component that is very critical for battery

1 material is graphite, a material that is currently 100%
2 imported. St. Mary's, Pennsylvania is a carbon
3 manufacturing hub in the United States. With the
4 availability of domestic carbon sources from coal, there is
5 an opportunity to develop synthetic graphite producing
6 capabilities in Pennsylvania based on Pennsylvania
7 resources.
8 Blue circles shown on Figure 4 -- and there are
9 plenty of those there -- indicate already existing
10 industrial supply chain infrastructure. Based on current
11 research results, a process flowchart has been developed at
12 Penn State for multi-metal recovery to recover 90% of
13 lithium, 95% of the iron and greater than 90% of aluminum,
14 and 75% concentration of mixed rare Earth oxide elements,
15 and over 90% of cobalt and manganese from underclays and
16 waste materials from Pennsylvania resources.
17 Potential for this to become a burgeoning
18 industry in Pennsylvania is substantial. Of course, Penn
19 State cannot do this alone. Along with other academic and
20 government partners, and our esteemed Penn State Power and
21 Minerals Industrial Stakeholders Group -- comprises of 40
22 industry representatives, and that include coal, power,
23 transportation, chemicals and rare Earth -- metal
24 industries. PMISG meets regularly with us, and several
25 members are taking the lead and supporting our research and

1 development efforts.
2 To summarize, the Commonwealth of Pennsylvania
3 and the United States have enormous potential to produce
4 critical mineral elements domestically while creating jobs,
5 reclaiming abandoned mine lands, remediating acid mine
6 drainage, and addressing a critical national security
7 issue. It's a win/win situation that we simply cannot pass
8 up. Finally, I want to thank you all again for this
9 opportunity.
10 MAJORITY CHAIRMAN METCALFE: Thank you, sir.
11 Members with questions? So, the acid mine drainage -- and
12 you were noting how much is discharged, like annually in
13 your testimony. Once it's discharged into the waterways,
14 is it settling in the beds then, normally? Or how far down
15 is it washing to? I mean, is it going to be reclaimed out
16 of the beds of those waterways where it has washed into?
17 MR. PISUPATI: This is -- the discharge is after
18 treatment. About 70% of it gets accumulated as sludge.
19 The --
20 MAJORITY CHAIRMAN METCALFE: Okay.
21 MR. PISUPATI: -- because it precipitates. They
22 are actually stored there for the precipitates to settle.
23 That's what is called sludge. And then the liquid -- the
24 water is discharged. Still, it contains about 30%,
25 roughly, of these rare Earth elements. They don't

1 precipitate out. They just go with the water.
2 MAJORITY CHAIRMAN METCALFE: Okay.
3 MR. PISUPATI: Yeah.
4 MAJORITY CHAIRMAN METCALFE: Good. Thank you.
5 No other members with questions? Thank you, sir, for your
6 testimony today. Thanks for making --
7 MR. PISUPATI: Thank you.
8 MAJORITY CHAIRMAN METCALFE: -- the trip here.
9 MR. PISUPATI: Thank you very much.
10 MAJORITY CHAIRMAN METCALFE: Have a great day.
11 And our final testifier is Mr. Pete Rozelle, Ph.D.,
12 Churnside Technology Management, LLC, retired program
13 manager at the US Department of Energy. Mr. Rozelle, do we
14 have you, sir? Griffin, do we have Mr. Rozelle? His
15 mic --
16 MR. CARUSO: [inaudible].
17 MAJORITY CHAIRMAN METCALFE: Is the microphone
18 on? He’s on the phone there. I think he’s trying to talk
19 into his phone, to use that. Looks like he’s still muted,
20 right, Griffin? I mean, from a distance here, it looks
21 like the microphone and the lines are on.
22 MR. ROZELLE: Yeah, can you hear me now?
23 MAJORITY CHAIRMAN METCALFE: We can hear you now,
24 sir. If you could raise your --
25 MR. ROZELLE: [inaudible] thank you --

