

Stenographic Transcript
Before the

COMMITTEE ON ENERGY & NATURAL
RESOURCES

UNITED STATES SENATE

FIELD HEARING TO CONSIDER RENEWABLE ENERGY
PRODUCTION, STRATEGIES, AND TECHNOLOGIES
WITH REGARD TO RURAL COMMUNITIES

Saturday, August 22, 2009

Chena Hot Springs, Alaska

ALDERSON REPORTING COMPANY
1155 CONNECTICUT AVENUE, N.W.
SUITE 200
WASHINGTON, D.C. 20036
(202) 289-2260

1	CONTENTS	
2	STATEMENT OF	PAGE
3	OPENING STATEMENT OF HON. LISA MURKOWSKI, U.S. SENATOR	
4	FROM ALASKA	3
5	STATEMENT OF DR. BRIAN HIRSCH, SENIOR PROJECT LEADER,	
6	ALASKA, DEPARTMENT OF ENERGY'S NATIONAL RENEWABLE	
7	ENERGY LAB	12
8	STATEMENT OF STEVE HAAGENSON, DIRECTOR, ALASKA ENERGY	
9	AUTHORITY	22
10	STATEMENT OF GWEN HOLDMANN, DIRECTOR, ALASKA CENTER FOR	
11	ENERGY AND POWER, UNIVERSITY OF ALASKA, FAIRBANKS	31
12	STATEMENT OF CHRIS ROSE, EXECUTIVE DIRECTOR, RENEWABLE	
13	ENERGY ALASKA PROJECT	39
14	STATEMENT OF BERNIE KARL, PRESIDENT, CHENA GEOTHERMAL	
15	ENERGY LLC	68
16	STATEMENT OF BARBARA DONATELLI, VICE PRESIDENT, FIRE	
17	ISLAND WIND FARM, COOK INLET REGION INC.	75
18	STATEMENT OF JIM DODSON, PRESIDENT, FAIRBANKS ECONOMIC	
19	DEVELOPMENT CORPORATION, MUNICIPAL SOLID WASTE PROJECT	
20	PROJECT	82
21	STATEMENT OF DOUG JOHNSON, ALASKA PROJECT DIRECTOR,	
22	OCEAN RENEWABLE POWER COMPANY	91
23	STATEMENT OF DENNIS MEINERS, INTELLIGENT ENERGY	
24	SYSTEMS	96
25		

1 FIELD HEARING TO CONSIDER RENEWABLE ENERGY
2 PRODUCTION, STRATEGIES, AND TECHNOLOGIES WITH REGARD TO
3 RURAL COMMUNITIES

4
5 Saturday, August 22, 2009

6
7 U.S. Senate
8 Committee on Energy and
9 Natural Resources
10 Chena Hot Springs, Alaska

11
12 The Committee met, pursuant to notice, at 10:22 a.m.
13 at Chena Hot Springs Resort, Milepost 56.5, Chena Hot
14 Springs Road, Hon. Lisa Murkowski, presiding.

1 OPENING STATEMENT OF HON. LISA MURKOWSKI, U.S.
2 SENATOR FROM ALASKA

3 Senator Murkowski: All right. Good morning. We will
4 call to order this hearing, this field hearing of the
5 Senate Energy and Natural Resources Committee. The hearing
6 this morning is concerning the potential importance of
7 renewable energy power sources to meet our nation's energy
8 needs.

9 It's wonderful to be here at Chena Hot Springs. It's
10 wonderful to be outside, even if we are in a tent, but
11 being here on a Saturday morning on a glorious Interior day
12 is terrific.

13 What we are -- what we will focus on today is the
14 important of renewable energy power sources, as I say, to
15 meet our nation's energy needs, what types of technology we
16 should be working to foster, what financial assistance may
17 be needed from Congress to make these differing types of
18 energy expand nationwide. And, of course, particular
19 interest at this hearing is the use of renewable energy in
20 high-cost rural areas.

21 Before I move further into my opening comments, I want
22 to recognize a few individuals. First, my -- where'd he
23 go -- my colleague, Senator Stevens, has joined us here
24 this weekend. Senator Stevens has long been a leader in
25 advancing energy issues in this state, and I'm delighted

1 that he is with us today. We have Representative Paul
2 Seaton from Homer who is with us. We also have
3 Representative John Harris -- actually Speaker John Harris
4 has joined us. And as others come into the room, I'll
5 hopefully be able to acknowledge them as well.

6 We know that renewable energy has been a topic, a very
7 popular topic, in recent years in Congress. Back in 2005
8 we passed the Energy Policy Act. We provided in that act a
9 host of research and development grants and tax aid for
10 renewables. Then in 2007, in the Energy Independence and
11 Security Act, we went even further, providing more aid for
12 geothermal and for ocean energy projects, and earlier this
13 year we extended the renewable tax credits for a number of
14 years. This winter the Obama Administration suggested that
15 this country should be spending \$15 billion a year to
16 expand renewable energy production.

17 We know that we've got a long ways to go to when it
18 comes to furthering the use of renewal energy. Petroleum
19 last year accounted for 39 percent of our total energy
20 needs, natural gas accounted for 23 percent, coal 22
21 percent, and nuclear power at 8 percent. All renewables
22 together accounted for just 7 percent of our nation's total
23 energy production, and what we think of as new renewable,
24 which is the wind, the solar, the geothermal, and new forms
25 of biomass, this is just at about 3 percent. So we've got

1 a long ways to go.

2 But it is a real improvement in the past five years.
3 Since 2003 we've seen wind energy generation has tripled,
4 up above 1 percent of total energy generation. Biomass
5 still leads all renewables, accounting for 53 percent of
6 renewable energy with hydropower in second place at 36
7 percent. Wind and geothermal are holding in there at about
8 5 percent, solar electricity accounts for 1 percent of
9 renewable energy, and ocean marine energy development is
10 barely a rounding error at this point in time.

11 But as Alaskans we know that renewable energy offers
12 great potential in this state, where we see -- particularly
13 during the winter, our electricity from diesel generation
14 costing about -- an average of about 65 cents per kilowatt
15 hour. I was in Newtok yesterday. They're sitting at about
16 85 cents a kilowatt hour. Given those prices, anything
17 that supports free fuel may produce real cost savings, if
18 the capital construction costs can be financed and can be
19 controlled.

20 About 40 percent of the state might benefit from
21 geothermal energy, either shallow vent geothermal, or the
22 future enhanced geothermal systems that are now under
23 study.

24 Right now about 24 percent of our state's total
25 electricity comes from hydropower. There's about 28 hydro

1 projects that are currently producing electricity
2 statewide. But we've got about another 250 projects that
3 are already identified sites for hydroelectric generation
4 from lake taps to water diversion from streams and rivers.

5 We lead the nation here in Alaska in the amount of
6 power that we could gain from ocean marine hydrokinetic
7 projects, using the waves, using the currents to produce
8 our power. Just the state's southern coast theoretically
9 could produce 1,250 terawatts of power a year. This is 300
10 times more power than Alaskans use each year.

11 We also lead the nation here in Alaska in traditional
12 per capita biomass. Alaskans are burning about 100,000
13 cords of firewood each year for space heat. The state is
14 already burning 8 million gallons of fish oil a year down
15 in Kodiak to power boilers to dry fish meal, and using some
16 of that for electricity generation.

17 We generate 650,000 tons of garbage a year, which
18 Fairbanks is already planning to convert into energy.
19 Anchorage is underway on generating 2.5 megawatts of
20 electricity from methane gas produced by the Anchorage
21 landfill. This is enough to power 2,500 homes. And none
22 of these forms of biomass take into account the 9.5 million
23 acres of timber lands in the Tongass National Forest in the
24 Southeast, or the lands and timber lands in the Chugach
25 National Forest down in Southcentral.

1 We all know about our enormous wind potential here in
2 the state. Kotzebue has 17 wind turbines that are
3 currently producing about 8 percent of the community's
4 power. There's more wind turbines already erected in
5 dozens of villages in rural Alaska. And most of southern
6 and western Alaska possess the best wind potential in the
7 whole country. We've got the Fire Island wind farm that's
8 on the threshold of construction in Anchorage, there are
9 good wind sites south of Fairbanks, and AVEC, the Alaska
10 Village Electric Co-op hopes to install more than 50
11 turbines in 36 rural villages, as -- got to find money,
12 it's always about the money. But the plan is out there.

13 And all of these sites, particularly the large
14 geothermal sites in the Aleutians and the hydro sites,
15 offer the possibility of using renewable energy to generate
16 hydrogen fuel or ammonia fuel that hopefully, someday, we
17 could export, like we export our oil today, to fuel
18 Alaska's economy of the future.

19 Now, hearing is meant to focus on the renewables, to
20 look at what the development can mean for the state, and
21 especially to look at the very innovative ways that
22 technology can be used to generate renewable energy and
23 energy efficiencies that will ultimately lower consumers'
24 costs.

25 And, you know, I mentioned the high prices that we're

1 paying. When we think about what happened last year when
2 Alaska as a state -- actually the country as a whole, but
3 more particularly the remote villages just got nailed with
4 the high prices of fuel, and, you know, we don't have a lot
5 of margin for air there.

6 We've got congressional hearings back in Washington
7 DC. Some of you have had an opportunity to speak to them.
8 The congressional hearings are a little bit different breed
9 than what you may have experienced if you have gone down to
10 Juneau. Congressional hearings almost never permit
11 unlimited verbal testimony, although someone can submit
12 written testimony for the hearing record. And I'll give
13 you the address later if you would like submit some
14 testimony if what you hear today prompts something that you
15 would like to submit.

16 Today at the hearing we've got two panels of witnesses
17 intended to provide a host of information. The witnesses
18 will cover an overview of renewables, their need and
19 potential, and what the federal government should be doing
20 to increase their energy generation. I expect we're going
21 to hear some innovative suggestions. I hope we will get
22 some innovative suggestions for the technology in the
23 future, and perhaps better information than what we get in
24 Washington for how renewables can be harnessed to generate
25 the power while we're producing less carbon.

1 We have a court reporter here today, and everything
2 that is said will be part of the record to be taken back to
3 DC, and this testimony from the hearing will be made
4 available to other senators on the Energy Committee
5 hearing. So the good ideas that are presented today will be
6 reviewed and studied by the Senate members and staff. So
7 I'm hopeful that this hearing will be a useful springboard
8 to advance renewable energy development, both here in
9 Alaska and nationwide.

10 So hopefully, we're counting on it being a good
11 sounding board to hear what we in Congress should be doing
12 when it comes to both a policy and a financial aid
13 standpoint to help renewable energy development.

14 The sites today -- when I spoke with Senator Jeff
15 Bingaman, who is the chairman of the Energy Committee, and
16 indicated that we wanted to hold this field hearing at the
17 Chena Energy Fair, we indicated that this was the perfect
18 place to do it. Chena is the first site in the country,
19 first site in the country, to sport a working
20 low-temperature geothermal power plant. As you know, the
21 plant is powering the PA system here this afternoon and
22 everything else from the ice museum's chiller system to the
23 greenhouse fans and lights.

24 And then later this afternoon I will be participating,
25 as I'm sure many of you will, in the christening of the

1 first truly mobile, self-contained geothermal power plant.
2 It's been built here, and it's awaiting field testing in
3 Florida.

4 The innovations here at Chena that have been developed
5 by Bernie Karl, who will be one of our witnesses on the
6 second panel, and those who have helped him, are truly an
7 inspiration a host of renewable projects that are under
8 consideration throughout the state. Whether it's the
9 Fire Island wind project or Mount Spurr or Naknek,
10 Manley Hot Springs, Atukan, the geothermal projects.
11 Whether it's the hydro projects that we're talking about,
12 Lake Chakachamna, Susitna, the Grant Lake hydropower near
13 Dillingham, we've got Thayer Creek down in Angoon. There's
14 so much out there.

15 So I'm hopeful that with this hearing and what we
16 gather today, we're going to be moving towards the day when
17 there are the resources at the federal, state, and local
18 level to make these projects proceed. Later this afternoon
19 at the energy fair, I'll talk a little bit more about what
20 the federal aid is and what's out there and available to
21 further renewables. But right now I would like to hear
22 from our witnesses about what more we should be doing to
23 spur our renewable power generation, where we should be
24 focusing those limited resources.

25 So today, this morning, we have on our first panel

1 Mr. Brian Hirsch. He's the senior project leader in Alaska
2 for the U.S. Department of Energy's National Renewable
3 Energy Lab. We also have a gentleman that is familiar to
4 so many in the energy world, Steve Haagenson, who's the
5 director of the Alaska Energy Authority. We have Gwen
6 Holdman. Gwen has taken me around Chena here numerous
7 occasions explaining all the wonders of what goes on. Gwen
8 is now the director of the Alaska Center for Energy and
9 Power at the University of Alaska Fairbanks. And we also
10 have Chris Rose. Chris has truly been a leader in
11 renewable energy. He's the executive director of the
12 Renewable Energy Alaska Project.

13 So, ladies and gentlemen, it's a pleasure to welcome
14 you here today. And without further adieu, why don't we
15 start with you, Mr. Hirsch, and just go down the line.
16 We'd ask you to try to limit your comments to about five
17 minutes. Your full written statement will be included as
18 part of the record. So if you want to summarize or add on
19 anything, we'd certainly appreciate it. But welcome to
20 you.

21

22

23

24

25

1 STATEMENT OF DR. BRIAN HIRSCH, SENIOR PROJECT LEADER,
2 U.S. DEPARTMENT OF ENERGY'S NATIONAL RENEWABLE ENERGY LAB

3 Dr. Hirsch: Thank you, Senator. Thanks for the
4 opportunity to discuss renewable energy technology and
5 development, especially as it pertains to rural energy in
6 Alaska, and the U.S. Department of Energy's involvement in
7 these issues.

8 As you stated, I am Brian Hirsch, on assignment here
9 in Alaska with the National Renewable Energy Laboratory,
10 which is the U.S. Department of Energy's primary National
11 Laboratory for research and development on energy
12 efficiency and renewable energy issues.

13 In recent years DOE and NREL has been called upon to
14 provide on location technical assistance and support to
15 state and local entities, especially in locations like
16 Alaska where there's high costs, complexities, and
17 challenges around logistics and rugged climates.

18 We face many challenges here in providing energy for
19 the state and the nation. And my testimony here will look
20 primarily at what we've been able to accomplish, and
21 challenges and opportunities for the future.

22 Alaska's well known for our substantial fossil fuel
23 resources. We are less well known for our renewable energy
24 opportunities, but they are equally abundant. And we
25 believe that with proper development, they can support

1 vibrant communities, help the environment, and a prosperous
2 future. And we need look no further than Chena Hot
3 Springs, as you mentioned.

4 And the U.S. Department of Energy has been involved
5 very much with everything from the very initial wells and
6 development of the lowest temperature electricity producing
7 geothermal systems here, as well as the mobile geothermal
8 system that will be unveiled today, and an experimental
9 3,000 foot well that is also looking at enhanced geothermal
10 production that may have broader application throughout
11 Alaska and the country.

12 As you mentioned, the -- Alaska has substantial tidal
13 and wave potential. The Electric Power and Research
14 Institute estimates that Alaska has 80 percent of tidal and
15 50 percent of wave potential for the entire country. And
16 just harvesting a small portion of that would more than
17 meet Alaska's needs and allow us to export and support
18 energy needs in the Lower 48 and elsewhere and become a
19 renewable energy exporting state, as well as a fossil fuel
20 exporting state.

21 Challenges associated with that have to do with
22 converting the energy, delivering it shore, and where it's
23 needed, and storing it for the time of year. Because of
24 our extreme seasonality, Alaska is the most challenged of
25 any state in the country on these issues. And these are

1 the areas of our focus.

2 So, for example, we've been partnering with the Denali
3 Commission on an emerging energy technology grant program
4 that both the National Renewable Energy Laboratory and the
5 National Energy Technology Laboratory combined establishing
6 the Arctic Energy Office is on review committee, and we are
7 targeting experimental technologies that really have most
8 potential benefit for Alaska around these storage and
9 delivery issues.

10 Alaska has considerable wind resources, as you
11 mentioned. The U.S. Department of Energy has a cost share
12 with the state of Alaska on an anemometer loan program that
13 can measure the wind resources, and high-resolution wind
14 maps to identify and pinpoint where those wind resources
15 are. And we've identified over 100 communities, primarily
16 on the coastal areas, that have commercially developable
17 wind resource, or cost effective wind resource.

18 And we are -- we've -- over the past several years,
19 through congressionally directed projects, we have
20 supported initiatives around in Kotzebue, on Saint Paul
21 Island, in Selawik and other areas with the utilities in
22 those communities. DOE's and NREL's early support of these
23 projects help to answer important questions about wind
24 turbine performance in cold weather, constructing
25 foundations in permafrost, and integrating wind power into

1 local electric grids.

2 And because of these early and sustained efforts,
3 Alaska is now widely recognized as a world leader in
4 wind-diesel technology. And we are working closely with
5 the University of Alaska Fairbanks, Alaska Center for
6 Energy and Power to help establish what's called the Wind-
7 Diesel Application Center. And I suspect you may hear a
8 little bit more about that on this panel later. There's
9 also several community scale wind energy projects now
10 operating or under construction throughout the state as a
11 result of some of these early efforts.

12 DOE's Tribal Energy Program is quite actively
13 fostering solutions as well. For example, one of the
14 projects we thought of is a comprehensive biomass effort in
15 the village of Fort Yukon with the Council of Athabascan
16 Tribal Governments. And that project is looking at
17 everything from forest management and local business
18 development to diesel fuel substitution for district
19 heating, and eventually electricity production. Which,
20 electricity production is really a challenge still.
21 Heating is a lot easier to do, and so really the cutting
22 edge of the technology is using biomass for these combined
23 heat and power units. And so that's another area of focus
24 that once we figure that out will be widely transferrable
25 to other parts of the state, and likely the nation.

1 Other Tribal Energy Program successes include
2 photovoltaic or solar electric system installations in
3 Arctic Village, the furthest north tribally owned tracking
4 array in the world -- solar tracking array in the world in
5 Venetie Village and Lime Village. I was personally
6 involved in some of the installations prior to my work here
7 at NREL in Arctic Village and Venetie installations. And
8 DOE was a fundamental and important partner in both
9 installation and some of the monitoring and distribution of
10 the information and performance from those systems.

11 Like early wind projects, installing solar panels in
12 far northern regions, we've been able to answer questions
13 about how well the solar panels perform in cold weather.
14 And what we've found, among other things, is that cold
15 weather actually improves performance of the solar panels
16 because there's less resistance in the panel itself. We
17 haven't quite figured out how to get the solar panels to
18 produce energy in the dark yet. We're working on that one.
19 I think that's way out there in the future. But what we
20 realize more so, seriously, is that obviously solar panels
21 are not going to be a year-round solution. But for up to
22 eight months a year, they substantially improve the energy
23 portfolio in many of the rural areas.

24 In-stream hydrokinetic is another very promising
25 technology. And also in my former life prior to working at

1 NREL, I was involved in the installation of the first in-
2 stream hydrokinetic turbine in the country on the Yukon
3 River in the Village of Ruby. And there is an exact
4 replica of the turbine, I noticed, out here for people to
5 observe at the Energy Fair here today. And so that was
6 with the Yukon River Intertribal Watershed Council
7 Consortium of 70 tribes and the First Nations in Alaska and
8 Canada, along with the Ruby Tribal Council and the City of
9 Ruby. And there is tremendous potential of tapping of power
10 and moving water in Alaska's streams and rivers.

11 The Alaska SeaLife Center in Seward is researching the
12 use of ocean water as a heat source for heat pumps. And
13 this is another exciting and innovative project that has
14 wide-scale potential for replication throughout the
15 country -- throughout the state and country in coastal
16 areas.

17 And emerging opportunity that probably is not widely
18 recognized is improved energy efficiency with marine
19 vessels. Alaska produces over 50 percent of the nation's
20 sea food, and is highly dependent on long-distance shipping
21 for harvesting, importing and exporting, which adds
22 significant costs to all goods that come from outside. And
23 some new diesel engines, modern controls, and operational
24 strategies such as replacing hydraulics with electric
25 motors

1 have the potential to save between 10 and 40 percent of
2 existing fuel. And there's so many goods that come here
3 from outside that we don't quite realize the hidden costs
4 of some of that improved energy efficiency.

5 Along those lines we're also looking at electric
6 vehicles, in particular in the rural areas, for things such
7 as four-wheelers and snow machines. There's also an effort
8 on designing sight and culturally appropriate housing.
9 There's a project that the Cold Climate Housing Research is
10 doing -- Cold Climate Housing Research Center, excuse me,
11 is doing through their Northern Shelters Program that is in
12 Anaktuvuk Pass. And that is combining traditional Inupiat
13 design principles with modern technologies to create a low-
14 cost, net zero energy home that is also -- the process at
15 least is widely applicable to elsewhere.

16 My testimony is primarily focused on rural areas, but
17 DOE and NREL have also been active in Railbelt with our
18 regional integrated resource planning effort and looking at
19 some of those projects that you mentioned earlier, Senator,
20 the Fire Island wind project and Mount Spur geothermal and
21 Lake Chakachamma and Susitna hydro projects. We're also
22 working with developers and industry in Cook Inlet and
23 Kachemak Bay looking at some tidal resource potential for
24 the large urban areas of Alaska.

25 So as we prepare for energy efficiency and renewable

1 energy driven economic transition, we're also looking at
2 work force development issues, and trying to nurture green
3 jobs wherever possible. Also looking at smart grids which
4 have tremendous potential in Alaska because the grid is of
5 a size that we can actually manage. Some of the issues
6 down in the Lower 48 are so large that it's very difficult
7 to even run projects and say if that's going to actually
8 have a real impact in a large scale, where here in Alaska
9 from island communities to just small remote areas, there's
10 much more of an opportunity to do so.

11 Finally, I would just draw your attention to DOE's
12 activities involving the administration of the American
13 Recovery and Reinvestment Act. There's \$18 million of
14 Weatherization Systems Program, \$28 million of the State
15 Energy Program, \$14 million of the Energy Efficiency and
16 Conservation Block Grant Program, as well as another \$12
17 million that's directly going to Tribal and -- Tribes and
18 Native Corporations through the Energy Efficiency and
19 Conservation Block Grant Program, totalling over \$72
20 million that DOE is distributing to the state and trying to
21 work in partnership with the state to effectively use that
22 money, or at least deliver it to them, and then it's up to
23 them. And we're very happy with how that's playing out.

24 So I thank you very much for this opportunity to
25 discuss DOE's and NREL's activities in the state, and I

1 welcome any questions you have.

2 [The prepared statement of Dr. Hirsch follows:]

3 [COMMITTEE INSERT]

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

1 Senator Murkowski: Thank you, Dr. Hirsch.

2 Mr. Haagenson. You might -- maybe you want to move that
3 mic stand. There you go.

4 Mr. Haagenson: This should work.

5 Senator Murkowski: Welcome.

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

1 STATEMENT OF STEVE HAAGENSON, DIRECTOR, ALASKA ENERGY
2 AUTHORITY

3 Mr. Haagenson: Thanks, Senator. Senator Murkowski
4 and the Democratic Staff, thanks for the opportunity to
5 talk to you today about this interesting topic of energy.
6 It seems to be taking up a lot of time and a lot of
7 interest because it's really our survival.

8 But my name is Steven Haagenson, and I'm the executive
9 director of the Alaska Energy Authority, and also the
10 statewide energy coordinator. I was appointed about a year
11 and a half ago to look at energy and come up with an energy
12 plan for Alaska. And as I look at Alaska, I found that
13 we're -- in knowledge, we're truly blessed in Alaska. And
14 along with that blessing comes a little bit of a curse.
15 And the curse we have, which makes us different than most
16 every other state, are our long distances and our low
17 usage. A small population that can -- and the long
18 distance to deliver energy can make almost any project
19 uneconomic, and it can really stress out a lot of the
20 economics throughout the whole industry.

21 So as we looked at that, we came up with a plan that
22 would actually address that. So we went out in Alaska and
23 we asked them three questions. We went out to about 28
24 communities in Alaska, and we said, what resources do you
25 know of that are available to make energy in your backyard

1 because you eat, sleep, play, hunt, and fish here? And the
2 second question is, what don't you want us to use? And the
3 third question would be, why not? And those three
4 questions gave us a lot of information it -- from Alaskans
5 that know more about it than we would from -- as a state
6 perspective.

7 And then also -- and then we said, okay, let's
8 determine how much energy they need. Because you need --
9 before you start planning a power plant or any source of
10 energy, you need to know what your need is. So we went
11 through and identified the amount of energy that was
12 consumed across Alaska in each community and put it into a
13 database. The database also put it into perspective of
14 what it would cost to make those resources, if they were
15 available to them, and make energy out of them.

16 And in January 2009, we issued a report called Alaska
17 Energy, A First Step Towards Energy Independence, and it's
18 being used across Alaska today. Many communities are
19 looking at it and using it as a resource to kind of say,
20 well, this -- I know I have this available now, so now how
21 can I make it real? As we look at the study also, we went
22 through and we developed a map. And the map of our
23 community so we can see what resources are available in
24 each community. And it's nice to see that there's wood in
25 this area, but remember the curse of distance. If it's

1 more than 20 miles away, you may not be able to afford to
2 get it there.

3 So we looked very specifically at every community and
4 said, what's in their backyard? And we have a map of that.
5 And we found out, a little bit to my surprise, that there
6 are some places that only have one resource. If you
7 looking the lower Yukon in the -- down in the YK Delta,
8 they may only have wind. There is no other resource for
9 them to use. If you look up in the upper Yukon, they may
10 only have wood. And so -- and there's some of the places
11 that have many blessings, many different resources.

12 But when we start thinking about what would you do if
13 you only had wind and we're trying to replace our
14 electricity, our heat, and our transportation fuels? And
15 so we said, well, let's use -- obviously use a wind
16 turbine. So how can we make elec- -- we can make
17 electricity very typical today. There's some challenges on
18 how much you can penetrate into the system with wind-diesel
19 coordination. So we wanted to jump past that and go to 100
20 percent wind.

21 As we deployed the wind, that makes a lot of sense,
22 when the wind is blowing, you make lots of extra energy.
23 And then we thought of -- you know, naturally I thought of
24 Chena Hot Springs, and we've made an artificial geothermal.
25 The rest of the energy would go into a big tank. And we're

1 looking at storage medium right now. The tank would
2 basically store hot water. That way when the wind -- now
3 you have a source of hot water to heat your community, and
4 you would have a source of hot water to possibly, if you
5 wanted to, to use an ORC or a Chena Chiller to make
6 electricity when the wind isn't blowing.

7 And the question is, what's the economics of that? We
8 hired a consultant to actually go through that, look at the
9 efficiencies, look at the economics, look at cost of that,
10 and we are working on developing that technology right now.
11 It's in the letter. We're looking at every community in
12 Alaska to see what resources they have and how we can
13 deploy them.

14 We also came up with a -- we started listening to
15 Alaskans, and we've been talking to Alaskans about what
16 they really want. And a lot of them are just saying, tell
17 me what you can do now. This is not about 10 to 20 years
18 from now. It's very tempting to get up and -- you know,
19 and come up with a plan out there and do a -- come up with
20 a great plan. I guess my analogy is if a person comes to
21 you and they're starving, you give them a few corn seeds
22 and say here, plant these, and by the time they grow, then
23 you eat that, and then you'll be fine forever. And that
24 works great as long as you can survive until they grow.

25 So that's, I think, the situation that Alaska is in

1 right now. We need to have an immediate plan, a short-term
2 plan, a mid-term plan, and a long-term plan. And we're
3 developing that. And we're also adding a stretch goal or
4 an aiming stake at coal to say where do we want to be in
5 the 20- to 30- to 40-year plan. And that simply put is to
6 be 100 percent renewable for all of our electric and all of
7 our heat and all of our transportation. It sounds like a
8 lofty goal, but it's a stretch goal. I think Alaska has
9 the resources to do it, if we have the courage to go down
10 that path.

11 With this plan, what we'll do is develop a resource
12 map for each community based on the resources available to
13 them. And it will be given to the community so they can
14 see if that's what they want to -- if they -- you know,
15 because at the end of the day, they need to own this. This
16 is not about coming up with a great plan -- and we've had
17 many brilliant plans in the past for energy. This is about
18 Alaskans owning the plan and wanting to go down the path.

19 At the end of the day, the best plan will fail if you
20 don't have ownership across the state. So our next step is
21 to go out to Alaska and say, here's what we see from our
22 perspective from what we know about your resources in your
23 backyard, then we can deploy it, and we'd like -- this is
24 what we see, so what you -- what do you want us to do in
25 the plan, then we'll make it theirs.

