THE STATE of ALASKA
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October 7, 2014

Quadrennial Energy Review Comment Docket
Office of Energy Policy and Systems Analysis, EPSA-60
U.S. Department of Energy
1000 Independence Avenue SW
Washington, D.C. 20585-0121

By electronic submission to QERComments@hq.doe.gov

To Whom It May Concern:

The State of Alaska (SOA) Department of Natural Resources (DNR) appreciates the opportunity to comment on and participate in the Department of Energy (DOE)'s Quadrennial Energy Review (QER) pursuant to the President's Memorandum of January 9, 2014. This letter represents the State's initial comments.

I. Introduction

Alaska is the site of significant elements of the Nation's infrastructure for transporting, transmitting, and delivering energy. It also holds a vast resource base that can support affordable, clean, and secure energy for the nation and the world in the future if federal and state policies align to support existing and developing infrastructure.

As will be detailed below – the State features existing infrastructure and a project under development that are international in scale and of vital national interest. There are also a number of other significant pieces of energy infrastructure that serve intra-state purposes and must be supported by sound federal environmental, occupational, security, and health and safety policies.

The State supports executive action under existing law that respects the State's sovereignty and primacy in many areas of regulation, and acts with a measured and circumspect approach in those areas of federal primacy to promote economic development. The State is also actively involved in reviewing, commenting, and participating in the federal legislative process to advance new bills and amendments that support the State's critical energy infrastructure and economic development.

The State is also a partner and supporter of scientific research, particularly related to the Alaskan Arctic. As the United States' only Arctic state, Alaska must occupy a uniquely cooperative role in federal decision making, research gathering, and policy development in the Arctic. It is important to continue to gather the data and analytical information that is already being collected in Alaska to better understand the Arctic – but it is also critical to push forward infrastructure developments that promote Alaska's economy and the nation's energy and national security.

Below please find overview information related to energy transmission, storage, and distribution infrastructure located in Alaska. The State stands ready to assist DOE in a cooperative manner to collect detailed and technical information about the subjects below. It is critical this information from the United States' only Arctic state is included in QER materials, and that the role Alaska's immense resource base will play in our energy future be considered when evaluating the infrastructure needs of tomorrow.

II. Petroleum Pipeline and Transportation Infrastructure

The Trans-Alaska Pipeline System

Alaska's most significant piece of existing energy infrastructure is also one of the North America's largest – the 800 mile Trans-Alaska Pipeline System (TAPS) stretching from Alaska's North Slope to the marine terminal in Valdez, Alaska. This crude oil pipeline has been in continuous operation since 1977, during which time it has shipped almost 17 billion barrels of oil to market. It continues to carry almost all of Alaska's oil production, with approximately 500,000 barrels per day reaching the southern terminus of the pipe, where it is transported to refiners and ultimately to market.

North Slope Transportation and Gathering Lines

TAPS' significant volumes are supplied by an extensive network of transportation and gathering lines that cover Prudhoe Bay, North America's largest oil field, and extend over 100 miles, east to west, across the many other significant producing fields on Alaska's North Slope. This network now stretches from the developments located on state and federal land in the eastern-most portions of the National Petroleum Reserve-Alaska – across the state-owned lands on the central North Slope – to the newly developing Point Thomson field located on state land in close proximity to the highly prospective coastal plain area of the Arctic National Wildlife Refuge (ANWR). This infrastructure is critical to supporting the commercialization of Alaska's significant conventional natural gas reserves, the continued production of conventional oil from both new and existing fields, and the further delineation of Alaska's significant unconventional potential.

Cook Inlet Transportation and Gathering Lines

In addition to the massive resources on the North Slope, Alaska's oldest hydrocarbon basin in Cook Inlet, in close proximity to the South Central communities in Anchorage and along the Kenai Peninsula, continues to see exploration, development, and significant production of both oil and natural gas. A network of both oil and gas transportation infrastructure has been developed in the area to support this activity. This network has recently been expanding as new investments, supported by policies of Governor Sean Parnell and the Alaska Legislature, have brought new players and new investment to the basin. Of note, Cook Inlet is the primary source of natural gas used for heat and electricity in the significant population centers around Cook Inlet, and the gas distribution network that supplies this local market is an absolutely critical part of Alaska's domestic infrastructure.

Intra-State Refined Products Transportation

While more challenging to summarize, Alaska also features a network of infrastructure that is responsible for transporting fuel sources throughout the state, including to rural communities. One significant element is the Alaska Railroad, which transports both raw commodities and refined products

from Fairbanks in the north to Seward in the south. Barge and boat traffic also plays a significant role in reaching Alaskans throughout the State. From the Southeast's numerous marine transportation hubs along the inside passage, to coastal communities in Southcentral, out to the fishing villages and port towns in the Southwest, and into the river systems such as Bethel on the Kuskokwim River, many communities receive goods and supplies, especially fuel, from marine sources. Transportation of refined products over hundreds or even thousands of miles to these remote areas continues to provide a unique and significant challenge in Alaska.

III. Alaska North Slope Gas Commercialization Efforts

The Alaska Liquified Natural Gas (AK LNG) Project

In addition to significant conventional oil reserves, Alaska's North Slope holds some of the world's largest untapped conventional natural gas fields, which have yet to be commercialized due to infrastructure restraints. The State now sees alignment between all of the parties necessary to advance a large scale natural gas commercialization project: the North Slope resource producers (ExxonMobil, BP, and ConocoPhillips), a world-class pipeline company (TransCanada) and the State of Alaska. Together, these parties are progressing the AK LNG Project through the stage-gated approach to evaluate a project to bring natural gas from Alaska's North Slope to both Alaskan communities and to tidewater in Southcentral Alaska, where liquefied natural gas (LNG) would be shipped to Asian and other world markets. With the passage of significant state legislation in 2014, the State was authorized to evaluate taking an equity stake in the full project and the project partners moved into the pre-front end engineering and design (pre-FEED) phase. This work, building on prior efforts by the AK LNG partners, is spending hundreds of millions of dollars and employing hundreds of people to move the project forward. Progress on this critical infrastructure will require coordination and efficiency from federal reviewers, including DOE export license issuance, expedient Federal Energy Regulatory Commission (FERC) review, as well as a suite of environmental reviews and permits from additional federal regulators.

The Alaska Stand Alone Pipeline (ASAP) Line

The State of Alaska is proceeding as a partner in the AK LNG project through a number of executive offices and Departments, including the Alaska Gasline Development Corporation (AGDC). However, AGDC is also engaged in advancing an alternative, smaller-scale gas commercialization effort relative to the AK LNG line. This effort is primarily focused on developing an in-state gasline to deliver natural gas to as many Alaskan communities as possible, and ensuring that a project to meet this objective is moving forward. The ASAP pipeline would extend from the North Slope to the Cook Inlet area where it would connect into the existing Cook Inlet natural gas delivery system with off-takes along the way for local supplies and a spur line to serve interior communities. In the event the AK LNG project progresses to a final investment decision it would meet these same needs, and AGDC can consolidate its efforts behind that project in the future.

To date, the ASAP project has been progressing on a number of fronts. Notably, it has completed work with a number of federal agencies, with the U.S. Army Corps of Engineers (USACE) as lead agency, on developing an Environmental Impact Statement for the project. As both of these gas commercialization projects move forward, federal regulators need to continue to support the development of

infrastructure to bring natural gas to meet the needs of Alaskans first, and then to international markets.

The AIDEA Interior Energy Plan LNG Trucking

The State is also moving forward on an immediate plan to bring natural gas from the North Slope into Interior Alaska to alleviate the significant energy costs borne by Alaskans in the region. These costs suppress economic activity and burden residents in the Interior. The Alaska Industrial Development and Export Authority (AIDEA) is leading this effort with its Interior Energy Project (IEP) to support the utilization of natural gas and develop the necessary distribution infrastructure around the community of Fairbanks. This project involves partnership with private industry and public utilities in a number of respects, including for financial and operational support for the LNG transportation and natural gas distribution elements of the project.

The primary focus of the IEP is the construction of a scaled North Slope liquefaction facility, which would provide LNG to be supplied by truck into Fairbanks and surrounding areas. The project would feature a number of infrastructure items: the LNG plant itself, transportation equipment and trucks, storage facilities, regasification facilities in the Interior, and the associated distribution network build-out. In the longer term, these assets could also be evaluated for supporting the penetration of LNG use for energy into rural areas of Alaska, including areas off the road system.

The current schedule for the project calls for the LNG plant to be operational at the end of 2015, with end user distribution and storage infrastructure being developed in an ongoing manner. AIDEA is anticipating over 400 million dollars of investment will be required to advance the project, with a significant share to be provided through state appropriations and bonds.

IV. Electrical Infrastructure

As a non-contiguous member of the United States, Alaska is not directly connected into the national electric grid, nor are there large scale trans-border connections into the Yukon Territory or British Columbia that link Alaska into the Canadian grid. As the first stages of the QER pertain to transportation and distribution of consumer energy, the State provides a detailed summary about the two primary geographical areas covered by unique Alaskan electrical grids below.

The Railbelt

The Railbelt Transmission System (RTS) is comprised of the collective transmission components owned by a number of electric utilities and the Alaska Intertie owned by the Alaska Energy Authority (AEA) that connects population centers containing approximately 80% of the State's population. The system stretches 580 miles from Homer, on the southern tip of the Kenai Peninsula, through Anchorage and the Matanuska-Susitna Valley, to Fairbanks in the Interior. It is used primarily to transport power north from the Bradley Lake Hydroelectric facility near Homer and from gas-fired generation in the Cook Inlet area. Although portions of the system have redundant capability, other sections are comprised of single contingency transmission.

AEA recently contracted for a technical review and evaluation of the RTS and has identified a list of upgrades and system additions that are needed to increase the capacity and reliability of the system, at

a total cost of approximately 900 million dollars. A cost benefit analysis performed as part of this work indicates that Railbelt consumers may benefit from the recommended improvements. AEA's focus is now on how to accomplish the recommended infrastructure investment.

AEA is also conducting active field studies and other technical work required to submit a license request to the Federal Energy Regulatory Commission for construction of a 600 megawatt hydroelectric dam at mile 184 on the Susitna River, which is between Fairbanks and Anchorage. This long-term supply of clean, renewable power would meet a huge portion of the electricity needs for Alaskans in the RTS, and advance the State's legislative goal of generating at least 50% of its power from renewable sources by 2025. Although not taken into account when the aforementioned cost/benefit analysis on the RTS upgrade was calculated, the infrastructure improvements it analyzed would accommodate the power from this proposed new source of clean electric energy.

The Southeast

The existing electric transmission systems in Southeast Alaska are isolated and disconnected with only three sub-regional grids and over a dozen individual electrical distribution utilities in the region. As many communities in the region are located on islands and in mountainous areas, there is often not even road access to other areas and aviation and water-borne vessels are heavily relied upon for the supply of goods. Due to this terrain, there is also immense hydropower potential in the Southeast which has now successfully been harnessed in some areas for over 100 years. These sub-regional grids often feature single interconnections and power supplies a measurable distance from the community, as detailed below:

- Petersburg and Wrangell are connected by means of the Lake Tyee transmission line and Ketchikan is connected to this system by the Swan-Tyee Intertie. This system is operated by the Southeast Alaska Power Agency (SEAPA).

- The Prince of Wales Island electrical grid is supplied and operated by Alaska Power and Telephone (AP&T) through their 4.5-megawatt Black Bear Lake Hydro storage project and the 2.0 megawatt, run-of-river South Fork Hydro. This grid serves the communities of Craig, Klawock, Hollis, Hydaburg, Thorne Bay, Kasaan, Coffman Cove and Naukati. Construction has begun and long term financing is being negotiated for the proposed 5 Megawatt Reynolds Creek hydropower facility as a joint venture between Haida Corporation and AP&T.

- The Upper Lynn Canal Power Supply System consists of four hydropower facilities (including the Dewey Lakes Hydro built in 1909) which connects the communities of Skagway and Haines via submarine transmission.

As DOE evaluates the state of the complex and interconnected national grid, these uniquely regional infrastructure pieces in Alaska should be noted and considered as well.