1 MAJORITY CHAIRMAN METCALFE: -- right hand, we'll
2 swear you in.
3 MR. ROZELLE: Yes, sir.
4 MAJORITY CHAIRMAN METCALFE: Do you swear or
5 affirm that the testimony you are about to give is true to
6 the best of your knowledge, information and belief? If so,
7 please indicate by saying, I do.
8 MR. ROZELLE: I do.
9 MAJORITY CHAIRMAN METCALFE: Thank you, sir.
10 Thank you for being with us. You can begin --
11 MR. ROZELLE: Thank you --
12 MAJORITY CHAIRMAN METCALFE: -- when you're
13 ready.
14 MR. ROZELLE: Okay. I am going to broaden the
15 topic a little bit to cover critical minerals in general.
16 And, just a little bit of background on myself, I am a
17 retired rare Earth program manager for one of the
18 headquarters DOE offices that began the rare Earth activity
19 in 2014, and before that I was a product of the mining and
20 metallurgical industries in Pennsylvania.
21 So, if we can get the presentation up here, we'll
22 get started. Some of this has already been covered. We'll
23 run through it fairly quickly. But again, I am going to
24 cover the critical minerals topic in general. Next slide.
25 Okay. Critical minerals problem has been a focus

1 of attention in the last three administrations. There was
2 an issue between China and Japan involving a fishing boat
3 in 2010. This is when it first hit the headlines that the
4 world was dependent on China for rare Earth minerals. One
5 of the results was an interagency working group under
6 Secretary Chu that contributed to a document that was put
7 out by the Department of Energy called a Critical Mineral
8 Strategy. It was updated in 2011, and multiple Federal R&D
9 programs were launched between 2010 and 2016 as a result.
10 One of the things that happened was the US
11 Geological Survey in their Mineral Commodity Summary Report
12 of 2016 noted that the US was importing $122 billion a year
13 worth of processed mineral materials, and that imports made
14 up more than one half of US apparent consumption of 50
15 non-fuel commodities. In some of these the US was 100%
16 import reliant. And -- but the value added to the gross
17 domestic product by major industries that use these mineral
18 materials in 2015 was over $2.7 trillion. It's not
19 trivial.
20 That was during the Obama Administration. During
21 the Trump Administration, in 2017 there was an executive
22 order to develop a federal strategy for critical minerals.
23 And interior -- Department of Interior was tasked with
24 releasing a list of critical minerals which is currently
25 being updated.

1 February of 2021, the White House executive --
2 issued Executive Order 14017 on American Supply Chain. The
3 report was released on that in June of 2021, and there is a
4 lot in there about critical supply chains, but there's also
5 a lot in there about critical minerals and the dependence
6 of these supply chains on critical minerals. Next slide.
7 Example applications, we've seen these before.
8 Transportation and infrastructure: critical minerals are
9 used in 5G technologies and in electric vehicles, both
10 batteries and magnets. In the energy game they're used in
11 wind turbines, solar panels and conventional power systems.
12 Rare Earths are not only used in renewable applications.
13 They are also used in conventional power systems, for
14 example in gas turbines.
15 And in the defense department, critical minerals
16 are used in magnets. They're used in hot gas path parts in
17 jet engines, just like they are in stationary gas turbines
18 for fossil power generation, and they're also used in
19 batteries. Next slide.
20 The committee has this PowerPoint, so we don't
21 need to go through the list of critical mineral commodities
22 individually. But the list is here, and it's under review
23 by Department of Interior for updating, and nickel and zinc
24 are expected to be added to the list as well. Next slide.
25 And again, this is base -- this is from the

