

COMMONWEALTH OF PENNSYLVANIA

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SENATE OF PENNSYLVANIA
ENVIRONMENTAL RESOURCES AND ENERGY COMMITTEE

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INFORMATIONAL BRIEFING ON
CARBON MANAGEMENT AND SEQUESTRATION

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Before:

SENATOR MARY JO WHITE, Chair
SENATOR RAPHAEL J. MUSTO
SENATOR EDWIN B. ERICKSON
J. BARRY STOUT
ANTHONY H. WILLIAMS
DONALD C. WHITE

- - -

Date: September 24, 2008, 9:15 a.m.
Place: Room 8E-A, East Wing
Harrisburg, Pennsylvania

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Department of Conservation and Natural Resources
MICHAEL DiBERARDINIS, Secretary
JOHN QUIGLEY, Chief of Staff

Pennsylvania State University
JONATHAN MATHEWS, Assistant Professor
Department of Energy and Mineral Engineering

1 CHAIRMAN WHITE: We will call this meeting
2 of the Senate Environmental Resources and Energy
3 Committee to order. We welcome our first speaker
4 from Pennsylvania Department of Conservation and
5 Natural Resources, Secretary Michael DiBerardinis.

6 SECRETARY DiBERARDINIS: Thank you. Would
7 you like me to begin, Senator?

8 CHAIRMAN WHITE: Yes, please.

9 SECRETARY DiBERARDINIS: Good morning,
10 Chairperson White and distinguished members of the
11 Senate Environmental Resources and Energy
12 Committee. I want to thank you for the opportunity
13 to provide a briefing on the report of DCNR's
14 Carbon Management Advisory Group, which I will call
15 CMAG throughout my remarks.

16 I would like to begin by acknowledging the
17 work of this Committee and of the General Assembly
18 in passing Act 70, the Pennsylvania Climate Change
19 Act of 2008. I applaud Senator Erickson for his
20 leadership and the members of this Committee for
21 supporting the development of the Commonwealth's
22 policy response to the most urgent environmental
23 challenge of our times. I look forward to being an
24 active member of the Committee established under
25 Act 70.

1 Since taking office in 2003, I've had the
2 opportunity to see the important role that DCNR
3 lands, facilities, and programs have in the lives
4 of Pennsylvanians. DCNR has a core responsibility
5 to its historic mission, which is to protect and
6 enhance the natural resources of the
7 Commonwealth -- the land, waters, forests and
8 geologic resources -- that are entrusted to us. I
9 believe that we do that exceedingly well.

10 Our state forest, for example, is one of
11 only a handful of state forests to be independently
12 certified as well-managed in a way that protects
13 its long-term health. Just as an aside, I think
14 this is the gold standard in quality forest
15 management, this certification.

16 And thanks to the leadership of Governor
17 Rendell and the support of the General Assembly in
18 passing Growing Greener II, we have protected more
19 environmentally sensitive land than at any time in
20 decades, substantially upgraded park and forest
21 infrastructure, and partnered with hundreds of
22 communities across the Commonwealth to invest in
23 conservation and recreation projects.

24 We have also worked very hard to broaden
25 our mission to help shape a sustainable

1 Pennsylvania. We are seeing very powerful and
2 encouraging results across the state in connecting
3 communities to their natural resources and placing
4 conservation at the heart of sustainable community
5 economic development strategies.

6 The CMAG report represents another
7 extension of our mission, one that attempts to meet
8 one of the most urgent challenges of the 21st
9 Century. Climate change is perhaps the biggest
10 single long run threat, long-term threat to
11 Pennsylvania's existing natural heritage and the
12 sustainability of our economy. DCNR stewardship
13 and sustainability mission demands that we rise to
14 the challenges of understanding and addressing this
15 threat within the extent of our work in a serious,
16 thoughtful and creative manner.

17 The Carbon Management Advisory Group is a
18 collaborative project that began in August of 2006,
19 in partnership with the Pennsylvania Environmental
20 Council. A total of 65 stakeholders representing
21 nongovernmental conservation organizations,
22 academia, substantial elements of the private
23 sector, and state and federal governments
24 participated in preparing the report.

25 DCNR commissioned this report in order to

1 get the best information with which to make
2 management and program decisions. We want to
3 elevate the value of open space protection and
4 stewardship of public and private land and, at the
5 same time, give Pennsylvania a competitive edge in
6 a world that restricts carbon emissions to address
7 climate change.

8 The CMAG report makes recommendations on
9 policy options that DCNR might pursue, using
10 Pennsylvania's land and geology to address global
11 warming. The recommendations are in four broad
12 categories: First, the potential to store carbon
13 dioxide emissions in underground geologic
14 formations and alternative pathways to developing
15 that potential;

16 Second, the potential to offset carbon
17 dioxide emissions and provide sustainable biomass
18 energy resources through a variety of forest
19 management options. Third, the potential to offset
20 carbon dioxide emissions and to capture
21 co-benefits -- habitat and water quality protection
22 and improved forest health and productivity, to
23 name a few -- through land conservation activities;

24 And finally, how to design for future
25 federal, regional, or private carbon credit

1 mechanisms and markets could encourage the most
2 effective utilization of the state's natural
3 resources.

4 Chairperson White and members of the
5 Committee, I thank you for your interest in our
6 carbon work, and now I will ask DCNR's Chief of
7 Staff, John Quigley, to give a more detailed
8 presentation of the CMAG report. John.

9 MR. QUIGLEY: Good morning. I will try to
10 be judicious with our time here, and I appreciate
11 the opportunity to come before you this morning. I
12 want to go over the main elements of our CMAG plan.
13 It starts with the premise that global warming, as
14 the Secretary said, is the single biggest long-term
15 threat to the state's natural heritage and to the
16 sustainability of our economy. According to the
17 latest science from the International Panel on
18 Climate Change, in our children's lifetimes, we
19 will see these effects: More frequent and severe
20 storms, increased flooding events, potential loss
21 of the cold water fisheries in Pennsylvania,
22 impacts on biodiversity, spread of tropical
23 diseases, heat waves, impacts on agriculture,
24 forest composition/diversity, reductions in stream
25 and river flows and lake levels and ground water,

1 which we think are going to be pretty significant,
2 and a curtailment of winter outdoor recreation,
3 very severe impacts according to the models that
4 have been put forth by the International Panel of
5 Sciences.

6 Pennsylvania is a major player in global
7 warming. The Commonwealth emits one percent of the
8 planet's global warming emissions. That's more
9 than 106 developing countries combined, and it is
10 third among all states. We are third only to Texas
11 and California in global emissions.