1 So let's look at the -- let's talk about what these
2 steps r. We have the immediate plan, and what can we do in
3 the immediate? Right now the immediate stuff is really
4 energy conservation and the efficiency increases, both
5 supply and demand side. There's a lot of things we can do
6 on the efficiency side. But energy efficiency and
7 conservation are two different things, and, you know, I'm
8 going to take some of the resources end of it.

9 Energy efficiency is something you can -- it will
10 happen whether we think about it or not. If you buy your
11 energy efficient refrigerator and you plug it in and you're
12 using it, you don't have to think about saving energy.
13 It's just going to save energy. If you get compact
14 fluorescents, you're going to save energy. If you decide
15 -- if you walk out of here and decide to turn the lights
16 off, right, that's a choice. And when -- in Alaska when it
17 gets 40, 50, 60 below, people make different choices then
18 when it's 60 above. And so you can't really rely on that.
19 So that's a choice. We have education needs that have to
20 be done, and make sure they're using energy wisely. And
21 then we'll figure out ways to use it more efficiently, and
22 then we'll go down the path.

23 As you see, the short-term solutions are really what
24 we're doing today. There's just way more of it. It's
25 wind-diesel applications, it's using wood that's available,

1 it's using the small hydrokinetic devices we can install.
2 There's a lot of things we can do today that are pretty
3 much proven, mature technologies. If you get into the mid-
4 term, then you start getting more risk in the technology.
5 When you get farther out, you get into the -- it's
6 artificial geothermal. You get into storage conversion
7 technologies that's risk; it's going to come up. So it
8 gets fuzzier.

9 We're going to try to give an aiming state goal so
10 people can go down the path to understand what their long-
11 term future will look like in Alaska. This report, and I'm
12 scared to say this, but it's -- hopefully we'll have this
13 -- we have a lot of work to do between now and then, but
14 we're hoping to have these out by the end of November so we
15 can get it to Alaskans and let people work on it and soak
16 on it and own it. This report will also have a concept in
17 there for financing the plan. Because just showing them a
18 path doesn't help them. We need to come up with methods
19 that will allow them to go down the path and make it real.

20 And the other thing that we have is to mitigate risk.
21 We need to mitigate the risk because -- like gaining
22 knowledge. Right now we have questions like how fast do
23 willows grow? If you're going to use willows as a
24 resource, you better know it's sustainable. Is the land
25 available? Can you -- and it may be great to have a

1 forest. In some places if you don't have access to land,
2 you're sunk. So all the different technologies, you have
3 to understand what you're going to rely on, how it can move
4 forward, and we'll be developing that as best we can. But
5 that's when you -- as you move into the future, we'll get
6 more information to answer those questions and identify an
7 effective path you want to continue down.

8 So remember that the aiming state concept -- I'm a
9 hunter, you know, so we're going to aim our -- so we're
10 going to start studying this rifle end. We're going to get
11 it on the paper first, and we're going to analyze the
12 bull's eye later on, but the first step is today is a
13 start. And I think we can study this to death. And I'm
14 not a studier, I'd rather sit there and do something. But
15 I think we need to make -- look at our money use wisely and
16 spend it correctly, because we don't have unlimited money.
17 We need to very carefully focus our mission, get it about
18 right, in the right quadrant or so, and move down that path
19 to success.

20 So I'll be available for any questions at your
21 convenience.

22 [The prepared statement of Mr. Haagenson follows:]

23 [COMMITTEE INSERT]

24

25

1 Senator Murkowski: Thank you, Steve. Let's next go
2 to Gwen Holdmann. Welcome.
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

1 STATEMENT OF GWEN HOLDMANN, DIRECTOR, ALASKA CENTER
2 FOR ENERGY AND POWER, UNIVERSITY OF ALASKA, FAIRBANKS

3 Ms. Holdmann: Thank you, Senator Murkowski and the
4 virtual members of the committee. I appreciate the
5 opportunity to appear before you today.

6 Senator Murkowski, I'd like to thank you personally
7 for all that you have done to increase focus on renewable
8 energy resources and the use of those resources to develop
9 energy projects in the state and across the country.
10 You've put a lot of work into this, and it is appreciated
11 and valued. So thank you very much.

12 I'd like to shift the focus a little bit about how we
13 talk about energy. Energy is often discussed as a means to
14 an end, but in actuality, energy is really a tool that we
15 need to obtain the goods and services that we need in our
16 lives every day. Stably priced energy such as what can be
17 achieved from renewable energy projects are needed so that
18 current and future Alaskans and Americans can benefit from
19 high-paying jobs, and so that we can continue to develop
20 our economy, and to build wealth for individual residents
21 and for our state and country as a whole.

22 Chena Hot Springs is a perfect example. Because it
23 has the geothermal power plant out here, Bernie and Connie
24 Karl know exactly what their energy costs are today. But
25 also what they're going to be 10 and 20 years from now.

1 Those stable prices allow them to build a business plan
2 based on that certainty, and that provides a lot of value
3 to them in terms of moving forward into that future.

4 Alaskans are the highest per capita energy users in
5 the country, in a country that is the highest per capita
6 user of energy in the world. That should give us pause for
7 thought. On average we use more energy per individual
8 resident here than anywhere else in the world. There are a
9 lot of reasons for this, and this does not mean that we are
10 necessarily more wasteful than other people. But the point
11 is is that we need a lot of energy. The cost of those
12 energies are not necessarily born equally by all of
13 Alaska's residents. Each region has particular challenges
14 associated with it.

15 Because we're talking about renewables today, I'll
16 focus on the rural communities, and we are currently on a
17 path right now to spend over \$4 billion dollars in diesel
18 fuel alone -- that's not all energy costs; that's just
19 diesel fuel -- in rural Alaska in the next 20 years.
20 That's a big number, and virtually all of those dollars
21 would go to interests based outside of our state. But with
22 those kinds of big numbers can also come big opportunities.

23 The high-cost of energy in Alaska, and particularly
24 rural Alaska, make emerging technologies like distributed
25 wind, biomass, geothermal, and tidal energy economic to

1 deploy today. However, many of those technologies are more
2 complex and expensive to install and operate than
3 traditional diesel systems. Is the role of applied energy
4 research like that conducted through the Alaska Center for
5 Energy and Power at the University of Alaska to try and
6 address the technical challenges associated with energy
7 projects in order to bring the costs down and make
8 renewable energy projects economic to install and reliable
9 to operate.

10 All energy projects are not created equal. And we
11 must be prudent in our investment and new technologies as
12 Mr. Haagenson just mentioned. To this end, the university
13 is working on improving the efficiency of diesel engines,
14 testing advanced energy storage and control systems, and a
15 variety of other renewable energy technologies.

16 We're also looking at the resources to make sure that
17 projects that we're developing are sustainable in the long
18 term. We're working with Bernie right here at Chena Hot
19 Springs to monitor the reservoir, and to continue to work
20 with him to develop strategies to tweak production and
21 injection of the hot water that makes this place work.
22 We're also looking at growing willows as a biomass crop and
23 what that would take, and doing research needed to deploy
24 in-river hydrokinetic turbines as part of our energy mix.

25 Many of the proposed solutions we are working on are

1 also more broadly relevant to achieving the U.S. goals for
2 increasing renewables as a component of our national energy
3 portfolio. For example, a major challenge in dealing with
4 the high penetration of renewables is that a high amount of
5 renewables on our grids, in particular wind, on our
6 electric grid infrastructure. Our grids were not designed
7 for fluctuating power sources, and that has become a
8 challenge not only in Alaska, but other parts of the
9 country.

10 For this reason, Alaska has the opportunity to serve
11 as a model and as a proving ground for the country, and I
12 hope that the Senate will recognize that role that Alaska
13 can potentially play. As an example, we've been working
14 with Kodiak Electric Association on modeling the
15 integration of hydropower wind and diesel on their electric
16 grid. Kodiak has a goal of 95 percent of their electric
17 power being produced by renewable resources in the very
18 near future. And they are really on track to achieve that
19 with the first megawatt-scale wind turbine federal thing
20 installed in the state of Alaska.

21 When we think about this 95 percent renewables, which
22 is also something that Chena has achieved here, is a very
23 lofty goal when you consider that, as you mentioned,
24 Senator, that in the country only 8 percent of our power
25 generation is from renewable resources. We have been

1 working with them to determine how to reach this objective
2 through the use of both short- and long-term energy
3 storage. Achieving those kinds of high penetration is not
4 a simple technical task, and it does require some
5 additional infrastructure to make that happen.

6 The work we're doing at Kodiak right now is very
7 relevant to much -- the much larger national grid as
8 certain parts of the country are quickly ramping up
9 installed wind power, too. The limited grid at Kodiak
10 affords an opportunity to optimize and prove really high-
11 powered models developed by Sandia National Lab for the
12 much more complex grid in the Lower 48 and verify those so
13 that we can be doing the same types of things in the rest
14 of the country. At a later time, testing new energy
15 storage options on the Kodiak grid to achieve that grid
16 stability will also be relevant to stabilizing the national
17 grid. At the University of Alaska, we've been testing the
18 next generation of battery technologies to meet the needs of
19 both in Alaska and throughout the country.

20 The U.S. also needs to rethink Alaska's role in the
21 context of future global energy needs. Alaska is an
22 exporting state, energy exporting state. Today we export
23 our fossil energy resources, and those will be critical to
24 Alaska's future for a long time. However, we must also
25 begin to consider how we can develop our stranded energy

1 sources, both fossil and renewable, to meet growing
2 international demand for energy.

3 There are ways to export energy other than through
4 electric power and through natural gas pipeline. And
5 that's through the value added processing of products and
6 raw materials. This presents a very real opportunity for
7 the U.S. to reshape and rethink how Alaska fits into the
8 global energy picture in a world that will become
9 increasingly hungry for cheap and stable energy prices.
10 This is not just an economic issue, this is also an issue
11 of national security. As we ship more and more of the
12 processing of raw materials we use every day off shore to
13 nations with cheaper energy than our own, we become
14 increasingly vulnerable to political upheaval and
15 instability in other regions.

16 We believe that it is our position that a long-range
17 strategy needs to be developed for optimally using Alaska's
18 energy resources for the benefit of both the state and the
19 nation. Thank you for your time. We recognize our future
20 energy solutions will include a mix of renewable resources
21 and fossil fuels. Alaska is a critical asset to furthering
22 a national agenda of providing affordable and stable energy
23 for the country, and we believe the energy research program
24 such as the university have a key role to play in shaping
25 that future.

1 We ask you to continue to press for funding for these
2 critical research programs so that we can develop more
3 economically viable projects and continue to improve the
4 ones that have already been built. And we would like to
5 ask you to also keep in mind that Alaska's particular needs
6 sometimes differ from those of the rest of the country, and
7 while we have a role to play, there can also be challenges
8 for us to fit into some of the funding opportunities that
9 are out there when we're looking at the specific issues
10 that are needed to be addressed up here in Alaska. Thank
11 you for your time.

12 [The prepared statement of Ms. Holdmann follows:]

13 [COMMITTEE INSERT]

14

15

16

17

18

19

20

21

22

23

24

25

1 Senator Murkowski: Thank you, Gwen. Chris Rose,
2 welcome.
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

1 STATEMENT OF CHRIS ROSE, EXECUTIVE DIRECTOR,
2 RENEWABLE ENERGY ALASKA PROJECT

3 Mr. Rose: Thank you, Senator Murkowski. And thank
4 you, members of the committee. I appreciate the
5 opportunity to speak here today. For the record, my name
6 is Chris Rose. I'm the executive director of the Renewable
7 Energy Alaska Project. REAP is a coalition of 67
8 organizations around the state, and also around the country
9 that share the goal of increasing the production of
10 renewable energy in the state and promoting energy
11 efficiency.

12 We are composed of almost 20 utilities, over 20
13 businesses and developers of renewable energy, four or five
14 environmental groups, consumer groups, Alaska Native
15 organizations, and we also have ten local state and federal
16 agencies that act as advisory members so that we can have
17 their input at our board meetings and in the work we do.
18 We're an education and advocacy group. We do things like
19 put on forums, renewable energy fairs, conferences, put
20 together, along with the Alaska Energy Authority the
21 Renewable Energy Atlas of Alaska, which we have now printed
22 and distributed almost 25,000 of over the last three years.
23 So those are the kinds of things we do, and we really focus
24 on statewide issues, and so I appreciate the opportunity to
25 talk about the federal issues, but just keep in mind that

1 we really focused a lot on the state things that are
2 happening here.

3 As many of the other members, the other witnesses have
4 stated, we have some of the best renewable energy resources
5 in the world, and you said that yourself, Senator. You
6 went through the list. We do have some of the, and
7 fortunately or not we've had so much oil and gas in this
8 state that we've, I think, ignored our renewable energy
9 resources up until relatively recently. They've just been
10 in the background, because we haven't necessarily needed
11 them, although we have been using our hydro resources for
12 quite some time.

13 We do have this huge opportunity now to seize, both
14 here in the state and also at a national level. And the
15 way that we frame this issue of renewable energy when we're
16 out there talking to people is in terms of risk management.
17 Because there are lots of risks, and continuing on the
18 status quo. The first one is already hitting us, and
19 that's price. Worldwide energy demand is expected to
20 double by the year 2050 and quadruple by the year 2100.

21 We're looking at places like India and China where
22 everybody wants to drive a car, everybody wants to have the
23 same kind of lifestyle that we have. If everybody in China
24 used the same amount of oil per capita as Americans,
25 Chinese today would use every drop of oil that's produced,

1 and there would not be anything for the Europeans or the
2 Americans or anybody else.

3 And so we're facing a future where worldwide demand
4 for energy is increasing quite rapidly. At the same time,
5 the fossil fuels that we have really built our civilization
6 on are a finite resource. And so they're diminishing, so
7 price is going to go up. It's going to trend up, and
8 that's a real risk if we don't diversify our portfolio and
9 put in flat price renewable energy resources, and that's, I
10 think, what Gwen and other people are talking about, is we
11 can predict the price of these renewable energy resources,
12 and that is a huge boon for investors and for the business
13 community.

14 Of course, another big risk is climate change. I
15 included in the testimony that I -- the written testimony,
16 a small article that I pulled off the Internet just two
17 days ago about some research that's just been done here in
18 Fairbanks, the University of Alaska Fairbanks, about ocean
19 acidification, which I think is probably the biggest
20 concern we have right now in terms of the short term.
21 Right now we're looking at a situation where pteropods and
22 other small creatures are unable to form shells because of
23 the increasing carbonic acid concentrations in the ocean.
24 And, of course, that could really impact our fishing
25 industry.

1 But the biggest insurance companies in the world see
2 this and an economic issue. They're the ones who are
3 paying for these climactic events that are occurring around
4 this -- around the world. And so another driver, and
5 that's what's driving us toward carbon regulation, which is
6 going to cause the price of fossil fuels to go even higher.

7 I think that one of the biggest risks is that this is
8 \$150 billion a year business right now, and most of that
9 business is happening elsewhere, not in the United States.
10 It's expected to quadruple by the year 2015. We have this
11 huge opportunity here to be a part of that clean energy
12 revolution. A lot of people are looking at this as the
13 next industrial revolution, and, in fact, it has to be,
14 because energy is the lifeblood of any economy. We can't
15 do anything, we can't grow food, we can't transport
16 ourselves, we can run businesses without energy. So we're
17 talking heat transportation and electricity.

18 And as Gwen and others have pointed out, we've got
19 this testing bed in rural Alaska, whether we recognize it
20 or not. When you can produce hydrokinetic energy, for
21 instance, at 50 cents a kilowatt hour, which is
22 demonstration technology, that's not going to really save
23 anybody money in the Lower 48. That saves people money
24 today in Alaska. So this is the perfect place to be
25 testing these kinds of things that are relatively

1 expensive, with 90 percent of the tidal and 50 percent of
2 the wave energy and all this geothermal and wind, we should
3 be leaders in this technology.

4 There's two billion people on the planet right now
5 with no electricity. That's almost a third of the world.
6 That's a huge market. All those people wanted electricity
7 yesterday. And if we can perfect these technologies like
8 wind-diesel hybrid systems and hydrokinetics and solar, we
9 can then be exporting that technology around the world. So
10 we have this huge opportunity that we see.

11 Solar, for instance, is one thing that's really
12 exciting for me. It really hasn't taken off in Alaska
13 because it doesn't follow our load. We don't use a lot of
14 air conditioning, we don't have a lot of lighting in the
15 summer, and yet, when plug-in hybrids come in next year,
16 I'll be buying one of those cars, I'll be putting solar
17 panels on my house, and I'll be running my car off of
18 solar. And so when you start applying solar to
19 transportation, all of a sudden the whole game changes in
20 terms of how we might be able to use that.

21 So with hydro, solar, all these other opportunities up
22 here, we clearly have a huge opportunity for Alaska. I
23 just want to hit a few federal policies, and like I said,
24 we're not -- we're not concentrated on those, but there are
25 a few federal policies that are important to mention right

1 now.

2 There's a Renewable Electricity Standard that's in
3 front of Congress. One thing that the REAP board has
4 talked about quite extensively at one of our board meetings
5 is the definition of hydro. Right now -- and I know you've
6 been working very hard on this, Senator -- I think the
7 Lower 48 sees hydro as something that has been kind of past
8 its life, and also is a -- can be of concern to fish. And,
9 of course, we're concerned about fish up here, too. But we
10 have many, many hydro projects or possibilities up here
11 that the Lower 48 doesn't have. And so if there's an RES
12 and a renewable electricity credit market, we want to make
13 sure that our hydro projects get those RECs.

14 Also, regarding RECs, we want to make sure that any
15 policy that is formed at the federal level for renewable
16 electricity as standard does not squash inadvertently the
17 voluntary REC market. Because the voluntary REC market
18 right now is really helping renewable energy grow. And so
19 we want to make sure there's no double counting, and that
20 if there's voluntary RECs out there, that they're not used
21 for compliance. We also want to make sure that if there
22 are RECs that are sold before an RES is actually
23 instituted, that the -- those RECs vest in the purchaser
24 and not the entity that produced the power. Because
25 otherwise if we don't do that, it can inadvertently squash

1 that voluntary REC market.

2 The Clean Renewable Energy Bonds have been a really
3 fantastic program. Kodiak Electric, which has been
4 mentioned here several times, used those bonds. They're
5 one of the first entities in Alaska to really use those
6 successfully. That program should be expanded, and maybe
7 more various types of projects could be included in that
8 program.

9 I just had a meeting with John Goll, who's the
10 regional director of MMS the other day, and we were talking
11 about a forum maybe later in the fall about the new MMS
12 leasing program. That's something we really have to look
13 at very closely, because any offshore wind industry,
14 hydrokinetic industry that's going to be evolving offshore
15 could really be hurt if this program is not setup
16 correctly.

17 And right now I think MMS is in a difficult position
18 to figure out how to actually evaluate those resources.
19 Because for one thing we don't have a lot of baseline
20 information about what the resources are, and I think there
21 might be an inherent conflict in extracting revenue through
22 those leases, and at the same time having policies like the
23 Federal Product Tax Credit that are actually rewarding and
24 incentivizing renewable energy. So there's a little
25 tension

1 there between those two, and especially with hydrokinetics
2 and offshore wind which are NASA industries. We really
3 want to make them get off the ground and grow. We don't
4 want to hold them back, but we're really pleased overall
5 that FREC and MMS have resolved the jurisdictional conflict
6 over that issue.

7 20 percent wind. DOE has had a 20 percent wind goal
8 now for about two years. There's a very extensive report.
9 As Brian Hirsch pointed out, NREL's been working on this.
10 The Wind Powering America program, which is part of NREL
11 has been working -- we've been working very closely with
12 them over the years. And that's a very important program
13 to educate people about wind.

14 There's no doubt technologically and physically that
15 we can do 20 percent wind by 2030 in this country. But
16 there's going to be a lot more transmission, there's going
17 to be a lot more education that's going to have to precede
18 that, and so we're really looking at DOE's goal of 20
19 percent wind as a doable goal. And we would like to see as
20 many resources put into that as possible, because that is
21 the most mature and commercially viable of all the new
22 renewable energy resources past hydro. 42 percent of all
23 installed new electrical capacity in the United States last
24 year was wind. So it's a very, very fast-growing industry.

25 On the issue of job training, research and

1 development, there's a lot to do there. We're going to
2 have to prepare all our workers, and we're going to have to
3 really be leaders in this. The things that Gwen's doing at
4 the Alaska Center of Energy and Power could really have
5 world ramifications if we can provide -- if we can get
6 better storage, if we can really work on these wind-diesel
7 hybrid systems, if we can perfect hydrokinetics. We have
8 this opportunity here in Alaska to help not only the
9 United States, but also the world.

10 I guess I would just close with the discussion of
11 vision, and that is -- and on the state level working on
12 the same thing, which is we need an overall vision and
13 policy about where we're going. Without that vision and
14 where we're going in 100 years, we're not going to be able
15 to draw the road map to see how we're going to get there.
16 But the fact is that we're probably going to run out of
17 fossil fuels sometime in the next 100 years, or at least
18 they're going to become so expensive it's going to be
19 difficult to use them.

20 And so where are we going to go? How are we going to
21 get to a place where we are 100 percent renewable like
22 Steve Haagenson says? We -- and it's the econ- -- it's the
23 economies and it's the cultures and the societies in this
24 world that see that like Iceland, like Brazil and other
25 places that have that vision that are going to be the most

1 economically competitive, and the ones that are going to
2 prosper. And so we're really hoping that Congress can look
3 50, 60, 70 years down the road for United States and say,
4 how are we going to get there? Because we have tremendous
5 renewable energy resources in this country, and especially
6 in Alaska.

7 I think it's crazy in some ways in Alaska that we're
8 looking at exporting this natural gas that we have that for
9 Alaskans could last 1,000 years. But if we pipe it to
10 Chicago, we'll run out of it in the same time the
11 Chicagoans run out of it. And so we got to think about
12 ways that we're going to be able to preserve some of our
13 resources here in Alaska and the United States, our fossil
14 reserves, and at the same time really push hard on the
15 renewables. And we really do appreciate all the work that
16 you've been doing on this, Senator Murkowski. Thank you
17 very much. And thank you for the opportunity to testify.

18 [The prepared statement of Mr. Rose follows:]

19 [COMMITTEE INSERT]

20

21

22

23

24

25

1 Senator Murkowski: Thank you. Thank all of you for
2 your testimony this morning. It's been very interesting,
3 good discussion, and I think a very important part of our
4 committee records. So I thank you for that. I've got
5 several questions that I'm going to ask of you, and
6 probably submit a lot more to you as your homework, and
7 we'll include that as part of the record, but in the
8 interest of moving through the panel to the second panel
9 today, I'll let you off the hot seat on some of it.

10 I want to acknowledge a few of our state leaders that
11 have joined us since the initial introduction. We've got
12 Senator Therriault in the back. I see Senator Bob -- or
13 excuse me, Representative Bob Herron back there as well.
14 Representative Dahlstrom, Representative Charisse Millett.
15 I think that's all that I've seen. Who else?
16 Representative John Coghill. So welcome to all of you, and
17 thank you for your leadership on energy interests. And
18 Representative Jay Ramras is in the back as well, so
19 pleased to have you all here. Who else am I missing.

20 Audience Member: Senator Thomas -- I mean, Paskvan.
21 Senator Paskvan.

22 Senator Murkowski: Senator Paskvan right back there.
23 Okay. Who else is back there. Thank you for joining us,
24 and for your leadership at the state level on these issues.
25 I know that there has been more than a few energy field

1 trips this summer for our legislators, and I think that
2 that's a very important part of what we're doing here at
3 the state.

4 I want to ask a question. We're here at Chena Hot
5 Springs, where you have one guy, basically, with a vision
6 and a plan and a sense of energy that made good things
7 happen, and he got a little bit of help from a DOE grant at
8 the outset. But a lot of this was shoestring stuff and
9 just really believing in the potential of what we have
10 here.

11 So much of what happens from a policy perspective back
12 in Washington DC is we've got a tendency, through our
13 policies, inadvertent or not, to pick winners and losers
14 when it comes to energy and how we advance it. And, Chris,
15 you suggested that, you know, wind is one that we've seen
16 real advances, and we can meet that goal. Well, I think
17 part of that is because we've really put those federal
18 dollars and those grant opportunities towards wind. But
19 they look at geothermal, for instance. And when I say
20 they, I mean the Department of Energy and others at the
21 federal government. They look at geothermal and say, well,
22 that's a mature technology. And as a mature technology,
23 you don't fit into these nice, neat opportunities where you
24 can get these emergency -- excuse me, emerging energy
25 technology grants.

1 And so you've got something going on here at
2 Chena Hot Springs that what we're dealing with is not
3 mature technology, it is a completely different process.
4 And it would qualify as emerging, but we've decided that
5 we're going to go with those more proven technologies.
6 Well, Steve, I think you mentioned that in your assessment
7 statewide of what potential is out there, we got a lot of
8 everything throughout the whole state, but in some areas
9 you just have wind, or you just have biomass. And so
10 through our initiatives and how we direct grant funding, to
11 a certain extent, we're kind of defining what's going to be
12 good and what's going to be bad, and it may not be what
13 works best in the YK Delta. It may not be what works best
14 in Southeast.

15 So help me out a little, and I'll start with you,
16 Mr. Hirsch, when we're talking about how we advance,
17 meaningfully advance some of these more cutting edge energy
18 vision -- visioning things, how do we do it so that it's
19 more than just a pilot project that gets a little bit of
20 funding and you get some interest, but it doesn't have any
21 follow through in terms of the funding to really put this
22 in the ground and make a difference?

23 Dr. Hirsch: Well, thank you. It's a really excellent
24 point, and a very incitful question to add. It's something
25 I personally have been wrestling with for many years, and

1 it's primarily our developer and the contractor prior to my
2 recent appointment here at NREL. And something I mentioned
3 briefly earlier as far as some of the projects I've been
4 working on that are very small scale. And there's several
5 approaches, I think. From the government perspective, what
6 seems to make sense is nobody wants to fund a loser. And
7 so there is a challenge about putting a lot of money into
8 something that doesn't work very well. And we all know
9 that anytime even you fund a grant, there's a risk that
10 they're not going to perform the way it's presented. And
11 so what I've seen happening, what I've actually personally
12 been promoting a lot is this sense of this emerging energy
13 technologies.

14 My sense of it in Alaska, more than almost anywhere
15 else, has these challenges that we -- that are more
16 difficult, and that we can benefit most greatly from.
17 Around, for example, this tidal and wave energy. We have
18 so much energy that we don't quite know how to handle it
19 even if we were to get it. And so I think what we need to
20 do is have a multi-tiered approach. Understandably, for
21 example, the Alaska Renewable Energy Fund at state level
22 that ADA is overseeing excellently. That's really for
23 commercial, off-the-shelf proven technology. And that's
24 the focus on reducing power costs with things that we know.

25 At the same time, and what several of us have been

1 pushing for, Chris Rose, all of us really, have been
2 identifying this need for this emerging energy technologies
3 fund where it's -- and there, you know, pretty strict
4 definition where the concept makes a lot of sense. It's
5 something that's three to five years out roughly for
6 developing this technology to the point where it could
7 become commercial. It's proving grounds.

8 And so Denali Commission has taken the first step in
9 funding some of their own money, putting their skin in the
10 game to develop that -- to essentially gamble on high risk,
11 but potentially very high payoff-type projects. And
12 looking at some of the energy storage issues around
13 anhydrous ammonia that you mentioned in your initial
14 discussion, as well as energy storage around wind to really
15 increase the high-penetration rates.

16 And then we're working on a state level -- or many
17 people are working on a state level mirror image of this
18 emerging energy technologies fund for -- similar to the
19 Renewable Energy Fund that the state is doing to -- and
20 it's probably not going to be as much money, and it will
21 have very targeted projects. It's a -- this could be a
22 game changer. And that's, I think, really what we're
23 looking for at this stage. And at the same time, we have
24 to, I think, believe, to some degree, in the American
25 history of innovation and really -- what I've seen is a

1 real opening of peoples' ideas. It used to be you talked
2 about solar thermal in Alaska, and people laughed you out
3 of the room. And now they're serious about this heat pump
4 in Seward, and Chena Hot Springs here is distributing
5 vacuum tubes with solar thermal that a few years ago you
6 would be -- you wouldn't be taken seriously.

7 So a lot of it has to do with hearings, such as what
8 you're holding here and the attention from the national
9 level and the real education that policy makers -- I've
10 seen an incredible increase of policy makers' understanding
11 of these issues. And so everybody who's getting involved
12 really ought to be commended. And I think together we're
13 working through those solutions, but they're absolutely
14 difficulties. So thank you.

15 Senator Murkowski: Well, and I appreciate your
16 perspective on that. I will, I guess, ask for your
17 encouragement within the administration. As you know, back
18 in 2007, we were successful in including within the Energy
19 Independence and Security Act a provision that allows for
20 the authorization of renewable energy deployment grants
21 here in Alaska where the federal government kicks in and
22 helps with matching funds there for construction of some of
23 these projects. And authorization is good. It's
24 absolutely important, it's necessary, but we'd sure like to
25 make sure that there is support within the president's

1 budget to allow for the funding to go forward.