Potential Trans-Boundary Grid Connections

The State of Alaska and Yukon have recently undertaken a project to review and evaluate creation of an Economic Development Corridor between Skagway, Alaska and Whitehorse, Yukon that could contain a cross-border electric connection. The Alaska Energy Authority also recently contracted with the Alaska

Center for Power and Energy to reevaluate the economics of a potential electric connection between the SEAPA transmission system in Ketchikan area and the electric transmission grid of British Columbia (BC). The evaluation concluded the limited power load that would currently utilize such a connection is not sufficient to finance the anticipated construction cost, but AEA is continuing to exchange information with entities exploring a possible business plan for an Alaska to BC electric connection.

V. Unique Alaska Energy Issues and Infrastructure Needs

Alaska's energy infrastructure is unique because its geographical and environmental position is unique. As the QER is developed and the interconnected energy systems of the continental United States are analyzed, Alaska's role in providing crude oil and natural gas for the national markets as well as its unique intra-state needs of its local markets must be thoroughly understood. Two particular issues should be considered:

TAPS Throughput Levels

One of the most critical issues facing Alaska's economic future is throughput decline in TAPS. As the North Slope's original mega-fields have matured, their production levels have declined and Alaska's crude oil production through the pipeline has decreased from a peak of over two million barrels per day in 1988 to approximately 500,000 today. Governor Parnell and the Alaska Legislature have recently enacted a number of policies that intend to promote investment and stem and reverse this decline, but it continues to be a source of technical and commercial issues for TAPS. In the course of the QER, DOE should consider the importance of all production and development on the North Slope as it effects the continued operation of the TAPS infrastructure, and the continued health of the Alaskan economy. Particularly, this requires coordination among federal regulators to ensure that new production in Alaska can be brought online in a timely and predictable manner.

Rural Energy Costs

One of the most critical issues for the health and welfare of Alaskans living throughout the State is the high price of energy, especially in remote areas and villages off the road system. Transporting goods into and out of these communities is time and energy intensive, and often affected by weather limitations. The State is working on a number of solutions to supply lower cost energy throughout these areas, and the QER should take these challenges into consideration as it evaluates future infrastructure needs in Alaska. Rural Alaska is already starting to see developments of distributed generation from a number of small scale sources. It is important that state and federal regulators are prepared to address these situations creatively and efficiently to support these regional solutions, and do not create delay or uncertainty that exacerbates this problem by failing to accommodate novel infrastructure in rural settings. For example, distributed solar, modular LNG, local hydrokinetics, individual wind turbines, geothermal springs, biomass boilers, and other generation sources may all serve to promote regional solutions to energy needs in the future and need to be accommodated and supported by flexible federal regulation.

VI. Alaska's Unparalleled Resource Base

The final element that should be noted for inclusion in the QER pertains to Alaska's immense resource potential that has not been fully utilized. As summarized above, the infrastructure and particularly the

oil and gas transportation systems that are already in place in Alaska have played a dramatic role in the state's economic development. For the forward-looking purposes of the QER, these infrastructure developments will continue to be critical because Alaska will play a continuing, and likely growing, role in the United States' energy and economic future. Furthermore, the expected growth of development and transportation throughout the Arctic will only amplify this role.

Most immediately, the State is working to advance significant North Slope gas commercialization projects to tap into the over 30 trillion cubic feet of known natural gas supplies on the North Slope. As detailed above, the State anticipates an 800 mile natural gas transportation pipeline being built, which will mirror TAPS in length and engineering complexity. Were this line to move forward, the State anticipates exploration and eventual development of the potentially 200 trillion cubic feet of natural gas that the United States Geological Survey (USGS) estimates may be recoverable but yet undiscovered on the North Slope.

In the future, the State also anticipates off-shore development in the Chukchi and Beaufort Seas moving forward, which could unlock billions and billions of additional barrels of oil that could be shipped to the facilities at Prudhoe Bay and then south to markets through TAPS. However, this will require significant expansion of the North Slope's transportation infrastructure, including a pipeline through the National Petroleum Reserve – Alaska.

Alaska also features unconventional resource potential that has yet to be explored and delineated. From shale oil and gas to methane hydrates to the heavy and viscous oils in Prudhoe Bay, Alaska may see many new developments, and needs for corresponding infrastructure, as technology and resource data improves.

DOE should review the numerous surveys and estimates about these areas of Alaska's abundant resource potential as the QER moves forward.

VII. Conclusion

The information provided in these comments provides only an overview of the important infrastructure that is present in Alaska, and what may need to be developed in the future to continue to support the State and the Nation's economy and energy security. The State supports the detailed consideration of these issues in the QER, and can supply more detailed information upon request. Attached to these comments are slides, maps, and further overview materials that provide information the topics covered.

Sincerely,

Bob Swenson
Deputy Commissioner
State of Alaska Department of Natural Resources

Attachments:

SOA Resources Final Presentation for QER Presentation
SOA Southeast Transmission Map
SOA Energy Sources (with transmission) Map
SOA Railbelt Grid Map

Suggested Links for further, detailed information:

SOA DNR
http://dnr.alaska.gov/commis/pco/
http://dnr.alaska.gov/commis/pco/documents/2013%20annual%20report/SPCO_2013_AR_FINAL.pdf
http://dog.dnr.alaska.gov/

SOA AIDEA/AEA
http://www.interiorenergyproject.com/
http://www.akenergyauthority.org/

SOA AK LNG/ AGDC
https://www.agdc.us/
http://www.ak-lng.com/

Attachment 1 - SOA Resources Final Presentation for QER

Overview for U.S. Department of Energy

Alaska Petroleum Resources & Reserves

Resource Evaluation Section
Alaska Division of Oil and Gas
September 11, 2014

STATE *of* ALASKA
- OIL & GAS RESOURCES -

North Slope

USGS estimates that Alaska's North Slope has more undiscovered recoverable oil than any other Arctic region

- **OIL:** Est. 40 billion barrels of conventional oil *(USGS & BOEMRE)*
- **GAS:** Est. 200 trillion cubic feet of conventional natural gas *(USGS)*

- Alaska has world-class unconventional resources, including tens of billions of barrels of heavy oil, **shale oil**, and viscous oil, and hundreds of trillions of cubic feet of shale gas, tight gas, and gas hydrates

Compared to most basins, Alaska is relatively underexplored, with 500 exploration wells on the North Slope, compared to Wyoming's 19,000.

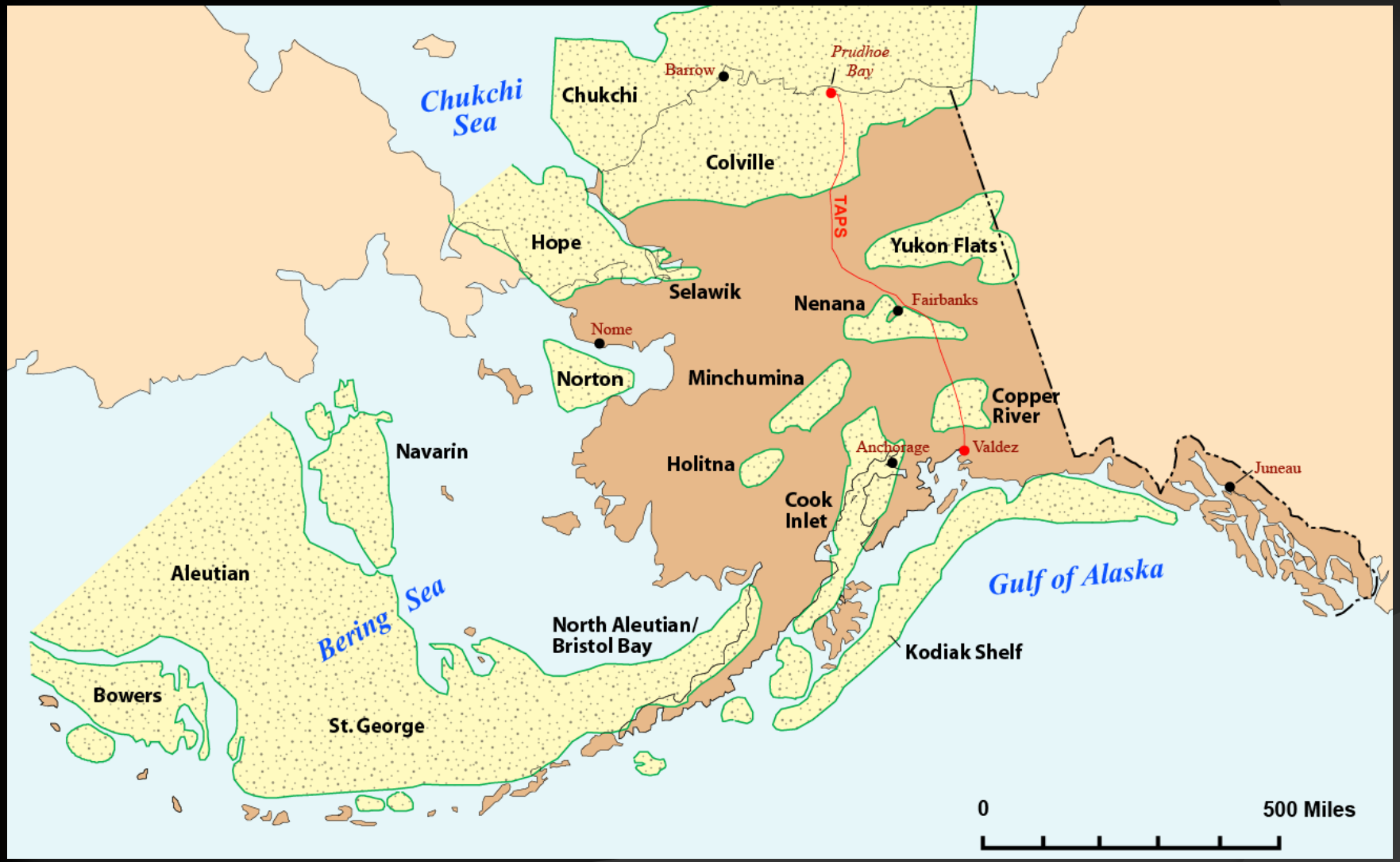
Alaska is one of the few places to explore <u>both</u> conventional and unconventional resources in the same basin

Cook Inlet

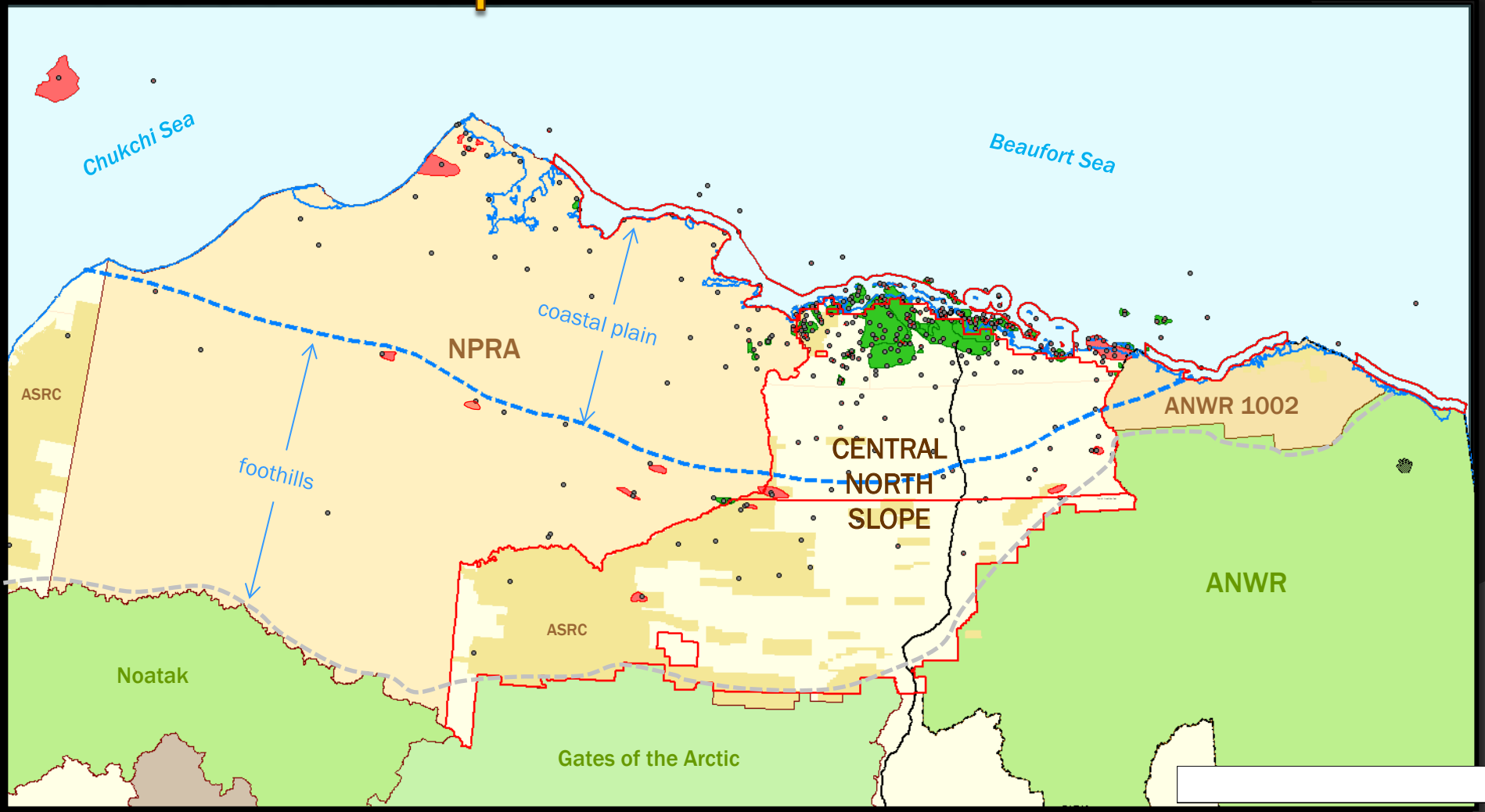
USGS estimates that significant undiscovered volumes of hydrocarbons remain to be found in the Cook Inlet:

- 19 trillion cubic feet of natural gas
- 600 million barrels of oil
- 46 million barrels of natural gas liquids

Sedimentary Basins in Alaska

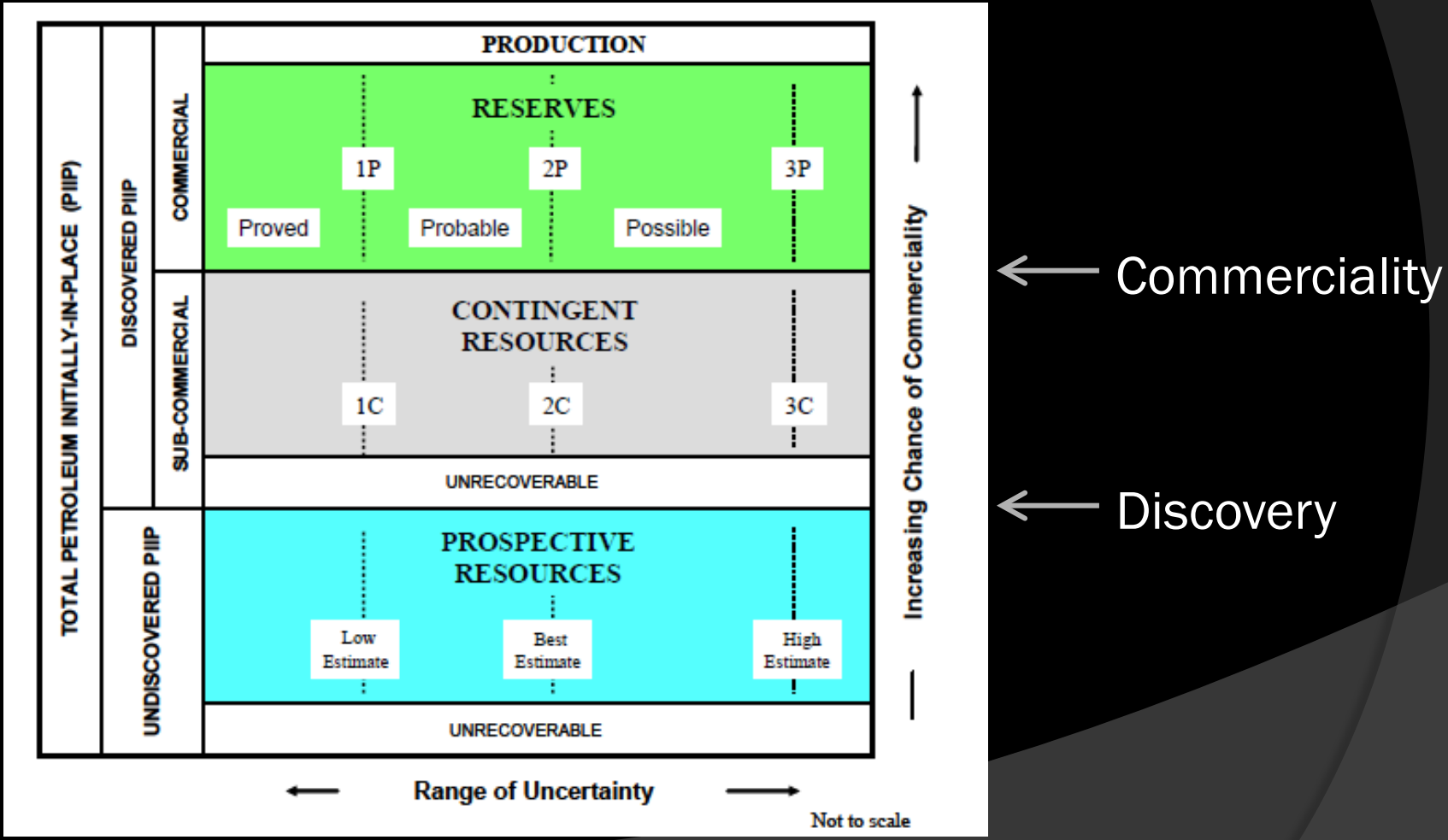


Northern Alaska Exploration Well Location Map



Resource and Reserves Classification

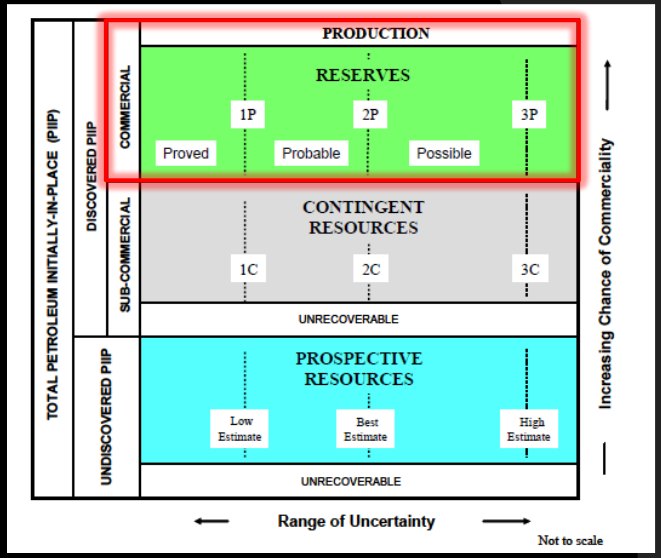
Petroleum Resources Management System (PRMS)



North Slope "Reserves"

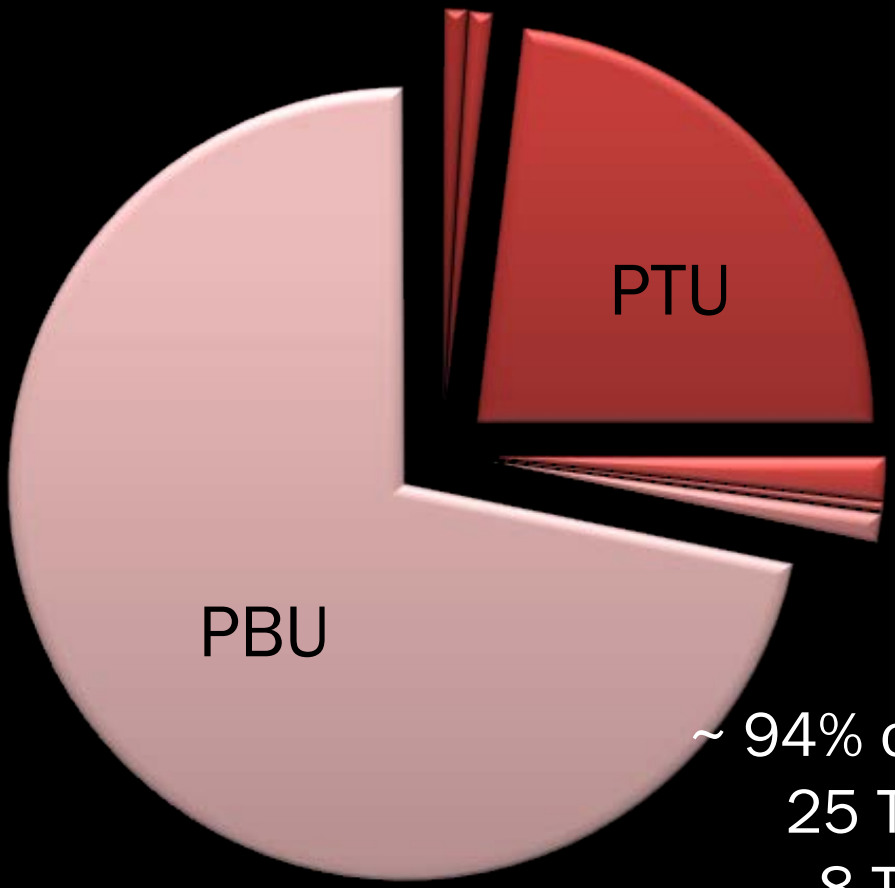
Reserves are:

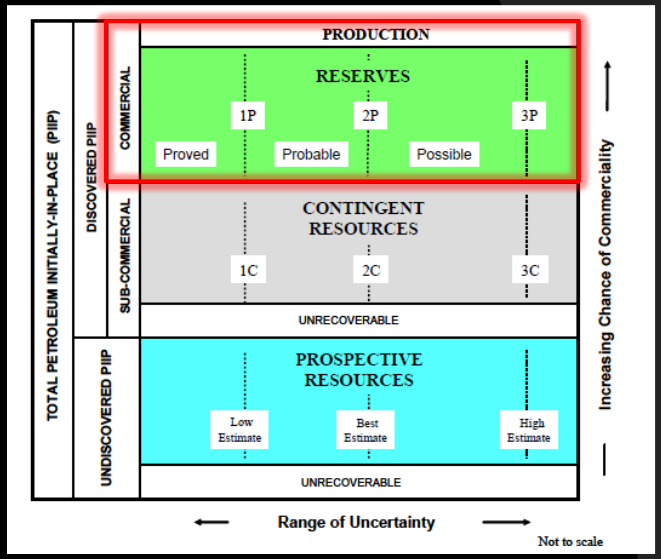
- *Discovered by drilling*
- *Recoverable*
- *Commercial to produce*
- *Remaining*



- EIA year end 2012: 3.3 billion barrels oil "proved oil reserves"
  9.6 trillion cubic feet "dry natural gas reserves"
- ~35 TCF "known gas" available in North Slope fields
- Except for local use at Barrow & Nuiqsut this gas is currently "stranded"/non-commercial…
- PRMS would put some or all of that gas in the next category:
  Contingent Resources

North Slope Gas "Reserves"

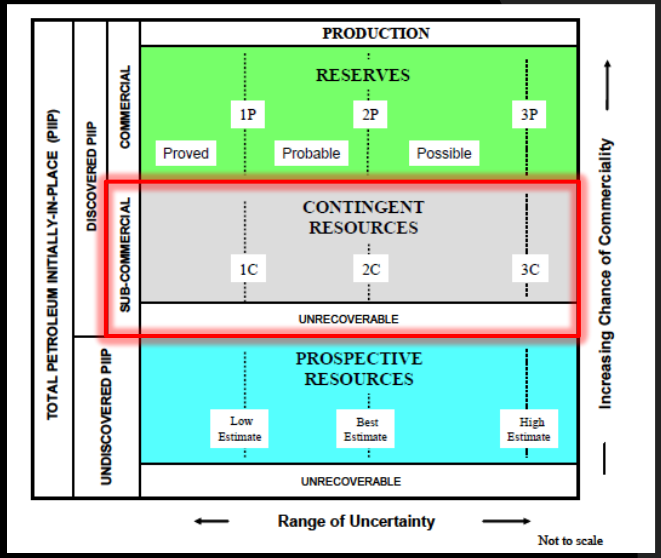




~ 94% of "known" gas is in 2 fields:
25 TCF Prudhoe Bay Unit (PBU) (?)
8 TCF Point Thomson (PTU)

~ 6% (2 TCF) other fields (?)