12 The purpose of our CMAG report is to think
13 ahead. We believe that it's inevitable that
14 national limits will be placed on carbon emissions,
15 and given the fact that more than 50 percent of the
16 Commonwealth's electricity is coal-fired, we need
17 to ask the question how will the Commonwealth cope
18 under the imposition of carbon restraints, and, in
19 fact, are there any competitive advantages that our
20 natural resources might provide under the
21 imposition of those carbon restraints?

22 So we commissioned the CMAG report, and it
23 involved a very large stakeholder Committee of
24 65 people, composed of various sectors. It is a
25 very broad-based effort to get all voices in the

1 room to look at our mission and to look at the role
2 of the state carbon restraints, and we took
3 21 months to do this study. In terms of the big
4 picture, this study is intended to be a first step
5 in extending our mission to address climate change.

6 We want to look at alternative scenarios
7 that we can quantify and put into context the
8 State's potential to offset its greenhouse gas
9 omissions and provide bioenergy feedstocks. We
10 want to look very seriously at the options for
11 policies/pilot projects that can give the
12 Commonwealth a competitive advantage when these
13 carbon constraints are imposed nationally, and one
14 of the main purposes of the report is to inform the
15 evolving and ongoing state policy development over
16 time. We think this will be particularly
17 important, and we look forward to discussing this
18 in as many ventures as we can.

19 Now, you might ask the question, why is
20 DCNR and the state parks and state forests involved
21 in a discussion about climate? It's very simple.
22 We are the largest landowner in the Commonwealth.
23 Our mission is one of sustainability. Shaping a
24 Sustainable Pennsylvania is the action plan that
25 we've developed in the early years of this

1 administration with the Secretary, who led that
2 process. We have more than 2 million acres in our
3 portfolio. We believe that those lands can very
4 significantly offset the State's greenhouse gas
5 emissions and provide valuable biomass feedstocks
6 energy, and, in addition, our Bureau of
7 Topographical and Geological Survey has been a
8 partner from the first days of the Midwest Regional
9 Carbon Sequestration Partnership, which is a
10 federally funded consortium of seven states and two
11 Canadian provinces that have been looking at carbon
12 sequestration for about the last seven years.

13 Our carbon report is premised on this
14 statement: The Commonwealth's land and geological
15 resources will be crucial to sustainable economic
16 growth under the imposition of Federal carbon
17 constraints. We think that is a given, and we
18 explored this concept in the process of development
19 of this report.

20 I want to first define a couple quick
21 terms. What is carbon sequestration? This is the
22 process of extracting carbon dioxide from the
23 atmosphere or from emission sources using good
24 old-fashioned photosynthesis like we all learned
25 about in third grade or through technology, through

1 technology called carbon capture and storage, or
2 CCS, and once that carbon is extracted from
3 smokestacks or the atmosphere, it's stored or
4 sequestered in what are called carbon sinks.

5 There's two main kinds of carbon sinks:
6 Terrestrial and geological. Terrestrial carbon
7 sinks is plants, grasses, trees, and soils. The
8 old-fashioned photosynthesis. Geological carbon
9 sinks include underground formations and unmineable
10 coal seams, which under the imposition of carbon
11 constraints can be viewed as a new natural resource
12 for the Commonwealth. We'll talk about the storage
13 capabilities in a second.

14 Carbon capture and storage, the
15 technological approach to reducing emissions.
16 Carbon is being extracted from emitters and
17 captured, piped, and stored underground around the
18 world, under the North Sea, Canada, Algeria and in
19 Texas in the process used for enhanced oil
20 recovery. Captured CO₂ liquefied, pump it
21 underground and force out unrecoverable deposits of
22 oil. We actually think there is some possibilities
23 for that in Pennsylvania.

24 So this technology is being applied around
25 the world. And indeed, last year MIT came out with

1 a seminal study called The Future of Coal which
2 said that this technology of capturing carbon and
3 storing it underground is the critical enabling
4 technology that will allow the world, which is so
5 dependent on fossil fuels, to lower carbon
6 emissions and be able to continue to meet the
7 world's energy needs, but they indicated strongly
8 that this technology needs to be demonstrated at a
9 power plant scale, and that's really the first
10 hurdle that we have to overcome. This technology
11 has yet to be applied at the scale of emissions of
12 a coal-fired power plant.

13 We're talking millions of tons of
14 liquefied carbon annually that would have to be
15 stored underground, and none of the projects around
16 the world are more than maybe a million or so tons
17 per year. So the scale is a challenge. The
18 current technology used to extract and capture this
19 carbon is costly, and the only way that those costs
20 are going to be able to be driven down is to employ
21 these pilots on a sufficient scale, so pilots are
22 needed to reduce the cost of this technology, and
23 obviously there are no market or regulatory drivers
24 to advance this technology yet. We think it's
25 inevitable, but they're not here yet.

1 There are a number of utilities scaled
2 projects on the drawing board, Indiana, in the
3 Netherlands, Australia, and there are more coming.
4 There's a lot of interest in developing this
5 technology, and, frankly, there is a race to become
6 the home for the development of this technology and
7 the jobs and export jobs that go with it.

8 The Midwest Regional Carbon Sequestration
9 Partnership, which has been working on this issue
10 for the last seven years, took a look at the
11 State's geological sequestration potential, and
12 based on an analysis of well data that they have,
13 essentially the western third of the Commonwealth
14 is where most of the oil and gas activity has
15 historically taken place. Based on an analysis of
16 that data, they have estimated that the
17 Commonwealth has more than 100 years' of geological
18 storage capacity at present emission rates, and
19 that's present total emission rates, not just from
20 the electric sector, but total state emissions we
21 have more than 100 years of storage capacity
22 literally beneath our feet in the various
23 formations that are outlined.

24 That clearly is a potential competitive
25 advantage to the Commonwealth if it can be cost

1 effectively developed, and we think it is very
2 important for us to understand the implications of
3 that opportunity, understand the costs involved and
4 to try to make sure that if this tool is a viable
5 one for the Commonwealth under the imposition of
6 carbon constraints, that we're ahead of the game
7 and ahead of the country in developing resources.

8 So to realize this potential 100-year
9 storage advantage, if we are successful in doing
10 it, and if no other technology presents itself, and
11 clearly the world is moving pretty fast, but if
12 this becomes the technology of choice, it would
13 mean less economic disruption in the Commonwealth
14 when carbon constraints are imposed. It would
15 allow the Commonwealth to maintain its position as
16 an energy exporter, and we believe it could mean
17 very significant amounts of economic development
18 opportunity, jobs in research and development, in
19 retrofitting existing emitters, in manufacturing
20 the actual technologies, and indeed, in exporting
21 these technologies.