2 Because I think all of you have discussed, in one way
3 or a shape or a form that the vision is good, but we've got
4 to have the financial aid, whether it's at the state,
5 local, or federal level to help facilitate. And so we
6 appreciate your encouragement. I don't know whether you
7 can speak for Secretary Chu, but if you can and you can
8 give me the affirmative answer now, I'd really appreciate
9 it.

10 Dr. Hirsch: I'd only do that once, and then that
11 would be over.

12 Senator Murkowski: Yeah, yeah, yeah. Okay. We don't
13 want to put you in that.....

14 Dr. Hirsch: Just very briefly there, you mentioned
15 this geothermal situation, for example, where it wasn't
16 viewed as a mature technology. Just this year there's been
17 a new understanding of that, and there has been a recent
18 solicitation on what they call enhanced geothermal systems
19 where there was exactly that issue where they realized all
20 of the technologies around geothermal are not mature. And
21 there has been new funding for that. Similarly with
22 hydropower where it's been recognized as mature. And just
23 this month, I believe, there was a solicitation that came
24 out on upgrading hydropower facilities that already exist.
25 So there's a beginning recognition of what you're talking

1 about, but more of this discussion will absolutely help.

2 Senator Murkowski: I want to ask a question, and I'll
3 throw it out to any of you. When we talk about the
4 technologies that are out there, whether it's for wind or
5 solar panels or anything else that we might be doing, we
6 recognize that our climate up here, our environment adds
7 some difficulties or some challenges. Steve, you mentioned
8 the fact that the solar panels actually enhance the energy
9 efficiency if it's cold. That's something that I didn't
10 know.

11 How much more of a challenge is it operating in an
12 Arctic environment when we're talking about our renewable
13 energy sources? I know that, for instance, with the wind
14 turbines, what we have up north has to be a little bit
15 different than what they're utilizing down there in
16 California. How unique is our market in terms of the
17 technologies, and how much more do we have to refine them
18 in order for them to really -- to work well here?

19 Mr. Haagenson: Senator, I think Alaska's always
20 different, right?

21 Senator Murkowski: Always different.

22 Mr. Haagenson: And that's the.....

23 Senator Murkowski: And we tell everybody, but they
24 don't believe it, so they come up here.

25 Mr. Haagenson: So starting at that point, I think we

1 do have some different challenges up here. I think one of
2 the things we -- like right now we have a lot of energy,
3 right? In the wintertime we don't. Like Chris mentioned,
4 they don't peak at the same times we need them. So I think
5 that one of the things that we need to look at is storage,
6 right. And if we can solve this problem in storing energy
7 for a day for tidal, for a month for wind, or for a year
8 for solar or hydrokinetic or something like, if we can
9 solve that problem, we can deploy it anyplace in the world.
10 Because this is one of the toughest environments to operate
11 in.

12 Senator Murkowski: You actually mentioned in your
13 comments that -- I think you said we are working on
14 developing that storage technology now. Who -- can you
15 give me a little more detail on that?

16 Mr. Haagenson: Yes, I can. We've hired a consultant,
17 WH Pacific, to actually take that concept and make it real
18 and find out if we have any operating deficiencies, the
19 storage, the size it would take, the costing effort. HMS
20 is helping us come up with a cost estimate. And then we'll
21 deploy that out to every community, you know, in our big
22 model. And so we'll see it as part of the costs, to see
23 what the best operating options would be.

24 So we're developing that. We're looking at one other
25 thing. I was talking to a friend of mine at the Cold

1 Climate Housing the other day, and we said we're going to
2 put a heat pump at Weller School. And in my days in
3 Fairbanks, I remember that the ground is about 38 degrees,
4 and you're trying to take it to 38 -- 32 degrees and it's
5 going to stop working. And he said, well, what we want to
6 do is we want to put thermal cells in -- I mean, thermal
7 cells, not the portable tape, but thermal and heat -- solar
8 cells, and we're going to collect, you know, a big slab of
9 concrete in Weller School parking lot, we're going to
10 insulate that slab, and we're going to just take that slab
11 up to about 190 degrees, say, and then in the wintertime,
12 it'll be hot, we'll then put a heat pump on that and take
13 it from 190 down to 32. So and they're thinking they can
14 get a lot of energy out of that slab.

15 Again, it's a storage technology. So there's a lot of
16 challenges here, but I think -- and I'm going to go back to
17 your first question that -- about the first answer, I think
18 what we need is passion, okay, in Alaska. And if you think
19 about Bernie for a second, I don't know how many of you
20 have had the pleasure of saying no to Bernie.

21 Senator Murkowski: It doesn't work.

22 Mr. Haagenson: It doesn't work, right. And so why is
23 that? Because he's passionate. He's the most passionate
24 guy I know. And you tell him no, and he's going to tell
25 you the five reasons why you can't say no. And he's going

1 to go forward without you. So we need more Alaskans like
2 Bernie. And I'm saying that with a little hesitation. We
3 need more Alaskans with passion like Bernie. Nothing
4 personal, Bernie.

5 Senator Murkowski: We all understand.

6 Mr. Haagenson: Thanks. So I mean, that's -- and
7 that's not a question do you have passion, you don't want
8 unbridled passion, but you need to -- now the question is
9 how do you handle risk. And like Dr. Hirsch mentioned, you
10 don't -- you know, you don't want to respond failure. You
11 don't want a bad budget, but the question is how can you
12 fund things like that, and who should fund it until you
13 make the next step? Because a lot of breakthrough
14 technologies need risk. Bernie took risk. He -- you know,
15 he was told many times that won't work, it's too cold. One
16 man told him that over and over again. He went and found a
17 solution, and they're wishing that they would have listened
18 to day one today.

19 So how do you encourage risk, and how do you -- you
20 know, how do you get people with passion to move the risk
21 forward? And you'll find solutions in Alaska. There are a
22 lot of passionate people in Alaska. There's a lot of
23 creativity across Alaska happening today. How do we get
24 that and share it, share the successes, and then learn from
25 the mistakes and don't repeat them?

1 So Brian also mentioned Renewable Energy Fund. I'm on
2 record on that -- on those projects as zero failure. Okay.
3 Now, he's -- and I think we can pull it off. But that's
4 not the program designed to look at technology, to look at
5 advanced technologies. It's just designed to deploy
6 technology. ACEP is very good at looking at technology,
7 looking at the risk, evaluating, bringing the issues to the
8 forefront and solving them. And that's really one of
9 Gwen's strong points.

10 So we need to, as Alaskans, come together and figure
11 out what we really value, how we want to move forward, how
12 are we going -- how we deal with risk, and don't hammer the
13 guy who has a little failure, and encourage him to say
14 well, okay, if that didn't work, tell me another way it
15 will work. So, you know, in my prior life, I was -- I was
16 told I would -- had to make two mistakes a day. And if I
17 wasn't making mistakes, I thought I wasn't doing anything.
18 I think we need to get that attitude in Alaska. Thanks.

19 Senator Murkowski: Okay, Gwen, you looked you wanted
20 to hop in there.

21 Ms. Holdmann: I did. I just -- I've just been
22 thinking about the project here at Chena, and maybe -- I'd
23 like to give a little bit of history on the very, very
24 early pre-Chena history of the -- of this low temperature
25 geothermal power plant. And I think that it might be

1 illustrative in the way this project was brought together
2 in the private sector and how we may be able to shift some
3 of the ways that things are done at a national level in
4 terms of having more collaboration between different
5 fields.

6 We tend to have stove pipe technologies a little bit.
7 The wind guys are wind guys. They work on wind. The
8 hydrokinetic guys, they work on hydrokinetics. You know,
9 that's also a challenge I've been dealing with at the
10 university. Energy is an interdisciplinary problem, it's
11 a -- and the solutions are going to be interdisciplinary,
12 too. We need to get more kind of cross collaboration
13 between different programs at the national level, and
14 especially I think within the national labs, I'd like to
15 see that happen as well.

16 The -- to give you a little background on how this
17 Chena chiller came to be is that United Technologies is a
18 very large company. They have a number of different
19 subsidiaries. And what they do from time to time, and this
20 is at the risk of telling this story without
21 representatives from United Technologies here, but they
22 bring different engineers, their top level, brightest guys
23 from different programs together and to kind of think tank
24 sort of circumstances. So guys that really have nothing to
25 do with each other in their areas, don't have anything in

1 common, to sit down and figure out what they might be able
2 to do together to come up with a new product or a new idea
3 that could ultimately become a marketable product and make
4 the company money.

5 And so in this case, they took some of their bright
6 guys from Carrier Refrigeration that had this very, you
7 know, standard, off-the-shelf, 100-year-old refrigeration
8 technology, mixed it with a guy that had designed a new
9 turbine for a jet engine, and literally out of that
10 thinking came to say gee, we're actually -- this waste heat
11 recovery, this low-temperature waste heat recovery system
12 using a new turbine design, coupled with the Carrier
13 Refrigeration system. So essentially this is running a
14 refrigeration system in reverse where you're taking --
15 where you're taking a temperature difference, a hot and a
16 low temperature, and then you're using that to make power
17 rather than electric power to create a temperature
18 difference. Which is what roof power refrigeration system
19 work.

20 So they got these guys together, they engineered this
21 system, and then in talking about it a little bit more,
22 they realized there's geothermal applications. And that's
23 really how this happened, but it really started from this
24 cross seeding of different technology areas. And I don't
25 see that we're doing that enough in this country. And if

1 there's ways that we can kind of facilitate that in order
2 to find new solutions, and I think improve all of our
3 systems and the challenges that we have, that would really
4 be something that would be worth taking a look at.

5 And I should also note that there's a critical
6 juncture in there, too, where DOE stepped in and kind of
7 funded that project here at Chena. And without that, I
8 don't think that there would be a United Technology peer
9 cycle, geothermal, low-temperature power plant today. I
10 don't know if that's true, but it certainly was a critical
11 juncture where that federal funding has now moved us into a
12 commercially available technology that hopefully will
13 benefit a lot of other people.

14 Senator Murkowski: Your point about kind of the silos
15 that we have within the energy world I think is very apt.
16 And we see that, and it's -- so much of it, unfortunately,
17 is about the funding that comes to you. If you're working
18 wind and you're competing with all of the other energy
19 sources for those dollars. And those federal dollars,
20 unfortunately, are limited, and they're limited at all
21 other levels as well. And so instead of the sharing and
22 the collaboration that you're talking about, and that I
23 absolutely agree must happen in order to facilitate some of
24 the ingenuity that has to go on in order to accomplish some
25 of these difficult tasks, our systems are not set up to

1 really allow for that.

2 I've actually had a conversation with Secretary Chu
3 about that. And, you know, he's coming at it from the
4 researcher/scientist point of view, and I think he
5 appreciates the difficulty of it. Our challenge is to do
6 what we can to really help facilitate a greater level of
7 collaboration. Because we don't have it. So maybe rather
8 than starting from the Secretary's position and working on
9 down, we need to force it from the bottom up. And I think
10 you see that, and I appreciate you giving the history and
11 the background on this, because I think it does demonstrate
12 that if you have the passion that Steve talks about and
13 enough people that are willing to think outside the box in
14 terms of the solutions, we can get there. And again,
15 jumping in with the DOE grants at the appropriate time
16 doesn't hurt the situation either.

17 Chris, I'll let you make a comment, and then we're
18 going to have to move to the next panel.

19 Mr. Rose: Sure. Just a quick comment that reflects
20 on both of your questions. Because there is -- there are
21 winners and losers that are chosen on the generation side
22 for a number of reasons, and we have unique challenges
23 here, but as Gwen pointed out, we're the highest energy
24 users per capita in the world here. So what we really
25 should be focusing on is energy efficiency. And there are

1 many reports out there and studies that point out we could
2 reduce our energy load by 20 to 25 percent.

3 So that's 20 to 25 percent of the future generation we
4 don't have to build. And so the more we can focus on the
5 energy efficiency part up front, the less we have --
6 generation we have to build. And if we're the highest
7 energy per capita users in the world, we should be leaders
8 in energy efficiency. And if we were looking at ourselves
9 as a business, we would call that waste, and we would say,
10 we're going to make more money because we're going to waste
11 less. And so I think we have to kind of look at ourselves
12 that way and say, we're going to waste less, but we're
13 going to keep all that money in our economy and we're going
14 to let it multiply. Thank you.

15 Senator Murkowski: I think when you remember and you
16 appreciate that we are the number one consumer, and you
17 also appreciate the extent to which energy costs impact us
18 in this state -- you go outside to the Lower 48 and the
19 average American household spends about 3 to 6 percent of
20 their income on energy costs. And in some of the rural
21 parts of this state, we have families that are spending,
22 you know, close to 47 percent of their income on energy
23 costs.

24 When you put it in that perspective, we've got an
25 obligation as a state to figure it out, how we're going to

1 do it here. Because yes, it impacts -- it impacts people
2 all over the country, but there's a huge difference between
3 3 to 4 percent of your family budget going towards energy
4 costs, and when the price spikes, boy, you deal with it.
5 But when you're paying close to 50 percent of your family
6 income on energy and price spikes, we don't have anywhere
7 to go. So this is an initiative that, again, should
8 consume all of us. It should make us passionate about how
9 we can really make a difference in reducing those costs,
10 working towards an energy efficiency and conservation. But
11 really using the ingenuity that I think makes Alaska
12 wonderfully unique and wonderfully independent and figure
13 out how we can do better by all those who live here.

14 So with that, I want to thank you for your comments.
15 And if you have additional input that you want to provide
16 for the record, we'd certainly welcome that. And you will
17 be receiving some additional questions from me that if I
18 could have you respond in writing, we will incorporate that
19 as part of the record, as well. So thank you for your time
20 and your leadership on energy issues.

21 Let's go ahead and invite up the second panel, if we
22 can, please.

23 Okay. I would like to go ahead and get started with
24 our second panel. We probably have about an hour to move
25 through this second group. I know that we've got a whole

1 schedule of events after this, and so I want to make sure
2 that we have sufficient time to hear from, again, this
3 distinguished group of individuals. We have on the second
4 panel, Mr. Bernie Karl. Bernie has been mentioned
5 repeatedly this morning. So I'm glad, Bernie, you
6 were here to take all the comments, compliments, and be
7 here to defend yourself if necessary. Bernie Karl is the
8 president of Chena Hot Springs Resort here, and the head of
9 Chena Energy LLC. We also have with us Barbara Donatelli.
10 Barbara is the vice president of CIRI, and is very involved
11 with the Fire Island wind farm. Next to Barbara we have
12 Jim Dodson, who is president of the Fairbanks Economic
13 Development Corporation. We also have Doug Johnson, who is
14 the Alaska project director for the Ocean Renewable Power
15 Company. And the final individual on the panel on the
16 panel rounding us out is Dennis Meiners of the Intelligent
17 Energy Systems. So it's a pleasure to have the five of you
18 with us this morning.

19 And, Bernie, we will begin with you. And as a thanks
20 to you and to your wife, Connie, for hosting the Renewable
21 Energy Fair, and allowing us to conduct this field hearing
22 at Chena. And we appreciate it a great deal.

23

24

25

1 STATEMENT OF BERNIE KARL, PRESIDENT, CHENA GEOTHERMAL
2 ENERGY LLC

3 Mr. Karl: Senator Murkowski, thank you for the
4 opportunity to address both you and the committee on what I
5 believe is probably the most important issue facing the
6 world today: energy. I'd like to -- a special thank you
7 today to Senator Stevens, who's been involved in all of our
8 energy fairs so far, and who has been one of the strongest
9 supporters of renewable energy in the country. And so my
10 thanks to Senator Stevens for being here today, and for all
11 that he's done for the state of Alaska, because it has been
12 tremendous, and without his help there would be a lot of --
13 a lot of rural Alaska that would not have water, would not
14 have sewer, and would not be looking at renewable energy
15 today.

16 With that being said, what can we do? Well, I think
17 that Einstein says it best. Einstein says that imagination
18 is more important than knowledge. And I think our problem
19 is, is that we don't teach imagination. We don't teach
20 that to our children to use it. And if you have an
21 imagination, you can imagineer. Without imagination
22 there's no imagineering going on.

23 And Gwen didn't have it exactly right when she talked
24 about United Technologies, because we were already going to
25 build a power plant, but not with them. We were building

1 it with Barbara Nichols. And there would have been a power
2 plant built, so she was wrong about that, because it would
3 have been built because I had already signed a contract
4 with them with a handshake. And we already had the
5 \$750,000 to do it. And it would have worked on this low-
6 grade temperature, because they were already doing it.

7 But what happened is United Technologies called us and
8 said, hey, we understand you're going to do this. You
9 heard of us? I said, no, I haven't heard of you. Who are
10 you? Well, we own Sikorsky Helicopter. Well, I know about
11 Sikorsky. We own United -- we own Carrier Refrigeration.
12 I said, well, I've got some of those rascals. We own Otis
13 Elevator. I said, I was on one this morning. Hamilton
14 Sundstrand. I said, well, I went to school for Sundstrand
15 Pumps. Okay, you're calling, how can I help you?

16 Well, you see, even though you have all of these
17 brilliant people doing brilliant things, sometimes you
18 still need a little imagination to go with it with all this
19 brilliance. So when they called, they said, hey, we got
20 this idea, would you want to be involved in it. Well, I
21 said, we already have a deal going. So no, I don't think
22 we want to be involved. Well, my contract with Barbara
23 Nichols, I was released from it because he said he's an
24 engineer and he also worked for Pratt & Whitney many years
25 ago. And he said, I believe this is a better idea, I

1 believe you should go with them. I believe this will be
2 better for more people.

3 And today you're going to find out it will be better
4 for more people. With a portable unit that will be able to
5 go to an oil well and hook up in one hour. There's 250,000
6 producing oil and gas wells just in Texas alone. One
7 state. Just one state. 150,000 oil wells that are not
8 even producing. They're capped off. If we just took that,
9 we could make 5- to 10,000 megawatts. Not my number. Not
10 my number. Comes from MIT.

11 If we harness 2 percent of the earth's energy, just 2
12 percent of it, that's a thousand times more than the world
13 consumes. We talk about solar, we talk about wind, we talk
14 about the money they get. Senator, as you know, the
15 geothermal budget was zeroed out. Zero. With your help
16 and with Senator Steven's help, you were able to get back
17 some money, a small amount. And thank you for that. Thank
18 you for what you've done. But it was zeroed out. It's not
19 like -- it's not like we care about zero. Try that on for
20 size.

21 Why do we have serial number 1, serial number number
22 2? Why do we have the first portable unit here if it's
23 such a mature industry? I say the geothermal is every bit
24 as important, or maybe even more important because you can
25 base load on it. It is the only renewable energy that you

1 can base load on. But yet it gets the least amount of
2 attention; even to this day it gets the least amount of
3 attention. Shame on us. It's because we're addicted to
4 oil in one arm, and we're addicted to greed that somehow we
5 have convinced people that we can't do it. Well, the word
6 can't is not in my vocabulary. And it shouldn't be in our
7 children's vocabulary.

8 Webster's got to be an idiot. Webster says that
9 failure is if you don't succeed. And so we have these
10 projects, you give them a grant, and they don't succeed, so
11 you say it's a failure. I say failure is if you don't try.
12 I say failure is if you give up. If you don't give up, you
13 could never be a failure. But yet we teach our children
14 that failure is if you don't succeed. Shame on us.

15 And I've not heard one person mention hydrogen, or
16 mention carbon. The two most prevalent elements on earth.
17 The good Lord builds everything out of carbon, and builds
18 everything out of hydrogen. The only one that doesn't use
19 it very well right now is man. The only mammal on earth
20 that deliberately destroys his environment and then denies
21 it is us. What is wrong with that picture? Something is
22 wrong with it.

23 I mean, we should be the world's leaders. Alaska
24 should lead this parade. Why do you want to follow a
25 parade

1 when you can lead it? With our high energy costs, we
2 should be leading the parade. My wife and I are motivated
3 by huge debt load. That's what motivates us. We have \$2
4 million of our money, and \$650,000 that we borrowed. If
5 anybody thinks he's a self-made man, he's a fool. Because
6 all of these people have helped you all through your life,
7 starting with your maker, and then with your parents, and
8 then all these people around us.

9 United Technologies has been a tremendous partner.
10 The University of Alaska Fairbanks has been a tremendous
11 partner. The food that you see growing here, none of that
12 would be happening without the university. There's a lot
13 of knowledge at the university. Go use your universities.
14 Do I think they should be funded? Absolutely. Do I think
15 we can overstudy stuff? Absolutely. Do I think we need
16 to have projects that are successes? Absolutely. Do I
17 think that the future is the brightest it's ever been in
18 the history of man? Absolutely. There's more opportunity
19 now than there's ever been in the history of man. But it's
20 in reinventing ourselves. It's not as business as usual.

21 Right now you'll notice when you look around this
22 Energy Fair, not only are there a lot of vendors that have
23 a lot of good ideas, but go look at the LEDs, the light-
24 emitting diodes. These have the same kelvin, they have the
25 same spectrum as your light bulbs. They will reduce your

1 power costs by -- for lighting by at least 50 percent. And
2 we will guarantee it. We will guarantee it. You look at
3 the new lights in the greenhouse. They're red and blue
4 spectrum, because that's what the plant wants. It's going
5 to cut our lighting load by 90 percent. By 90 percent.
6 We've spent three years of our life looking into it. Now
7 we are importing them. They'll be available for Alaska. I
8 believe that Alaska can cut its lighting load for all of
9 Alaska in the next two years by 50 percent. In two years'
10 time. What can you do now? You do that. And you do it
11 now, not tomorrow, today.

12 What was the best time to plant a tree, a Chinese
13 proverb? Thirty years ago. What's the best -- second best
14 time? Today. Change your light bulbs. Look at the solar
15 heating out here. Why do we have it here? Because it
16 makes infinite good sense. That's why. And because
17 technology has come that far. It's here today. Change
18 today. Do what you can do today. Remember that if you
19 take just a hug, just a hug from the earth, there is enough
20 energy there to take care of all of our needs. All of our
21 needs. I'm not saying that it is the silver bullet. I'm
22 just saying there's enough there, and there's been very
23 little effort put into it. Thank you for the opportunity.

24 [The prepared statement of Mr. Karl follows:]

25 [COMMITTEE INSERT]

1 Senator Murkowski: Thank you, Bernie. Appreciate
2 your vision and your passion. Barbara Donatelli.

3 Ms. Donatelli: Yes.

4 Senator Murkowski: Welcome.

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

1 STATEMENT OF BARBARA DONATELLI, VICE PRESIDENT, FIRE
2 ISLAND WIND FARM, COOK INLET REGION INC.

3 Ms. Donatelli: Thank you very much, Senator
4 Murkowski.

5 I really appreciate the opportunity to be here today
6 and give an update on the Fire Island Wind Farm. That's
7 currently the largest renewable energy project under
8 development in Alaska, and we're really pleased to be able
9 to be a part of working on bringing this project online.

10 CIRI and its partner, enXco formed Wind Energy Alaska
11 in 2007 to develop and operate commercial-scale renewable
12 projects in Alaska. The company is developing Alaska's
13 first commercial-scale wind farm on Fire Island three miles
14 west of Anchorage in Cook Inlet. The 36-turbine, 54-
15 megawatt project will product clean renewable electricity,
16 and serve as an anchor to help additional railbelt wind
17 projects to achieve national goals for energy independence
18 and reduction of greenhouse gas emissions. We expect to
19 generate enough power to -- enough power for more than
20 18,000 homes in Anchorage.

21 Southcentral Alaska currently relies on natural gas
22 from the Cook Inlet basin for most of its electricity and
23 heating energy. In 2008, Railbelt Utilities, excluding
24 Golden Valley Electric, generated more than 93 percent of
25 their power with natural gas. However, as we all have

1 heard, the Cook Inlet gas production is in steep decline,
2 down from 205 billion cubic feet in 2005 to 146 billion
3 cubic feet in 2008. An alarming 29 percent drop in only
4 three years. At the same time, price volatility is
5 increasing.

6 In 2008, natural gas prices fluctuated from a high of
7 \$13.32 per million cubic feet in July to a low of \$5.38 in
8 December. Fluctuations of this magnitude make planning
9 difficult and have a devastating impact on both residents
10 and businesses. The Fire Island project will generate
11 flat-price renewable power. That will diversify
12 Southcentral Alaska's energy resources to increase
13 reliability, and decrease rate payer's vulnerability to
14 natural gas shortages and price swings.

15 Developing the Fire Island project has not been
16 without its challenges. A key challenge we still must
17 overcome is securing approval from the FAA to relocate the
18 aviation navigation equipment, commonly referred to as the
19 VOR, off of the island. As it currently stands, FAA
20 restriction necessitated by the VOR will not permit us to
21 build and economically viable project.

22 On July 15, 2009, Wind Energy Alaska filed new
23 applications with the FAA to expand the proposed Fire
24 Island Wind Farm to a financially viable 36-turbine
25 project. And then just this week, in anticipation of

1 receiving a notice of presumed hazard, Wind Energy went to
2 Washington DC and delivered a VOR relocation plan. We
3 believe that plan will provide the FAA the data it needs to
4 determine that the potential interference caused by the
5 turbines can be mitigated by relocating the VOR and thereby
6 allowing the project to move forward.

7 Our plan is to construct an upgraded digital doppler
8 VOR on property at Ted Stevens Anchorage International
9 Airport. Then after FAA certification of the new
10 equipment, the existing Fire Island VOR facility will be
11 decommissioned. Analysis indicates that the VOR can be
12 relocated with no adverse impact to airspace operations,
13 and with the benefits of increased facility security,
14 reduced operation and maintenance costs, and equivalent or
15 improved air navigational services for pilots.

16 Importantly, Wind Energy Alaska is not asking the FAA
17 to move the VOR. Instead we are asking FAA to enter into a
18 memorandum of agreement that would allow the project to
19 move the VOR with FAA support on an expedited basis. If we
20 can meet this schedule, the Fire Island project will begin
21 delivering power by the third quarter of 2011.

22 Now, a little bit about rural Alaska energy needs. As
23 we've heard already from many other folks who've testified,
24 currently most rural heat and electricity needs are met
25 with heating fuel and diesel. And these costs have risen

1 sharply in recent years. Some communities are trying to
2 find ways to reduce their energy costs by improving
3 efficiencies, and by developing renewable energy sources.

4 Currently the lowest cost renewable energy available
5 today is wind. There are nearly a dozen communities around
6 the state with combination wind-diesel systems displacing
7 diesel fuel burned in those communities. As we've also
8 heard, the energy storage is one of the biggest challenges
9 to renewable energy development. Electricity produced by
10 wind generation must be used pretty much at the same time
11 it's produced. It can't really adjust to changing demand.
12 Consequently, a system is needed to store that excess
13 energy when demand is low, and then to supply extra power
14 when demand is high.

15 Currently, electricity storage is difficult,
16 inefficient, and expensive. Commercial batteries, for
17 instance, run into the millions of dollars per megawatt
18 capacity. Other hurdles to broader development of rural
19 wind systems include lack of availability of village-scale
20 turbines, lack of availability of spare parts, and lack of
21 a trained work force in many cases.

22 Unfortunately some of our communities in Alaska lack
23 adequate wind sources necessary for the existing turbine
24 design. Research into low-speed wind turbines could lead
25 to the development of a machine capable of serving

1 communities that currently don't have sufficient wind
2 resources for wind generation.

3 There are some potential synergies between the
4 Fire Island wind project and rural renewable energy
5 initiatives. The Fire Island project could include several
6 smaller-scale turbines that could be used to teach Alaskans
7 to install, maintain, and operate wind projects in their
8 own communities.

9 Finally, some recommendations about what can be done
10 to promote wind development. On the policy side in
11 locations where wind development has proposed potential
12 hazards to aviation and must be approved by the FAA, we
13 believe the current process could be streamlined to help
14 bring projects online on a more timely basis. This could
15 possibly be accomplished through establishing an office
16 within FAA, or assigning a project manager to potential
17 wind development. And that could help navigate the wind
18 developer amongst the various FAA directorates and help,
19 you know, get it through the approval process in a more
20 timely manner. We think that would be area that could --
21 we could really be a help to not only wind projects in
22 Alaska, but potentially around the country.

23 On the technology side, research into the development
24 of energy storage systems that really address this
25 intermittent nature of most renewable energy technologies

1 would be a real boost to not only wind generation, but to
2 other renewable projects. We think the development of work
3 force training centers that support the implementation,
4 operation, and maintenance of renewable energy technology
5 -- technologies would be an important factor as well. And
6 the development of enhancements to existing wind turbine
7 designs to extract more energy at low wind speeds.