Contingent Resources



- *Discovered by drilling, but*
- *Commerciality not yet established (undeveloped)*

Undeveloped Discoveries

1. Burger—gas and cond
2. East Kurupa—gas (Na
3. East Umiat—gas (Nati
4. Fish Creek—oil (NPR
5. Gubik—gas (Native lan
6. Gwydyr Bay—oil (Stat
7. Hammerhead—oil (Fed
8. Hemi Springs—oil (Stat
9. Kalubik—oil (State offsh
10. Kavik—gas (State onsho
11. Kemik—gas (State onsh
12. Kuvlum—oil (Federal off
13. Liberty—oil (Federal offs
14. Meade—gas (NPRA)
15. Mikkleson—oil (State ons
16. Mooses Tooth—oil (NPR
17. Rendezvous—oil (NPRA)
18. Sandpiper—gas and conde
19. Sikulik—gas (Native lands
20. Simpson—oil (NPRA)
21. Square Lake—gas (NPRA)
22. Stinson—oil (State offshore
23. Umiat—oil (NPRA)
24. Wolf Creek—gas (NPRA)

Table 2.8. North Slope, Alaska–Undeveloped oil and gas accumulations as of January 1, 2005 (after Bird, 1991 and Thomas, and others, 1991 and 1993)

Accumulation or Field/ Reservoir Formation(s)	Year of Discovery	Estimated Technically Recoverable Resources
Umiat[11]/Nanushuk Fm.	1946	70 MMBO, 50 BCF
Fish Creek[11]/Nanushuk Fm.	1949	OIL (? MMBO)
Simpson[11]/Nanushuk Fm.	1950	12 MMBO
Meade[11]/Nanushuk Fm.	1950	20 BCF
Wolf Creek[11]/Nanushuk Fm.	1951	GAS (? BCF)
Gubik[11]/TuluvakAnd Nanushuk Formations	1951	600 BCF
Square Lake[11]/Nanushuk Fm.	1952	58 BCF
E. Umiat/Nanushuk Fm.	1964	4 BCF
Kavik/Ivishak Fm.	1969	115 BCF
Gwydyr Bay[12]/Ivishak Fm.	1969	30-60 MMBO
Kemik/Shublik Fm.	1972	100 + BCF
Flaxman Island/Canning Fm.	1975	OIL (? MMBO)
East Kurupa/Torok-Fortress Mtn. Formations	1976	GAS (? BCF)
Pt. Thomson/Thomson Sandstone and Canning Fm.	1977	~~300 MMBO, 5000 BCF~~
Mikkelson/Canning Fm.	1978	OIL (? MMBO)
Tern Is. (Liberty)/Kekiktuk Conglomerate	1982	150 MMBO
Hemi Springs/Kuparuk Fm.	1984	OIL (?MMBO)
Hammerhead/Sagavanirktok Fm.	1985	~200 MMBO
Sandpiper/Ivishak Fm.	1986	150 MMBO/GAS (? BCF)
Sikulik/Barrow Sandstone	1988	16 BCF
Stinson[13]/????	1990	OIL (? MMBO)
Burger/Kuparuk Equivalent	1990	14,000 BCF, 724 MMBO
Kuvlum[13]/????	1993	400 MMBO
Thetis Island[13]/Nuiqsuit	1993	OIL (? MMBO)
Nikaitchuq[13]/Nuiqsut and Sag River Sandstones(?)	2004	70 MMBO(?)
Tuvaaq/Schrader Bluff Fm.	2005	OIL (?MMBO)
		2,300 + MMBO/ 20,000 + BCF

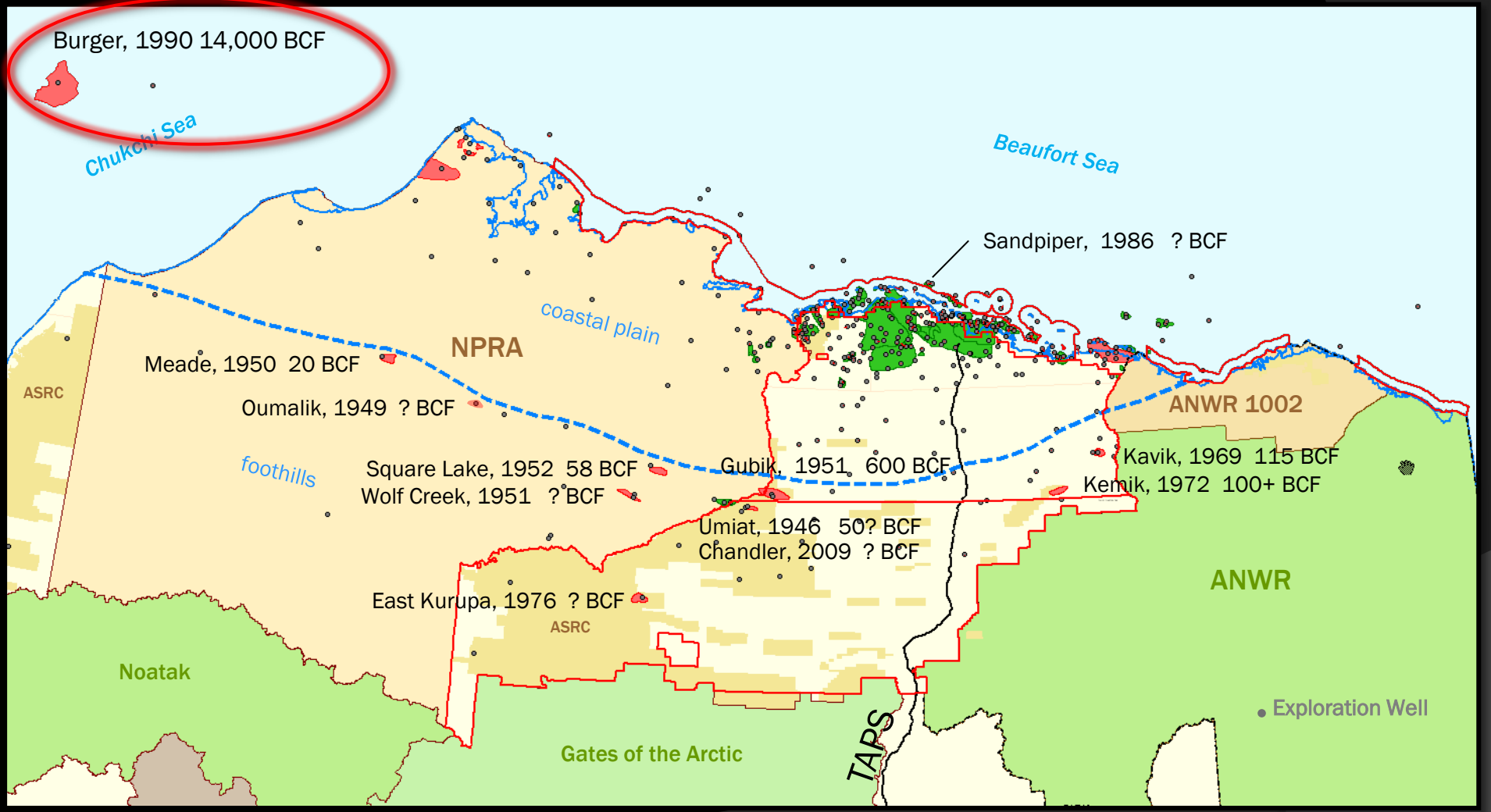
15+ TCF Contingent Resources in North Alaska
Drilled, known accumulations, potentially recoverable

Thomas and others, 2007

Houseknecht and Bird, 2005

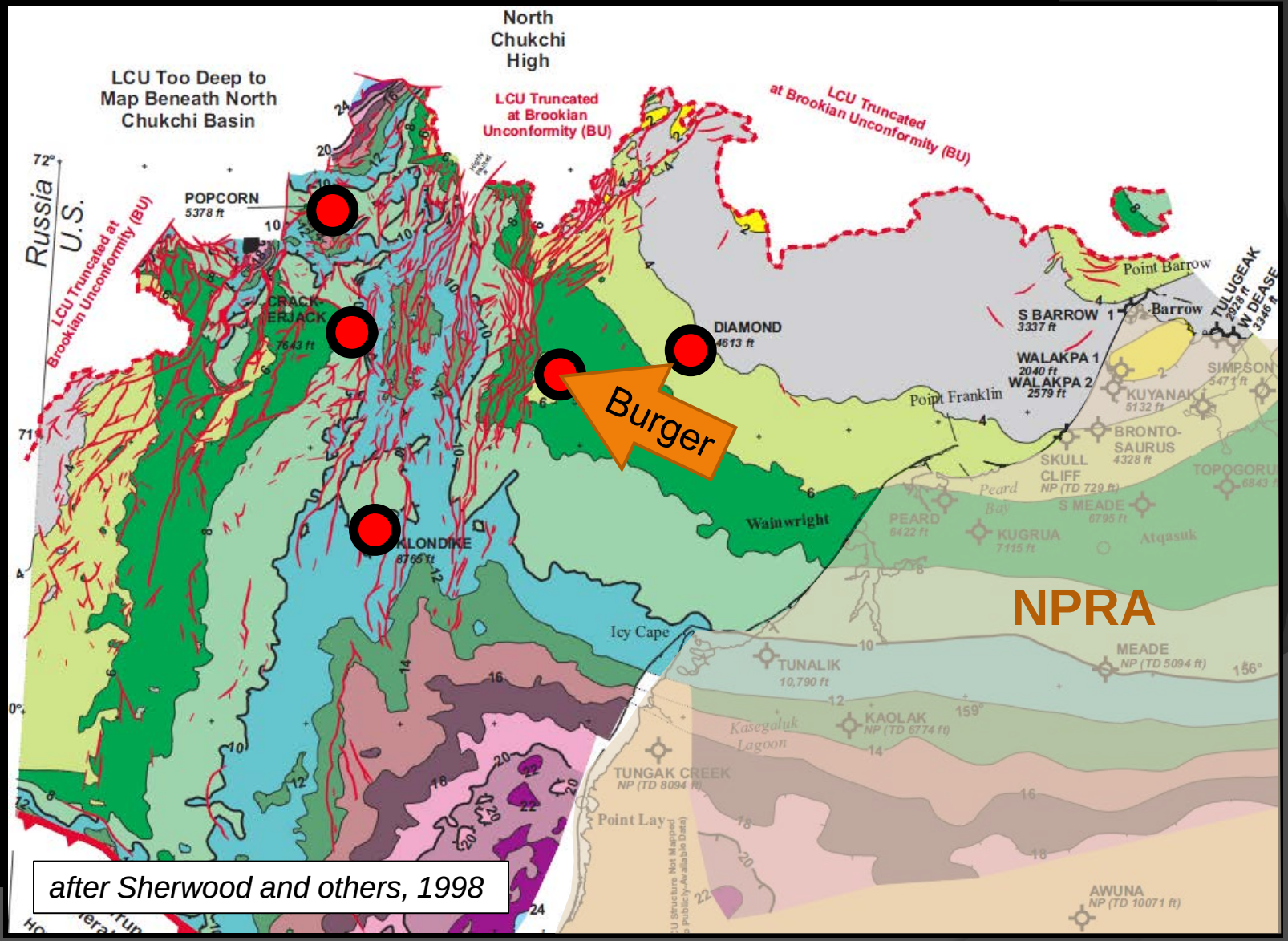
Contingent Gas Resources

15+ TCF – Bulk of discoveries/volume on Federal & Arctic Slope Regional Corporation (ASRC) acreage