22 China and India at some point are going to
23 be brought into the international fold and will
24 have to limit their emissions. We believe that the
25 Commonwealth has an opportunity to be the home for

1 these jobs, that cannot be outsourced, that cannot
2 be off-shored. We think there is a significant
3 economic development upside to realizing the
4 potential of geologic sequestration.

5 However, there are some issues that need
6 to be understood, and they are listed here. Where
7 would you site an underground storage facility?
8 Clearly we have natural gas stored in various areas
9 around the Commonwealth. How would one site handle
10 a carbon sequestration facility? What would the
11 pipeline network look like? There is an issue of
12 mineral rights. Storage rights are essentially
13 tied up in mineral rights, so who owns the pore
14 space? Liability concerns in the event of a
15 leakage. There is some regulatory uncertainty,
16 although the Federal Government is moving towards
17 rulemaking on underground sequestration. This
18 year, in fact.

19 Are there safety issues? What about
20 leakage? Are there seismic issues? If you
21 overpressurize a formation you could essentially
22 cause a manmade earthquake, but that's relatively
23 straightforward geologic work. What are the
24 impacts on ground water? Early data suggests the
25 carbon formations for storage in Pennsylvania are

1 well below ground water, so that may not be an
2 issue in Pennsylvania, but clearly we have to
3 understand it.

4 And then the final one is probably the
5 most important. While the geology and
6 geochemistry, I am told, is relatively
7 straightforward, the biggest issue is going to be
8 public education and acceptance. You've heard it
9 "not in my backyard." Now you face a phenomenon
10 called "not under my backyard," so we certainly
11 need to elevate the discussion and educate the
12 public and raise the comfort level this is the
13 technology that's going to be explored in the
14 Commonwealth.

15 Having said all that, there is a number of
16 states that are moving in this direction. Texas
17 and Illinois have already passed legislation
18 assuming public ownership of and liability for
19 geologically stored carbon. The state of Wyoming
20 has already passed legislation to say the pore
21 space runs with surface rights. Kansas has passed
22 tax incentives for carbon capture and storage.
23 Ohio is drilling test wells to understand the
24 resources. California, New Mexico, Oregon,
25 Washington and New York are all moving in this

1 policy sphere, and the list is growing every day.

2 Given all of that, CMAG looked at what are
3 the strategic opportunity and policy directions for
4 the Commonwealth to understand this resource. On
5 the geologic side they suggested we develop
6 protocols to site and operate these projects. What
7 will a project look like? How will a site be
8 picked? We have already amassed a significant
9 amount of data, as I said, on the western third of
10 the Commonwealth. We don't have nearly as much
11 data on the eastern two-thirds of the Commonwealth.

12 To understand the totality of our
13 geological resources we need to assess central and
14 eastern Pennsylvania. We need to scope out what
15 carbon infrastructure would look like. Can we use
16 existing rights and ways to create pipeline
17 networks, cost-effective storage? Can we develop
18 pilot projects? Is there an opportunity in
19 southwest Pennsylvania to develop an enhanced oil
20 recovery project and kind of kill two birds with
21 one stone and get a win-win situation? Are there
22 other opportunities in the southwest part of the
23 state? Are there indeed opportunities under state
24 forestland where we own 85 percent of the mineral
25 rights, as the Secretary has said? We at least

1 need to ask the question is this a potential
2 compatible use of state forestlands and in a way
3 that is keeping with our mission? So we're asking
4 ourselves that question.

5 CMAG also suggested we look at
6 northeastern Pennsylvania at the possibility of
7 capturing fugitive coal-mined methane. Methane, as
8 you might know, is 21 times more potent as a
9 greenhouse gas than carbon dioxide, so capturing a
10 little bit of methane is equivalent to capturing an
11 awful lot of carbon dioxide. Is there an economic
12 opportunity in northeastern Pennsylvania to capture
13 this fugitive methane while storing carbon
14 emissions at the same time? And again, an
15 opportunity may exist for a triple win that we need
16 to explore.

17 CMAG also took a look at the terrestrial
18 side at the role of the state's 17 million acres of
19 public and private forests. Some important
20 statistics. All of the annual growth of
21 Pennsylvania's forests, both public and private,
22 currently offsets about 5 percent of the State's
23 emissions, and that 5 percent is critical. When
24 you look at the magnitude of the challenge, science
25 is suggesting we need to capture or reduce at least

1 80 percent of our emissions or capture 80 percent
2 of our future emissions and store them someplace.

3 That 5 percent is a big number and it's
4 significant, and the question becomes, how do we
5 preserve that terrestrial sequestration capacity?
6 How do we grow it? And you do that very simply in
7 four ways: You plant and restore forests; protect
8 and manage the existing forest, and there are
9 certain techniques that can be applied that will
10 actually increase the amount of carbon storage.

11 You use more forest products. This
12 actually (indicating) is carbon sequestration. So
13 what are the implications for the state's forest
14 products industry and is there a value, a carbon
15 sequestration value to Pennsylvania's wood products
16 that can be captured? We think it's an interesting
17 and pretty challenging question that might lead to
18 economic benefit for the Commonwealth.

19 And one of the last things you do is you
20 plant trees in open areas, not only sequestering
21 carbon but to reduce energy consumption. You
22 offset the urban heat island effect and cities can
23 become more energy-efficient in the process. So
24 those tasks are relatively straightforward.

25 In terms of land conservation, forest

1 conversion to developed use results in a one-time
2 surge of carbon emissions. When you clear the
3 forest, that releases an enormous amount of soil
4 carbon into the atmosphere, and by that act you're
5 foregoing sequestration capacity. So land
6 conservation becomes important in a carbon
7 constrained world, and we found and actually
8 analyzed one of the cost-effective aspects of this
9 and what do the actual numbers look like in terms
10 of cost and benefits, and CMAG found that
11 conserving our forestland base, reducing clearing,
12 promoting working forests are all very
13 cost-effective carbon reduction policies.

14 We also took a look at registries. When
15 carbon constraints are imposed naturally it's very
16 likely that it will involve in some measure a
17 cap-and-trade system, so there will be a price
18 placed on carbon omissions and perhaps an
19 opportunity for trade of those emission credits,
20 and the rules by which that will be done are very
21 critical, and there is a wide disparity around the
22 country in the various voluntary registries that
23 are currently operational, but the standards of the
24 accounting, how you measure emissions and offsets,
25 are going to be very critical, and we need to

1 participate in that game and in the development of
2 those rules on a national level.