1 100-day supply chain review that was released by the White
2 House in June of last year. Semiconductor supply chain:
3 silicon metal is not on the criticals list, but I added it
4 here because Pennsylvania is involved in the supply chain
5 for producing silicon metal, and of course it's the basis
6 for the semiconductor industry.
7 The industry also uses gallium, germanium and
8 indium which are on the critical list. The lithium ion
9 battery supply chain which includes EV, electric vehicle,
10 applications and includes defense applications, that
11 include -- that involves cobalt, graphite, lithium,
12 manganese and nickel. And there was also a critical
13 minerals and materials supply chain review in the document,
14 and that was primarily focused on rare Earth products.
15 Next slide.
16 Recommendations from the 100-day supply chain
17 review for semiconductors include strengthen the US
18 domestic semiconductor manufacturing ecosystem. And, raw
19 materials again include silicon metal, gallium, germanium
20 and indium. For the battery supply chain, it include --
21 the recommendations included strengthen responsibly sourced
22 supplies for key advance battery minerals. The primary
23 mineral of concern there is cobalt due to child labor
24 issues with some of the places where foreign interests are
25 mining cobalt. And with respect to critical minerals and

1 materials, the recommendation was expanding sustainable
2 domestic production and processing capacity, including
3 recovery from secondary and unconventional sources and
4 recycling. And, Sarma just discussed some of the
5 unconventional sources that are available in the
6 Commonwealth for some of these critical mineral
7 commodities.
8 Little bit of context. Pennsylvania is not new
9 to this. In fact, Pennsylvania was the leader in early
10 production of some of these materials and was the pioneer.
11 With respect to semiconductors, Sylvania -- we have here a
12 quote from the Elmira Star newspaper about Sylvania
13 building up semiconductor manufacturing operation based on
14 gallium up in Tawanda. This would have been 1952.
15 With respect to batteries, a lot of early battery
16 activity happened in Pennsylvania, including Stackpole
17 which was in St. Mary's, and including the Electric Storage
18 Battery Company which became Exide which was headquartered
19 in Pennsylvania until, I think, about 2000.
20 With respect to rare Earths, the first rare Earth
21 production company was -- which was the Welsbach
22 Incandescent Light Company, was founded in Philadelphia by
23 the same people that founded UGI in the 1880s. Some of you
24 may be familiar with a company called Molycorp. That was
25 originally the Molybdenum Corporation of America, which was

1 established as a division of the Electric Reduction Company
2 in Pittsburgh, and it became the largest rare Earth
3 producer until the 1980s and had operations in Washington
4 County and York County.
5 With respect to cobalt, Pennsylvania was the
6 first cobalt producer. It was produced as a byproduct of
7 Mr. Wharton's nickel operations in Lancaster County, and
8 Pennsylvania was the largest producer in the US of cobalt
9 in the 1940s and the 1960s. And with respect to graphite,
10 natural graphite, the US is 100% import dependent; however,
11 synthetic graphite can be used as a substitute for natural
12 graphite in many of these applications, particularly
13 rechargeable batteries. And as we all know, America's
14 carbon products hub is in St. Mary's, and that's where a
15 lot of the synthetic graphite technology was originally
16 pioneered.
17 Another thing about Pennsylvania is that a lot of
18 the supply chains required to produce these critical
19 minerals commodities and put them in a form that could be
20 used by advanced manufacturing operations is already here,
21 and that includes a lot of the mining and the metallurgical
22 supply chain in the Commonwealth. Things like equipment
23 dealerships, equipment vendors for process equipment,
24 trucking firms, railroads, fabrication shops.
25 And, just a quick review of where some of these

1 supply chain operations are is on the map, in the middle
2 right-hand side of the slide here. And one of the things
3 that needs to be worked out, these unconventional resources
4 recovering these rare Earth commodities from these
5 byproducts has been left from legacy industry activities.
6 You have to figure out where you're going to plug the
7 product into these supply chains and the process technology
8 that you need to produce those products. Next slide.
9 Example opportunity: silicon metal. Global
10 production of silica -- silicon metal for the semiconductor
11 industry and the other applications including solar panels
12 is $7 billion a year; a $7 billion market. Pennsylvania
13 anthracite is used to produce the furnace electrodes for
14 silicon metal furnaces. Pitch is required. It's a -- kind
15 of an asphalt-like carbon product that's used as a binder
16 in the formulations of synthetic graphite. Unfortunately,
17 the US only produces about 3% of global pitch production
18 capacity. Most of it has moved over offshore, but
19 fortunately new pitch production capacity in Pennsylvania
20 is under development. And, hopefully we'll have some of
21 that production back in place over the next few years.
22 Just to see where the silicon metal is coming
23 from, this is a combination of silicon metal and
24 ferrosilicon which is another silicon product. And you can
25 see that the majority of it is coming from China, and the