Chukchi Sea OCS

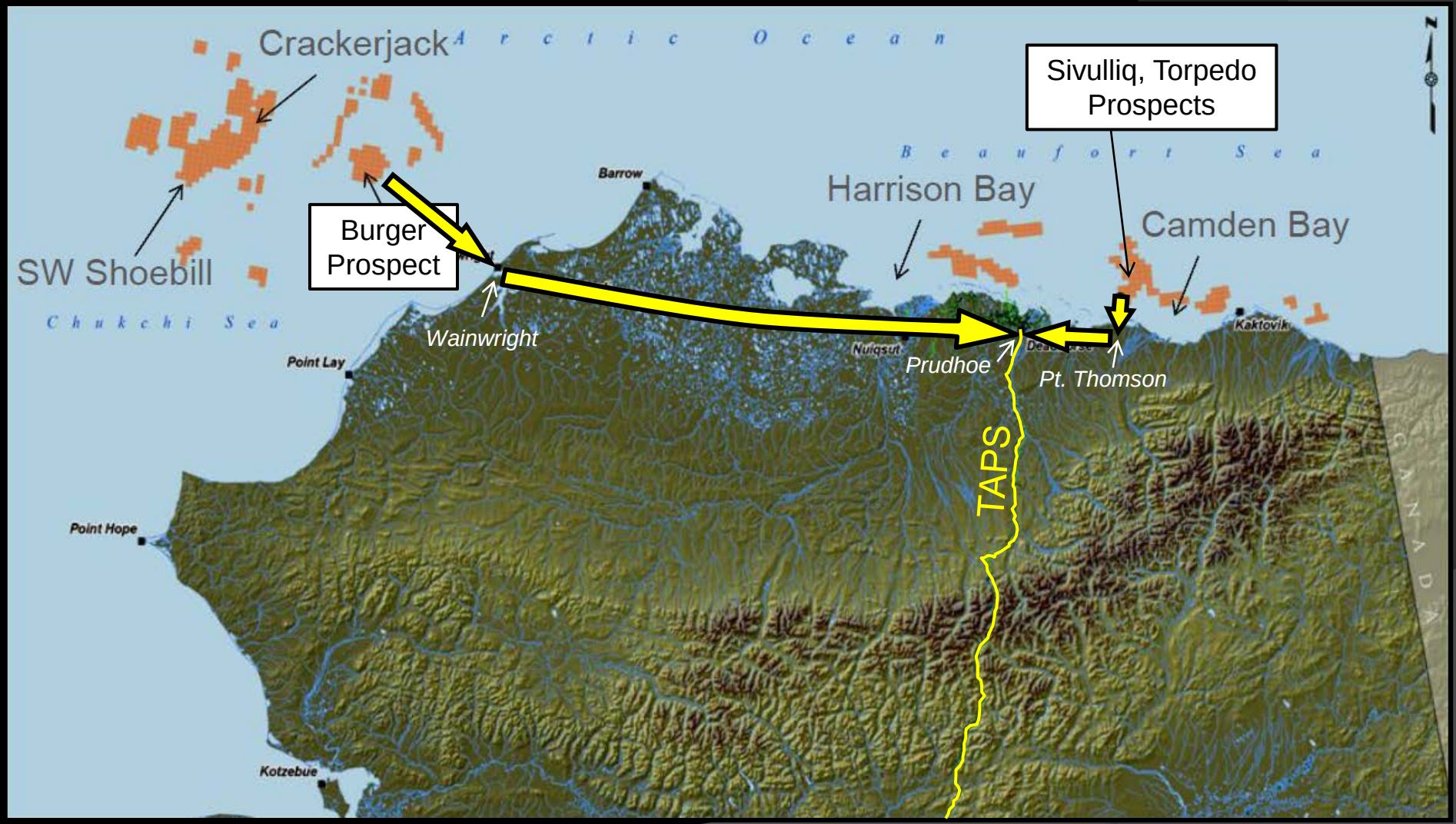
LCU Depth Structure & Wells to Date



after Sherwood and others, 1998

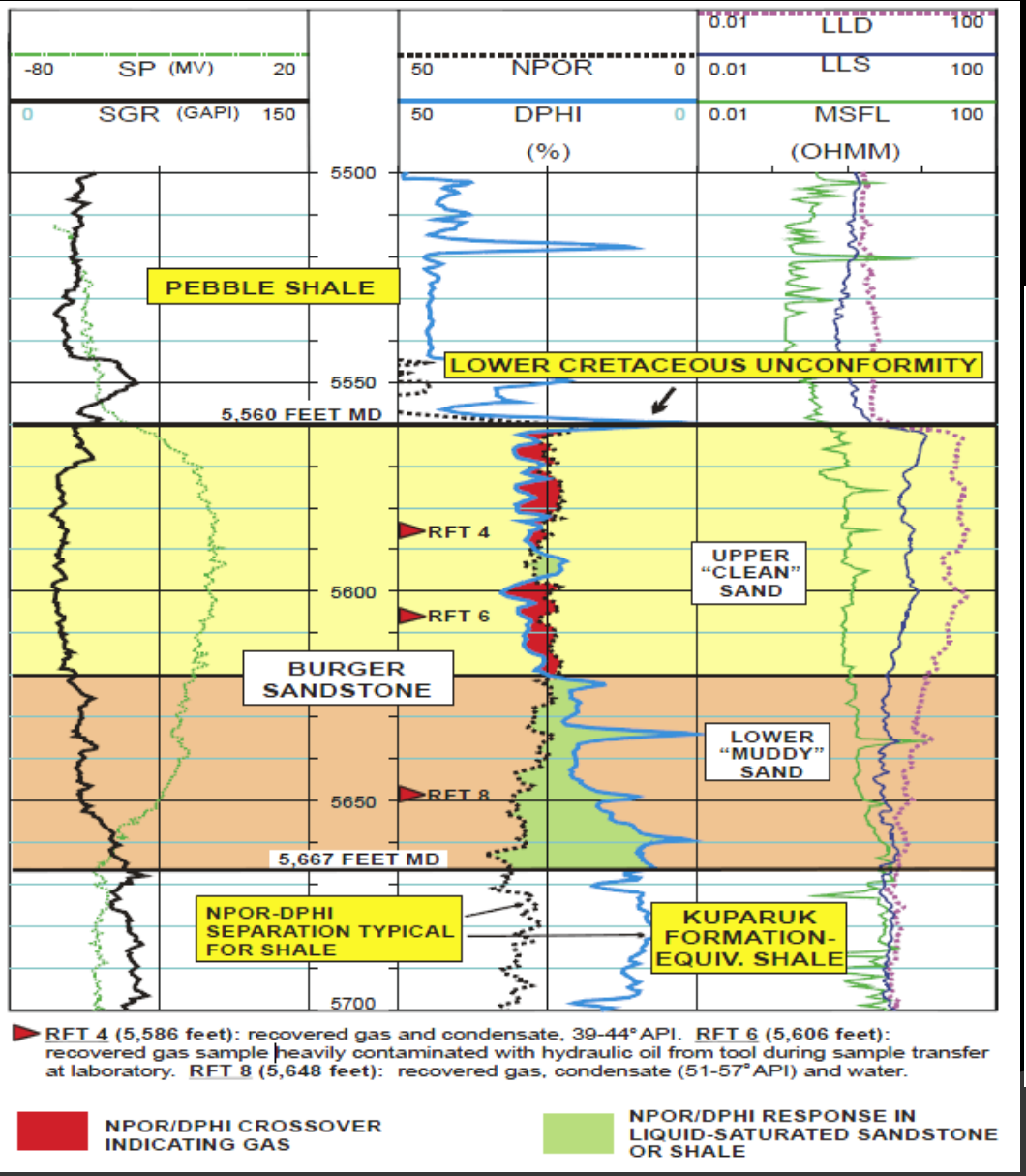
Beaufort and Chukchi Seas OCS

Leases and Schematic Potential Pipelines

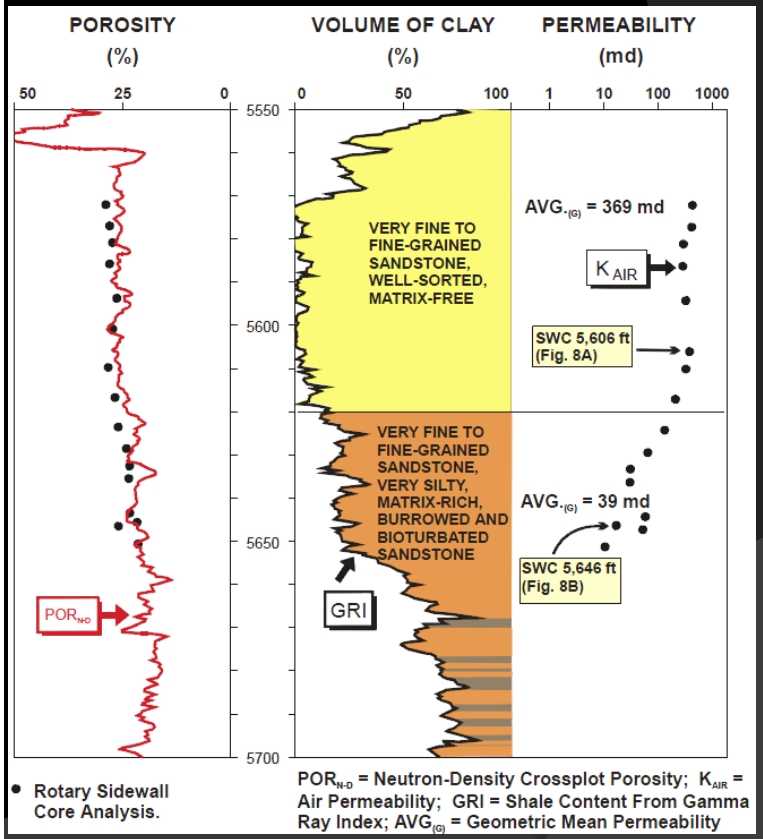


Shell Burger Discovery

Chukchi Sea OCS



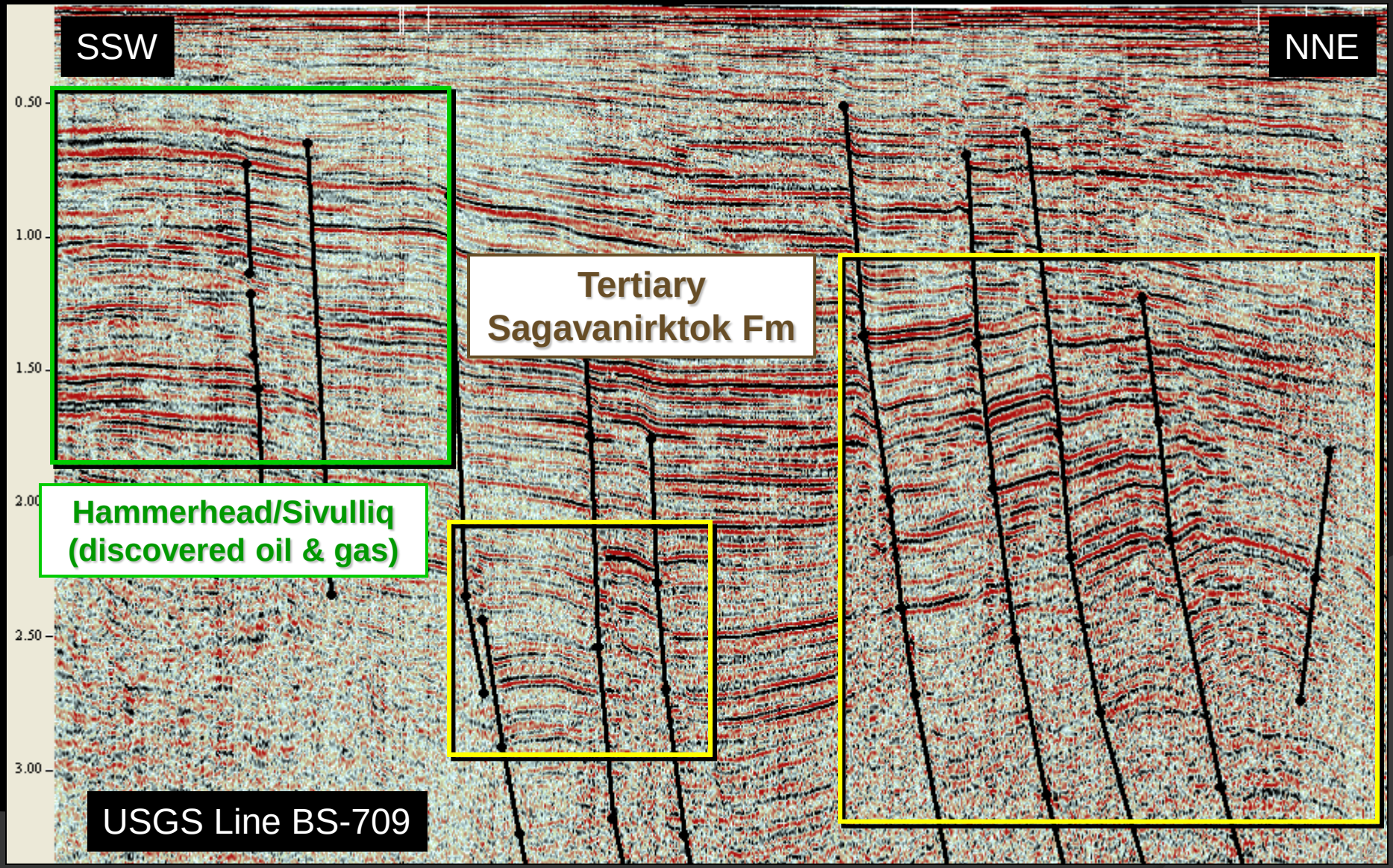
- Shell Burger #1 (1990)
- Kuparuk Fm sandstone, 107' thick
- Most Likely Resource:
  14 TCF + 724 MMB condensate