3 Our goal is to encourage participation in
4 the carbon market by the owners of the state's
5 terrestrial and geological resources. We think
6 there is an economic gain to be had if the rules
7 are written appropriately. So we outlined some
8 registry design parameters that would position the
9 state favorably to meet that challenge, and we are
10 trying to advance them in some regional and
11 national discussions.

12 CMAG also took a look at forest biomass
13 energy. Obviously, the work that the General
14 Assembly has done this year alone, Act 2, the
15 biofuel subsidies legislation, and Act 10, which
16 requires 10 percent cellulosic ethanol content in
17 gasoline once certain in-state production limits
18 are reached, they are two very important pieces of
19 legislation, and we commend the General Assembly
20 for that work.

21 That is helping to drive an interest in
22 wood for biomass energy. Utility scale, community
23 scale and indeed even residential, pellet stoves,
24 are all receiving a heightened level of attention
25 and are going to be looked at as a source of fuel,

1 and certainly with the rise of cellulosic ethanol,
2 the legislation the Commonwealth passed this year,
3 the interest that was already being displayed by at
4 least three different cellulosic ethanol
5 manufacturers who are actively looking at sites in
6 the Commonwealth now, so there is a lot of interest
7 in biomass energy.

8 The question before the Commonwealth is,
9 what is a sustainable level of use of the forests
10 to provide biomass energy? What is sustainable
11 growth environmentally to protect the resources, to
12 protect the productivity and ensure long-term
13 sustainable growth from harvesting, and what is
14 economically sustainable? We need to provide a
15 level of business certainty to these big investors,
16 the Perenia corporations, we must gather these
17 cutting-edge companies who are now looking to
18 develop these new technologies, we need to be able
19 to inform their investment decisions so that they
20 have a level of business certainty, and we think
21 this is a happy confluence of environmental and
22 economic sustainability going hand-in-hand.

23 So we ask the question, how much wood is
24 really out there? There's been one we think
25 courageous estimate by Dr. Chuck Ray at Penn State,

1 who has done extensive work on biomass energy, and
2 has estimated that there is about 6 million tons of
3 low value wood that can be annually harvested from
4 all of the public and private forestland in the
5 Commonwealth. When you start converting that into
6 energy, you get some pretty interesting numbers.
7 That 6 million tons of sustainable supply is
8 equivalent to about 6 percent of the state's
9 current gasoline use on a BTU basis, and if you
10 converted it all to electricity, it would be
11 equivalent to about 13 percent of electricity.
12 They are very significant numbers.

13 However, I think it's obvious that
14 6 percent and 13 percent do not represent magic
15 bullets. The forest is not the solution in terms
16 of either transportation of fuels or electricity
17 generation. It's an important component, but it's
18 not solely. We also asked the question, how can
19 wood supplies be enhanced? How can we get beyond
20 that 6 million tons of sustainable parks? And
21 there are opportunities around the Commonwealth in
22 our abandoned mine lands and in the almost
23 3 million acres of marginal agricultural land in
24 the Commonwealth to perhaps consider short rotation
25 woody crops, fast growing trees that can be

1 harvested for biomass energy, and when you run some
2 numbers, if you look at the appetite of a
3 cellulosic ethanol facility, a 25 million gallon
4 plant, which is really a drop in the bucket in
5 terms of the Commonwealth's consumption, requires
6 over 325,000 tons of wood a year. It has the
7 appetite of a pulp, and there were only ever seven
8 pulp mills operating in the Commonwealth
9 simultaneously, so there is a limit to how much
10 wood we can sustainably supply. At 5 tons per acre
11 per year, that 25 million gallon cellulosic ethanol
12 plant needs about 65,000 acres if all of its supply
13 were to be supplied in the plantation. So there
14 are limitations that you need to understand.

15 If you look at electricity, we talked to a
16 number of energy developers, and to satisfy the
17 demands of an electricity generation facility,
18 they're using a number of 1,000 acres of plantation
19 that's horticulture or forestry per megawatt.
20 1,000 acres per megawatt. Very land-intensive
21 operations. So again, agroforestry is not
22 necessarily a silver bullet either. It is part of
23 a portfolio approach.

24 For us the policy essentials relative to
25 forest biomass is to avoid inadvertently

1 incentivizing deforestation and conversion of
2 forests, and we think the legislation that the
3 General Assembly passed this year is appropriately
4 sized, a 10 percent target. We think it's
5 appropriate and achievable and sustainable,
6 adopting that portfolio approach to biomass energy
7 that I spoke of and really emphasizing the
8 sustainable economic use and sustainable
9 environmental use of this resource go hand-in-hand.

10 The scale, the biomass energy scale is
11 critical. The most easily supportable uses of
12 forest biomass are community scale, the Fuels for
13 Schools Model where a community, a hospital, a
14 school district might consider converting from
15 fossil fuels to biomass energy. They are readily
16 sustainable and the numbers work today. We have to
17 be a little bit more cautious in considering these
18 big cellulosic ethanol facilities and make sure
19 that they're sited appropriately in a way that
20 makes sense, and our role is to help to inform in
21 siting decisions of these companies, certainly not
22 to put a thumb on the scale, but to just give them
23 the best information we possibly can.

24 Going forward, DCNR intends to be an early
25 actor and demonstrator wherever we can in this

1 realm. We want to contribute to the policy
2 discussion. We are a leading agency, along with
3 DEP and the Department of Agriculture, and the
4 Fuels for Schools and Beyond Program, to
5 incentivize on a community scale biomass energy
6 development. The Commonwealth has already joined
7 The Climate Registry, which is a voluntary process
8 registry, and in the Climate Change Advisory
9 Committee, we are talking at the next meeting about
10 the possible designation of voluntary emission
11 offsets for industries, and we will be heavily
12 involved in that conversation.

13 We earlier this year published Sustainable
14 Forest and Biomass Harvest Guidelines, again to
15 inform in the use and development of forest biomass
16 feedstocks. We participated very strongly in the
17 recent Chesapeake Bay Commission Biofuels Summit
18 that talked about the potential for this region to
19 become a home for the next generation of biofuels,
20 and as we said, we are certainly heavily involved
21 in Climate Change Advisory Committee and looking
22 forward to that process. Thank you.

23 CHAIRMAN WHITE: Thank you. Very
24 informative. Thanks. Senator Musto?

25 SENATOR MUSTO: Good morning.

1 SECRETARY DiBERARDINIS: Good morning.

2 MR. QUIGLEY: Good morning.

3 SENATOR MUSTO: In your presentation you
4 mentioned that there were a number of issues to be
5 addressed, such as siting, liability and pipelines,
6 and before DCNR moves forward, do you feel there is
7 need for a State legislation in order for you to
8 accomplish this?