1 US is -- between these two products the US produces less
2 than 4% of the global total. And again, the silicon metal
3 for semiconductors is turned from this type of silicon
4 metal into polysilicon, and then that's used directly in
5 the semiconductor fabrication.
6 Another example is gallium, which is of interest
7 because it's required for 5G technologies and 5G
8 infrastructure in the US. And, you can see here that small
9 amounts of gallium are produced worldwide, but it goes into
10 8 billion worth of gallium arsenide RF devices, 750 million
11 a year worth of gallium nitride RF devices, and 13 billion
12 worth of high-power LEDs. So, these materials serve
13 markets that generate billions of dollars a year in
14 revenue.
15 Critical mineral opportunities underway that are
16 being explored in Pennsylvania right now. The number one
17 focus is on the linkage of recovering these critical
18 mineral commodities with the reclamation of degraded land
19 and water from past industrial activities. As Sarma said,
20 cobalt, indium, lithium and manganese are all under active
21 exploration in Pennsylvania, as are rare Earths.
22 And, you heard from Zeke about the project that
23 he's working on that's a combination of a lithium and rare
24 Earths project. Rare -- elevation concentrations of rare
25 Earths have been found both in rocks and acid mine

1 drainage. There is some different parts of work underway
2 in the Commonwealth now to try to explain why we found
3 these elevated concentrations in underclays. You heard
4 some of that from Dr. Blackmer of the Pennsylvania
5 Geological Survey.
6 And, one of the key points here is that there is
7 a limited amount of money available for reclaiming old mine
8 sites and old metallurgical sites, but the revenue from the
9 critical mineral production can help fund these reclamation
10 activities. Pennsylvania has been a pioneer in this over
11 the last 30 or so years with respect to reclaiming old coal
12 refuse dumps, and without the need for taxpayer-funded
13 work.
14 This is an example of how you can take these
15 commodities that are available in the Commonwealth and plug
16 them into the existing supply chain. On the left side of
17 this -- oh, the next slide, please. Is this showing the
18 R&D: Plugging Pennsylvania Critical Mineral Resources
19 slide?
20 MAJORITY CHAIRMAN METCALFE: Yes, it is.
21 MR. ROZELLE: Okay. The flowsheet -- the four
22 blocks on the left are the flowsheet from the 100-day
23 supply chain report for the rechargeable battery industry
24 in the US. And on the right side is processes that have
25 been developed at Penn State to take the available

1 materials, both acid mine drainage sludges and
2 cobalt-bearing mineral products, particularly what's found
3 in mining byproducts and turn them into things that can
4 plug directly into the battery supply chain.
5 And what's -- what they're working on here is the
6 critical gap that was identified by the White House in the
7 100-day supply chain report for the -- for cobalt
8 production was being able to refine and process the
9 materials and put them into a form where they can go
10 directly into battery production.
11 And as you can see here, this -- the light blue
12 portion of the flowsheet is the process technology that's
13 been developed to go straight downstream of that critical
14 gap, and basically it would take these secondary materials
15 available in Pennsylvania and put them directly into the
16 manufacturing process and bypass what's been identified as
17 the critical gap. Next slide.
18 And, we've got lots of results to talk about in
19 the Commonwealth as far as developing opportunities. The
20 university has recently published a paper that's related to
21 the work that Zeke's doing in Clearfield County, and that's
22 with respect to the Mercer underclay as a polymetallic
23 deposit involving lithium, rare Earths and alumina. And,
24 Sarma discussed the cobalt and manganese report that we put
25 out last month. And, that could -- has the potential to