8 So thank you again for allowing us to testify about
9 our project and some of the challenges and -- that we've
10 encountered.

11 [The prepared statement of Ms. Donatelli follows:]

12 [COMMITTEE INSERT]

13

14

15

16

17

18

19

20

21

22

23

24

25

1 Senator Murkowski: Thank you for hanging in there.

2 It's been a long process.

3 Ms. Donatelli: It has.

4 Senator Murkowski: We know that. Next let's go to

5 Jim Dodson. Jim, welcome.

6 Mr. Dodson: Do I need to move this?

7 Senator Murkowski: Yes, you do. Actually, if you can

8 just kind of pick it up, it'll probably be easier. We've

9 got a volunteer technician. Thank you.

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

1 STATEMENT OF JIM DODSON, PRESIDENT, FAIRBANKS
2 ECONOMIC DEVELOPMENT CORPORATION, MUNICIPAL SOLID WASTE
3 PROJECT PROJECT

4 Mr. Dodson: Thank you, Senator Murkowski. And thank
5 you for your continued commitment to all Alaskans and
6 Alaska's energy needs.

7 Alaska is blessed with vast energy resources. Beyond
8 our conventional non-renewable resources of oil, natural
9 gas, and coal, Alaska is also blessed with abundant natural
10 resources -- renewable natural resources in the form of
11 water, wind, geothermal, solar, biomass -- renewable
12 resources that could provide for Alaska's energy needs
13 virtually indefinitely. Unfortunately, these renewable
14 energy resources, most within easy reach of all Alaska
15 communities, have been woefully underexplored and
16 underdeveloped until only recently, while our vast
17 conventional energy resources, particularly oil, have been
18 a boon to state government, but have proven a drain on most
19 Alaska citizens and most Alaska communities.

20 Alaska is a sparsely populated state, only 680,000
21 Alaskans. Our communities are spread across an immense
22 state that covers 660,000 square miles. This makes the
23 distribution of goods and services, like heating fuel and
24 electric power, expensive and challenging. Over 50 percent
25 of all Alaska homes are heated with fuel oil. And 67

1 percent of their energy cost is from -- are from home
2 heating.

3 The cost of energy is crushing our economy. Many
4 rural Alaska residents are leaving their communities,
5 communities that have existed for hundreds of years are no
6 longer sustainable because of the cost of energy. For
7 Interior and rural Alaskans living in a winter Arctic
8 environment, saving money by simply turning down the
9 thermostat at 40 below, or turning off our lights when the
10 sun only shines a few hours a day is not an option.

11 Alternative and renewable energy sources can be a part
12 of Alaska's energy solution, but it is not the entire
13 solution. Affordable, reliable, and sustainable
14 alternative energy will take time, research, and investment
15 if we are to achieve America's goal of 25 percent
16 renewables by 2025. 25 percent renewable, 75 percent
17 conventional, but 100 percent affordable.

18 Fairbanks Economic Development Corporation and the
19 Fairbanks community has promoted energy issues from
20 conservation, to biomass, to energy from municipal waste,
21 to in-state use of natural gas, to hydroelectric power
22 generation, to a biomass/coal to liquids project.

23 When working on a biomass projects we found that
24 though the resource potential in the Fairbanks community,
25 including woody biomass, crop slash, processed timber

1 residue, land clearing and fire mitigation materials, and
2 municipal solid waste were substantial. Only municipal
3 solid waste was at a stage where it might be immediately
4 used for energy production. For other biomass resources,
5 questions regarding their true abundance, chemistry,
6 cultivation, reforestation would all have to be answered
7 before they could truly be utilized as a sustainable energy
8 source.

9 Alaska has vast forest lands. Its forest resource
10 potential is immense. However, Alaska lags far behind
11 other states in accurate, up-to-date forest inventory
12 analysis. Neither the federal government nor the state
13 have adequately invested in the necessary forest
14 inventories. Surveying for forest type and tree species
15 using on-ground techniques is critical for any sustainable
16 use of biomass for energy resource.

17 Also, just as a birch is different from barley, the
18 energy output of different plant species can be radically
19 different. Understanding the Btu output per volume of
20 individual indigenous and introduced species is critical.
21 We must determine what crops will produce more energy from
22 use than they consume from production and transportation.

23 When working on a waste-to-energy project, we found
24 that existing commercial technologies were not scaled to be
25 economic for similar communities. Communities such as

1 Fairbanks, with just less than 100,000 people, and all of
2 rural Alaska, cannot afford the heat and power generated
3 from waste-to-energy projects that are currently -- or
4 equipment that is currently available commercially.
5 Research, development, and testing, demonstration must be
6 continued to allow waste-to-energy projects to become a
7 viable part of the energy solution for a small Arctic
8 communities.

9 In December of 1958, an ad in the Fairbanks Daily
10 News-Miner read: Coming, Natural Gas for Fairbanks,
11 Nature's Perfect Fuel for Home and Industry. As you know
12 today, more than 50 years later, that fuel source is still
13 coming. With only 680,000 residents, Alaska is not a large
14 enough market to attract private investment in a gas line
15 solely to service Alaska markets. That perfect fuel that
16 could reduce Alaska's energy cost, that should be Alaska's
17 fuel for 75 percent -- be the Alaska fuel for communities
18 use 75 percent of their energy needs, that would contribute
19 to the reduction of Alaska's CO2 footprint, that can
20 eliminate the Fairbanks PM2.5 issue. It is no closer to
21 Fairbanks today or the majority of Alaska communities than
22 it was 50 years ago. Conventional thinking will not solve
23 this problem; simply hoping for private industry to make
24 natural gas available to all Alaskans at an affordable
25 price will not reduce our energy costs, meet EPA air

1 quality guidelines, or reduce our CO2 emissions.

2 Innovative thinking and bold leadership from our national
3 and state officials is needed to make natural gas available
4 to all Alaskans, and it is needed now.

5 The first license request to build the Susitna Dam
6 project was submitted to the Federal Regulatory Commission
7 in 1984. That application was dropped within a year when
8 the price of oil dropped and energy was perceived to be
9 cheap.

10 Hindsight tells us that the decision to drop the
11 Susitna Dam application was wrong; energy produced from
12 crude oil is not cheap, and our 1985 decision not to
13 proceed with the construction of that project has
14 contributed to today's high energy costs, increased CO2
15 emissions, and possibly global warming. Building Susitna
16 Dam is a long-term project; it is not the answer for
17 today's staggering energy costs, but it is an answer for
18 future clean energy needs, and today is the time to restart
19 the Susitna Dam project.

20 In 2008, the Fairbanks Economic Development
21 Corporation contracted with Hatch Limited for an
22 engineering and feasibility study on a coal, biomass, and
23 natural gas to liquid facility. That facility would take
24 underutilized, low-value Alaska resources -- biomass and
25 coal -- and produce jet fuel, Arctic-grade home heating

1 fuel, no-sulfur road diesel. It would provide synthetic-
2 blended liquid fuel for the United States military, firmly
3 anchoring Alaska's military, a full 25 percent of our
4 economy, to Alaska. It could be a base-load consumer for
5 an in-state natural gas pipeline. And according to
6 publications by Dr. Paul Metz of the University of Alaska
7 and the U.S. Department of Energy, there is a strong
8 indication that the CO2 produced in such a facility would
9 be as valuable as a miscible injectant for enhanced oil
10 recovery, sequestered, while at the -- still at
11 the same time allowing for the production of up to 12
12 billion additional barrels of North Slope crude from
13 existing fields.

14 Alaska is uniquely positioned to help America -- to
15 help American transition to a new energy future. No other
16 people and no other state in our nation are more reliant on
17 energy for their survival. No other people have more to
18 lose should we fail to succeed than the people of Alaska.
19 No other people have more of a vested interest in seeing
20 that these new and innovative technologies work. No other
21 state has such a wide diversity of renewable, sustainable
22 fuel sources at such a tremendous -- at such an enormous
23 abundance than Alaska. Therefore, no state is better
24 positioned to drive the research on these new technologies
25 than Alaska. If you create it, Alaska can power it. No

1 other state has such a wide range of temperatures and
2 climatic extremes, is as hard or unforgiving as Alaska.
3 Therefore, Alaska is better positioned to serve as a test
4 bed and proving ground for new energy technologies than
5 Alaska. Alaska tested, Alaska tough resonates for a
6 reason. If you can make it work here, you can make it work
7 anywhere.

8 It is unfortunate that the national discussion on
9 energy is often dominated by advocates of the extremes --
10 those who say we can continue on forever with business as
11 usual, or those who say we must chuck conventional energy
12 sources and move wholesale into renewable. Alaska and
13 America need both renewable and conventional energy. The
14 president's goal is 25 percent energy generated from
15 renewable sources by 2025. In Alaska, if we were able to
16 provide rural Alaska with 25 percent renewable energy for
17 free, their energy bill would still be unsustainably
18 expensive. Alaska -- energy is a fundamental component of
19 any economy. 25 percent renewable, 75 percent
20 conventional, but 100 percent affordable. Growing our
21 economy, creating jobs and opportunity for people, that
22 should be our mission. The president's 25/75 target is
23 bold, but it is realistic. And at least in Alaska it is
24 achievable. Together we must begin the journey that will
25 complete our mission. Thank you for your time.

1 [The prepared statement of Jim Dodson follows:]
2 [COMMITTEE INSERT]
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

1 Senator Murkowski: Thank you, Jim. Appreciate your
2 testimony. Doug Johnson, welcome.

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

1 STATEMENT OF DOUG JOHNSON, ALASKA PROJECT DIRECTOR,
2 OCEAN RENEWABLE POWER COMPANY

3 Mr. Johnson: Good afternoon. And to those of you
4 that aren't Alaskans, welcome to Alaska. Thank you for
5 taking your valuable time to hear our testimony today.

6 I'm Doug Johnson, the Alaska projects director for
7 Ocean Renewable Power Company. Our company is currently
8 developing two projects here in Alaska and one in Maine.
9 Our project in Maine is a tidal energy project in Western
10 Passage, on the American side of the Bay of Fundy. Our
11 projects here in Alaska are a tidal energy project in Cook
12 Inlet adjacent to Anchorage and a river energy project on
13 the Tanana River about 100 miles from here in the community
14 of Nenana.

15 My great-grandfather came to Alaska in the gold rush.
16 His cousin was one of the Three Lucky Sweeds that made the
17 original gold strike in Nome. Today, like those pioneers
18 of the past, a new generation here in Alaska is pioneering
19 the development of the renewable energy industry.

20 Never before has there been a greater opportunity for
21 new sustainable economic development here in Alaska and
22 across our country than today. The transition to low or no
23 carbon renewable energy is inevitable. As the climate data
24 is telling us, it's needed sooner rather than later.

25 Currently in the arena in marine hydrokinetics, the

1 Europeans are the world leaders. Fortunately it is still
2 early in the game and we have the opportunity to leap-frog
3 the Europeans using our native innovative abilities. If we
4 don't take advantage of this opportunity, it will be
5 another loss of stature for the United States in the global
6 arena. And, more importantly, a loss of new jobs in a key
7 emerging industry. The world looks to the United States as
8 a leader in innovation, and we have the unique opportunity
9 to demonstrate our leadership once again.

10 To take advantage of this opportunity, our industry
11 needs your help now. As a fledgling industry here in
12 Alaska we see four key road blocks that government can
13 remove. Without this help, we will not be able to realize
14 the environmental and economic promise of marine renewable
15 energy.

16 Roadblock number one: Lack of federal agency
17 coordination. Lack of timely coordination amongst the
18 agencies wastes scarce and valuable human and monetary
19 capital, a luxury an emerging industry cannot afford. We
20 need agencies to be well coordinated producing streamlined
21 highly -- high-quality development processes.

22 Roadblock number two: Technology-stifling impact of
23 baseline data collection requirements for pilot projects.
24 We are spending a million dollars this year in Cook Inlet,
25 with agencies requesting we do the same or more next year

1 without ever having a device in the water. We believe that
2 in Alaska a year of baseline combined with the substantial
3 available data is adequate with the proviso that we
4 continue extensive monitoring with our devices in the
5 water. This is the best way to assess the potential
6 environmental effects. If we find a serious problem, our
7 devices can be shut down immediately and removed in days.

8 Roadblock number three: Increased federal and state
9 research role. We need the federal and state agencies to
10 actively partner with us as stewards of the public resource
11 to assist in a more fully -- to assist in more fully
12 characterizing our pilot sites energy resources, physical
13 and environmental and marine life.

14 Roadblock number four: Lack of continuity between
15 pilot project license and full commercial license.
16 Presently there is no clear pathway to go from a pilot
17 project license to a commercial project license. We
18 propose the development of a clear bridge from successful
19 pilot to a commercial license.

20 I have included a detailed discussion of each of these
21 points in my written testimony, including our proposed
22 solutions. The time is now, the opportunity is before us,
23 and we in the marine renewable energy industry are ready to
24 move forward. With your help, our country can take the
25 leadership role in this exciting new industry. Thank you

1 for the time to speak with you today.

2 [The prepared statement of Doug Johnson follows:]

3 [COMMITTEE INSERT]

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

1 Senator Murkowski: Thank you, Doug. And our final
2 panelist this afternoon is Mr. Dennis Meiners. Welcome.

3 Mr. Meiners: Thank you, Senator. Can you hear me?
4 Yeah.

5 Senator Murkowski: We're good.

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

23

24

25

1 STATEMENT OF DENNIS MEINERS, INTELLIGENT ENERGY
2 SYSTEMS

3 Mr. Meiners: Senator, thank you very much for the
4 opportunity to speak with you and the committee today. My
5 name is Dennis Meiners. I'm the CEO of Intelligent Energy
6 Systems, and director of Power Corp. Alaska.

7 Intelligent Energy Systems is a project coordinator
8 and developer for rural energy projects. We work directly
9 with villages to develop appropriate solutions to solve
10 energy problems. And Power Corp. Alaska is an integrator
11 and advanced control system provider.

12 But what I'm here to talk to you about is the group --
13 the Chaninik Wind Group, and our Chaninik projects. I have
14 been working in wind-diesel for the last 15 years, 10 at
15 the Alaska Energy Authority. And when it came to
16 renewables, we were looking at using renewables to decrease
17 dependency on diesel fuel at the Energy Authority.

18 And I think that there are three truths that are -- or
19 3.5 truths that are self-evident about rural energy. The
20 first one is that we must -- there's no choice, we must end
21 the dependency on fossil fuels. Two, right now with the
22 current tools we have, we can decrease the use of fossil
23 fuels by 40 to 50 percent in over 100 villages based on
24 wind. And that's not just for electricity, but that's for
25 heating fuel, transportation, and electricity. The third

1 truth is that village wind heat -- I'll call it village
2 high-penetration wind heat -- is really a pathway to our
3 national energy future.

4 Now, some people may laugh at that, but we've heard
5 from other panel members that villages are proving grounds
6 for the integration, stability, and management of high
7 levels of renewable energy. And that's the truth. The .5
8 truth is wow, Bernie, I agree with Bernie.

9 What we're doing in the Chaninik Group is a group of
10 four villages between Kwigillngok, Kipnuk, Kongiganak, and
11 Tuntutuliak at the mouth of the Kuskokwim River. And they
12 have a very good wind resource there. And their goal was
13 to combine as a group to build wind-diesel systems to make
14 the communities more self-reliant.

15 We have three projects underway. Each of those
16 projects has about one kilowatt of installed capacity per
17 resident. And we're taking that energy -- that's a lot of
18 wind power in relation to the population and the electric
19 load. In fact, at most times the wind power will provide
20 more energy than is needed to meet the electric load. That
21 excess energy will be stored in thermal storage units in
22 individual homes to decrease heating costs.

23 One of the first things we did was to do an energy
24 survey to find out how much energy individual homes were
25 using, and where there energy budget was being spent. And

1 what we realized early on was that although electricity is
2 expensive at about 65 cents a kilowatt hour, the real
3 impact on a household was paying the heating bill. You can
4 have 1,000 square foot house, and they may have a heating
5 bill that's 6- to \$8,000 a year for a family that's maybe
6 -- has an income of around \$40,000 total. Then when you
7 look at a subsistence lifestyle that requires you to use
8 outboards and snowmachines to go gather your food, and
9 gasoline is expensive, what we see is that probably two-
10 thirds of a home energy budget goes to heating fuel, and
11 maybe 15 percent goes to electricity, and the rest goes to
12 transportation.

13 So the major problem that we're trying to address is
14 heat, we're -- and when you look at the wind, the wind
15 resources available, and when you need the heat, it's when
16 the wind blows. Most of the wind blows at night in the
17 wintertime, so you need to store it. So we're taking -- we
18 have installed excess wind capacity. We take that excess
19 wind, and we store it in individual thermal devices in
20 homes. These devices are about the size of a Toyo Stove,
21 which is a common heating appliance in rural homes. It
22 contains bricks that heat up to around 1,200 degrees.
23 Those bricks store the heat, and they're used throughout
24 the day.

25 We estimate that with our current projects we can only

1 provide for about a 50 percent heating fuel displacement in
2 a quarter of the homes. What we see in the next phase of
3 projects in -- we're looking at a project in Kipnuk where
4 we would like to go to provide three to five kilowatts of
5 installed wind capacity per resident and displace a total
6 of 50 percent of the heating fuel and the fuel used to
7 generate electricity in the entire community.

8 We have to innovate with wind power. Current wind
9 systems that are going in now have about one-third of a
10 kilowatt of installed capacity of wind per resident. And
11 the energy produced from that -- from those -- from that
12 wind is used to displace fuel at the powerhouse only. And
13 what we see is that that's not a solution. When you
14 install a small amount of wind power, say one or two wind
15 turbines, the economics don't favor a scaled construction
16 effort to drive the individual cost of -- per kilowatt
17 down, and also the systems don't produce enough electricity
18 to make the maintenance operations economic.

19 If we put in large wind turbines in small communities
20 and we focus on displacing the major portion of fuel, which
21 is used for home heating, that changes the entire economics
22 of renewable energy in rural Alaska. First of all, you're
23 no longer sending dollars out of the community to the fuel
24 companies. You're keeping those heating dollars in the
25 local pockets of the residents. Too, we can sell that

1 using advanced metering and control systems with grid
2 stability. We can sell that electricity to a resident for
3 at least 50 percent of the cost of the heating fuel. So
4 not only have you reduced the heating cost to the consumer,
5 but you've also increased revenues to the local utility.

6 So the Chaninik Group was formed with a focus on 100
7 percent displacement of fossil fuels with renewables. Now
8 that's a long-term goal, but our short-term goal, it's in
9 the church of the here and now. And we're doing hand-to-
10 hand combat with the technologies that we have, and we know
11 that we can get to 40 to 50 percent. Now, if the Chaninik
12 Group is successful, then that model should spread to at
13 least half of the villages in Western Alaska.

14 And I think that if we look at wind not as supplying
15 electricity, but if we look at the whole energy picture in
16 a community, there's solutions here. Those same solutions
17 apply across the nation. Because if you look at wind --
18 the wind resources available in the Midwest, there's a lot
19 of excess wind at night. So the same wind heat storage
20 solution is applicable throughout the country. The same
21 backbone, the same control backbone, the same metering
22 backbone that has to go in to manage that wind energy
23 separate than diesel-generated electricity is the same
24 backbone that's needed to provide lower-cost electricity or
25 use renewable types of energy to provide power for plug-in

1 vehicles.

2 So the Chaninik Group, we see ourselves sort of as the
3 little gnat out there that's annoying the tail that wags
4 the dog. And the big dog is the electric -- the big boys
5 with the big wind turbines and the big oil companies and
6 the -- you know, the major energy suppliers. We need
7 solutions that are applicable for us now. And we're
8 pioneering those. And we think they're going to be
9 valuable for everyone.

10 And I know this is a national sort of a -- a national
11 issue. And I just want to say that there are a lot of
12 other small companies and small efforts across the country
13 that are helping us. We have partners in South Dakota,
14 North Dakota, North Carolina, Vermont. We're encouraging
15 new -- new wind manufacturers in Arkansas, we're
16 buying software and engine generator controller parts from
17 across the -- from Colorado and Michigan, all across the
18 country. We need the helps of -- we need the help of many,
19 many small businesses to assist our efforts. So this is
20 not just an Alaska effort, this is a -- this is a must for
21 Alaska, but it's also important for the rest of the
22 country.

23 So thank you, Senator, for the opportunity to speak
24 today.

25 [The prepared statement of Mr. Meiners follows:]

1 [COMMITTEE INSERT]
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

1 Senator Murkowski: Appreciate your testimony.

2 Dennis, how much are the thermal units if it's in
3 somebody's residence? What does the unit cost right now?

4 Mr. Meiners: A thermal unit is probably around
5 \$2,000. But in rural communities, because the electric
6 system is so -- may not be up to code, some code
7 improvements have to be made, so a typical installation for
8 one of these systems is -- could be 3- to \$4,000.

9 Senator Murkowski: You know, the conversation that
10 we've had with this panel particularly, whether it's
11 geothermal, wind, biomass, ocean tidal, or wind
12 opportunities, wind-diesel, I think we recognize that
13 unless we can be building things to scale to allow for the
14 efficiencies in small communities, wonderful technology is
15 happening all over out there, but if you can't figure out
16 how you make it cost efficient in a village, cost efficient
17 in a smaller community where, you know, we're not hooked
18 into anybody else. And one of the discussions that we
19 haven't had which really gets people a little bit agitated
20 when I bring it up because it's -- it is something that
21 we've got to deal with, if you're not living right where
22 the energy source is, you got to move it to get it to the
23 people, and it's all -- the big issue about transmission,
24 which, on a national scale, is something that, you know,
25 some of my colleagues just don't even want to go there,

1 because then we're really talking about some controversial
2 issues. But I think it's important to recognize that we're
3 going to have to figure out in this state how we can take a
4 small community like Kipnuk, which, you know, maybe has
5 350, 450 people there -- 800 in Kipnuk? Okay. So I'm down
6 by half. But still, you've got an 800-person community,
7 and for us to go in and say well, we're going to help you
8 reduce your energy costs, but the cost of doing so is
9 absolutely prohibitive, we haven't helped them out. So
10 getting things to scale.

11 And the project that you described, Dennis, in how we
12 can really be looking to the whole energy picture and how
13 we reduce those costs is, I think, something that we need
14 to key into with -- particularly in this state. I was in
15 Newtok yesterday, and they're moving that village to
16 another spot on higher ground on Nelson Island. There's
17 four different villages on that island, and the question
18 now is how they tie into one another to utilize some of the
19 energy opportunities that exist out there. But again, this
20 is something that we haven't had much, if any, discussion
21 here in these two panels this morning. But I think, again,
22 we recognize that our geography makes it complicated and
23 difficult, but we've got to be looking to how we deal with
24 the transmission issues as well.

25 As I mentioned with our first panel, I've got a whole

1 host of questions that I will ask to each of you in writing
2 and would ask for your cooperation so that we can include
3 them as further part of the record. But I want to just
4 kind of throw out to each of you -- and I'm watching my
5 watch, Bernie; I think we've got about ten minutes before
6 we got to cut it off here so we can move on to your
7 program? Is that about right?

8 Mr. Karl: You got all the time you want, Senator.

9 Senator Murkowski: All right. I'm not going to mess
10 with the schedule here. But from your perspectives,
11 whether it's in geothermal or wind or ocean or biomass, how
12 can we, from the federal level, better help to facilitate
13 some of the smaller-scale projects? Because they're not
14 nearly as interesting and intriguing on paper. If you're
15 not supplying power to large regions, large numbers, how
16 can we better help to facilitate that?

17 You know, Bernie, you have made your -- the
18 Chena Hot Springs here, it's a self-contained unit. And
19 you're doing everything for this little community. But
20 again, when DOE is looking to move grants, you're competing
21 against requests that look pretty good on paper in terms on
22 supplying and meeting the needs. Now, the Fire Island
23 project, you get that pulled together and the ability to
24 offset some of our energy costs, particularly as we see
25 costs rising in the future as we see the reserves coming

1 out of Cook Inlet dwindling, we've got to be addressing
2 that. How do we better facilitate some of these smaller-
3 scale opportunities? And I throw that out to any one of
4 you.

5 Mr. Karl: Well --

6 Senator Murkowski: Bernie, go ahead.

7 Mr. Karl: -- to start with, Senator, there's a
8 tremendous opportunity right now with the administration
9 and the money that -- I don't know where you're getting it.
10 I guess you're printing it because.....

11 Senator Murkowski: That's another hearing for another
12 date, I think.

13 Mr. Karl: But with that being said, right, wrong, or
14 indifferent, the opportunities are tremendous right now.
15 And I think it's in reinventing ourselves, as I stated once
16 before, but in Fairbanks, Alaska, right now with the help,
17 again, of United Technologies, and with the help of Alaska
18 Energy Authority, I can tell you the Alaska Energy
19 Authority has been a tremendous -- a tremendous resource
20 for the state of Alaska. It has tremendously good
21 leadership who gets it, who understands that there has to
22 be an energy policy. And they are helping Chena Power in
23 Fairbanks, Alaska, to build a 500 kW power plant that will
24 be running with no smokestack. It will be the first
25 commercial power plant. It will scaled to work in any

1 village in Alaska. And I can assure you that any village
2 in Alaska can be self-sufficient for all of its fuel, for
3 all of its energy, and for all of its food in the next ten
4 years if it wants to be. And you can be thankful to United
5 Technologies, and you can be thankful to AEA for believing
6 in the project and not being a hinderance.

7 But you see, one of the biggest things was, well, you
8 got to get this permit and you got to get that permit.
9 Well, let's work at not having permits.

10 Senator Murkowski: I think the ocean energy guys
11 would like that. I know that for a fact.

12 Mr. Karl: But let me tell you -- let me tell you how
13 you work at not having permits. You have to imagine it
14 again. The J. Florida project was going to fail. You want
15 to know why. \$1 million for getting the permits, and
16 another year of time. So Quantum Resources said forget it,
17 we didn't buy into that. Mr. Karl, we told you our share
18 was \$348,000, now our engineer says another million for
19 permitting, we're not going to do the project.

20 So what do you do? You come back to Alaska and you
21 tell them okay, we'll do it with no permits. They say,
22 yeah, right. We made it portable. We have no emissions.
23 It's legal height, it's legal width, legal weight for all
24 50 states. You have to look at what you can do. In
25 Fairbanks, Alaska, we're building a new biomass plant with

1 no smokestack. I don't need to worry about air permits
2 because I don't have any emissions. I don't need to worry
3 about disposal permits because I'm not going to dispose
4 anything. It's called biomimicry. You mimic what nature
5 does.

6 The Native populations of Alaska have been doing that
7 for centuries. They've lived off of biomass. They've used
8 their environment for 10,000 years. For 10,000 years
9 they've used their environment. Cold is a wonderful thing
10 if you use it. So is heat, it's a wonderful thing if you
11 use it. Well, what if we combine the two? What if we
12 combine them? We can make a tremendous amount of energy on
13 a Delta-T of just 100 degrees. And with a company like
14 United Technologies to help, it's pretty easy.

15 Do we need the Department of Energy's help?
16 Absolutely. Absolutely. Because when you're doing all of
17 these so-called experimental things, there's a lot of risk.
18 I've never, ever considered risk. Now, maybe I should.
19 And my wife tells me all the time, she says, you are no
20 philanthropist. And I said, some day I want to be. So --
21 oh, she's like having a 50,000 pound anchor on the old rear
22 end. But I need her, obviously.

23 So with that being said, these opportunities right now
24 are real. And it takes -- as Senator Stevens always said,
25 money is going to evaporate for Alaska. We need to work

1 together. There's going to be less funds. So you need the
2 federal government, you need Alaska Energy Authority, you
3 need the university, you need private sector, you need
4 United Technologies, you need everybody working together as
5 a synergy, as a synergy. And you can get a lot done. You
6 have to be willing to work together and share these ideas.

7 And I think that is the future for renewable energy.
8 I don't say there's a silver bullet, I say you have to use
9 it all. And storing energy is like a no brainer. The good
10 Lord's been storing energy his whole life. Right? Right
11 in the earth. We store energy all the time. And it's ours
12 to take, but to use it wisely.

13 Senator Murkowski: I want to ask, too, a little bit
14 more about the permitting issue, because that's where we at
15 the federal level -- you say there's roadblocks out there.

16 Mr. Johnson: Yes.

17 Senator Murkowski: And I think it's important for us
18 to understand how we can realistically remove or perhaps
19 soften some of these roadblocks. Because wonderful ideas
20 on paper, but if the government is saying, okay, we got a
21 great energy policy out here, we want to encourage all
22 these renewables, and yet we put these hurdles up in front
23 of you that are either so bureaucratically impossible or so
24 incredibly expensive, we haven't facilitated anything.