9 MR. QUIGLEY: Well, to do a study,
10 Senator, perhaps not, but certainly I think that
11 appropriation wouldn't hurt to do some of the
12 really intensive work. Clearly I think given
13 what --

14 SENATOR MUSTO: That didn't go over my
15 head.

16 MR. QUIGLEY: I got you. Given the fact
17 that other states have already moved. We think
18 it's appropriate to consider, for example, public
19 consumption of liability for say Serial No. 0001
20 through 0005 of an underground sequestration. I
21 know that some of the amendments that have been
22 considered by the Special Session Senate Bill 25
23 certainly would advance the ball and, if enacted,
24 would place the Commonwealth at that cutting edge
25 of this policy development, but certainly as you

1 deliberate these kind of issues, we would be more
2 than happy to provide any additional information
3 that you might need.

4 SENATOR MUSTO: We are certainly willing
5 to work with you in whatever way we can.

6 CHAIRMAN WHITE: Senators, any questions?

7 SENATOR STOUT: Yes. If the Commonwealth
8 assumes this liability, what's in it for the
9 Commonwealth financially if we store these
10 emissions and so forth?

11 SECRETARY DiBERARDINIS: This is the
12 conversation we want to have. We certainly would
13 hope if we get started and this process actually
14 has legs and begins to move forward, this is an
15 important question. So we want to posit it as an
16 important question.

17 I believe, just my own personal view is
18 that if we do assume the liability on some level,
19 and I'm not assuming broad long-term liability, but
20 again, this is a discussion and a debate that we're
21 trying to frame out here, trying to put these
22 questions before as many interested groups and
23 inform the Legislature and the business sector and
24 the private sector, academia, we want to put these
25 questions out there, so I believe that there is

1 some role. What is that role, I'm not sure, for
2 the State in assuming some liability. I think we
3 should look out for the interests of my Department
4 and the State in general in that process, and I
5 think we ought to have some agreement with whatever
6 businesses that are in with us, some arrangement,
7 some legal or business arrangement where there is
8 the state and the citizens accrue benefit from
9 this.

10 So I think if you look at this in the
11 way -- I think John did a great job -- is all this
12 stuff has to be thought about and framed out, and
13 what we're putting before you today are the
14 questions that need to be answered and what we see.
15 We've taken a lead, and we said: Here are the
16 possibilities, here are the challenges, and here's
17 the framing. We're trying to frame the debate and
18 the discussion, and that's why we're so happy to be
19 here in front of this Committee to sort of put that
20 forward.

21 To answer your question directly, I don't
22 know what those benefits are, but I would certainly
23 think that there would be significant benefit to
24 the citizens, to the businesses in the state and to
25 the State Government.

1 SENATOR STOUT: Thank you.

2 CHAIRMAN WHITE: If we were to develop
3 such a facility, do you envision that we could
4 reserve that capacity for Pennsylvania power plants
5 or do you think we might be in a position of having
6 to open it to all commerce?

7 MR. QUIGLEY: I would imagine, Senator,
8 that the lawyers would have to carefully consider
9 the Interstate Commerce Clause. There are some
10 practical limits relative to transportation of
11 liquefied CO₂. At some distance it becomes cost-
12 prohibitive, so again, depending on where the
13 facility might, a first facility might be sited, it
14 might be too distant from other out-of-state
15 emitters to be financially feasible.

16 CHAIRMAN WHITE: So there is some circle,
17 in other words, locational? That makes sense.

18 MR. QUIGLEY: Right. And that's one of
19 the things that we're trying to understand right
20 now is, what are the transportation economics
21 involved? There's been a lot of work done, and
22 we're combing through and trying to understand this
23 and get the best information available.

24 CHAIRMAN WHITE: Well, I was interested in
25 your comment about market security. It just seems

1 to me that we're sort of at a bad time to be
2 talking about capital markets and trying to get
3 what we need to get one of these things done.
4 Unless there is significant State involvement right
5 now, I don't know where we're heading. Do we have
6 cost estimates on this?

7 MR. QUIGLEY: Well, it depends on what
8 piece you're talking about. To actually develop,
9 fully develop a sequestration site, just the actual
10 we would have to run seismic lines, build test
11 wells. One well can cost upwards of \$2 million.
12 Ballpark? We've estimated based on work that the
13 MRCSP has done and scaling that up, somewhere
14 between 5 and 10 million dollars to actually
15 develop and have ready to open a geologic
16 sequestration facility.

17 The question becomes what size, how long
18 will that facility last? The approach, the logical
19 approach would be to try to size that facility such
20 that they could serve multiple emitters for a very
21 long time horizon. The cost of capture is another
22 question entirely. Right now there's any number of
23 estimates about what the additional costs would be
24 to capture carbon emissions. Kind of the mode if
25 you look at and consider the statistical analysis,

1 you have a mean median mode, an average, the most
2 frequently occurring number, what's in the middle.
3 What's in the middle right now is something on the
4 order of 30 to 40 dollars per ton or 30 to
5 40 percent more costly than current generation, but
6 that number has never been tested in the real
7 world, and there is a limit to its value. The MIT
8 study suggests that with at scale pilot projects,
9 that cost, whatever it is, can be driven down very
10 significantly and perhaps very rapidly, so that
11 might be one --

12 CHAIRMAN WHITE: You mean by volume?

13 MR. QUIGLEY: By volume and by testing and
14 demonstrating the technology, by advancing it in
15 terms of innovation and adaptation of the
16 technology. They suggest that getting down that
17 cost curve can be done relatively quickly. So I
18 wouldn't want to put too much emphasize on any cost
19 estimate that is out there right now because it's
20 essentially a paper calculation that needs to be
21 tested at scale in the real world.

22 Directionally it gives you some
23 information, but our fundamental belief is that
24 there is a real opportunity that we can do
25 something at a utility plant scale and not only

1 capture the economic development upside but to
2 radically drive down these cost curves and make it
3 something that is actually affordable in terms of
4 electricity and not have a negative impact on
5 economic growth.

6 CHAIRMAN WHITE: We have a little bit of a
7 chicken and an egg?

8 MR. QUIGLEY: Yes, absolutely, absolutely.

9 CHAIRMAN WHITE: Is this technology
10 similar to deep well injection?

11 MR. QUIGLEY: The underground storage,
12 yes. It is very similar to underground natural gas
13 storage. You drill the well to target formation
14 and you pump liquefied CO₂ into that well, and then
15 it disperses and resides in the pore space of the
16 rock just like natural gas storage is essentially
17 done in rock.