Craig and Sherwood, 2005

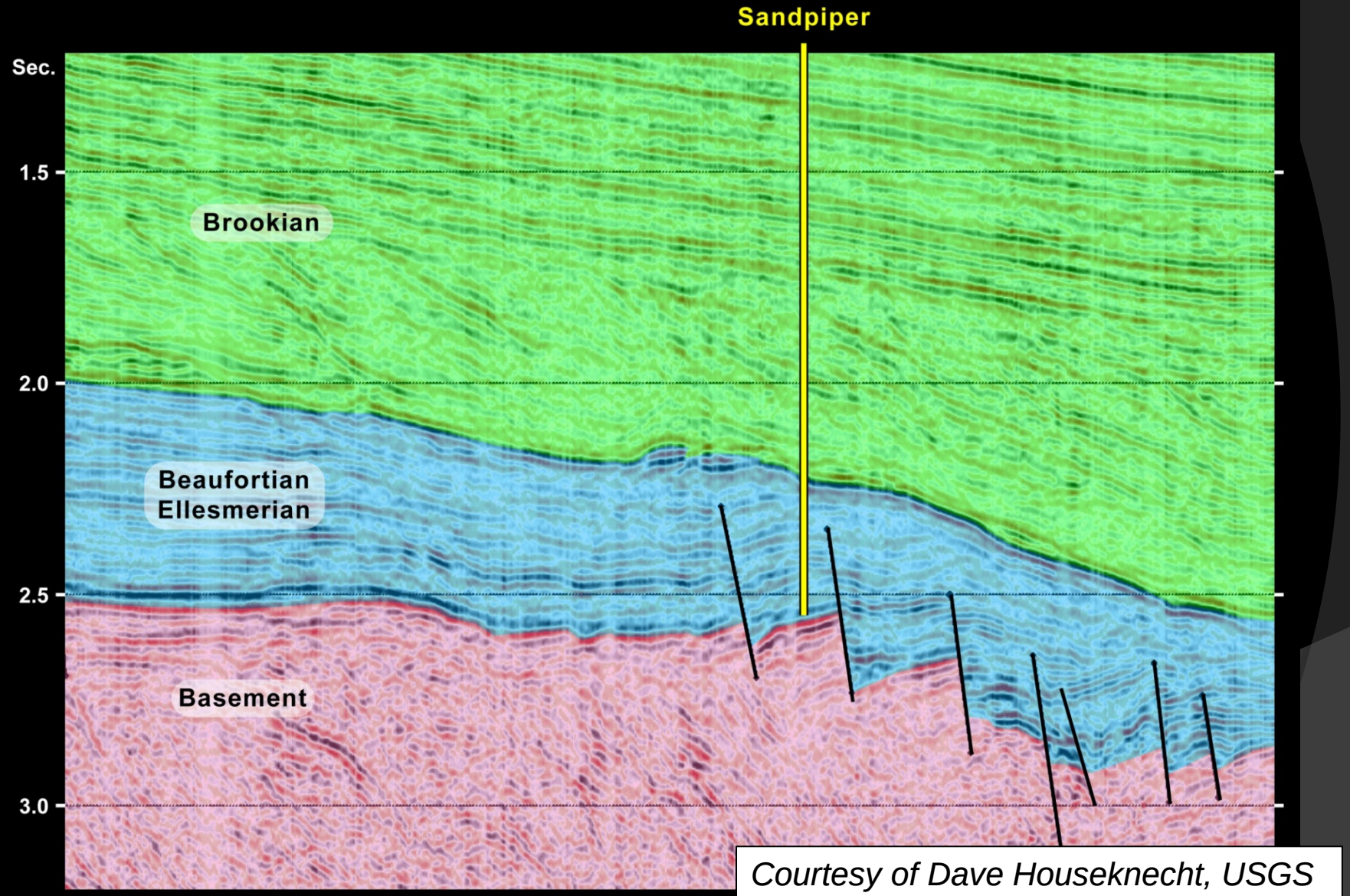
Shell Sivulliq -- Torpedo area

Eastern Beaufort Sea OCS, Tertiary growth fault trend



Sandpiper Gas & Condensate Discovery

Central Beaufort Sea OCS, ~150 MMBOE



Courtesy of Dave Houseknecht, USGS

Prospective Resources

Yet to be discovered by drilling

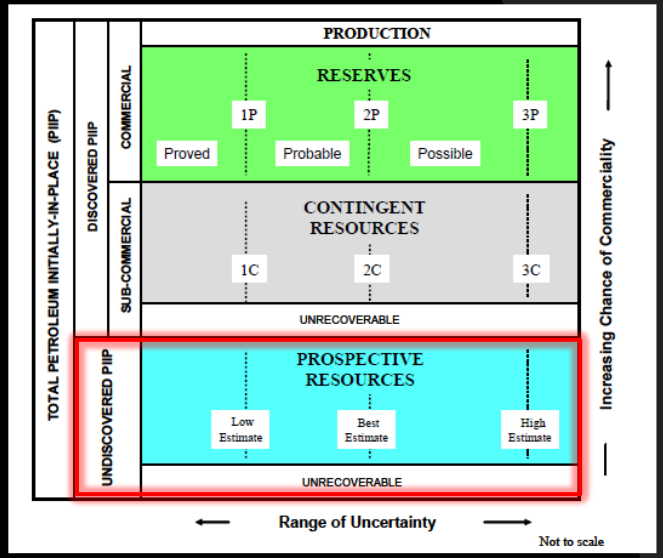
- *volumes inherently uncertain*

USGS & BOEM assessments

- *undiscovered*
- *technically recoverable*
- *assessed in broad play areas, not discrete prospects*

No way to know:

- *how much will be discovered*
- *where discoveries may occur*
- *when discoveries may occur*
- *how much will be commercial*

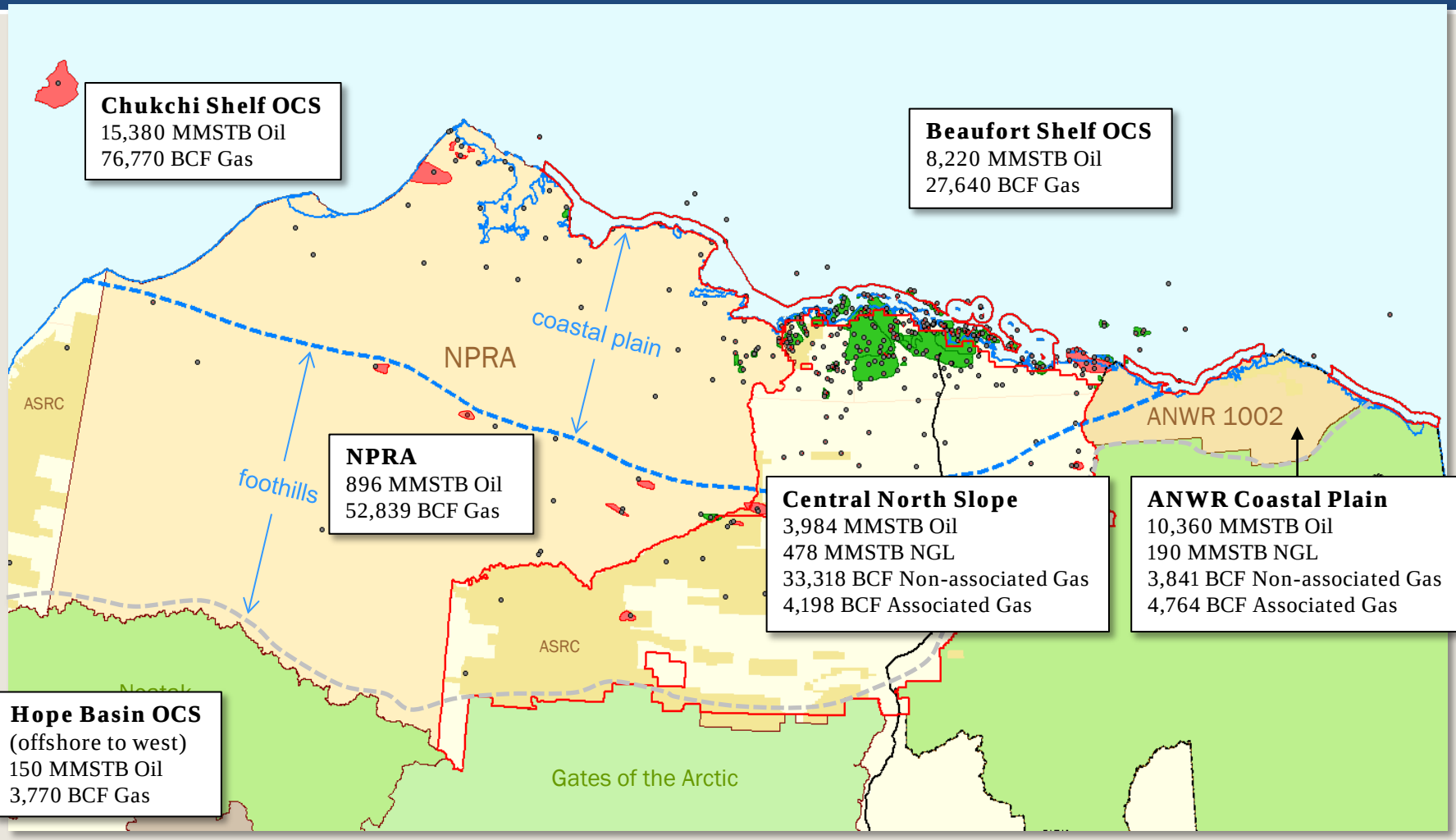


Alaska Resource Assessments*
- Federal Estimates – Undiscovered, Technically Recoverable -