25 Mr. Johnson: Exactly. Thank you, Senator. I have an

1 idea for you. I think we should be pitching Alaska as the
2 laboratory for our country, the laboratory for developing
3 renewables, and the laboratory for developing a process to
4 facilitate this. We got an amazing innovation here. Just
5 look around us and see what Bernie is doing, look at what
6 Dennis is doing out in Western Alaska, look at what we're
7 trying to do with the hydrokinetics. It's happening. But
8 what we have to be able to do is facilitate the development
9 of it. And yet that policy that's there, the permitting
10 processes that are there, what we need is agency
11 coordination. Because we can unleash the innovation that
12 we have if we can have the agencies work with us and sit at
13 the table and work through this and develop processes that
14 don't.

15 Senator Murkowski: Do you feel that you do not have
16 that cooperation presently?

17 Mr. Johnson: We're working toward it, but it's a --
18 it's challenging because you've got people in, you know,
19 different places in the country physically, and you've got
20 different people in different sort of mind or thought
21 processes or where they're at in terms of their ideas
22 around renewables and how they ought to be developed. So
23 it's policy and developing the coordination between the
24 agencies.

25 Like, in our instance, it's Federal Energy Regulatory

1 Commission, or FERC, and the folks at NOAA. You know,
2 trying to get NOAA and NIMS and FERC all working together
3 so that we can get the permit process moving forward in a
4 way that makes sense that we can participate, that doesn't
5 bankrupt us in the process.

6 Senator Murkowski: From the state perspective, do you
7 feel that there is greater ability working within -- at the
8 state level?

9 Mr. Johnson: Yeah, the state of Alaska has been
10 fabulous. This Alaska -- our Alaska Energy Authority is a
11 tremendous asset to us here. And virtually everyone that
12 I've met in state government has been tremendously
13 supportive of our efforts. And I know in renewables in
14 general. So the state's been great to work with.

15 Senator Murkowski: We've got some issues with it, and
16 I think we heard a little bit of that from the first panel
17 as well. But I know with the Fire Island project, this is
18 something that has been in process for years, and it has
19 been the federal government, which has been the impediment,
20 whether it's the FAA issue. But it is -- it really seems
21 to be that the stumbling blocks are at the federal level,
22 even though we have put in place this huge initiative that
23 we're going to advance renewable energy in a meaningful and
24 significant way. Dennis?

25 Mr. Meiners: Senator, and on the permitting issue, I

1 think it's just -- at least from the wind projects, if
2 federal money comes in and you use federal money for a wind
3 project, it spins you in a whole new parallel universe of
4 permitting and agency interest. In these recent renewable
5 energy projects, it was state funded. And I think that
6 there are certain agency representatives who are just not
7 well educated about the impacts or the nonimpacts of these
8 systems, say, on tribal lands or in communities. And so
9 they tend to slow the process down and try to spin it back
10 into that whole permit process. So I think there needs to
11 be a clear dividing line between where the jurisdiction is
12 and where it isn't. And they can say we have no
13 jurisdiction here and be able to do it very quickly. So
14 that would speed things up.

15 Mr. Johnson: Absolutely.

16 Mr. Meiners: Because there's a lack of ability to
17 make decisions there, there are new people, so there needs
18 to be some kind of reeducation, perhaps, at that level.
19 Because I have projects -- the projects in the Chaninik
20 area do not require permits. And you go to certain people,
21 and they say, we don't have any jurisdiction here, and
22 other people say, oh, I think we might have jurisdiction
23 here, and so six months later they decide that you don't.
24 So I just think there needs to be maybe some retraining on
25 the permit level.

1 Senator Murkowski: Well, and certainly from the
2 jurisdiction perspective, as we know, with the offshore
3 energy issues, there's a huge controversy and fight between
4 the FERC and MMS, and literally a process that took years
5 to resolve, and, you know, we're hopeful that, in fact, now
6 it has been resolved and that projects can be moving
7 forward. But again, you've got good substantive projects
8 on the drawing board that can't advance because of federal
9 agency issues that just shouldn't be there in my opinion.

10 I am going to, again, submit a series of questions to
11 each of you, but I want to thank you for your contribution
12 here at this field hearing. And I think it's been
13 interesting to have a little bit from the various sectors
14 that are making some good things happen within the state.
15 If you don't -- if you're not excited about what our
16 potential is for renewable energy in this state, you
17 haven't woken up yet this morning, because it is real and
18 it is vibrant and it's a terrific thing.

19 I want to close by reminding, not only the panelists,
20 but any of you who have attended today, that if you have
21 comments, if you wish to submit written testimony on any
22 other Alaska Renewable Energy projects or ideas that you
23 might have, you can submit them to the committee in
24 writing. We will hold the record open for ten days for you
25 to do so. You can send them to the Committee on Energy and

1 Natural Resources in Washington DC. Or you can e-mail them
2 to Chuck Kleeschulte, who is on my energy staff here.
3 Chuck's e-mail address -- or I can't give it to you because
4 I can't spell his last name. You can get it from Chuck.
5 But you can e-mail him, or you can also send it to my
6 Fairbanks office here. Althea Saint Martin, who is
7 standing up taking the picture there, is located in
8 Fairbanks. Her number here in Fairbanks is 456-0233. She
9 can get them to our committee's Washington staff and get
10 them included in the formal record.

11 I want to acknowledge and thank the committee staff
12 that have joined us, both down from the Democratic side and
13 the Republican side. They helped to facilitate these field
14 hearings, and their advance work is greatly appreciated.
15 So Mike and Chuck, thank you very much. And with that, we
16 will conclude.

17 [Whereupon, at 12:46 p.m., the hearing was adjourned.]

18

19

20

21

22

23

24

25

A				
abilities 92:3	4:5 49:10	advances 50:16	2:10 3:2 6:5,11	101:20,21
ability 105:23	114:11	advancing 3:25	7:5,6,9 8:2 9:9	106:16,17,18
111:7 112:16	acres 6:23	advantage 92:4	11:1,5,8,9,12	106:20,23
able 4:5 12:20	act 4:8,8,11	92:10	12:6,9,16	107:1,2,20,25
16:12 24:1	19:13 39:16	adverse 77:12	13:11,12,14,24	108:6,25 109:2
43:20 47:14	54:19	advisory 39:16	14:8,10,12	110:1,6 111:9
48:12 61:2	active 18:17	advocacy 39:18	15:3,5,5 17:7	111:10,10
62:1 70:4,16	actively 15:12	advocates 88:9	17:11,19 18:24	113:22
75:8 88:15	93:10	AEA 107:5	19:4,8 22:1,9	Alaskans 5:11
92:13 110:8	activities 19:12	affirmative 55:8	22:12,12,13,22	6:10,12 23:4
112:13	19:25	afford 24:1 85:2	22:24 23:12,16	25:15,15 26:18
absolutely 54:13	actuality 31:14	92:19	23:18 25:12,25	28:15 31:18
54:24 56:1	ad 85:9	affordable	26:8,21 27:16	32:4 48:9 59:1
63:23 72:14,15	ADA 52:22	36:22 83:13,17	28:11 31:1,2	59:3 60:10
72:16,18 104:9	add 11:18 51:24	85:24 88:20	32:19,23,24	79:6 82:5,21
108:16,16	added 36:5	affords 35:10	33:4,5 34:8,10	83:7 85:24
112:15	addicted 71:3,4	afternoon 9:21	34:12,20 35:17	86:4 91:4
abundance 84:5	adding 26:3	9:24 10:18	35:19,21 36:7	Alaska's 7:18
87:23	additional 35:5	91:3 95:2	36:21 37:10	12:22 13:17
abundant 12:24	66:15,17 75:16	agencies 39:16	39:2,7,14,20	17:10 32:13
82:9	87:12	92:18,20,25	39:21 41:18	35:20,24 36:17
access 29:1	address 8:13	93:9 110:12,24	42:19,24 43:12	37:5 56:19
accomplish	22:22 33:6	agency 92:16	43:22 45:5	75:12 76:12
12:20 63:24	68:4 79:24	110:10 112:4,6	47:4,8 48:6,7	82:6,12 83:12
accomplished	98:13 114:3	113:9	48:13 52:14,21	85:16,16,19
79:15	addressed 37:10	agenda 36:22	54:2,21 58:18	87:3
account 6:22	addressing	agitated 103:19	59:21,22,23	Aleutians 7:14
accounted 4:19	106:1	ago 22:11 41:17	60:18 66:11	allow 13:17
4:20,22	adds 17:21 56:6	54:5 69:25	67:14 68:11,13	28:19 32:1
accounting 5:5	adequate 78:23	73:13 85:22	71:23 72:10	55:1 64:1
accounts 5:8	93:3	agree 63:23 97:8	73:7,8,9 75:8	77:18 85:6
accurate 84:11	adequately	agreement	75:10,12,21	103:13
ACEP 60:6	84:13	77:18	76:22 77:16,22	allowing 67:21
achievable	adieu 11:14	ahead 66:21,23	78:22 79:22	77:6 80:8
88:24	adjacent 91:12	106:6	82:7,9,14,19	87:11
achieve 34:18	adjourned	aid 4:9,11 9:12	82:19,20,25	allows 54:19
35:15 75:17	114:17	10:20 55:4	83:4 84:9,10	alternative
83:15	adjust 78:11	aim 29:9	85:2,13,15,17	83:11,14
achieved 31:17	administration	aiming 26:4	85:21 86:24	Althea 114:6
34:22	4:14 19:12	28:9 29:8	87:4,6,14,18	amazing 110:4
achieving 34:1	54:17 106:8	air 8:5 43:14	87:23,25,25	America 46:10
35:3	advance 9:8	77:15 85:25	88:2,3,5,5,5,12	87:14 88:13
acid 41:23	50:14 51:16,17	108:1	88:15,16,18,23	American 19:12
acidification	111:23 113:8	Airport 77:9	91:1,4,6,8,11	53:24 65:19
41:19	114:14	airspace 77:12	91:15,18,21	87:15 91:10
acknowledge	advanced 33:14	alarming 76:3	92:12 93:2	Americans
	60:5 96:11	Alaska 1:4,6,8	96:6,10,15	31:18 40:24
	100:1	1:10,11,13,21	99:22 100:13	41:2

America's 83:15	76:23	28:6	average 5:14	36:16,23 53:24
ammonia 7:16	applied 33:3	asked 22:23	32:7 65:19	55:23 56:24
53:13	apply 100:17	asking 77:16,17	aviation 76:18	68:5 69:25
amount 6:5	applying 43:18	assess 93:5	79:12	70:1,1 73:8
23:11 34:4	appointed 22:10	assessment 51:6	awaiting 10:2	77:3 79:13
40:24 70:17	appointment	asset 36:21	a.m 2:12	93:1
71:1,2 99:14	52:2	111:11	B	believing 50:9
108:12	appreciate	assigning 79:16		107:5
Anaktuvuk	11:19 31:4	assignment 12:8	back 4:7 8:6 9:2	benefit 5:20
18:12	39:4,24 48:15	assist 93:11,11	46:4 49:12,13	14:8 31:18
analogy 25:20	54:15 55:6,8	101:19	49:18,22,23	36:18 52:16
analysis 77:11	64:10 65:16,17	assistance 3:16	50:11 54:17	63:13
84:12	67:22 74:1	12:14	58:16 70:16	benefits 77:13
analyze 29:11	75:5 90:1	associated 13:21	107:20 112:9	Bernie 1:14 10:5
anchor 75:16	103:1	32:14 33:6	backbone	31:23 33:18
108:21	appreciated	Association	100:21,21,22	58:19,20 59:2
Anchorage 6:19	31:10 114:14	34:14	100:24	59:3,4,14 67:4
6:20 7:8 75:14	appreciates 64:5	assure 107:1	background	67:4,5,7,19
75:20 77:8	approach 52:20	Athabaskan	40:10 61:16	68:1 74:1 97:8
91:12	approaches 52:5	15:15	64:11	97:8 105:5,17
anchoring 87:3	appropriate	Atlas 39:21	backyard 22:25	106:6 110:5
anemometer	18:8 64:15	attended 113:20	24:4 26:23	best 7:6 26:19
14:12	96:9	attention 19:11	bad 51:12 59:11	29:4 40:4
Angoon 10:13	approval 76:17	54:8 71:2,3	bankrupt 111:5	51:13,13 57:23
anhydrous	79:19	attitude 60:18	Barbara 1:16	68:17 73:12,13
53:13	approved 79:12	attract 85:14	67:9,10,11	73:13 93:5
annoying 101:3	apt 63:15	Atukan 10:10	69:1,22 74:2	better 8:23
answer 14:23	Arctic 14:6 16:3	Audience 49:20	75:1	28:24 47:6
16:12 29:6	16:7 56:12	August 2:5	barely 5:10	66:13 69:25
55:8 58:17	83:7 85:7	Authority 1:9	barley 84:17	70:2,3 87:23
86:16,17	Arctic-grade	11:5 22:2,9	barrels 87:12	88:3 105:12,16
answered 84:6	86:25	39:20 96:15,17	base 70:25 71:1	106:2
anticipation	area 15:23 23:25	106:18,19	based 26:12	Beyond 82:7
76:25	79:20 112:20	109:2 111:10	32:2,21 96:23	big 24:25 32:20
anybody 41:2	areas 3:20 14:1	authorization	baseline 45:19	32:22,22 41:14
42:23 72:5	14:16,21 16:23	54:20,23	92:23 93:2	57:21 58:8
103:18	17:16 18:6,16	availability	base-load 87:4	101:4,4,5,5
anyplace 57:9	18:24 19:9	78:19,20	basically 25:2	103:23
anytime 52:9	51:8 61:25	available 9:4	50:5	biggest 41:19
appear 31:5	62:24	10:20 22:25	basin 75:22	42:1,7 78:8
appliance 98:21	arena 91:25	23:15,20,23	basis 77:19	107:7
applicable 18:15	92:6	26:12 27:25	79:14	bill 88:17 98:3,5
100:20 101:7	Arkansas	28:25 29:20	batter 35:18	billion 4:15
application	101:15	63:12 73:7	batteries 78:16	32:17 42:8
13:10 15:7	arm 71:4	78:4 85:4,24	Bay 18:23 91:10	43:4 76:2,2
86:7,11	array 16:4,4	86:3 93:3	bed 42:19 88:4	87:12
applications	article 41:16	98:15 100:18	beginning 55:25	Bingaman 9:15
27:25 62:22	artificial 24:24	AVEC 7:9	believe 12:25	biomass 4:25

5:4 6:12,22 15:14,22 32:25 33:22 51:9 82:11 83:20,23 83:25 84:4,16 86:22,24 103:11 105:11 107:25 108:7	boy 66:4 boys 101:4 brainer 109:9 Brazil 47:24 breakthrough 59:13 breed 8:8 Brian 1:5 11:1 12:1,8 46:9 60:1 bricks 98:22,23 bridge 93:18 briefly 52:3 55:14 bright 62:5 brightest 61:22 72:17 brilliance 69:19 brilliant 26:17 69:17,17 bring 33:7 61:22 79:14 103:20 bringing 60:7 75:9 broader 13:10 78:18 broadly 34:1 brought 61:1 Btu 84:19 budget 55:1 59:11 66:3 70:15 97:25 98:10 build 31:20 32:1 65:4,6 68:25 76:21 86:5 97:13 106:23 building 68:25 86:15 103:13 107:25 builds 71:17,17 built 10:2 37:4 41:5 69:2,3 bulbs 72:25 73:14 bullet 73:21 109:8 bull's 29:12	bureaucratica... 109:23 burned 78:7 burning 6:12,14 business 15:17 32:1 41:12 42:8,9 65:9 72:20 88:10 businesses 39:13 42:16 76:10 101:19 buy 27:10 107:17 buying 43:16 101:16	cause 42:6 caused 77:4 cells 58:6,7,8 Center 1:10 11:8 15:5,7 17:11 18:10 31:1 33:4 47:4 centers 80:3 cents 5:14,16 42:21 98:2 centuries 108:7 CEO 96:5 certain 35:8 51:11 112:6,20 certainly 11:19 63:10 66:16 113:1 certainty 32:2 certification 77:9 chairman 9:15 Chakachamma 18:21 Chakachamna 10:12 challenge 15:20 34:3,8 52:7 56:11 61:9 64:5 76:16 challenged 13:24 challenges 12:17 12:18,21 13:21 24:17 32:13 33:6 37:7 52:15 56:7 57:1 58:16 63:3 64:22 76:16 78:8 80:9 challenging 82:24 110:18 change 41:14 73:14,17 changer 53:22 changes 43:19 99:21 changing 78:11	Chaninik 96:13 96:13 97:9 100:6,11 101:2 112:19 characterizing 93:12 Charisse 49:14 cheap 36:9 86:9 86:12 cheaper 36:13 chemistry 84:5 Chena 1:14 2:10 2:13,13 3:9 9:17,18 10:4 11:6 13:2 24:24 25:5 31:22 33:18 34:22 50:4 51:2 54:4 60:22 61:17 63:7 67:8,9,22 68:1 105:18 106:22 Chicago 48:10 Chicagoans 48:11 children 68:20 71:13 children's 71:7 chiller 9:22 25:5 61:17 China 40:21,23 Chinese 40:25 73:12 choice 27:16,19 96:20 choices 27:17 chosen 64:21 Chris 1:12 11:10 11:10 38:1 39:1,6 50:14 53:1 57:3 64:17 christening 9:25 Chu 55:7 64:2 chuck 88:11 114:2,4,15 Chuck's 114:3
---	---	---	---	---

Chugach 6:24	101:17	82:5	competing	14:19
church 100:9	combat 100:10	committee 2:8	63:18 105:20	Connie 31:23
circumstances	combination	2:12 3:5 9:4,15	competitive	67:20
61:24	78:6	14:6 20:3	48:1	Consequently
CIRI 67:10	combine 97:13	29:23 31:4	complete 88:25	78:12
75:10	108:11,12	37:13 39:4	completely 51:3	conservation
citizens 82:19	combined 14:5	48:19 49:4	complex 33:2	19:16,19 27:4
City 17:8	15:22 93:2	68:4 73:25	35:12	27:7 66:10
civilization 41:5	combining	80:12 89:2	complexities	83:20
clean 42:11 45:2	18:12	94:3 96:4	12:16	consider 2:1
75:15 86:18	come 4:4 17:22	102:1 113:23	compliance	34:23 35:25
clear 93:16,18	18:2 22:11	113:25 114:11	44:21	considerable
112:11	25:19,19 28:7	committee's	complicated	14:10
clearing 84:1	28:18 32:22	114:9	104:22	consideration
clearly 43:22	43:15 56:24	common 62:1	compliments	10:8
climactic 42:3	57:20 60:10	98:21	67:6	considered
climate 18:9,10	62:2 73:17	commonly	component 34:2	108:18
41:14 56:6	107:20	76:18	88:18	Consortium
58:1 91:23	comes 4:18 5:25	communities	composed 39:12	17:7
climates 12:17	9:12 22:14	2:3 13:1 14:15	comprehensive	construct 77:7
climatic 88:2	25:20 50:14	14:22 19:9	15:14	constructing
close 47:10	63:17 70:10	22:24 23:18	concentrated	14:24
65:22 66:5	112:2	32:16 78:1,5,7	43:24	construction
113:19	coming 26:16	78:22 79:1,8	concentrations	5:18 7:8 15:10
closely 15:4	64:3 85:10,13	82:15,19,21	41:23	54:22 86:13
45:13 46:11	105:25	83:4,5 84:25	concept 28:16	99:15
closer 85:20	commended	84:25 85:8,17	29:8 53:4	consultant 25:8
coal 4:20 26:4	54:12	85:21 97:14	57:17	57:16
82:9 86:22,25	comment 64:17	99:19 103:5,14	concern 41:20	consume 66:8
coalition 39:7	64:19	112:8	44:8	84:22
coast 6:8	comments 3:21	community 15:9	concerned 44:9	consumed 23:12
coastal 14:16	11:16 57:13	23:12,23,24	concerning 3:6	consumer 39:14
17:15	66:14 67:6	24:3 25:3,11	conclude 114:16	65:16 87:4
code 103:6,6	113:21	26:12,13 41:13	concrete 58:9	100:4
Coghill 49:16	commercial	57:21 83:19,24	conditioning	consumers 7:23
cold 14:24 16:13	52:23 53:7	91:13 99:7,23	43:14	consumes 70:13
16:14 18:9,10	78:16 84:24	100:16 103:17	conduct 67:21	contains 98:22
56:9 57:25	93:15,17,19	104:4,6 105:19	conducted 33:4	CONTENTS
59:15 108:9	106:25	community's	conferences	1:1
collaboration	commercially	7:3	39:19	context 35:21
61:4,12 63:22	14:16 46:21	compact 27:13	conflict 45:21	continue 29:7
64:7	63:12 85:4	companies 42:1	46:5	31:19 33:19
colleague 3:23	commercial-s...	99:24 101:5,12	Congress 3:17	37:1,3 88:10
colleagues	75:11,13	company 1:22	4:7 9:11 44:3	93:4
103:25	Commission	61:18 62:4	48:2	continued 82:5
collect 58:8	14:3 53:8 86:6	67:15 75:12	congressional	85:6
collection 92:23	111:1	91:2,7,7	8:6,8,10	continuing
Colorado	commitment	108:13	congressionally	40:17

continuity 93:14	corn 25:21	79:22 91:22	77:24 78:4,15	decided 51:4
contract 69:3,22	Corp 96:6,10	93:24 100:20	79:1 85:3,4	decision 86:10
contracted	Corporation	101:12,18,22	91:7,25	86:12
86:21	1:19 67:13	110:2,19	currents 6:7	decisions 112:17
contractor 52:1	82:2 83:18	coupled 62:12	curse 22:14,15	decline 76:1
contribute	86:21	courage 26:9	23:25	decommission...
85:18	Corporations	course 3:18	cut 73:5,8 105:6	77:11
contributed	19:18	41:14,24 44:9	cutting 15:21	decrease 76:13
86:14	correctly 29:16	court 9:1	51:17	96:16,22 97:22
contribution	45:16	cousin 91:16	cycle 63:9	defend 67:7
113:11	cost 5:17 14:11	cover 8:18		deficiencies
control 33:14	14:17 18:14	covers 82:22	D	57:18
96:11 100:1,21	23:14 25:9	Co-op 7:10	Dahlstrom	defining 51:11
controlled 5:19	32:11 57:20	CO2 85:19 86:1	49:14	definition 44:5
controller	78:4 83:1,3,6	86:14 87:8	Daily 85:9	53:4
101:16	85:16 99:16	crazy 48:7	Dakota 101:13	degree 53:24
controls 17:23	100:3,4 103:3	create 18:13	101:14	degrees 58:3,4
controversial	103:16,16	62:17 87:25	Dam 86:5,11,16	58:11 98:22
104:1	104:8	created 33:10	86:19	108:13
controversy	costing 5:14	creating 88:21	dark 16:18	deliberately
113:3	57:19	creativity 59:23	data 77:3 91:23	71:20
convenience	costs 5:18 7:24	creatures 41:22	92:23 93:3	delighted 3:25
29:21	12:16 17:22	credit 44:12	database 23:13	deliver 19:22
conventional	18:3 31:24	45:23	23:13	22:18
82:8,17 83:17	32:18 33:7	credits 4:13	date 106:12	delivered 77:2
85:22 88:11,13	52:24 57:22	Creek 10:13	day 3:11 10:16	delivering 13:22
88:20	65:17,20,23	critical 35:23	26:15,19 31:16	77:21
conversation	66:4,9 72:1	36:21 37:2	36:12 45:10	delivery 14:9
64:2 103:9	73:1 77:14,25	63:5,10 84:15	57:7 58:1	Delta 24:7 51:13
conversion 28:6	78:2 85:25	84:20	59:18 60:16	Delta-T 108:13
convert 6:18	86:14,17 97:22	crop 33:22	71:2 83:10	demand 27:5
converting	104:8,13	83:25	98:24 108:20	36:2 40:19
13:22	105:24,25	crops 84:21	days 41:17 58:2	41:3 78:11,13
convinced 71:5	Council 15:15	cross 61:12	93:7 113:24	78:14
Cook 1:17 18:22	17:6,8	62:24	DC 8:7 9:3	Democratic
75:2,14,22	counting 9:10	crude 86:12	50:12 77:2	22:4 114:12
76:1 91:11	44:19	87:12	114:1	demonstrate
92:24 106:1	country 4:15 7:7	crushing 83:3	deal 60:12 66:4	64:11 92:9
cooperation	8:2 9:18,19	cubic 76:2,3,7	67:22 69:21	demonstration
105:2 110:16	13:11,15,25	cultivation 84:6	103:21 104:23	42:22 85:5
coordinated	17:2,15,15	culturally 18:8	dealing 34:3	Denali 14:2 53:8
92:20	31:9,21 32:5,5	cultures 47:23	51:2 61:9	denies 71:20
coordination	34:9,11,24	current 31:18	death 29:13	Dennis 1:23
24:19 92:17,17	35:8,14,19	79:13 96:22	debt 72:3	67:16 95:2
110:11,23	36:23 37:6	98:25 99:8	December 76:8	96:1,5 103:2
coordinator	39:8 46:15	currently 6:1	85:9	104:11 110:6
22:10 96:7	48:5 62:25	7:3 32:16 75:7	decide 27:14,15	111:24
cords 6:13	66:2 68:9	75:21 76:19	112:23	Department 1:6

11:2 12:2,6,10 13:4 14:11 50:20 87:7 108:15 dependency 96:17,21 dependent 17:20 deploy 25:13 26:23 33:1,23 57:9,21 60:5 deployed 24:21 deployment 54:20 described 104:11 design 18:13 62:12 78:24 designed 34:6 60:4,5 62:8 designing 18:8 designs 80:7 destroys 71:20 detail 57:15 detailed 93:20 determine 23:8 35:1 77:4 84:21 devastating 76:9 develop 26:11 31:8,19 33:20 35:25 37:2 53:10 75:11 96:9 110:13 developable 14:16 developed 10:4 23:22 35:11 36:17 110:22 developer 52:1 79:18 96:8 developers 18:22 39:13 developing 25:10 26:3 29:4 33:17 53:6 57:14,24 75:12 76:15	78:3 91:8 110:2,3,23 development 1:19 4:9 5:9 7:20 9:8,13 12:5,11,25 13:6 15:18 19:2 47:1 67:13 75:8 78:9,18,25 79:10,11,17,23 80:2,6 82:2 83:18 85:5 86:20 91:19,21 92:21 93:18 110:8 device 93:1 devices 28:1 93:4,7 98:19 98:20 diesel 5:13 15:7 15:18 17:23 32:17,19 33:3 33:13 34:15 77:25 78:7 87:1 96:17 diesel-generat... 100:23 differ 37:6 difference 51:22 62:15,18 66:2 66:9 different 8:8 22:15 24:11 27:7,17 29:2 51:3 56:15,20 56:21 57:1 61:4,13,18,22 61:23 62:24 84:17,18,19 104:17 110:19 110:20,20 differing 3:17 difficult 19:6 45:17 47:19 52:16 63:25 76:9 78:15 104:23	difficulties 54:14 56:7 difficulty 64:5 digital 77:7 Dillingham 10:13 diminishing 41:6 diodes 72:24 direct 51:10 directed 14:19 directly 19:17 96:8 director 1:8,10 1:12,21 11:5,8 11:11 22:1,9 31:1 39:1,6 45:10 67:14 91:1,6 96:6 directorates 79:18 discuss 12:4 19:25 discussed 31:13 55:2 discussion 47:10 49:3 53:14 56:1 88:8 93:20 104:20 discussions 103:18 displace 99:5,12 displacement 99:1 100:7 displacing 78:6 99:20 disposal 108:3 dispose 108:3 distance 22:18 23:25 distances 22:16 distinguished 67:3 distributed 32:24 39:22 distributing 19:20 54:4 distribution	16:9 82:23 district 15:18 diversify 41:8 76:11 diversion 6:4 diversity 87:21 dividing 112:11 doable 46:19 Dodson 1:18 67:12 81:5,6 82:1,4 89:1 DOE 12:13 16:8 18:17 19:20 46:7 50:7 63:6 64:15 105:20 DOE's 14:22 15:12 19:11,25 46:18 dog 101:4,4 doing 8:19 9:11 10:22 18:10,11 27:24 33:23 35:6,13 47:3 48:16 50:2 53:19 56:5 60:17 62:25 69:6,17 97:9 100:9 104:8 105:19 108:6 108:16 110:5,6 dollars 32:17,20 50:18 63:19,19 78:17 92:24 99:23,24 dominated 88:9 Donatelli 1:16 67:9 74:2,3 75:1,3 80:11 81:3 doppler 77:7 double 40:20 44:19 doubt 46:14 Doug 1:21 67:13 90:2 91:1,6 94:2 95:1 dozen 78:5 dozens 7:5	Dr 1:5 12:1,3 20:2 21:1 51:23 55:10,14 59:9 87:6 drain 82:18 draw 19:11 47:15 drawing 113:8 drive 40:22 87:24 99:16 driven 19:1 driver 42:4 driving 42:5 drop 40:25 76:3 86:10 dropped 86:7,8 dry 6:15 dwindling 106:1 E earlier 4:12 18:19 52:3 early 14:22 15:2 15:11 16:11 60:24 92:2 98:1 earth 71:16,19 73:19 109:11 earth's 70:11 easier 15:21 81:8 easy 82:14 108:14 eat 23:1 25:23 econ 47:22 economic 1:18 19:1 32:25 33:8 36:10 42:2 67:12 82:2 83:18 84:25 86:20 91:21 92:14 99:18 economically 37:3 48:1 76:21 economics 22:20 25:7,9 99:15
---	---	--	---	--