18 There is a magic number. CO₂ will stay
19 liquid if it's below 2,500 feet. The target
20 formations that we're looking at in Pennsylvania
21 are probably 4 to 5 thousand feet and deeper, so
22 that liquid CO₂ will stay liquid indefinitely and
23 reside in the pore space of the rock and not impact
24 ground water and so forth.

25 CHAIRMAN WHITE: Any other questions?

1 Thank you. This has been very informative.

2 SECRETARY DiBERARDINIS: Thank you.

3 MR. HENDERSON: Our next witness is
4 Jonathan Mathews, Assistant Professor for the
5 Department of Energy and Mineral Engineering, at
6 Penn State University

7 CHAIRMAN WHITE: Good morning.

8 MR. MATHEWS: Good morning, Chairman,
9 members of the Committee. Thank you very much for
10 the invite and the opportunity to be here. I'd
11 first like to commend DCNR for putting forth this
12 extensive document that really achieves I think its
13 main goal of starting out, of giving some
14 indication where the opportunities are and where
15 the barriers for moving forward. I don't have a
16 written statement, but I do have some insights and
17 some comments that I would like to add.

18 CHAIRMAN WHITE: We would also appreciate
19 your comments on what you have heard from the
20 previous testimony, if you have any.

21 MR. MATHEWS: Certainly the State of
22 Pennsylvania is very important for energy
23 nationally. Historically, we've played a very
24 significant role whether it be in anthracite coal,
25 the Industrial Revolution, whether it be for

1 drilling for oil in Titusville. There are examples
2 with natural gas. We see leadership now in
3 renewables, portfolio energy and moving forward
4 with things like ethanol and biodiesel.

5 I think the report correctly identifies
6 that there is an interesting opportunity for
7 Pennsylvania, specifically in the area of CO₂
8 sequestration. There is no silver bullet. There
9 is going to have to be a portfolio of methodologies
10 used. I don't think there is going to be such a
11 bad thing. Carbon storage anywhere is going to be
12 a good thing. It's going to be a question of
13 scale, and that's very much one of the things that
14 I would like to address is that the issue of global
15 climate change and mitigating CO₂, or preventing the
16 CO₂ from being in the atmosphere, is really a grand
17 challenge. It is something that's at a remarkable
18 scale. When you look to see what it is we'll have
19 to achieve, this is something that is going to take
20 a lot of resources and a lot of energy and effort
21 on the part of many people throughout the
22 Commonwealth.

23 When you look to CO₂ sequestration
24 options, enhanced oil recovery is by far the one in
25 which there is the most confidence. There is over

1 a 40-year history of putting carbon dioxide in the
2 ground, to increase the pressure to help drive
3 crude oil out of that ground. It's not been
4 extensively done in Pennsylvania to my knowledge,
5 and there would be some interesting challenges
6 because of the history of the region and things
7 like orphan wells, but the industry is very
8 confident with that regard.

9 Other options such as coal-bed methane and
10 sequestration in unmineable coal mines, unmineable
11 coal beds, sorry, is another option. Orion
12 certainly has the largest capacity and is certainly
13 a target for much of the work that's being done,
14 and then the oil and natural gas fields are other
15 locations of potential sequestration sites. I
16 would add that the state is the third in the nation
17 in CO₂ emissions. We're also the fourth in the
18 nation with coal mining. The two go somewhat
19 hand-in-hand, and I commend the report on
20 identifying that CO₂ may not necessarily be a
21 burden but could be a great opportunity for the
22 Commonwealth.

23 If we have the ability to sequester and we
24 demonstrate this at scale, and then there is the
25 opportunities with Federal money, research money,

1 and one of the things I'm interested in is bringing
2 along the human capacity we will need to address
3 the carbon constraint work. Portions of -- certain
4 nations are already in a carbon constrained world.
5 We very much believe it's coming, and what will
6 happen is we'll see it coming in various stages
7 presumably, but the average coal-fired power plant
8 in the United States is of my age. That means they
9 were built in the 1960s, late 1960s I might like to
10 add for the record, but anything we construct now
11 to meet this growing electricity demand that we
12 need to serve the Commonwealth is likely going to
13 be around for 40 to 50 years, and so now is an
14 appropriate time to address these issues and look
15 forward to identifying how we can mitigate or how
16 we can prevent that CO₂ from being emitted into the
17 atmosphere to slow global climate change.

18 I would add that I've been involved in
19 coal research for close to twenty years, energy,
20 environmental education for over ten years and
21 sequestration research in coal for the last eight
22 years. During this time period remarkable changes
23 have occurred in the public's desire and the
24 recognition of the influence of climate change and
25 the growing need to do something about it, so I

1 without advancing CO₂ no one's going to be
2 injecting it in the ground. There's been some
3 interesting demonstrations. We should keep careful
4 eye on the regional partnership's activities, and
5 internationally we're seeing a lot more
6 demonstrations going on. Relatively small scale,
7 but I think it is important that we move up to a
8 large scale demonstration.

9 CHAIRMAN WHITE: Do you see a consortium
10 of some kind doing that as opposed to an individual
11 state or company?

12 MR. MATHEWS: I think these are things
13 that should be explored. I think some of the
14 geology crosses borders and is very similar, and so
15 in those cases there is certainly opportunities for
16 partnerships. In other areas you see very
17 different geology and very different opportunities
18 for different types of sequestration, and so in
19 those cases much less so.

20 I would also like to add that I think not
21 only with electricity growth predicted now, we see
22 electric vehicles impacting the transportation
23 market and coal to liquids coming on that also go
24 along with an additional role to play in the
25 transportation market that could even increase its

1 current estimates.

2 CHAIRMAN WHITE: The question that keeps
3 coming back to me is if the State assumes the
4 liability, if you will, like in the Illinois
5 project, what are the risks? Carbon dioxide
6 doesn't particularly scare me in terms of health
7 effects, but once it's liquefied and injected into
8 the ground, what are the risks of escape, sudden or
9 gradual, and what are the potential impacts on
10 human health and safety?

11 MR. MATHEWS: It's an interest question to
12 be addressed, and it varies depending on what type
13 of formation you're going to be injecting into. I
14 think that we can have a reasonable amount of
15 confidence that if you're injecting CO₂ into a
16 location where a gas or even a liquid has been held
17 over geological ages, millions of years, that there
18 should be some reasonable confidence that it will
19 stay there. There are research issues that need to
20 be addressed to ensure that you don't
21 overpressurize, that you don't acidify the water
22 too much and start developing --

23 CHAIRMAN WHITE: Again, that's pretty
24 much -- we've done projections, haven't we?

25 MR. MATHEWS: Yes.

1 CHAIRMAN WHITE: We know how to pressurize
2 wells?

3 MR. MATHEWS: We learn from our mistakes,
4 and so there is certainly a great deal of knowledge
5 in the natural gas industry for storing methane in
6 geologic storage. This is going to be slightly
7 different, but you certainly need to go back and
8 look to find out what is our state of knowledge to
9 see what's going on.