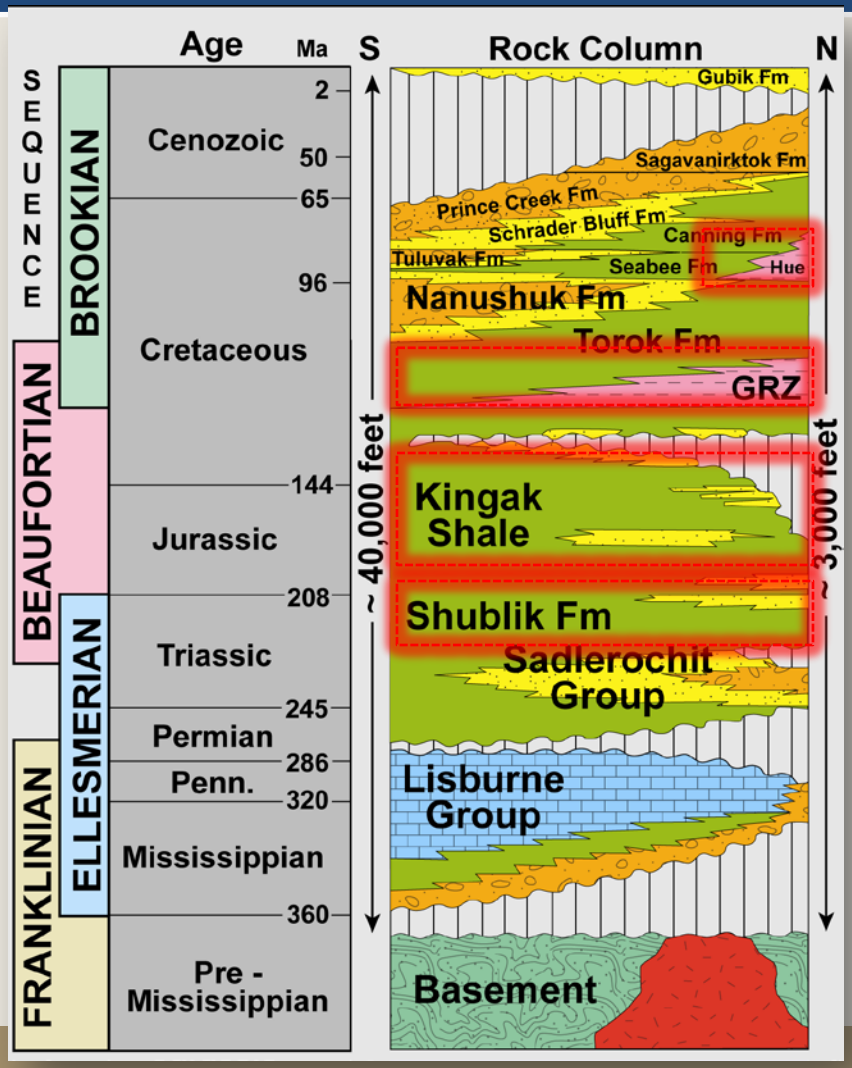
Region	Mean Oil Estimate (Million Barrels)	Mean Gas Estimate (Billion Cubic Feet)
Onshore Arctic	15,908	98,960
Offshore Arctic	23,750	108,180
	~40 BBO	**~207 TCF**
Interior Basins (only partially assessed)	234	5,641
Upper Cook Inlet	599	19,037
Other Southern Alaska	2,859	23,458
TOTAL	**43 BBO**	**255 TCF**

*Excludes shale oil, shale gas, methane hydrates, and most coal bed methane

North Slope
- Arctic Alaska USGS & BOEM Assessments -

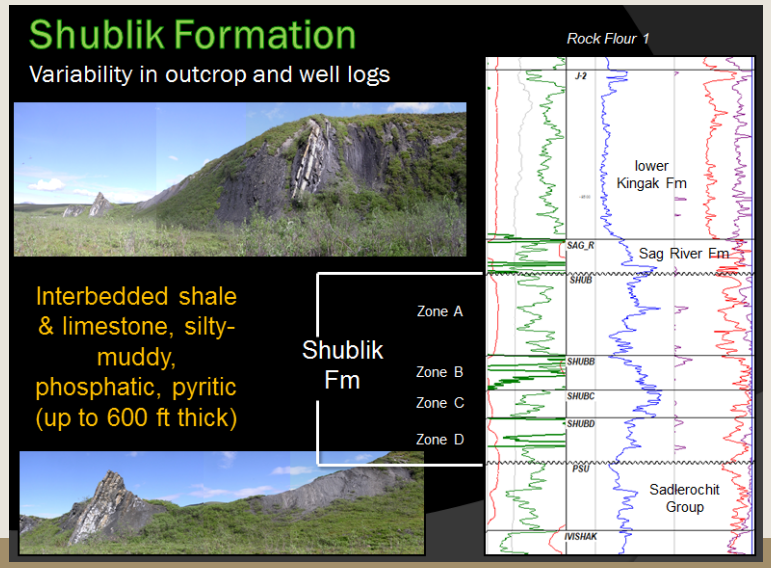


North Slope
- Shale Oil & Gas Resources -



- 3 prolific oil source rock units have sourced nearly all North Slope oil & gas fields.
- Shale oil plays are currently seeing their very first dedicated exploration wells.
- USGS assessment places greatest shale resource potential in Cretaceous and Triassic source rocks beneath state lands:
  - *Organic richness*
  - *Kerogen type*
  - *Brittleness*
  - *Thickness*
  - *Thermal maturity*

North Slope
- Shale Oil & Gas Resources -

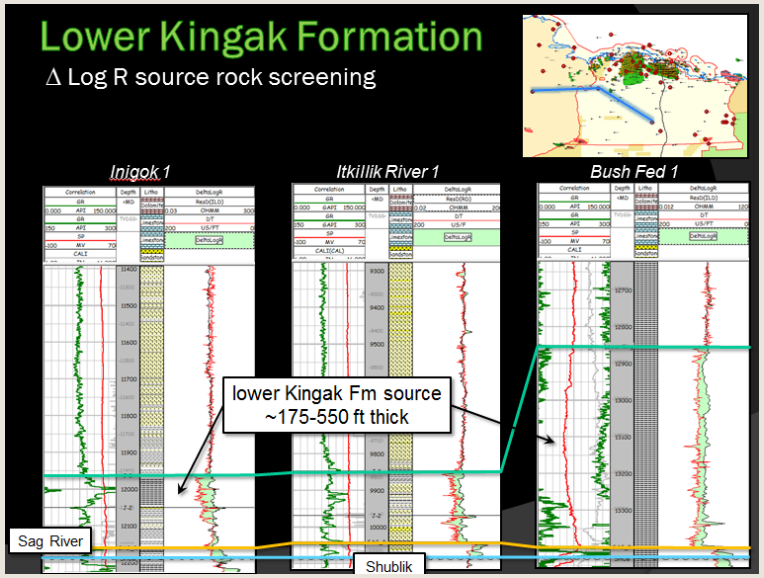


Total assessed resources: (USGS, 2012)

Shale Oil: 0 – 2 BBO (mean **940** MMBO)

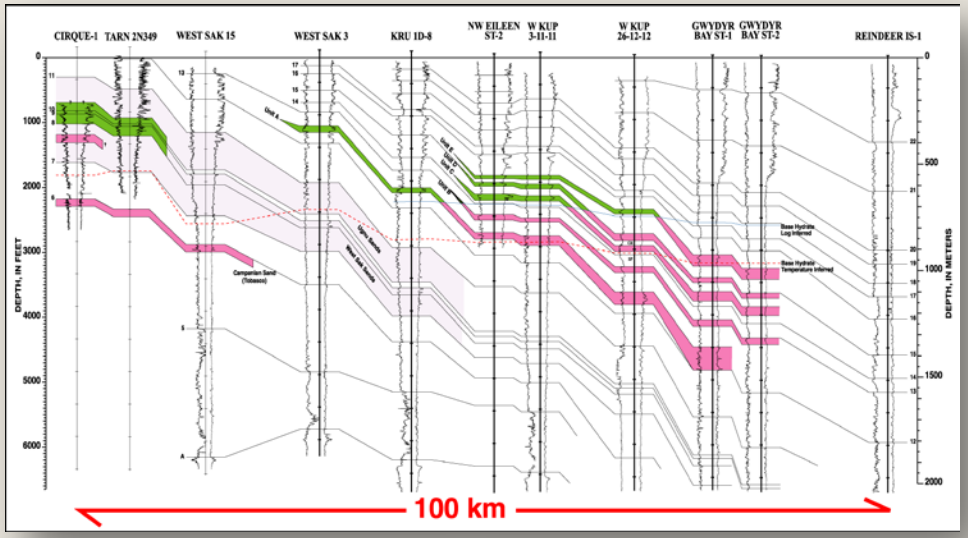
Shale NGL: 0 – 571 MMBO (mean **262** MMBO)

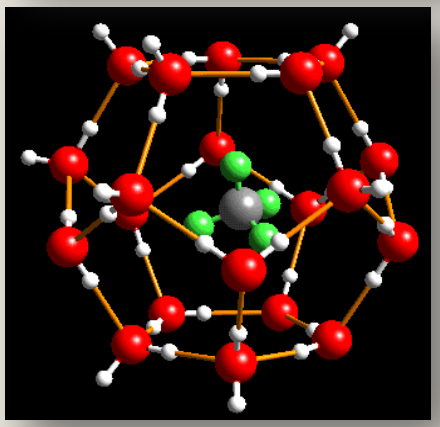
Shale Gas: 0 – 80 TCF (mean **42** TCF)



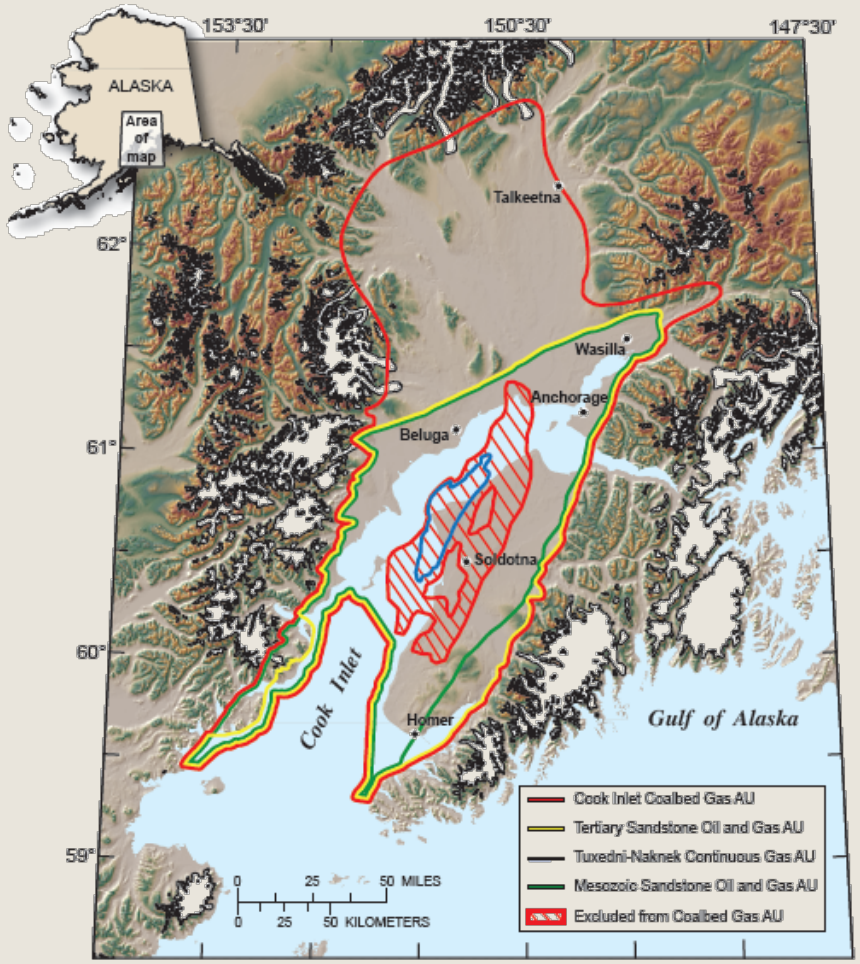
North Slope
- Methane Hydrate Resource Potential -

- Mean estimated onshore hydrate resource is 590 TCF gas-in-place
- Extraction remains experimental
- Recovery factor unknown
- PRMS resource classification: "Contingent Resources – Currently Unrecoverable"
- Very large reserve additions IF:
  - long-term production testing successful, and
  - AKLNG pipeline sanctioned