99:21	36:4 45:3	7:23 8:20 9:4,8	65:5,7,8,17,20	engineer 69:24
economies 47:23	62:17 75:24	9:13,15,17	65:22 66:3,6	107:18
economy 7:18	82:24 97:18,20	10:19 11:3,4,5	66:10,20 67:9	engineered
31:20 42:14	101:4 103:5	11:8,11,12	67:17,21 68:2	62:20
65:13 83:3	electrical 46:23	12:2,4,5,9,11	68:6,8,9,14	engineering
87:4 88:19,21	electricity 5:8	12:12,18,23	70:11,25 72:1	86:22
edge 15:22	5:13,25 6:1,16	13:4,18,19,22	72:22 73:20	engineers 61:22
51:17	6:20 13:6	14:3,4,5,6,11	75:7,10,17,23	engines 17:23
educate 46:13	15:19,20 24:14	15:6,9,12 16:1	76:12,22 77:1	33:13
educated 112:7	24:17 25:6	16:18,22 17:5	77:16,22 78:2	enhance 56:8
education 27:19	42:17 43:5,6	17:18 18:4,14	78:3,4,8,9,13	enhanced 5:22
39:18 46:17	44:2,12,16	18:25 19:1,15	79:4,24,25	13:9 55:18
54:9	75:15,22 77:24	19:15,18 22:1	80:4,7 82:6,7	87:9
effective 14:17	78:9,15 96:24	22:5,9,10,11	82:12,14,17	enhancements
29:7	96:25 98:1,11	22:11,18,25	83:1,3,6,11,12	80:6
effectively 19:21	99:7,17 100:2	23:8,10,11,15	83:14,19,20	enormous 7:1
effects 93:6	100:15,23,24	23:17,17 24:22	84:4,7,16,18	87:22
efficiencies 7:23	elements 71:16	24:25 26:17	84:21 85:7,16	enter 77:17
25:9 78:3	Elevator 69:13	27:4,6,9,11,12	85:18,25 86:8	entire 13:15
103:14	eliminate 85:20	27:13,14,20	86:11,14,17,18	83:12 99:7,21
efficiency 12:12	emergency	31:2,8,9,13,13	87:7,15,17	entities 12:15
17:18 18:4,25	50:24	31:14,16,17,24	88:4,9,11,13	45:5
19:15,18 27:4	emerging 14:3	32:4,6,7,11,18	88:14,16,17,18	entity 44:24
27:6,6,9 33:13	17:17 32:24	32:23,25 33:3	91:9,11,12,19	environment
39:11 56:9	50:24 51:4	33:5,6,8,10,14	91:23 92:15	13:1 56:6,12
64:25 65:5,8	52:12 53:2,18	33:15,24 34:2	93:12,23 96:1	71:20 83:8
66:10	92:7,19	35:2,14,21,22	96:5,7,8,10,15	108:8,9
efficient 27:11	emissions 75:18	35:23,25 36:2	96:17,19 97:3	environmental
103:16,16	86:1,15 107:22	36:3,8,9,13,18	97:7,17,20,21	39:14 92:14
efficiently 27:21	108:2	36:20,22,23	97:23,24,25	93:6,13
effort 15:14 18:7	emitting 72:24	39:2,7,10,10	98:10 99:11,22	environments
18:18 57:19	encountered	39:13,19,20,21	100:15,22,25	57:10
73:23 99:16	80:10	40:4,8,15,19	101:6 103:22	enXco 75:10
101:20	encourage 59:19	41:4,9,11	104:8,12,19	EPA 85:25
efforts 15:2,11	60:13 109:21	42:11,14,16,20	105:24 106:18	equal 33:10
101:12,19	encouragement	43:2 44:18	106:18,22	equally 12:24
111:13	54:17 55:6	45:2,24 46:22	107:3,10	32:12
eight 16:22	encouraging	47:4 48:5	108:12 109:2,7	equipment
Einstein 68:17	101:14	49:17,25 50:6	109:9,10,11,21	76:18 77:10
68:17	energies 32:12	50:14,20,24	110:25 111:10	85:4
either 5:21	energy 1:7,8,11	51:17 52:12,17	111:23 112:5	equivalent
64:16 109:23	1:13,15,23 2:1	52:18,21 53:2	113:3,16,22,25	77:14
elec 24:16	2:8 3:5,7,7,14	53:12,14,18,19	114:2	erected 7:4
electric 7:10	3:15,18,19,25	54:18,20 56:8	Energy's 1:6	error 5:10
13:13 15:1	4:6,8,10,12,16	56:13 57:2,6	11:2 12:2,6,10	especially 7:21
16:2 17:24	4:18,19,23 5:3	58:14 60:1	108:15	12:5,15 46:1
18:5 26:6 34:6	5:4,6,9,9,11,21	61:10 63:15,18	engine 62:9	48:5 61:14
34:14,15,16	6:18 7:15,22	64:23,25 65:2	101:16	essentially 53:10

62:13 establish 15:6 establishing 14:5 79:15 estimate 57:20 98:25 estimates 13:14 Europeans 41:1 92:1,3 evaluate 45:18 evaluating 60:7 evaporate 108:25 events 42:3 67:1 eventually 15:19 everybody 40:22,22,23 54:11 56:23 109:4 evolving 45:14 exact 17:3 exactly 31:24 55:19 68:23 109:25 example 14:2 15:13 31:22 34:3,13 52:17 52:21 55:15 excellent 51:23 excellently 52:22 excess 78:12 97:21 98:18,18 100:19 excited 113:15 exciting 17:13 43:12 93:25 excluding 75:23 excuse 18:10 49:13 50:24 executive 1:12 11:11 22:8 39:1,6 exist 55:24 104:19 existed 83:5 existing 18:2 77:10 78:23	80:6 84:24 87:13 expand 3:18 4:16 76:23 expanded 45:6 expect 8:20 75:18 expected 40:19 42:10 expedited 77:19 expensive 33:2 43:1 47:18 78:16 82:24 88:18 98:2,9 109:24 experienced 8:9 experimental 13:8 14:7 108:17 explaining 11:7 export 7:17,17 13:17 35:22 36:3 exporting 13:19 13:20 17:21 35:22,22 43:9 48:8 extended 4:13 extensive 46:8 93:4 extensively 44:4 extent 51:11 65:17 extra 24:22 78:13 extract 80:7 extracting 45:21 extreme 13:24 extremes 88:2,9 eye 29:12 e-mail 114:1,3,5 F FAA 76:17,19 76:23 77:3,9 77:16,17,19 79:12,16,18 111:20	fabulous 111:10 face 12:18 facilitate 55:5 63:1,23 64:6 105:12,16 106:2 110:4,8 114:13 facilitated 109:24 facilities 55:24 facility 77:10,13 86:23,23 87:8 facing 41:3 68:5 fact 42:13 47:16 56:8 97:19 107:11 113:5 factor 80:5 fail 26:19 87:18 107:14 failure 59:10 60:2,13 71:9 71:11,11,12,13 71:14 fair 9:17 10:19 17:5 67:21 72:22 Fairbanks 1:11 1:18 6:18 7:9 11:9 15:5 31:2 41:18,18 58:3 67:12 72:10 82:1 83:18,19 83:24 85:1,9 85:10,20,21 86:20 106:16 106:23 107:25 114:6,8,8 fairs 39:19 68:8 fall 45:11 familiar 11:3 families 65:21 family 66:3,5 98:5 fans 9:23 fantastic 45:3 far 16:12 52:3 68:8 73:17 84:10	farm 1:17 7:7 67:11 75:2,6 75:13 76:24 farther 28:5 fast 28:22 fast-growing 46:24 favor 99:15 feasibility 86:22 federal 8:19 10:17,20 34:19 39:15,25 43:23 43:25 44:15 45:23 50:17,21 54:21 55:5 63:11,19 84:12 86:6 92:16 93:8,9 105:12 109:2,15 110:25 111:19 111:21 112:2,2 113:8 feel 110:15 111:7 feet 76:2,3,7 FERC 111:1,2 113:4 field 2:1 3:4 9:16 10:2 49:25 67:21 113:12 114:13 fields 61:5 87:13 fight 113:3 figure 15:24 27:21 45:18 60:10 62:1 65:25 66:12 103:15 104:3 figured 16:17 filed 76:22 final 67:15 95:1 Finally 19:11 79:9 financed 5:18 financial 3:16 9:12 55:4 financially 76:24	financing 28:17 find 7:11 57:18 59:21 63:2 70:3 78:2 93:6 97:24 fine 25:23 finite 41:6 fire 1:16 7:7 10:9 18:20 67:11 75:1,6 75:13 76:10,15 76:23 77:10,20 79:4,5 84:1 105:22 111:17 firewood 6:13 firmly 87:2 first 3:22 9:18 9:19 10:1,25 17:1,7 23:17 29:11,12 34:19 40:18 45:5 53:8 58:17,17 70:22 75:13 86:5 96:20 97:23 99:22 104:25 106:24 111:16 fish 6:14,15 23:1 44:8,9 fishing 41:24 fit 37:8 50:23 fits 36:7 five 5:2 11:16 39:13 53:5 58:25 67:17 99:4 flat 41:9 flat-price 76:11 fledgling 92:11 Florida 10:3 107:14 fluctuated 76:6 fluctuating 34:7 Fluctuations 76:8 fluorescents 27:14 focus 3:13 7:19
---	--	--	---	---

14:1 15:23 29:17 31:7,12 32:16 39:23 52:24 65:4 99:20 100:6 focused 18:16 40:1 focusing 10:24 64:25 folks 77:23 111:1 follow 43:13 51:21 71:24 follows 20:2 29:22 37:12 48:18 73:24 80:11 89:1 94:2 101:25 food 17:20 42:15 72:11 98:8 107:3 fool 72:5 foot 13:9 98:4 footprint 85:19 force 19:2 64:9 78:21 80:3 forefront 60:8 forest 6:23,25 15:17 29:1 84:9,9,11,13 84:14 forever 25:23 88:10 forget 107:16 form 41:22 55:3 82:10 formal 114:10 formed 44:15 75:10 100:6 former 16:25 forms 4:24 6:22 Fort 15:15 fortunately 40:7 92:1 forum 45:11 forums 39:19 forward 29:4 32:3 55:1 59:1	59:21 60:11 77:6 93:24 111:3 113:7 fossil 12:22 13:19 35:23 36:1,21 41:5 42:6 47:17 48:13 96:21,22 100:7 foster 3:16 fostering 15:13 found 16:14 22:12 24:5 59:16 83:23 84:23 foundations 14:25 four 39:13 92:12 93:14 97:10 104:17 four-wheelers 18:7 frame 40:15 FREC 46:5 free 5:17 88:17 friend 57:25 front 44:3 65:5 109:22 fuel 5:17 7:16,16 7:17 8:4 12:22 13:19 15:18 18:2 32:18,19 77:25 78:7 82:23,25 85:11 85:12,15,17,17 86:25 87:1,2 87:22 96:17,25 98:10 99:1,6,6 99:12,20,23 100:3 107:2 fuels 24:14 36:21 41:5 42:6 47:17 96:21,23 100:7 full 11:17 87:3 93:15 fully 93:11,11 fund 52:6,9,21	53:3,18,19 59:12,12 60:1 fundamental 16:8 88:18 funded 63:7 72:14 112:5 funding 37:1,8 51:10,20,21 53:9 55:1,21 63:11,17 funds 54:22 109:1 Fundy 91:10 further 3:21 4:11 10:21 11:14 13:2 105:3 furthering 4:18 36:21 furthest 16:3 future 5:22 7:18 8:23 12:21 13:2 16:19 28:11 29:5 31:18 32:3 34:18 35:21,24 36:19,25 41:3 65:3 72:17 86:18 87:15 97:3 105:25 109:7 fuzzier 28:8	87:5 gasoline 98:9 gather 10:16 98:8 gee 62:10 general 111:14 generate 6:17 7:15,22 8:24 75:19 76:10 99:7 generated 75:24 85:2 88:14 generating 6:19 generation 5:3,4 5:13 6:3,16 8:20 10:23 34:25 35:18 64:21 65:3,6 78:10 79:2 80:1 83:22 91:18 generator 101:16 gentleman 11:3 gentlemen 11:13 geography 104:22 geothermal 1:14 4:12,24 5:7,21 5:21,22 7:14 9:20 10:1,10 13:7,7,9 18:20 24:24 28:6 31:23 32:25 43:2 50:19,21 55:15,18,20 60:25 62:22 63:9 68:1 70:15,23 82:11 103:11 105:11 getting 28:4 54:11 104:10 106:9 107:15 give 8:12 25:21 28:9 32:6 55:8 57:15 60:23 61:16 71:10,12 71:12 75:6	114:3 given 5:16 26:13 giving 64:10 glad 67:5 global 35:21 36:8 86:15 92:5 glorious 3:11 gnat 101:3 go 3:23 4:17 5:1 11:15 21:3 24:19,25 25:8 26:9,18,21 27:22 28:10,19 30:1 32:21 41:7 42:6 47:20 51:5 55:1 58:16 59:1 63:24 65:18 66:7,21 66:23 69:18 70:1,5 72:13 72:23 81:4 93:16 98:8 99:4 100:22 103:25 104:7 106:6 112:20 goal 26:3,8,8 28:9 34:16,23 39:9 46:7,18 46:19 50:16 83:15 88:14 97:12 100:8,8 goals 34:1 75:17 goes 11:7 98:10 98:11,11 going 8:20 10:16 16:21 19:7,17 27:8,13,14 28:7,9,23 29:3 29:9,10,10,11 31:25 41:7,7 42:6,22 45:14 46:16,16,17 47:1,2,13,14 47:14,15,16,18 47:18,20,20,25 48:1,4,12 49:5
---	--	--	--	---

51:1,5,11,12 52:10 53:20 58:1,5,8,9,10 58:16,24,25 60:12 61:11 64:18 65:10,10 65:12,13,13,25 66:3 68:22,24 69:8,21 70:3 73:4 99:9 101:8 104:3,7 105:9 107:14 107:19 108:3 108:25 109:1 111:23 113:10 gold 91:15,17 Golden 75:24 Goll 45:9 good 3:3 7:9 9:5 9:10 49:3 50:6 51:12 54:23 55:3 60:6 71:17 72:23 73:16 91:3 95:5 97:12 105:21 106:20 109:9 113:7,14 goods 17:22 18:2 31:15 82:23 government 8:19 50:21 52:5 54:21 82:18 84:12 92:12 109:2,20 111:12,19 Governments 15:16 grade 69:6 grant 10:12 14:3 19:16,19 50:7 50:18 51:10 52:9 71:10 grants 4:9 50:25 54:20 64:15 105:20 great 5:12 25:20 25:24 26:16	28:25 67:22 109:21 111:14 greater 64:6 91:20 111:7 greatly 52:16 114:14 great-grandfa... 91:15 greed 71:4 green 19:2 greenhouse 9:23 73:3 75:18 grid 19:4 34:6 34:16 35:7,9 35:12,15,15,17 100:1 grids 15:1 19:3 34:5,6 ground 34:11 46:3 51:22 58:3 88:4 104:16 grounds 53:7 97:5 group 39:18 66:25 67:3 96:12,13 97:9 97:9,13 100:6 100:12 101:2 groups 39:14,14 grow 25:22,24 28:23 42:15 44:18 46:3 growing 33:22 36:1 72:11 88:20 guarantee 73:2 73:2 guess 25:20 47:10 54:16 106:10 guidelines 86:1 guy 50:5 58:24 60:13 62:8 guys 61:7,7,8,22 61:24 62:6,20 107:10 Gwen 1:10 11:5	11:6,7 30:2 31:1 38:1 41:10 42:18 60:19 64:23 68:23 Gwen's 47:3 60:9 H Haagenson 1:8 11:4 21:2,4 22:1,3,8 29:22 33:12 47:22 56:19,22,25 57:16 58:22 59:6 half 22:11 100:13 104:6 Hamilton 69:13 hammer 60:12 hand 100:10 handle 52:18 59:9 handshake 69:4 hand-to 100:9 hanging 81:1 happen 27:10 35:5 50:7 61:15 63:23 113:14 happened 8:1 62:23 69:7 happening 40:2 42:9 52:11 59:23 72:12 103:15 110:7 happens 50:11 happy 19:23 hard 44:6 48:14 88:2 harness 70:11 harnessed 8:24 Harris 4:3,3 harvesting 13:16 17:21 Hatch 86:21 hazard 77:1 hazards 79:12	head 67:8 hear 8:14,21 9:11 10:21 15:7 67:2 91:5 95:3 heard 69:9,9 71:15 76:1 77:23 78:8 97:4 111:16 hearing 2:1 3:4 3:4,5,19 7:19 8:12,16 9:3,5,7 9:16 10:15 67:21 106:11 113:12 114:17 hearings 8:6,8 8:10 54:7 114:14 heat 6:13 15:23 17:12,12 24:14 25:3 26:7 42:17 54:3 58:2,7,12 62:10,11 77:24 85:2 97:1,2 98:14,15,22,23 100:19 108:10 heated 82:25 heating 15:19,21 73:15 75:23 77:25 82:23 83:2 86:25 96:25 97:22 98:3,4,10,21 99:1,6,21,24 100:3,4 height 107:23 Helicopter 69:10 help 9:13 13:1 14:23 15:6 28:18 47:8 50:7 51:15 55:5 56:1 64:6 68:12 69:15 70:15,16 75:16 79:13,17,18,21 87:14,15 92:11	92:13 93:24 101:18 104:7 105:12,16 106:16,17 108:14,15 helped 10:6 72:6 104:9 114:13 helping 44:18 57:20 101:13 106:22 helps 54:22 101:18 Herron 49:13 hesitation 59:2 hey 69:8,19 hidden 18:3 high 7:25 8:4 12:16 34:4,4 35:3,10 53:10 53:11 72:1 76:6 78:14 86:14 97:6 higher 42:6 104:16 highest 32:4,5 64:23 65:6 highly 17:20 92:21 high-cost 3:20 32:23 high-paying 31:19 high-penetrati... 53:15 97:2 high-quality 92:21 high-resolution 14:13 hinderance 107:6 Hindsight 86:10 hired 25:8 57:16 Hirsch 1:5 11:1 11:15 12:1,3,8 20:2 21:1 46:9 51:16,23 55:10 55:14 59:9 history 53:25
---	---	---	--	---

60:23,24 64:10 72:18,19 hit 43:23 hitting 40:18 HMS 57:19 hold 9:16 46:4 113:24 holding 5:7 54:8 Holdman 11:6 Holdmann 1:10 30:2 31:1,3 37:12 60:21 home 18:14 83:1 85:11 86:25 98:10 99:21 Homer 4:2 homes 6:21 75:20 82:25 97:22,24 98:20 98:21 99:2 homework 49:6 Hon 1:3 2:14 3:1 hook 70:5 hooked 103:17 hop 60:20 hope 8:21 34:12 hopeful 9:7 10:15 113:5 hopefully 4:5 7:16 9:10 28:12 63:12 hopes 7:10 hoping 28:14 48:2 85:23 host 4:9 8:17 10:7 105:1 hosting 67:20 hot 2:10,13,13 3:9 10:10 13:2 24:24 25:2,3,4 31:22 33:18,21 49:9 50:4 51:2 54:4 58:12 62:15 67:8 105:18 hour 5:15,16 42:21 66:24 70:5 98:2	hours 83:10 house 43:17 98:4 household 65:19 98:3 housing 18:8,9 18:10 58:1 hug 73:19,19 huge 40:13 41:12 42:11 43:6,10,22 66:2 72:3 111:22 113:3 human 92:18 hundreds 83:5 hungry 36:9 hunt 23:1 hunter 29:9 hurdles 78:18 109:22 hurt 45:15 64:16 hybrid 43:8 47:7 hybrids 43:15 hydraulics 17:24 hydro 5:25 7:14 10:11 18:21 40:11 43:21 44:5,7,10,13 46:22 hydroelectric 6:3 83:21 hydrogen 7:16 71:15,18 hydrokinetic 6:6 16:24 17:2 28:1 33:24 42:20 45:14 57:8 61:8 hydrokinetics 43:8 46:1 47:7 61:8 91:25 110:7 hydropower 5:6 5:25 10:12 34:15 55:22,24	ice 9:22 Iceland 47:24 idea 62:2 69:20 69:25 110:1 ideas 9:5 54:1 72:23 109:6,19 110:21 113:22 identified 6:3 14:15 23:11 identify 14:14 29:6 identifying 53:2 idiot 71:8 ignored 40:8 illustrative 61:1 image 53:17 imagination 68:17,19,21,21 69:18 imagine 107:13 imagineer 68:21 imagineering 68:22 immediate 26:1 27:2,3,3 immediately 84:3 93:7 immense 82:21 84:10 impact 19:8 41:24 65:17 76:9 77:12 92:22 98:3 impacts 66:1,1 112:7 impediment 111:19 implementation 80:3 importance 3:6 important 3:14 14:23 16:8 43:25 46:12 49:3 50:2 54:24 68:5,18 70:24,24 80:5 101:21 104:2 109:17	importantly 77:16 92:6 importing 17:21 73:7 impossible 109:23 improve 16:22 37:3 63:2 improved 17:18 18:4 77:15 improvement 5:2 improvements 103:7 improves 16:15 improving 33:13 78:2 inadvertent 50:13 inadvertently 44:16,25 incentivizing 45:24 incitful 51:24 include 16:1 36:20 49:7 78:19 79:5 105:2 included 11:17 41:15 45:7 93:20 114:10 including 54:18 83:25 93:21 income 65:20,22 66:6 98:6 incorporate 66:18 increase 8:20 31:7 53:15 54:10 76:12 increased 77:13 86:14 93:8 100:5 increases 27:4 increasing 34:2 39:9 41:4,23 76:5 increasingly	36:9,14 incredible 54:10 incredibly 109:24 indefinitely 82:13 independence 4:10 23:17 54:19 75:17 independent 66:12 India 40:21 indicated 9:16 9:17 indicates 77:11 indication 87:8 indifferent 106:14 indigenous 84:20 individual 31:20 32:7 67:15 84:20 97:22,24 98:19 99:16 individuals 3:22 67:3 industrial 42:13 industries 46:2 industry 18:22 22:20 41:25 45:13,14 46:24 70:23 85:11,23 91:19 92:7,10 92:11,19 93:23 93:25 inefficient 78:16 inevitable 91:23 infinite 73:16 information 8:17,23 16:10 23:4 29:6 45:20 infrastructure 34:6 35:5 ingenuity 63:24 66:11 inherent 45:21 initial 13:5
---	--	--	--	---

49:11 53:13 initiative 66:7 111:22 initiatives 14:20 51:10 79:5 injectant 87:9 injection 33:21 Inlet 1:17 18:22 75:2,14,22 76:1 91:12 92:24 106:1 innovate 99:8 innovation 53:25 92:8 110:4,11 innovations 10:4 innovative 7:21 8:21,22 17:13 86:2 87:20 92:3 input 39:17 66:15 INSERT 20:3 29:23 37:13 48:19 73:25 80:12 89:2 94:3 102:1 inspiration 10:7 instability 36:15 install 7:10 28:1 33:2,8 79:7 99:14 installation 16:9 17:1 103:7 installations 16:2,6,7 installed 34:20 35:9 46:23 97:16 98:18 99:5,10 installing 16:11 instance 42:21 43:11 50:19 56:13 78:17 110:25 Institute 13:14 instituted 44:23	insulate 58:10 insurance 42:1 integrated 18:18 integrating 14:25 integration 34:15 97:6 integrator 96:10 Intelligent 1:23 67:16 96:1,5,7 intended 8:17 interdisciplin... 61:10,11 interest 3:19 22:7 49:8 51:20 87:19 112:4 interesting 22:5 49:2 105:14 113:13 interests 32:21 49:17 interference 77:4 Interior 3:11 83:7 intermittent 79:25 international 36:2 77:8 Internet 41:16 Intertribal 17:6 intriguing 105:14 introduced 84:20 introduction 49:11 Inupiat 18:12 inventories 84:14 inventory 84:11 invested 84:13 investment 33:11 83:14 85:14 investors 41:12 invite 66:21	involved 13:4 16:6 17:1 54:11 67:10 68:7 69:20,22 involvement 12:6 involving 19:12 in-river 33:24 in-state 83:21 87:5 In-stream 16:24 island 1:17 7:7 10:9 14:21 18:20 19:9 67:11 75:2,6 75:13 76:10,15 76:19,24 77:10 77:20 79:4,5 104:16,17 105:22 111:17 issue 36:10,10 40:15 42:2 46:6,25 55:19 68:5 85:20 101:11 103:23 109:14 111:20 111:25 issued 23:16 issues 3:25 12:7 12:12 13:25 14:9 19:2,5 37:9 39:24,25 49:24 53:12 54:11 60:7 66:20 83:19 104:2,24 111:15 113:3,9 it'll 58:12 81:8	job 46:25 jobs 19:3 31:19 88:21 92:6 John 4:3,3 45:9 49:16 Johnson 1:21 67:13 90:2 91:1,3,6 94:2 109:16,25 110:17 111:9 112:15 joined 3:23 4:4 49:11 114:12 joining 49:23 journey 88:24 July 76:7,22 jump 24:19 jumping 64:15 junction 63:6,11 Juneau 8:10 jurisdiction 112:11,13,21 112:22 113:2 jurisdictional 46:5	51:11 61:12,23 63:1,6,14 65:11 81:8 105:4 112:18 kinds 32:22 35:3 39:23 42:25 Kipnuk 97:10 99:3 104:4,5 Kleeschulte 114:2 know 4:6,17 5:11 7:1,25 8:4 9:20 22:25 23:5,10,20 24:23 25:18 26:14,22 27:7 28:24 29:9 31:24 44:5 49:25 50:15 52:8,18,24 53:3 54:17 55:6 56:10,13 57:21 58:8,19 58:24 59:10,14 59:20 60:15 61:8 62:7 63:10 64:3 65:22 66:25 69:10 70:14 79:19 81:4 85:11 100:10 101:6,10 103:9 103:17,24 104:4 105:17 106:9 107:11 107:15 110:18 111:1,13,17 113:2,5 knowledge 22:13 28:22 68:18 72:13 known 12:22,23 Kodiak 6:15 34:14,16 35:6 35:9,15 45:3 Kongiganak 97:10 Kotzebue 7:2
---	---	---	---	--