10 In things like oil, in abandoned oil wells
11 or active oil wells, if there are orphan wells,
12 then that's a mechanism by which CO₂ could escape
13 to the surface again. It's all a question of rate.
14 I don't think we're looking at events where you'll
15 get large die-offs of vegetation, but it's very
16 difficult to find these orphan wells. I think in
17 fact in some cases the way you find them is you
18 look to see biomass blooming of CO₂ would be
19 helpful. If it's being released at a relatively
20 slow rate and slow concentration, you would see a
21 greening of the area from where the CO₂ emission is
22 coming from.

23 But it's the catastrophic release, it's
24 the large scale release that is a concern, but
25 generally because the geologic storage traps the

1 CO₂ in either pore space, so between very small
2 grains of sand, or in the case of coal, in pores
3 that are only slightly bigger than the CO₂
4 molecule, it's very difficult to get these things
5 out, so any deliberate attempt to drill down into
6 the coal seam to try and release the CO₂, you'll
7 find it's a very slow process of release.

8 We know this with the coal-bed methane
9 industry that even a coal core of a certain size
10 might take a year in a worst case scenario to
11 actually release its methane, so each individual
12 sequestration site and its history and its
13 placement will impact the safety. There's some
14 interesting work done out at the Lawrence Livermore
15 National Lab where they've looked at an abandoned
16 well and release of CO₂ and whether it was
17 hazardous to the public health, and those are the
18 sort of risk assessments that we would need to do
19 for any potential sites.

20 CHAIRMAN WHITE: Did that study reach any
21 conclusion?

22 MR. MATHEWS: That particular
23 presentation, and we have natural analogs of CO₂
24 coming out of the ground, is that there was no
25 public health risk in those endeavors. There are

1 other natural analogs where that's certainly not
2 the case where it is a very dangerous situation,
3 but these are not necessarily related to geologic
4 sequestration. It is more volcanic activity and
5 the like.

6 CHAIRMAN WHITE: Questions? Senator
7 Erickson? Senator Stout, any questions? Senator
8 Williams?

9 SENATOR WILLIAMS: You mentioned the
10 resources. Do you have any idea of the magnitude
11 that we're talking about involved with what is
12 necessary for the process to move along?

13 MR. MATHEWS: Not really. I think for the
14 process to move along, more in long time resources,
15 human capacity is something that we should be
16 concerned about. I'm sure the Committee is aware
17 of the demographics of the energy industry and that
18 that many of them joined in the oil issues of the
19 1970s, and much of our human capacity and
20 experience is closer in time to retiring, and so
21 that we have a human capacity issue that we want to
22 make sure that we have the right people in place to
23 meet this growing opportunity.

24 And it's also an interesting opportunity
25 in the sense that we don't train people necessarily

1 to be carbon sequestration personnel, but the
2 issues that are involved go cross-disciplinary,
3 interdisciplinary, so it is an interesting teaming
4 of people that you need to ensure movement forward.
5 But if the question is how much money do we need to
6 move forward, I --

7 SENATOR WILLIAMS: Actually it's both, and
8 the part that you're mentioning is one that in a
9 different part of activity here I spend a lot of
10 time on is the fact that in science, engineering,
11 math we are far behind the rest of the globe, and
12 consequently, as a matter of fact, the numbers I
13 just read the other day are that India, China, and
14 Japan are outproducing us. We used to outproduce
15 them, and now they're outproducing us, so forget
16 the fact that we're dependent on them for money.
17 We will be depending upon them for intellectual
18 infusion in terms of this industry, and we're
19 actually outsourcing our jobs but importing people
20 to do the jobs here. I guess that's what you're
21 talking about.

22 MR. MATHEWS: Absolutely. We need to have
23 learning and learn the skill that we can drill down
24 and place pipes in the ground, but we also need the
25 people with the skills to do it, and it goes

1 across-the-board from hydrologists to reservoir
2 modelers to coal scientists to GIS experts.

3 CHAIRMAN WHITE: Is this significantly
4 different than what we've been using in oil and gas
5 operations, petroleum engineers, geologists,
6 hydrologists? Aren't they the same disciplines
7 essentially?

8 MR. MATHEWS: In many cases they are, and
9 the oil industry isn't a collection of an
10 individual entity. I think though when you start
11 looking at some of the specialty cases like
12 unmineable coal, coal scientists come into the mix.
13 You start adding in some different structural
14 entity. When you go into monitoring, mitigation
15 and verification, these are some of the same
16 people, but we're adding another skill set.

17 I think the Committee's well aware that
18 coal companies, oil companies and now energy
19 companies, they're changing their range of
20 portfolio, so this is very much a similar sort of
21 sense in that now we see an expanding perhaps of
22 the skill set or teaming of skill sets that will be
23 necessary to safely do this at scale.

24 SENATOR WILLIAMS: Actually, I'm not sure
25 we as a Committee frankly or we as a Commonwealth,

1 nor as a nation are we educated in what you're
2 talking about. We're talking about this in like
3 low volume tones. We are at a very jeopardized
4 level when it comes to what you're talking about,
5 having people retiring. We really don't have a
6 bench.

7 MR. MATHEWS: The human capacity should be
8 a very serious concern moving forward in our energy
9 policies. With things like petroleum, natural gas
10 engineers, they're going to the oil industry and
11 making a significant amount of money, as are coal
12 mining engineers -- mining engineers, and to have
13 excess capacity to try and do something new is
14 going to be very restrictive.

15 SENATOR WILLIAMS: The other part, I was
16 talking about money, but I put them frankly at
17 equal levels, because I think even if we showed up
18 with a bunch of money, we would find that we would
19 be very challenged to find the people to do the
20 work that we would want to do. That's it. Money.
21 I'm not asking for a dollar figure so much as where
22 do we go to as a Committee to understand.

23 Our Chairman commented on whether it is
24 the government, private sector or market, where do
25 you go to find the level of commitment that's

1 required by the Commonwealth, not by the nation,
2 but by the Commonwealth, to get engaged in this
3 kind of development?

4 MR. MATHEWS: I think that hopefully the
5 ideal situation is a teaming effort where you
6 utilize the resources that we have available to us,
7 be it State resources, which we have a great deal,
8 the intellectual base of the leading research
9 universities, industry, that has a lot of
10 experience, and it's hopefully a teaming effort.