Cook Inlet Basin
- Resource Potential: USGS Resource Assessment 2011 -



Undiscovered, Technically Recoverable Oil and Gas

- mean conventional oil 599 MMBO

372 MMBO in Tertiary Ss play

227 MMBO in Mesozoic Ss play

- mean conventional gas 13.7 TCF

12.2 TCF in Tertiary Ss play

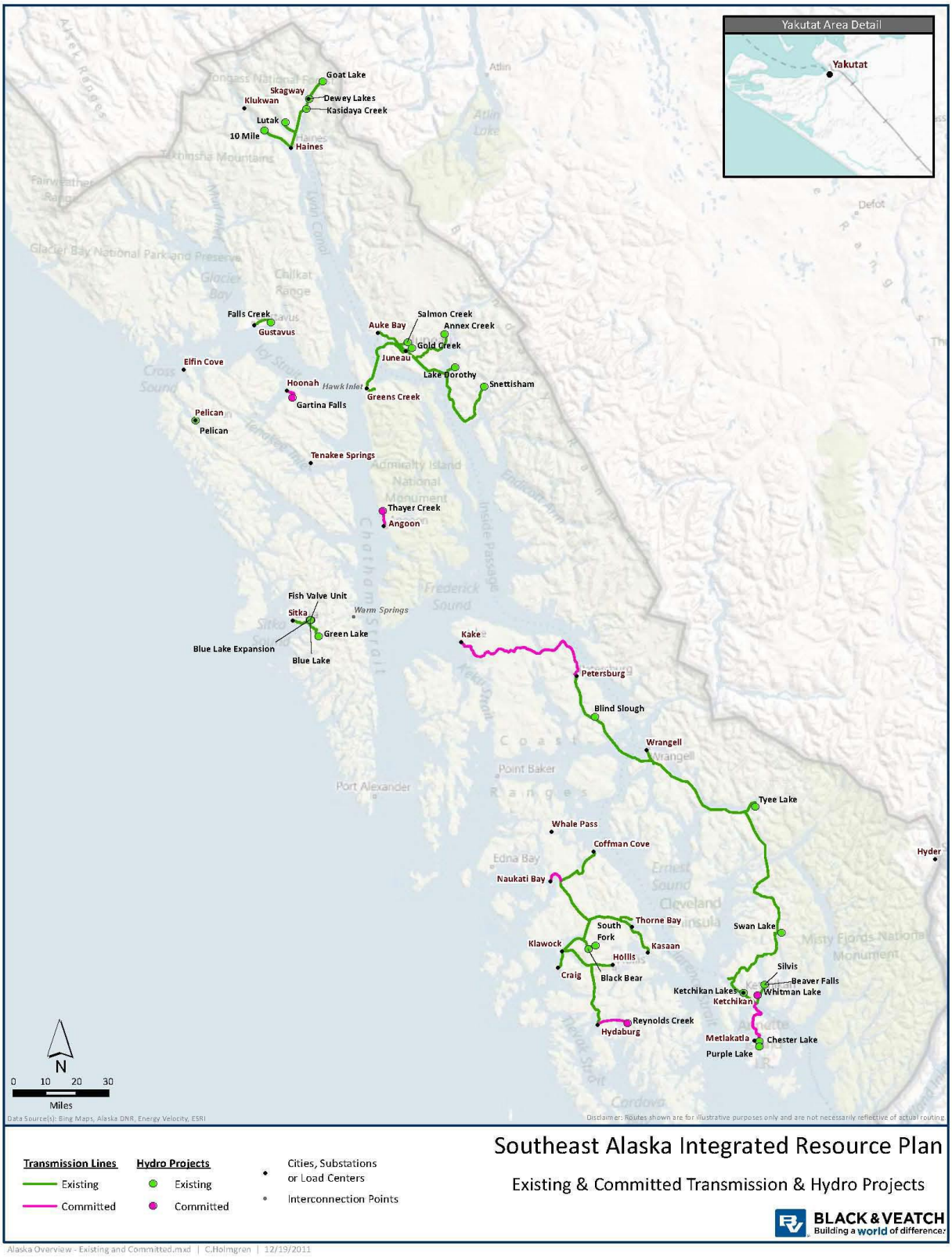
1.5 TCF in Mesozoic Ss play

- mean unconventional gas 5.3 TCF

0.6 TCF Mesozoic tight ss play

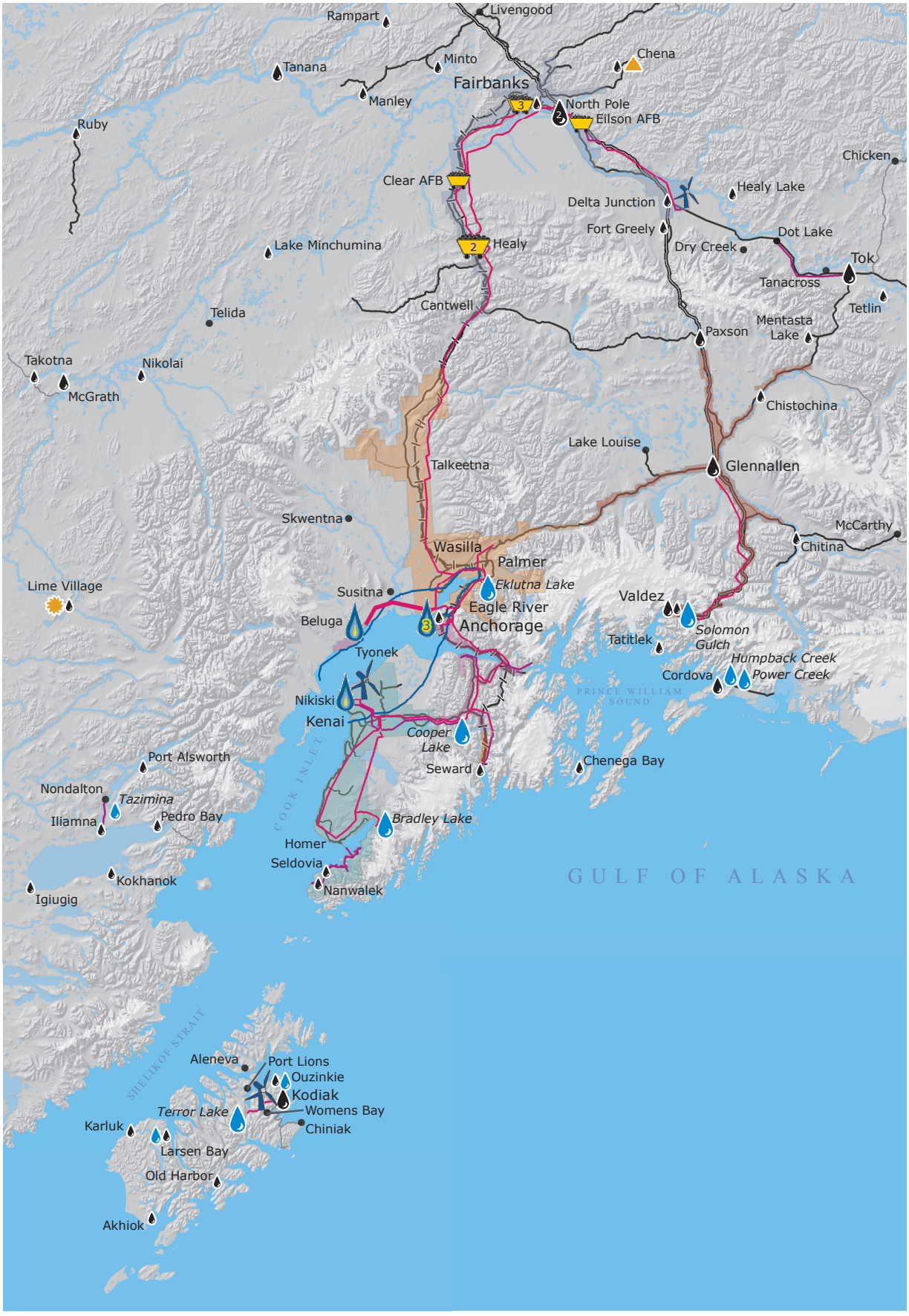
4.7 TCF Tertiary Coalbed play

Attachment 2 - SOA Southeast Transmission Map



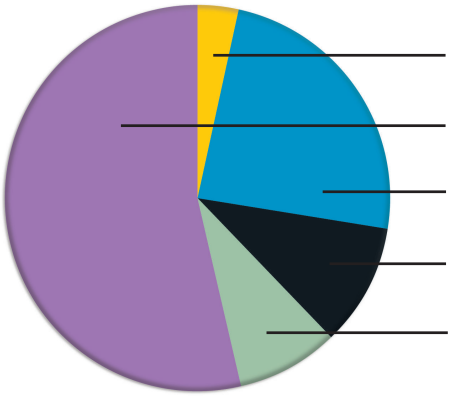
Attachment 3 - SOA Energy Sources (with transmission) Map

Infrastructure: Fairbanks to Kodiak



Infrastructure: Southeast Alaska

Statewide Electrical Generation in Alaska by Energy Source



Wind, solar, and biomass account for 0.2% of Alaska's energy generation.

Infrastructure

Average Electrical Generation

MW	Gas	Oil	Coal	Hydro-electric	Wind	Bio-mass	Solar	Geo-thermal
< 0.1		●			●	—	●	—
0.1 - 1		●	—	●	●	●	—	▲
1 - 10	●	●	●	●	●	●	—	—
> 10	●	●	●	●	—	—	—	—

Electric Transmission

> 100 kV

< 100 kV

Electric Service Areas

- Anchorage Municipal Light & Power
- Chugach Electric Association
- Copper Valley Electric Association
- Golden Valley Electric Association
- Homer Electric Association
- Matanuska Electric Association
- Seward Electric Association

Major Pipelines

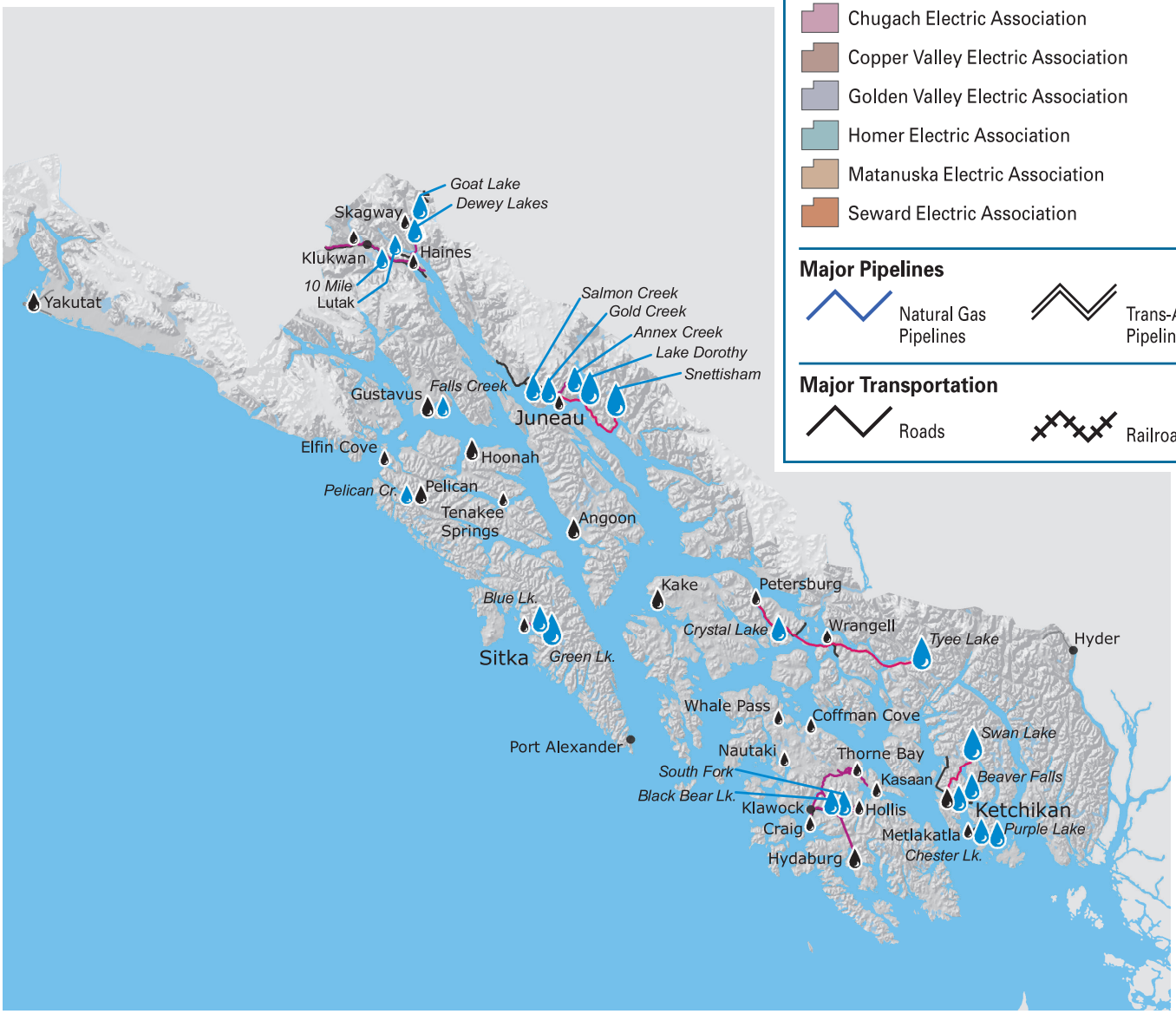
Natural Gas Pipelines

Trans-Alaska Pipeline

Major Transportation

Roads

Railroad



Attachment 4 - SOA Railbelt Grid Map