14:20 Kuskokwim 97:11 kW 106:23 Kwigillingok 97:10	leading 72:2 leads 5:5 leap-frog 92:2 learn 59:24 leases 45:22 leasing 45:12 leaving 83:4 LEDs 72:23 legal 107:23,23 107:23 legislators 50:1 letter 25:11 let's 23:7 24:15 27:1,1 30:1 66:21 81:4 107:9 level 10:18 40:14 44:15 47:11 49:24 52:21 53:16,17 54:9 55:5 61:3 61:13,22 64:6 105:12 109:15 111:8,21 112:18,25 levels 63:21 97:7 license 86:5 93:15,15,17,17 93:19 life 16:25 44:8 60:15 72:6 73:6 93:13 109:10 lifeblood 42:14 lifestyle 40:23 98:7 light 72:23,25 73:14 lighting 43:14 73:1,5,8 lights 9:23 27:15 73:3 83:9 Lime 16:5 limit 11:16 limited 10:24 35:9 63:20,20 86:21 line 11:15 85:14	112:11 lines 18:5 liquid 86:23 87:2 liquids 83:22 Lisa 1:3 2:14 3:1 list 40:6 listened 59:17 listening 25:14 literally 62:9 113:4 little 8:8 10:19 15:8 22:14 24:5 31:12 45:24 50:7 51:15,19 56:14 57:15 59:2 60:13,23 61:6 61:16 62:21 69:18 73:23 77:22 101:3 103:19 105:19 109:13 111:16 113:13 live 66:13 lived 108:7 lives 31:16 living 83:7 103:21 LLC 1:15 67:9 68:2 load 43:13 65:2 70:25 71:1 72:3 73:5,8 97:19,20 loan 14:12 local 10:17 12:15 15:1,17 39:15 55:5 99:25 100:5 located 114:7 location 12:14 locations 12:15 79:11 lofty 26:8 34:23 logistics 12:17 long 3:24 4:17 5:1 22:16,17	25:24 28:10 33:17 35:24 81:2 longer 83:6 99:23 long-distance 17:20 long-range 36:16 long-term 26:2 35:2 86:16 100:8 look 7:20,21 12:19 13:2 22:11,12 23:21 24:9 25:8,9,9 27:1 28:11 29:15 45:12 48:2 50:19,21 57:5 60:4,4 63:4 65:11 72:21,23 73:2 73:14 98:7,14 100:14,15,17 105:21 107:24 110:5,5,6 looked 22:21 24:3 60:19 looking 13:9 15:16 18:5,18 18:23 19:1,3 23:19 24:7 25:1,11 33:16 33:22 37:9 40:21 41:21 42:12 46:18 48:8 53:12,23 57:24 60:6,7 65:8 68:14 73:6 96:16 99:3 104:12,23 105:20 looks 92:7 looser 52:6 Lord 71:17 Lord's 109:10 lose 87:18 losers 50:13	64:21 loss 92:5,6 lot 8:4 15:21 22:6,6,19 23:4 24:21 25:16 27:5 28:2,13 31:10 32:2,9 32:11 40:1 42:12 43:13,14 45:19 46:16,17 47:1 49:6 50:8 51:7 52:7,12 53:4 54:7 57:2 58:9,14,15 59:13,22,22 63:13 68:12,13 72:12,22,23 97:17 100:18 101:11 108:17 109:5 lots 24:22 40:17 low 18:13 22:16 60:24 62:16 69:5 76:7 78:13 80:7 91:22 lower 7:23 13:18 19:6 24:7 35:12 42:23 44:7,11 65:18 lower-cost 100:24 lowest 13:6 78:4 low-speed 78:24 low-temperat... 9:20 62:11 63:9 low-value 86:24 Lucky 91:16 luxury 92:19
L				
Lab 1:7 11:3 12:2 35:11 laboratory 12:9 12:11 14:4,5 110:2,2,3 labs 61:14 lack 78:19,20,20 78:22 92:16,17 93:14 112:16 ladies 11:13 lags 84:10 lake 6:4 10:12 10:12 18:21 land 28:24 29:1 84:1 landfill 6:21 lands 6:23,24,24 84:9 112:8 large 7:13 18:24 19:6,8 61:18 85:13 99:19 105:15,15 larger 35:7 largest 75:7 laugh 97:4 laughed 54:2 lead 6:5,11 71:24 72:1 78:24 leader 1:5 3:24 11:1,10 12:1 15:3 92:8 leaders 43:3 47:3 49:10 65:7 71:23 92:1 leadership 49:17,24 66:20 86:2 92:9 93:25 106:21				
M				
machine 78:25 machines 18:7 magnitude 76:8 Maine 91:8,9 maintain 79:7 maintenance				

77:14 80:4 99:18 major 34:3 98:13 99:20 101:6 majority 85:21 maker 72:7 makers 54:9,10 making 60:17 113:14 mammal 71:19 man 59:16 71:19 72:5,18,19 manage 19:5 100:22 management 15:17 40:16 97:6 manager 79:16 Manley 10:10 manner 79:20 manufacturers 101:15 map 23:22,22 24:4 26:12 47:15 maps 14:14 margin 8:5 marine 5:9 6:6 17:18 91:25 92:14 93:13,23 market 43:6 44:12,17,17 45:1 56:16 85:14 marketable 62:3 markets 85:15 Martin 114:6 matching 54:22 materials 36:6 36:12 84:1 mature 28:3 46:21 50:22,22 51:3 55:16,20 55:22 70:23 meal 6:15 mean 7:20 32:9 49:20 50:20	58:6 59:6 71:23 meaningful 111:23 meaningfully 51:17 means 31:13 meant 7:19 measure 14:13 medium 25:1 meet 3:7,15 13:17 35:18 36:1 50:16 77:20 85:25 97:20 meeting 45:9 105:22 meetings 39:17 44:4 megawatt 75:15 78:17 megawatts 6:19 70:9 megawatt-scale 34:19 Meiners 1:23 67:16 95:2,3 96:1,3,5 101:25 103:4 111:25 112:16 Member 49:20 members 9:6 31:4 39:4,16 40:3 97:5 memorandum 77:18 mention 43:25 71:15,16 mentioned 7:25 13:3,12 14:11 18:19 33:12 34:23 45:4 51:6 52:2 53:13 55:14 56:7 57:3,12 59:9 60:1 67:4 104:25 mess 105:9	met 2:12 77:24 111:12 metering 100:1 100:21 methane 6:20 methods 28:18 Metz 87:6 mic 21:3 Michigan 101:17 mid 28:3 Midwest 100:18 mid-term 26:2 Mike 114:15 Milepost 2:13 miles 24:1 75:13 82:22 91:13 military 87:2,3 Millett 49:14 million 6:14,22 19:13,14,15,17 19:20 72:4 76:7 92:24 107:15,18 millions 78:17 mimic 108:4 mind 37:5 39:25 110:20 mine 57:25 minutes 11:17 105:5 mirror 53:17 miscible 87:9 missing 49:19 mission 29:17 88:22,25 mistakes 59:25 60:16,17 MIT 70:10 mitigate 28:20 28:21 mitigated 77:5 mitigation 84:1 mix 33:24 36:20 mixed 62:8 MMS 45:10,11 45:17 46:5 113:4	mobile 10:1 13:7 model 34:11 57:22 100:12 modeling 34:14 models 35:11 modern 17:23 18:13 monetary 92:18 money 7:11,12 19:22 29:15,16 42:23,23 52:7 53:9,20 62:4 65:10,13 70:14 70:17 72:4 83:8 106:9 108:25 112:2,2 monitor 33:19 monitoring 16:9 93:4 month 55:23 57:7 months 16:22 112:23 morning 3:3,6 3:11 10:25 49:2 67:5,18 69:13 104:21 113:17 motivated 72:2 motivates 72:3 motors 17:25 Mount 10:9 18:20 mouth 97:11 move 3:21 21:2 29:3,5,18 59:20 60:11 64:18 66:24 77:6,17,19 81:6 88:12 93:24 103:22 105:6,20 moved 63:11 moving 10:16 17:10 32:3 49:8 104:15 111:3 113:6 multiply 65:14	multi-tiered 52:20 municipal 1:19 82:2 83:20 84:2,2 Murkowski 1:3 2:14 3:1,3 21:1 21:5 22:3 30:1 31:3,6 38:1 39:3 48:16 49:1,22 54:15 55:12 56:2,21 56:23 57:12 58:21 59:5 60:19 63:14 65:15 68:3 74:1,4 75:4 81:1,4,7 82:4 90:1 95:1,5 103:1,9 105:9 106:6,11 107:10 109:13 109:17 110:15 111:6,15 113:1 museum's 9:22 N nailed 8:3 Naknek 10:9 name 22:8 39:5 96:5 114:4 NASA 46:2 nation 6:5,11 12:19 15:25 36:19 87:16 100:17 national 1:6 6:23,25 11:2 12:2,9,10 14:4 14:5 34:2 35:7 35:11,16 36:11 36:22 40:14 54:8 61:3,13 61:14 75:17 86:2 88:8 97:3 101:10,10 103:24 nations 17:7
--	--	---	---	---

nationwide 3:18 9:9	92:20 93:9 98:15,17 101:6 101:18,18 104:13 108:1,2 108:15,22,25 109:1,2,3,3,3,4 110:10	night 98:16 100:19 NIMS 111:2 NOAA 111:1,2 Nome 91:17 nonimpacts 112:7 non-renewable 82:8 north 16:3 56:14 87:12 101:14 101:14 northern 16:12 18:11 note 63:5 notice 2:12 72:21 77:1 noticed 17:4 November 28:14 no-sulfur 87:1 NREL 12:13 16:7 17:1 18:17 46:10 52:2 NREL's 14:22 19:25 46:9 nuclear 4:21 number 4:13 32:20 61:18 64:22 65:16 70:9,10,21,21 70:21 92:16,22 93:8,14 114:8 numbers 32:22 105:15 numerous 11:6 nurture 19:2	occurring 42:3 ocean 1:22 4:12 5:9 6:6 17:12 41:18,23 67:14 91:2,7 103:11 105:11 107:10 offer 7:15 offers 5:11 office 14:6 79:15 114:6 officials 86:3 offset 105:24 offshore 45:13 45:14 46:2 113:2 off-the-shelf 52:23 62:7 oh 108:21 112:22 oil 6:14 7:17 40:7,24,25 70:5,6,7 71:4 82:8,17,25 86:8,12 87:9 101:5 okay 23:7 49:23 55:12 58:18 60:2,14,19 66:23 69:15 104:5 107:21 109:20 old 108:21 once 15:24 55:10 92:9 106:15 ones 37:4 42:2 48:1 one-third 99:9 online 75:9 79:14 on-ground 84:15 open 113:24 opening 1:3 3:1 3:21 54:1 operate 33:2,9 57:10 75:11 79:7	operating 15:10 56:11 57:18,23 operation 77:14 80:4 operational 17:23 operations 77:12 99:18 opinion 113:9 opportunities 12:21,24 32:22 37:8 43:21 50:18,23 103:12 104:19 106:3,14 108:23 opportunity 8:7 12:4 17:17 19:10,24 22:4 31:5 34:10 35:10 36:6 39:5,24 40:13 42:11 43:10,22 47:8 48:17 68:4 72:18 73:23 75:5 88:21 91:20 92:2,4,8,10 93:22 96:4 101:23 106:8 optimally 36:17 optimize 35:10 option 83:10 options 35:15 57:23 ORC 25:5 order 3:4 33:7 56:18 63:1,23 63:24 organizations 39:8,15 original 91:17 Otis 69:12 ought 54:12 110:22 outboards 98:8 output 84:18,19 outset 50:8
-------------------------------	--	--	--	---

outside 3:10 17:22 18:3 32:21 64:13 65:18 overall 46:4 47:12 overcome 76:17 overseeing 52:22 overstudy 72:15 overview 8:18 owned 16:3 ownership 26:20 owning 26:18	participate 111:4 participating 9:24 particular 3:18 18:6 32:13 34:5 37:5 particularly 5:12 7:13 8:3 32:23 82:17 103:10 104:14 105:24 partner 16:8 72:9,11 75:10 93:10 partnering 14:2 partners 101:13 partnership 19:21 parts 15:25 34:8 35:8 65:21 78:20 101:16 Paskvan 49:20 49:21,22 Pass 18:12 Passage 91:10 passed 4:8 passion 58:18 59:3,7,8,20 64:12 74:2 passionate 58:23,23 59:22 66:8 path 26:10,18 27:22 28:10,18 28:19 29:7,18 32:17 pathway 93:16 97:2 Paul 4:1 14:20 87:6 pause 32:6 payer's 76:13 paying 8:1 42:3 66:5 98:3 payoff-type 53:11 peak 57:4	peer 63:8 penetrate 24:18 penetration 34:4 35:3 people 17:4 27:17 28:10,15 32:10 40:16 41:10 42:12,23 43:4,6 46:13 53:17 54:2 59:20,22 63:13 64:13 66:1 69:17 70:2,4 71:5 72:6,8 85:1 87:16,17 87:18,19 88:21 97:4 103:19,23 104:5 110:18 110:20 112:17 112:20,22 peoples 54:1 perceived 86:8 percent 4:19,20 4:21,21,22,25 5:4,5,7,8,8,20 5:24 7:3 13:14 13:15 17:19 18:1 24:20 26:6 34:16,21 34:24 43:1,1 46:7,7,15,19 46:22 47:21 65:2,3,19,22 66:3,5 70:11 70:12 73:1,5,5 73:9 75:24 76:3 82:24 83:1,15,16,16 83:17 85:17,18 87:3 88:14,16 88:19,19,20 96:23 98:11 99:1,6 100:3,7 100:11 perfect 9:17 31:22 42:24 43:7 47:7 85:11,15	perform 16:13 52:10 performance 14:24 16:10,15 permafrost 14:25 permit 8:10 76:20 107:8,8 111:3 112:10 112:25 permits 107:9 107:13,15,21 108:1,3 112:20 permitting 107:19 109:14 110:9 111:25 112:4 person 25:20 71:15 personal 59:4 personally 16:5 31:6 51:25 52:11 perspective 23:6 23:13 26:22 50:11 52:5 54:16 65:24 111:6 113:2 perspectives 105:10 pertains 12:5 Petroleum 4:18 phase 99:2 philanthropist 108:20 photovoltaic 16:2 physical 93:12 physically 46:14 110:19 pick 50:13 81:8 picture 36:8 71:21 100:15 104:12 114:7 pilot 51:19 92:23 93:12,15 93:16,19 pilots 77:15	pinpoint 14:14 pioneering 91:18 101:8 pioneers 91:17 pipe 48:9 61:6 pipeline 36:4 87:5 pitching 110:1 place 5:6 9:18 33:21 42:24 47:21 111:22 places 24:6,10 29:1 40:21 47:25 110:19 plan 7:12 22:12 22:21 25:19,20 26:1,2,2,2,5,11 26:16,18,19,25 27:2 28:17 32:1 50:6 77:2 77:3,7 planet 43:4 planning 6:18 18:18 23:9 76:8 plans 26:17 plant 9:20,21 10:1 23:9 25:22 31:23 60:25 63:9 68:25 69:2 73:4,12 84:18 106:23,25 107:25 play 23:1 34:13 36:24 37:7 playing 19:23 please 66:22 pleased 46:4 49:19 75:8 pleasure 11:13 58:20 67:17 plug 27:11 plug-in 43:15 100:25 PM2.5 85:20 pockets 99:25 point 5:10 32:10
---	---	---	---	--

51:24 53:6 56:25 63:14 64:4 65:1 pointed 42:18 46:9 64:23 points 60:9 93:21 policies 43:23,25 45:22 50:13 policy 4:8 9:12 44:15 47:13 50:11 54:9,10 79:10 106:22 109:21 110:9 110:23 political 36:14 popular 4:7 populated 82:20 population 22:17 97:18 populations 108:6 portable 58:7 70:4,22 107:22 portfolio 16:23 34:3 41:8 portion 13:16 99:20 position 36:16 45:17 64:8 positioned 87:14 87:24 88:3 possess 7:6 possibilities 44:10 possibility 7:15 possible 19:3 46:20 possibly 25:4 79:15 86:15 potential 3:6 5:12 7:1,6 8:19 13:13,15 14:8 17:9,14 18:1 18:23 19:4 50:9 51:7 77:4 79:3,11,16 83:24 84:10	93:5 113:16 potentially 34:13 53:11 79:22 pound 108:21 power 1:11,22 3:7,14 4:21 6:6 6:8,9,10,15,21 7:4 8:25 9:20 10:1,23 11:9 13:13 14:25 15:6,23 17:9 23:9 31:2,23 33:5 34:7,17 34:24 35:9 36:4 44:24 47:4 52:24 60:25 62:16,17 62:18 63:9 67:14 68:25 69:1 73:1 75:19,19,25 76:11 77:21 78:13 82:24 83:21 85:2 87:25 91:2,7 96:6,10 97:18 97:19 99:8,14 100:25 105:15 106:22,23,25 powered 35:11 powerhouse 99:12 powering 9:21 46:10 Pratt 69:24 precede 46:17 predict 41:11 prepare 18:25 47:2 prepared 20:2 29:22 37:12 48:18 73:24 80:11 89:1 94:2 101:25 presented 9:5 52:10 presently 93:16	110:16 presents 36:6 preserve 48:12 president 1:14 1:16,18 67:8 67:10,12 68:1 75:1 82:1 president's 54:25 88:14,22 presiding 2:14 press 37:1 presumed 77:1 pretty 28:2 53:3 78:10 105:21 108:14 prevalent 71:16 pre-Chena 60:24 price 40:19 41:7 41:9,11 42:6 66:4,6 76:4,14 85:25 86:8 priced 31:16 prices 5:16 7:25 8:4 32:1 36:9 76:6 primarily 12:20 14:15 18:16 52:1 primary 12:10 principles 18:13 printed 39:21 printing 106:10 prior 16:6,25 52:1 60:15 private 61:2 85:14,23 109:3 probably 17:17 41:19 47:16 49:6 53:20 66:24 68:5 81:8 98:9 103:4 problem 57:6,9 61:10 68:18 85:23 93:6 98:13 problems 96:10	proceed 10:18 86:13 process 18:14 51:3 79:13,19 81:2 110:3 111:3,5,18 112:9,10 113:4 processed 83:25 processes 92:21 110:10,13,21 processing 36:5 36:12 produce 5:17 6:7,9 16:18 42:20 84:21 86:25 99:17 produced 6:20 34:17 40:25 44:24 78:9,11 86:11 87:8 99:11 produces 17:19 producing 6:1 7:3 8:25 13:6 70:6,8 92:20 product 45:23 62:2,3 75:15 production 2:2 4:16,23 13:10 15:19,20 33:20 39:9 76:1 84:4 84:22 87:11 products 36:5 program 14:3 14:12 15:12 16:1 18:11 19:14,15,16,19 36:23 45:3,6,8 45:12,15 46:10 46:12 60:4 105:7 programs 37:2 61:13,23 prohibitive 104:9 project 1:5,13 1:19,20,21 10:9 11:1,12	12:1 15:16 17:13 18:9,20 22:18 39:2,7 51:19 60:22 61:1 63:7 67:14 75:7,9 75:15 76:10,15 76:21,25 77:6 77:18,20 79:4 79:5,16 80:9 82:3,3 83:22 84:23 86:6,13 86:16,19 91:1 91:9,9,11,12 93:15,17,17 96:7 99:3 104:11 105:23 107:6,14,19 111:17 112:3 projects 4:12 6:1,2,7 10:7,10 10:11,18 14:19 14:23 15:9,14 16:11 18:19,21 19:7 31:9,17 33:7,8,10,17 37:3 44:10,13 45:7 52:3 53:11,21 54:23 60:2 71:10 72:16 75:12,17 79:7,14,21 80:2 83:23 85:3,6 91:6,8 91:11 92:23 96:8,13 97:15 97:16 98:25 99:3 105:13 112:1,5,19,19 113:6,7,22 promise 92:14 promising 16:24 promote 79:10 promoted 83:19 promoting 39:10 52:12 prompts 8:14 proper 12:25
--	--	---	--	---

property 77:8	51:21 55:13	Ramras 49:18	REAP 39:7 44:3	84:6
propose 93:18	58:2,6,12	range 88:1	rear 108:21	refrigeration
proposed 33:25	65:24 73:23	rapidly 41:4	reason 34:10	62:6,7,13,14
76:23 79:11	99:19 109:22	rascals 69:12	88:6	62:18 69:11
93:21	111:22	rate 76:13	reasons 32:9	refrigerator
prosper 48:2	putting 43:16	rates 53:15	58:25 64:22	27:11
prosperous 13:1	52:7 53:9	raw 36:6,12	REC 44:17,17	REGARD 2:2
prove 35:10	p.m 114:17	reach 35:1 82:14	45:1	regarding 44:14
proven 28:3	Q	read 85:10	receiving 66:17	84:5
51:5 52:23	quadrant 29:18	ready 93:23	77:1	region 1:17
82:18	quadruple	real 5:2,17 19:8	recognition	32:13 75:2
proverb 73:13	40:20 42:10	23:21 28:19	55:25	regional 18:18
provide 8:17	qualify 51:4	36:6 41:8	recognize 3:22	45:10
12:14 47:5	quality 86:1	50:16 54:1,9	34:12 36:19	regions 16:12
66:15 77:3	Quantum	57:17 80:1	42:19 56:6	36:15 105:15
82:12 87:1	107:16	98:2 108:24	103:12 104:2	regulation 42:5
88:16 97:19	quarter 77:21	113:17	104:22	Regulatory 86:6
99:1,4 100:24	99:2	realistic 88:23	recognized 15:3	110:25
100:25	question 23:2,3	realistically	17:18 55:22	reinventing
provided 4:8	25:7 50:4	109:18	recommenda...	72:20 106:15
provider 96:11	51:24 56:2	realize 16:20	79:9	Reinvestment
provides 32:2	58:17 59:7,8	18:3 92:13	record 8:12 9:2	19:13
providing 4:11	59:11 104:17	realized 55:19	11:18 39:5	relation 97:18
12:18 36:22	questions 14:23	62:22 98:1	49:7 60:2	relatively 40:9
proving 34:11	16:12 20:1	really 14:7	66:16,19 105:3	42:25
53:7 88:4 97:5	22:23 23:4	15:20,21 22:7	113:24 114:10	released 69:23
provision 54:19	28:22 29:6,20	22:19 25:16	records 49:4	relevant 34:1
proviso 93:3	49:5 64:20	27:3,18,23	recovery 19:13	35:7,16
prudent 33:11	66:17 84:5	31:14 34:18	62:11,11 87:10	reliability 76:13
pteropods 41:21	105:1 113:10	35:10 39:23	RECs 44:13,14	reliable 33:8
public 93:10	quick 64:19	40:1 41:5,24	44:20,22,23	83:13
publications	quickly 35:8	42:22 43:11,12	red 73:3	reliant 87:16
87:6	112:13	44:18 45:2,5	reduce 65:2	relies 75:21
pull 60:3	quite 15:12	45:12,15 46:2	72:25 78:2	relocate 76:17
pulled 41:16	16:17 18:3	46:4,18 47:3,4	85:16,25 86:1	relocated 77:12
105:23	40:12 41:4	47:6 48:2,14	104:8,13	relocating 77:5
pump 54:3 58:2	44:4 52:18	48:15 50:9,17	reduced 77:14	relocation 77:2
58:12	quo 40:18	51:21,23 52:22	100:4	rely 27:18 29:3
pumps 17:12	R	53:1,14,22,25	reducing 52:24	remember
69:15	r 27:2	54:12 55:8	66:9	23:25 29:8
purchaser 44:23	radically 84:18	56:18 60:8,11	reduction 75:18	58:3 65:15
pursuant 2:12	railbelt 18:17	61:24 62:23,23	85:19	73:18
push 48:14	75:16,23	63:3 64:1,6,24	reeducation	reminding
pushing 53:1	ramifications	66:9,11 75:5,8	112:18	113:19
put 23:12,13	47:5	78:11 79:21,24	referred 76:18	remote 8:3 19:9
26:5 31:10	ramping 35:8	97:2 103:19	refine 56:17	remove 92:13
39:19,19 41:9		104:1,12	reflects 64:19	109:18
46:20 50:17		111:20	reforestation	removed 93:7

renewable 1:6 1:12,22 2:1 3:7 3:14,19 4:6,13 4:16,23 5:6,9 5:11 7:15,22 9:8,13 10:7,23 11:2,11,12 12:2,4,9,12,23 13:19 14:4 18:25 26:6 31:7,17 33:8 33:15 34:17,25 36:1,20 39:2,6 39:10,13,19,21 40:4,8,15 41:9 41:11 44:2,12 44:15,18 45:2 45:24 46:22 47:21 48:5 52:21 53:19 54:20 56:12 60:1 67:14,20 68:9,14 70:25 75:7,11,15 76:11 78:3,4,9 79:4,25 80:2,4 82:10,11,13 83:11,16 87:21 88:12,13,15,16 88:19 91:2,7 91:19,23 92:14 93:23 97:7 99:22 100:25 109:7 111:23 112:4 113:16 113:22	replace 24:13 replacing 17:24 replica 17:4 replication 17:14 report 23:16 28:11,16 46:8 reporter 9:1 reports 65:1 Representative 4:1,3 49:13,14 49:14,16,18 representatives 61:21 112:6 Republican 114:13 request 86:5 requesting 92:25 requests 105:21 require 35:4 112:20 requirements 92:23 requires 98:7 RES 44:11,22 research 4:9 12:11 13:13 18:9,10 33:4 33:23 36:23 37:2 41:17 46:25 78:24 79:23 83:14 85:5 87:24 93:9 researcher/sci... 64:4 researching 17:11 reserves 48:14 105:25 reservoir 33:19 reshape 36:7 residence 103:3 resident 32:8 97:17 99:5,10 100:2 residents 31:20	32:13 76:9 83:4 85:13 99:25 residue 84:1 resistance 16:16 resolve 113:5 resolved 46:5 113:6 resonates 88:5 Resort 2:13 67:8 resource 14:17 14:17 18:18,23 23:19 24:6,8 26:11 28:24 41:6 83:24 84:9,16 93:10 97:12 106:19 resources 2:9 3:5 10:17,24 12:23 14:10,13 14:14 22:24 23:14,23 24:11 25:12 26:9,12 26:22 27:8 31:8,8 33:16 34:17,25 35:23 36:18,20 40:4 40:9,11 41:9 41:11 45:18,20 46:20,22 48:5 48:13 76:12 79:2 82:7,8,10 82:10,12,14,17 84:4 86:24 93:12 98:15 100:18 107:16 114:1 respond 59:10 66:18 rest 24:25 35:13 37:6 98:11 101:21 restart 86:18 restriction 76:20 result 15:11 rethink 35:20 36:7	retraining 112:24 revenue 45:21 revenues 100:5 reverse 62:14 review 14:6 reviewed 9:6 revolution 42:12 42:13 rewarding 45:23 rifle 29:10 right 3:3 5:24 10:21 25:1,10 26:1 27:3,16 28:22 29:18,18 32:17 33:18 35:6 41:20,21 42:8 43:4,25 44:5,18 45:17 49:22 56:20 57:2,3,6 58:22 68:23 71:19 72:21 96:21 103:3,21 105:7 105:9 106:8,13 106:14,16 107:22 108:23 109:10,10 risen 77:25 rising 105:25 risk 28:4,7,20,21 40:16 41:8,14 52:9 53:10 59:9,14,14,19 59:20 60:7,12 61:20 108:17 108:18 risks 40:17 42:7 river 17:3,6 91:12,13 97:11 rivers 6:4 17:10 road 2:14 47:15 48:3 87:1 92:12 Roadblock 92:16,22 93:8 93:14	roadblocks 109:15,19 role 33:3 34:12 35:20 36:24 37:7 93:9,25 roof 62:18 room 4:4 54:3 Rose 1:12 11:10 38:1 39:1,3,6 48:18 53:1 64:19 roughly 53:5 rounding 5:10 67:16 Ruby 17:3,8,9 rugged 12:17 run 19:7 42:16 47:16 48:10,11 78:17 running 43:17 62:13 106:24 rural 2:3 3:20 7:5,11 12:5 16:23 18:6,16 32:16,19,24 42:19 65:20 68:13 77:22,24 78:18 79:4 83:4,7 85:2 88:16 96:8,19 98:21 99:22 103:5 rush 91:15 S Saint 14:20 114:6 Sandia 35:11 Saturday 2:5 3:11 save 18:1 27:13 27:14 42:22 saves 42:23 saving 27:12 83:8 savings 5:17 saying 25:16 58:20 59:2
--	---	---	---	---