11 I would say that even though moving to a
12 demonstration scale is important, there are some
13 fundamental questions that still should be
14 addressed, and it's accompanying research with
15 demonstrations is something that could be improved
16 upon in future endeavors.

17 SENATOR WILLIAMS: Two things. One, this
18 does indirectly point to some things we need to do
19 in other committees, the issue of schools. The
20 students that are coming here, some are on
21 scholarships. We have a wonderful higher education
22 body that relates to this area, but a lot of the
23 students that are now showing up in these graduate
24 levels who are studying this stuff are from other
25 countries, and they are leaving. At this point

1 what we may need to do as a Commonwealth is start
2 figuring out how we control access to this
3 information for our own benefit, and the students
4 who are going to be here on scholarship, we're
5 going to ask for them to return.

6 And the last thing is, I note on here it
7 says the Pennsylvania State University. You're an
8 Assistant Professor there?

9 MR. MATHEWS: That's correct.

10 SENATOR WILLIAMS: Is that Penn State?

11 MR. MATHEWS: Yes. We are.

12 SENATOR WILLIAMS: They don't say, "We are
13 Pennsylvania State University." They say "Penn
14 State," right?

15 MR. MATHEWS: Absolutely.

16 SENATOR WILLIAMS: Congratulations this
17 year so far.

18 MR. MATHEWS: Thank you. We had a good
19 run.

20 CHAIRMAN WHITE: Any other questions? I
21 just have one. When you transport this material
22 from the place of generation to the place of
23 storage, I heard you say it's in a liquid form?

24 MR. MATHEWS: In most cases you will
25 compress it and put it into liquid form. That's

1 for ease of transportation. If you were going into
2 a relatively shallow coal field where you're below
3 that depth necessarily to make it liquid, there is
4 a different mechanism of absorption. It wouldn't
5 necessarily have to be liquid. But any
6 transportation over any distance, liquid is going
7 to be the most desirable form.

8 CHAIRMAN WHITE: When you say over any
9 distance, what are we talking about, miles?

10 MR. MATHEWS: That I'm not sure of. But
11 again, depending on how you're capturing it and
12 depending on where you're going to inject it, it
13 makes -- you have changing penalties in converting
14 between a gas into liquid or vice versa, and so
15 what you want to do is even if you're going to be
16 putting it in a liquid format, you may as well get
17 the benefit of transporting it in that liquid
18 format with pressure, by pressurizing it rather
19 than chilling and then transporting it that way.

20 CHAIRMAN WHITE: So I guess my question
21 was are there special challenges in the
22 transportation of the material from point of
23 generation to the point of --

24 MR. MATHEWS: We do have an existing CO₂
25 pipeline network, so those issues have mostly I

1 think been resolved. There are standards for the
2 quality of CO₂. You wouldn't want to have any
3 sulfur dioxide or water in the CO₂, because it would
4 lead to corrosion in your pipelines, so I think
5 that is perhaps not the larger issue.

6 The larger issue is in things like the
7 cement and metals that are going to be underground
8 in that environment where they could be attacked by
9 CO₂ over geologic ages, having to ensure things
10 like concrete, the cement that they use, that we
11 can seal these entities and seal them for
12 geological time. So there is some interesting
13 research to be done with CO₂/metals interface and
14 concretes and well casings and things of that
15 nature.

16 CHAIRMAN WHITE: Thank you. Any further
17 questions of the panel? Thank you very much,
18 Professor Mathews.

19 MR. MATHEWS: Thank you.

20 SENATOR STOUT: One other question, Madam
21 Chair. I understand electric generating plants,
22 they consume about 8 percent of their output to run
23 the operation. Is there any figure of what the
24 carbon sequestration, how much energy would it
25 consume?

1 MR. MATHEWS: It would be considerable
2 depending on how you generate your electricity and
3 the efficiency of your plant. 25 percent,
4 35 percent are numbers that have been discussed.

5 SENATOR STOUT: So that can consume up to
6 25 to 30 percent of the output of the generation of
7 the plant. Most in Pennsylvania are coal-fired.
8 And I know the question about the methane, the
9 Courts have determined that the coal companies own
10 the methane, when they own the major seams. In
11 driving out methane and so forth, who would get the
12 revenues from that methane gas?

13 MR. MATHEWS: I'm probably not the best
14 person to answer that. Obviously, the ownership of
15 coal-bed methane is an interesting question because
16 there's been arguments in court over whether it's a
17 coal mine or coal ownership or whether it's natural
18 gas ownership, and we have this interesting mixture
19 of these things in the state, in the Commonwealth,
20 so we have both sort of cases going along. I'm not
21 sure on the legal aspects of who has ownership to
22 coal mine methane or coal-bed methane.

23 SENATOR STOUT: In southwestern
24 Pennsylvania, they mainly mine the Pittsburgh seam
25 of coal, but now they're looking at mining the

1 Freeport seam of coal, which is deeper, and it
2 comes and goes in thickness, but this process would
3 not adversely affect the Freeport seam of coal?

4 MR. MATHEWS: If you're going to be mining
5 a coal seam, it seems the industry is moving
6 somewhat more towards predrainage of the methane.
7 When I'm talking about CO₂ sequestration, they're
8 thinking of putting it away from active mining
9 areas in the deeper coal seams that you would not
10 mine. Most mining done in the United States I
11 believe is at a depth less than 1,000 feet. There
12 are much deeper examples when coal quality is high
13 enough, but we want to stay away from active mining
14 areas, and we would not inject CO₂ in a coal seam
15 that we intended to mine in the future.

16 If the question is on coal mine methane,
17 coal-bed methane, then you extract the methane
18 without the process of CO₂ sequestration just by
19 drilling holes, and I have a graduate student
20 involved in that research. There are huge
21 benefits. One is that you capture the methane, it
22 is easy to capture at that point because it's
23 concentrated, rather than let it go out with mine
24 air. You require less electricity for the fans
25 that pull and push mine air throughout the coal

1 mine, and, of course, there's the added benefit of
2 safety that should not be negated. And you enhance
3 productivity because you don't have to shut down
4 because of gas building up.

5 SENATOR STOUT: Thank you.

6 CHAIRMAN WHITE: Thank you very much.
7 Thanks to the Committee, and thank you very much
8 for your information.

9 MR. MATHEWS: Thank you.

10 SENATOR WHITE: That concludes the
11 hearing.

12 (Whereupon, the proceedings were concluded
13 at 10:23 a.m.)

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CERTIFICATE

I hereby certify that the proceedings and evidence are contained fully and accurately in notes taken by me on the within proceedings, and that this copy is a correct transcript of the same.

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