1 substantially increase the reserve base of the United
2 States if a pathway can be found to economically produce
3 from them.
4 And, one of the most fun things about doing the
5 exploration work is going out with drilling rigs and
6 pulling cores out of the ground. And you can see the
7 beginning of a core in the lower left side of the slide.
8 Last slide, next slide.
9 What this can do for Pa. It can generate
10 production operations and production jobs in the critical
11 supply chains in the Commonwealth. As a former employee in
12 coal production myself, I would differ with the previous
13 opinion we've heard about replacing the coal industry.
14 Raw material production from secondary materials
15 can help anchor downstream manufacturing facilities. I
16 think that's the big one, and it's basically taking the
17 model of the steel industry in the 1800s and running it
18 through a Xerox machine, because Pennsylvania's iron ore
19 and coke availability is what attracted the steel industry
20 here in the first place. It can build resilience into the
21 regional economy, and it can help reclaim abandoned mine
22 lands. Are there any questions?
23 MAJORITY CHAIRMAN METCALFE: Thank you, sir. Any
24 members have questions? Representative Vitali?
25 MINORITY CHAIRMAN VITALI: Yeah, thank you,

1 Mr. Chairman. This -- and thank you for your testimony.
2 This is kind of a basic question. Could you give us a
3 working definition of critical minerals of -- versus rare
4 Earth elements? And are rare Earth elements a perfect
5 subset of critical minerals?
6 MR. ROZELLE: Yes. The rare Earth elements are a
7 subset of critical minerals. There are currently 35
8 different commodities that are identified by the Department
9 of Interior as critical minerals. And, rare Earths grouped
10 together are one of those.
11 MINORITY CHAIRMAN VITALI: So, what's the
12 difference between a critical mineral -- I mean, I'm trying
13 to understand why something would be a critical mineral and
14 not a rare Earth element. Like what's -- well, like,
15 what's kind of the working definition of each?
16 MR. ROZELLE: Critical minerals are commodities
17 that have important uses in the US Economy, and for which
18 the US is more than 50% import dependent. Included among
19 those are cobalt and lithium which are not rare Earth
20 elements, but they are critical minerals.
21 Rare Earth elements include 14 naturally
22 occurring lanthanide elements, plus yttrium and scandium.
23 They typically are grouped together as rare Earths. But,
24 rare Earth elements themselves are a subset of the critical
25 minerals list.

1 The PowerPoint that I provided to the committee
2 has the critical minerals list, and you'll see that
3 there's, I believe, 35 entries on that list, and that rare
4 Earths are just one of them.
5 MINORITY CHAIRMAN VITALI: Okay, thank you.
6 MAJORITY CHAIRMAN METCALFE: Thank you, sir, for
7 your testimony today. We appreciate you taking your time
8 to share your expertise with us.
9 MR. ROZELLE: Thank you.
10 MAJORITY CHAIRMAN METCALFE: Thank you. Have a
11 good day. And, thank you to Representative Armanini for
12 suggesting this topic.
13 REPRESENTATIVE ARMANINI: Yeah, yeah.
14 MAJORITY CHAIRMAN METCALFE: And I'd like to
15 recognize Minority Chair, Representative Vitali to
16 recognize one of his staff.
17 MINORITY CHAIRMAN VITALI: Oh, thank you,
18 Mr. Chairman. Sarah Iversen, my Executive Director, will
19 have her last day with the caucus on Friday, and this will
20 be her last committee meeting. She has served me and my
21 committee members with great distinction. Her research has
22 been of the highest quality. She has gone above and beyond
23 in fulfilling her duties, and she will be greatly missed.
24 I'd just like to thank her publicly for her good work for
25 the committee.

1 MAJORITY CHAIRMAN METCALFE: Thank you,
2 Representative Vitali. And, Sarah, we wish you the best
3 with your next endeavor. No other members seeking
4 recognition? Thank you to the members for their time
5 today. We look forward to follow up on some of this
6 information that we have received today, and at this time
7 we will adjourn. Everyone have a good day. This meeting
8 is adjourned.
9
10 (The hearing concluded at 12:16 p.m.)

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