73:21,22 109:20 says 47:22 68:17 68:17 71:8 107:18 108:19 scale 15:9 19:8 52:4 103:13,24 104:10 106:3 scaled 84:24 99:15 106:25 scarce 92:18 scared 28:12 schedule 67:1 77:20 105:10 school 58:2,9 69:14 sea 17:20 SeaLife 17:11 seasonality 13:24 seat 49:9 Seaton 4:2 second 5:6 10:6 23:2 49:8 58:19 66:21,24 66:25 67:3 73:13 Secretary 55:7 64:2 Secretary's 64:8 sector 61:2 109:3 sectors 113:13 securing 76:17 security 4:11 36:11 54:19 77:13 see 5:12 23:23 23:24 25:12 26:14,21,24 27:23 42:1 43:10 46:19 47:15,24 49:12 57:22,22 61:15 62:25 63:16 64:10 69:16 72:11 92:12 98:9 99:2,13	101:2 105:24 105:25 107:7 110:5 seeding 62:24 seeds 25:21 seeing 87:19 seen 5:3 49:15 50:15 52:11 53:25 54:10 sees 44:7 seize 40:13 Selawik 14:21 self-contained 10:1 105:18 self-evident 96:19 self-made 72:5 self-reliant 97:14 self-sufficient 107:2 sell 99:25 100:2 Senate 2:7 3:5 9:6 34:12 Senator 1:3 3:2 3:3,23,24 9:14 12:3 18:19 21:1,5 22:3,3 30:1 31:3,6 34:24 38:1 39:3 40:5 44:6 48:16 49:1,12 49:12,20,21,22 49:22 54:15 55:12 56:2,19 56:21,23 57:12 58:21 59:5 60:19 63:14 65:15 68:3,7 68:10 70:14,16 74:1,4 75:3 81:1,4,7 82:4 90:1 95:1,3,5 96:3 101:23 103:1,9 105:8 105:9 106:6,7 106:11 107:10 108:24 109:13	109:17,25 110:15 111:6 111:15,25 113:1 senators 9:4 send 113:25 114:5 sending 99:23 senior 1:5 11:1 12:1 sense 24:21 50:6 52:6,12,14 53:4 73:16 111:4 separate 100:23 sequestered 87:10 serial 70:21,21 series 113:10 serious 54:3 93:6 seriously 16:20 54:6 serve 34:10 75:16 88:3 service 85:15 services 31:15 77:15 82:23 serving 78:25 set 63:25 setup 45:15 Seward 17:11 54:4 sewer 68:14 shallow 5:21 Shame 71:3,14 shape 55:3 shaping 36:24 share 14:11 39:9 59:24,24 107:17 109:6 sharing 63:21 sharply 78:1 shells 41:22 Shelters 18:11 shift 31:12 61:2 shines 83:10 ship 36:11	shipping 17:20 shoestring 50:8 shore 13:22 36:12 short 35:2 41:20 shortages 76:14 short-term 26:1 27:23 100:8 showing 28:17 shut 93:7 side 27:5,6 64:21 79:10,23 91:10 114:12 114:13 sight 18:8 signed 69:3 significant 17:22 111:24 Sikorsky 69:10 69:11 silos 63:14 silver 73:21 109:8 similar 53:18 84:25 Similarly 55:21 simple 35:4 simply 26:5 83:8 85:23 sit 29:14 62:1 110:12 site 9:18,19 sites 6:3 7:9,13 7:14,14 9:14 93:12 sitting 5:15 situation 25:25 41:21 55:15 64:16 six 112:23 size 19:5 57:19 70:20 98:20 skin 53:9 slab 58:8,10,10 58:14 slash 83:25 sleep 23:1 Slope 87:12	slow 112:9 small 13:16 19:9 22:17 28:1 41:16,22 52:4 70:17 85:7 99:14,19 101:12,12,19 103:14 104:4 smaller 103:17 106:2 smaller-scale 79:6 105:13 smart 19:3 smokestack 106:24 108:1 snow 18:7 snowmachines 98:8 soak 28:15 societies 47:23 soften 109:19 software 101:16 solar 4:24 5:8 16:2,4,11,13 16:15,17,20 43:8,11,16,18 43:18,21 54:2 54:5 56:5,8 57:8 58:7 70:13 73:14 82:11 sold 44:22 solely 85:15 solicitation 55:18,23 solid 1:19 82:2 84:2,3 solution 16:21 59:17 83:12,13 85:7 99:13 100:20 solutions 15:13 27:23 33:25 36:20 54:13 59:21 61:11 63:2 64:14 93:22 96:9 100:16,16
--	--	---	---	--

101:7 solve 57:6,9 85:22 96:9 solving 60:8 somebody's 103:3 someday 7:16 sooner 91:24 sort 61:24 101:2 101:10 110:20 sounding 9:11 sounds 26:7 source 17:12 23:9 25:3,4 84:8 85:12 103:22 sources 3:7,14 34:7 36:1 56:13 63:19 78:3,23 83:11 87:22 88:12,15 south 7:9 101:13 Southcentral 6:25 75:21 76:12 Southeast 6:24 51:14 southern 6:8 7:5 so-called 108:17 space 6:13 spare 78:20 sparsely 82:20 speak 8:7 39:5 55:7 94:1 96:4 101:23 Speaker 4:3 special 68:6 species 84:14,18 84:20 specific 37:9 specifically 24:3 spectrum 72:25 73:4 speed 112:14 speeds 80:7 spell 114:4 spend 29:16 32:17	spending 4:15 65:21 92:24 spends 65:19 spent 73:6 97:25 spikes 66:4,6 spin 112:9 spins 112:3 spoke 9:14 sport 9:19 spot 104:16 spread 82:21 100:12 springboard 9:7 Springs 2:10,13 2:14 3:9 10:10 13:3 24:24 31:22 33:19 50:5 51:2 54:4 67:8 105:18 spur 10:23 18:20 Spurr 10:9 square 82:22 98:4 squash 44:16,25 stability 35:16 97:6 100:2 stabilizing 35:16 stable 32:1 36:9 36:22 Stably 31:16 staff 9:6 22:4 114:2,9,11 stage 53:23 84:3 staggering 86:17 stake 26:4 stand 21:3 standard 44:2 44:16 62:7 standing 114:7 standpoint 9:13 stands 76:19 start 11:15 23:9 24:12 28:4 29:10,13 43:18 51:15 106:7 started 25:14	62:23 66:23 starting 56:25 64:8 72:7 starving 25:21 state 3:25 5:12 5:20 6:13 7:2 7:20 8:2 10:8 10:17 12:15,19 13:19,20,25 14:12 15:10,25 17:15 19:14,20 19:21,25 22:16 23:5 26:20 28:9 29:8 31:9 31:21 32:21 34:20 35:22,22 36:18 39:8,10 39:15 40:1,8 40:14 47:11 49:10,24 50:3 51:8 52:21 53:16,17,19 55:4 65:18,21 65:25 68:11 70:7,7 78:6 82:18,20,22 84:12 86:3 87:16,21,23 88:1 93:8,9 104:3,14 106:20 111:6,8 111:9,12 112:5 113:14,16 stated 12:8 40:4 106:15 statement 1:2,3 1:5,8,10,12,14 1:16,18,21,23 3:1 11:17 12:1 20:2 22:1 29:22 31:1 37:12 39:1 48:18 68:1 73:24 75:1 80:11 82:1 89:1 91:1 94:2 96:1 101:25 states 42:9 46:23	47:9 48:3,13 84:11 87:2 92:5,7 107:24 statewide 6:2 22:10 39:24 51:7 state's 5:24 6:8 stature 92:5 status 40:18 stat's 111:14 steep 76:1 step 23:17 26:20 29:12 53:8 59:13 stepped 63:6 steps 27:2 Steve 1:8 11:4 22:1 30:1 47:22 51:6 56:7 64:12 Steven 22:8 Stevens 3:23,24 68:7,10 77:8 108:24 Steven's 70:16 stewards 93:10 stop 58:5 storage 14:8 25:1 28:6 33:14 35:3,15 47:6 53:12,14 57:5,14,19 58:15 78:8,15 79:24 97:21 100:19 store 25:2 78:12 98:17,19,23 109:11 stored 97:21 storing 13:23 57:6 109:9,10 story 61:20 stove 61:6 98:20 stranded 35:25 strategies 2:2 17:24 33:20 strategy 36:17 stream 17:2	streamlined 79:13 92:20 streams 6:4 17:10 stress 22:19 stretch 26:3,8 strict 53:3 strike 91:17 strong 60:9 87:7 strongest 68:8 studied 9:6 studier 29:14 studies 65:1 study 5:23 23:21 29:13 86:22 studying 29:10 stuff 27:3 50:8 72:15 stumbling 111:21 submit 8:11,13 8:15 49:6 113:10,21,23 submitted 86:6 subsidiaries 61:19 subsistence 98:7 substantial 12:22 13:12 84:2 93:2 substantially 16:22 substantive 113:7 substitution 15:18 succeed 71:9,10 71:14 87:18 success 29:19 successes 16:1 59:24 72:16 successful 54:18 93:18 100:12 successfully 45:6 sudden 43:19 sufficient 67:2 79:1
---	--	---	---	--

suggested 4:14 50:15	Sweeds 91:16	51:16 55:25	43:3,9 50:22	80:8
suggestions 8:21 8:22	swings 76:14	56:12 57:25	50:22,25 51:3	testimony 8:11
summarize 11:18	synergies 79:3	62:21 63:22	52:23 53:6	8:12,14 9:3
summer 43:15 50:1	synergy 109:5,5	104:1	55:16 57:14	12:19 18:16
sun 83:10	synthetic 87:1	talks 64:12	58:15 60:4,6,6	41:15,15 49:2
Sundstrand 69:14,14	system 9:21,22 13:8 16:2	Tanana 91:13	62:8,24 63:8	90:2 91:5
sunk 29:2	24:18 62:11,13	tank 24:25 25:1 61:23	63:12 73:17	93:21 103:1
suppliers 101:6	62:14,18,21	tape 58:7	79:23 80:4	113:21
supply 27:5 78:13	78:12 96:11	taping 17:9	103:14	testing 10:2
supplying 100:14 105:15	103:6	taps 6:4	Technology-st... 92:22	33:14 35:14,17
105:22	systems 1:24	target 88:22	Ted 77:8	42:19,25 85:5
support 12:14	5:22 13:7	targeted 53:21	tell 25:16 56:23	Texas 70:6
12:25 13:17	16:10 19:14	targeting 14:7	58:24,24 60:14	thank 12:3
14:22 54:25	33:3,14 43:8	task 35:4	106:18 107:12	19:24 21:1
77:19 80:3	47:7 55:18	tasks 63:25	107:12,21	30:1 31:3,6,11
supported 14:20	63:3,25 67:17	tax 4:9,13 45:23	telling 61:20	36:19 37:10
supporters 68:9	78:6,19 79:24	teach 68:19,19	91:24	38:1 39:3,3
supportive 111:13	96:2,6,7 97:13	71:13 79:6	tells 86:10	48:16,17 49:1
supports 5:17	99:9,17 100:1	technical 12:14	108:19	49:1,4,17,23
sure 9:25 27:20	103:8 112:8	33:6 35:4	temperature 13:6 60:24	51:23 54:14
33:16 44:13,14	T	technician 81:9	62:15,16,17	65:14 66:14,19
44:19,21 54:24	table 110:13	techniques 84:15	69:6	68:3,6 70:17
54:25 64:19	tail 101:3	technologically 46:14	temperatures 88:1	70:17 73:23
67:1	take 6:22 27:8	technologies 2:2	tempting 25:18	74:1 75:3 80:8
surprise 24:5	33:23 57:17,19	14:7 18:13	ten 39:15 105:5	81:1,9 82:4,4
survey 97:24	58:4,10,12	28:3,7 29:2	107:3 113:24	88:25 90:1
Surveying 84:14	67:6 73:19,20	32:24 33:1,11	tend 61:6 112:9	91:4 93:25
survival 22:7 87:17	83:14 86:23	33:15 35:18	tendency 50:12	95:1,3 96:3
survive 25:24	92:4,10 93:24	43:7 51:5	tension 45:25	101:23 109:25
Susitna 10:12	98:18 104:3	52:13 53:2,18	tent 3:10	113:11 114:11
18:21 86:5,11	109:12	55:20 56:4,17	terawatts 6:9	114:15
86:15,19	taken 9:2 11:6	59:14 60:5	term 28:4,11	thankful 107:4,5
suspect 15:7	43:12 53:8	61:6,17,21	33:18 41:20	thanks 12:3 22:3
sustainable 28:24 33:17	54:6	68:24 69:7	terms 32:3	22:4 59:6
83:6,13 84:7	takes 108:24	72:9 79:25	40:16 41:20	60:18 67:19
84:15 87:21	talk 10:19 22:5	80:5 84:24	43:20 51:21	68:10
91:21	27:1 31:13	87:20,24 88:4	56:16 61:4	Thayer 10:13
sustained 15:2	39:25 56:3	100:10 106:17	64:14 105:21	theirs 26:25
	96:12	107:5 108:14	110:21	theoretically 6:8
	talked 44:4 54:1	109:4	terrific 3:12	thermal 54:2,5
	68:23	technology 3:15	113:18	58:6,6,7 97:21
	talking 10:11	7:22 8:22 12:4	test 88:3	98:19 103:2,4
	25:15 32:15	14:3,5 15:4,22	tested 88:5	thermostat 83:9
	40:16 41:10	16:25 25:10	testified 77:23	Therriault 49:12
	42:17 45:10	28:4 42:22	testify 48:17	thing 28:20
				34:19 43:11
				44:3 45:19

47:12 57:25 108:9,10 113:18 things 16:14 18:6 27:5,7 28:2 35:13 39:18,23 40:1 42:25 47:3 50:6 51:18 52:24 57:2,5 59:12 61:3 69:17 97:23 103:13 104:10 107:7 108:17 112:14 113:14 think 4:23 8:1 16:19 25:25 26:8 27:10,12 29:13,15 34:21 40:8 41:10,19 42:7 44:6 45:17,20 48:7 48:11 49:3,15 50:1,16 51:6 52:5,19 53:22 53:24 54:12 55:2 56:19,25 57:1,4,13 58:16,17,18 60:3,18,25 61:14,23 63:2 63:8,15 64:4,9 64:11,13 65:11 65:15 66:11 68:16,18 69:21 72:14,14,15,17 79:20 80:2 96:18 100:14 101:8 103:12 104:2,13,21 105:5 106:12 106:15 107:10 109:7,17 110:1 111:16 112:1,5 112:10,22,24 113:12 thinking 24:12 58:13 60:22	62:10 85:22 86:2 thinks 72:5 third 23:3 43:5 77:21 96:25 thirds 98:10 Thirty 73:13 Thomas 49:20 thought 15:14 24:23,23 32:7 60:17 110:20 thousand 70:12 three 22:23 23:3 39:22 53:5 73:6 75:13 76:4 91:16 93:8 96:18 97:15 99:4 threshold 7:8 throw 56:3 105:4 106:3 tidal 13:12,14 18:23 32:25 43:1 52:17 57:7 91:9,11 103:11 tie 104:18 timber 6:23,24 83:25 time 5:10 13:23 22:6 25:22 35:14,24 36:19 37:11 40:12 41:4 45:22 48:10,14 52:25 53:23 61:19,19 64:15 66:19 67:2 73:10,12 73:14 76:4 78:10 83:14 86:18 87:11 88:25 91:5 93:22 94:1 105:8 107:16 108:19 109:11 timely 79:14,20 92:17 times 6:10 45:4	57:4 59:15 70:12 97:19 today 3:13 4:1 7:17 8:14,16 9:1,5,14 10:16 10:25 11:14 13:8 17:5 22:5 23:18 24:17 27:24 28:2 29:12 31:5,24 32:15 33:1 35:22 39:5 40:25 42:24 49:9 59:18,23 63:9 68:6,7,10 68:15 70:3 73:11,14,17,18 73:18 75:5 78:5 85:12,21 86:18 91:5,17 91:22 94:1 96:4 101:24 113:20 today's 86:14,17 told 59:15,16 60:16 107:17 tomorrow 73:11 Tongass 6:23 tons 6:17 tool 31:14 tools 96:22 top 61:22 topic 4:6,7 22:5 total 4:19,22 5:4 5:24 98:6 99:5 totalling 19:19 tough 88:5 toughest 57:10 Toyo 98:20 track 34:18 tracking 16:3,4 traditional 6:11 18:12 33:3 trained 78:21 training 46:25 80:3 transferrable 15:24	transition 19:1 87:15 91:22 transmission 46:16 103:23 104:24 transport 42:15 transportation 24:14 26:7 42:17 43:19 84:22 96:25 98:12 tree 73:12 84:14 tremendous 17:9 19:4 48:4 68:12 72:9,10 87:22 106:8,14 106:19,19 108:12 111:11 tremendously 106:20 111:12 trend 41:7 tribal 15:12,16 16:1 17:8 19:17 112:8 tribally 16:3 tribes 17:7 19:17 tripled 5:3 trips 50:1 true 63:10 84:5 truly 10:1,6 11:10 22:13 84:7 truth 97:1,7,8 truths 96:18,19 try 11:16 28:9 33:5 70:19 71:11 112:9 trying 19:2,20 24:13 58:4 78:1 98:13 110:7 111:2 tubes 54:5 Tuntutuliak 97:11 turbine 14:24 17:2,4 24:16 34:19 62:9,12	78:23 80:6 turbines 7:2,4 7:11 33:24 56:14 77:5 78:20,24 79:6 99:15,19 101:5 turn 27:15 turning 83:8,9 tweak 33:20 two 8:16 27:7 41:16 43:4 46:1,8 60:16 71:16 73:9,9 91:8 92:22 96:21 98:9 99:14 104:21 108:11 type 84:14 types 3:15,17 35:13 45:7 100:25 typical 24:17 103:7
U				
ultimately 7:23 62:3 unable 41:22 unbridled 59:8 underdeveloped 82:16 underexplored 82:15 understand 28:10 29:3 59:5 69:8 109:18 Understandably 52:20 understanding 54:10 55:17 84:19 understands 106:21 underutilized 86:24 underway 6:19 97:15				

uneconomic 22:19	up-to-date 84:11	various 45:7 79:18 113:13	44:17,20 45:1	wasteful 32:10
unforgiving 88:2	urban 18:24	vast 82:7,16 84:9	volunteer 81:9	wastes 92:18
unfortunate 88:8	usage 22:17	vehicles 18:6 101:1	VOR 76:19,20 77:2,5,8,10,11 77:17,19	waste-to-energy 84:23 85:3,6
unfortunately 63:16,20 78:22 82:13	use 3:19 4:18 6:10 17:12 19:21 23:2 24:9,15,15 25:5 27:21 28:23 29:15 31:8 32:7 35:2 36:12 40:25 43:13,20 45:5 47:19 68:20 71:18 72:13 83:21 84:16,22 85:18 96:22 98:7 100:25 108:10,11 109:8,12 112:2	vendors 72:22 Venetie 16:5,7 vent 5:21 verbal 8:11 verify 35:12 Vermont 101:14 vessels 17:19 vest 44:23 vested 87:19 viable 37:3 46:21 76:21,24 85:7 vibrant 13:1 113:18 vice 1:16 67:10 75:1 view 64:4 viewed 55:16 village 7:10 15:15 16:3,5,5 16:7 17:3 97:1 97:1 103:16 104:15 107:1,1 villages 7:5,11 8:3 96:9,23 97:5,10 100:13 104:17 village-scale 78:19 virtual 31:4 virtually 32:20 82:13 111:11 vision 47:11,12 47:13,25 50:5 51:18 55:3 74:2 visioning 51:18 vocabulary 71:6 71:7 volatility 76:4 volume 84:19 voluntary 44:17	vulnerability 76:13 vulnerable 36:14	watch 105:5 watching 105:4 water 6:4 17:10 17:12 25:2,3,4 33:21 68:13 82:11 93:1,5 Watershed 17:6 wave 13:13,15 43:2 52:17 waves 6:7 way 16:19 25:2 27:24 40:15 52:10 55:2 60:14 61:1 65:12 93:5 111:4,24 ways 4:17 5:1 7:21 27:21 36:3 48:7,12 61:3 63:1 78:2 wealth 31:20 weather 14:24 16:13,15 Weatherization 19:14 Webster 71:8 Webster's 71:8 week 76:25 weekend 3:24 weight 107:23 welcome 11:13 11:19 20:1 21:5 30:2 38:2 49:16 66:16 74:4 81:5 90:2 91:4 95:2 Weller 58:2,9 wells 13:5 70:6,7 went 4:11 22:22 22:23 23:10,21 40:6 59:16 69:14 77:1 west 75:14 western 7:6 91:9
unique 56:16 64:22 66:12 92:8	United 42:9 46:23 47:9 48:3,13 61:17 61:21 63:8 68:24 69:7,11 72:9 87:2 92:5 92:7 106:17 107:4 108:14 109:4		W	
uniquely 87:14	units 15:23 97:21 103:2		wags 101:3	
unit 70:4,22 103:3,4 105:18	universe 112:3		walk 27:15	
united 42:9	utilities 14:21 39:12 75:23		want 3:21 11:18 21:2 23:2 25:16 26:4,14 26:24 29:7 43:23 44:12,14 44:19,21 46:3 46:4 49:10 50:4 55:13 56:2 58:5,6 59:7,10,11 60:11 66:14,15 67:1 69:20,22 71:24 101:11 103:25 105:3,8 107:14 108:20 109:13,21 113:11,19 114:11	
universities 72:13	utility 100:5		wanted 9:16 24:19 25:5 43:6 60:19	
university 1:11 11:9 15:5 31:2 33:5,12 35:17 36:24 41:18 61:10 72:10,12 72:13 87:6 109:3	utilize 104:18		wanting 26:18	
unleash 110:11	utilized 84:7		wants 40:22,22 52:6 73:4 107:4	
unlimited 8:11 29:16	utilizing 56:15		warming 86:15	
unsustainably 88:17	U.S 1:3 2:7 3:1 11:2 12:2,6,10 13:4 14:11 34:1 35:20 36:7 87:7		Washington 8:6 8:24 50:12 77:2 114:1,9	
unveiled 13:8	V		wasn't 55:15 60:17,17	
update 75:6	vacuum 54:5		waste 1:19 62:10 62:11 65:9,10 65:12 82:2 83:20 84:2,3	
upgraded 77:7	Valley 75:24			
upgrading 55:24	valuable 87:9 91:5 92:18 101:9			
upheaval 36:14	value 32:2 36:5 60:11			
upper 24:9	valued 31:11			
	variety 33:15			

100:13 110:6 we'll 26:11,25 27:21,22 28:12 29:4,5 48:10 49:7 57:20,22 58:12 107:21 we're 7:25 8:20 8:25 9:10 10:11,16 16:18 18:5,21 19:1 19:23 22:13,13 24:13,25 25:11 26:2,3 27:24 28:9,14 29:9,9 29:10,11 32:15 33:16,17,18,22 35:6 37:9 39:18 40:15,21 41:3,21 42:16 43:24,24 44:9 46:4,18 47:1,2 47:13,14,14,15 47:16 48:2,7 48:12 50:2,4 51:2,5,11,16 53:16,22 54:12 56:12 57:24,24 58:1,8,9,10 62:10,25 64:17 64:23 65:6,10 65:10,12,12,13 65:25 71:3,4 75:8 95:5 97:9 97:17 98:13,14 98:17 99:3 100:9 101:7,14 101:15 103:17 104:1,2,7 107:19,25 110:6,17 111:23 113:5 we've 4:17,25 5:3 6:2 7:7 8:6 8:16 10:13 12:20 14:2,15 14:18 16:12,14 24:24 25:15 26:16 34:13	35:17 40:7,8 42:18 46:11 49:11 50:12,15 50:17 51:4 55:3 57:16 65:24 66:25 73:6 77:23 78:7 80:9 81:8 97:4 103:10,21 104:23 105:5 106:1 111:15 WH 57:17 where'd 3:22 Whitney 69:24 wholesale 88:12 who've 77:23 wide 87:21 88:1 widely 15:3,24 17:17 18:15 wide-scale 17:14 width 107:23 wife 67:20 72:2 108:19 willing 64:13 109:6 willows 28:23,23 33:22 wind 1:17 4:24 5:3,7 7:1,2,4,6 7:7,9 10:9 14:10,13,13,14 14:17,17,23,25 15:6,9 16:11 18:20 24:8,13 24:15,20,21,22 25:2,6 32:25 34:5,15,19 35:9 43:2 45:13 46:2,7,7 46:10,13,15,19 46:24 50:15,18 51:9 53:14 56:4,13 57:7 61:7,7,7 63:18 67:11 70:13 75:2,6,10,13 75:16 76:22,24 77:1,16 78:5	78:10,19,23,24 79:1,2,4,7,10 79:11,17,17,21 80:1,6,7 82:11 96:13,24 97:1 97:2,12,18,19 98:14,14,16,16 98:18,19 99:5 99:8,8,10,12 99:14,14,19 100:14,17,18 100:19,19,22 101:5,15 103:11,11 105:11 112:1,2 wind-diesel 15:4 24:18 27:25 43:8 47:6 78:6 96:14 97:13 103:12 winners 50:13 64:21 winter 4:14 5:13 83:7 wintertime 57:3 58:11 98:17 wisely 27:20 29:15 109:12 wish 113:21 wishing 59:17 witnesses 8:16 8:17 10:5,22 40:3 woefully 82:15 woken 113:17 wonderful 3:9 3:10 103:14 108:9,10 109:19 wonderfully 66:12,12 wonders 11:7 wood 23:24 24:10 27:25 woody 83:25 word 71:5 work 16:6 19:2 19:21 21:4	28:13,15 31:10 33:19,21 35:6 39:17 47:6 48:15 52:8 56:18 58:21,22 59:15 60:14,15 61:7,8 62:19 78:21 80:2 87:20 88:6,6 96:8 106:25 107:9,13 108:25 109:6 110:12,13 111:14 114:14 worked 69:5,24 workers 47:2 working 3:16 9:19 15:4 16:18,25 18:22 25:10 33:13,18 33:25 34:13 35:1 44:6 46:9 46:11,11 47:11 52:4 53:16,17 54:13 57:13 58:5 63:17 64:8 66:10 75:9 83:23 84:23 96:14 109:4 110:17 111:2,7 works 25:24 51:13,13 world 11:4 15:3 16:4,4 32:6,8 36:8 40:5 42:1 42:4 43:5,9 47:5,9,24 57:9 63:15 64:24 65:7 68:6 70:12 92:1,7 worldwide 40:19 41:3 world's 71:23 worry 108:1,2 worth 63:4 wouldn't 54:6 wow 97:8	wrestling 51:25 writing 66:18 105:1 113:24 written 8:12 11:17 41:15 93:21 113:21 wrong 69:2 71:21,22 86:11 106:13 Y yeah 55:12,12 55:12 95:4 107:22 111:9 year 4:13,15,19 6:9,10,13,14 6:17 8:1 13:23 16:22 22:10 40:20,20 42:8 42:10 43:15 46:24 55:16 57:7 86:7 92:24,25 93:2 98:5 107:16 years 4:7,14 5:2 12:13 14:18 25:17 31:25 32:19 39:22 46:8,12 47:14 47:17 48:3,9 51:25 53:5 54:5 69:24 73:6,9,9,13 76:4 78:1 83:5 85:12,22 96:14 107:4 108:8,8 111:18 113:4 year-round 16:21 yesterday 5:15 43:7 104:15 YK 24:7 51:13 Yukon 15:15 17:2,6 24:7,9 Z zero 18:14 60:2 70:15,19
---	---	---	---	--

zeroed 70:15,18	150,000 70:7	66:3 103:8	650,000 6:17
	17 7:2	3,000 13:9	660,000 82:22
\$	18,000 75:20	3.5 96:19	67 39:7 82:25
\$1 107:15	190 58:11,13	30 26:5	68 1:15
\$12 19:16	1958 85:9	300 6:9	680,000 82:20
\$13.32 76:7	1984 86:7	31 1:11	85:13
\$14 19:15	1985 86:12	32 58:4,13	
\$15 4:15		350 104:5	7
\$150 42:8	2	36 5:6 7:11	7 4:22
\$18 19:13	2 70:11,11,22	36-turbine	70 17:7 48:3
\$2 72:3	2,500 6:21	75:14 76:24	75 1:17 83:16
\$2,000 103:5	2.5 6:19	38 58:3,4	85:17,18 88:19
\$28 19:14	20 24:1 25:17	39 1:13 4:19	
\$348,000 107:18	26:5 31:25		8
\$4 32:17	32:19 39:12,12	4	8 4:21 6:14 7:3
\$4,000 103:8	46:7,7,15,18	4 66:3	34:24
\$40,000 98:6	65:2,3	40 5:20 18:1	80 13:14
\$5.38 76:7	2003 5:3	27:17 83:9	800 104:5
\$650,000 72:4	2005 4:7 76:2	96:23 100:11	800-person
\$72 19:19	2007 4:10 54:18	40-year 26:5	104:6
\$750,000 69:5	75:11	42 46:22	82 1:20
\$8,000 98:5	2008 75:23 76:3	450 104:5	85 5:16
	76:6 86:20	456-0233 114:8	
1	2009 2:5 23:16	47 65:22	9
1 5:4,8 70:21	76:22	48 13:18 19:6	9.5 6:22
1,000 48:9 98:4	2011 77:21	35:12 42:23	90 43:1 73:5,5
1,200 98:22	2015 42:10	44:7,11 65:18	91 1:22
1,250 6:9	2025 83:16		93 75:24
10 18:1 25:17	88:15	5	95 34:16,21
31:25 96:14	2030 46:15	5 5:8 70:9 97:7	96 1:24
10,000 70:9	205 76:2	50 7:10 13:15	
108:8,8	2050 40:20	17:19 27:17	
10:22 2:12	2100 40:20	42:21 43:1	
100 14:15 24:19	22 1:9 2:5 4:20	48:3 66:5 73:1	
26:6 47:14,17	23 4:20	73:9 82:24	
47:21 83:17	24 5:24	85:12,22 96:23	
88:20 91:13	25 65:2,3 83:15	99:1,6 100:3	
96:23 100:6	83:16 87:3	100:11 107:24	
108:13	88:14,16,19	50,000 108:21	
100,000 6:12	25,000 39:22	500 106:23	
85:1	25/75 88:22	53 5:5	
100-year-old	250 6:2	54 75:14	
62:7	250,000 70:5	56.5 2:13	
12 1:7 87:11	28 5:25 22:23		
12:46 114:17	29 76:3	6	
146 76:2		6 65:19 98:5	
15 76:22 96:14	3	60 27:17,18 48:3	
98:11	3 1:4 4:25 65:19	65 5:14 98:2	