



Alternative Clean Energy  
OHIO VALLEY UNIVERSITY



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# Ohio Valley University's Alternative Clean Energy Facility



**Marcus Wiley, P.E.**  
**Chairman - TCG Global, LLC**

THIRTY - THIRD ANNUAL  
INTERNATIONAL PITTSBURGH

**COAL CONFERENCE**

University of Pittsburgh - Swanson School of Engineering  
Cape Town, South Africa - August 10, 2016





# Mark Wiley

## Chairman, TCG Global, LLC

- A registered professional engineer with 45 years of experience in engineering and management with an emphasis on coal
- Worked for (at the time the second largest US coal company) Consolidation Coal (now Consol Energy) – in mine exploration, planning, permitting, front line supervision, construction, mine superintendent and general mine management in operations located in four major U.S. coal fields
- Co-inventor and co-patent holder for a revolutionary gasification process and personally led the engineering, procurement and construction of a commercial scale reference plant based on this technology
- Part owner and President of two different coal companies with mines in Oklahoma, Arkansas and West Virginia
- Holds a BS in Mine Engineering from New Mexico Institute of Mining & Technology
- Taught for 4 years and is a PhD Candidate at Colorado School of Mines
- Currently serves on the Oklahoma Christian University Board of Trustees



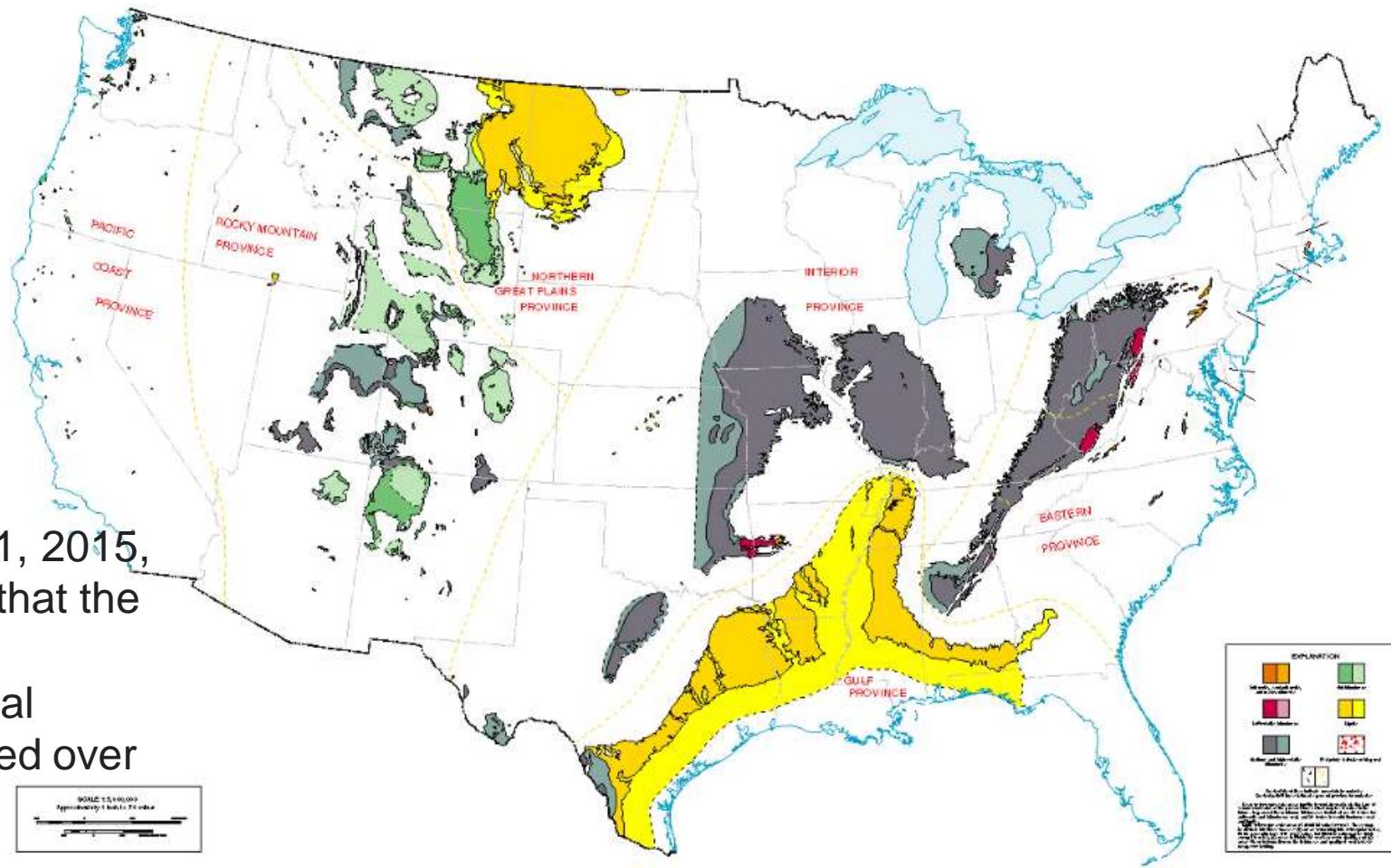
# TCG Global, LLC

- **TCG Global was formed in 2010 to further the commercialization of an innovative gasification technology**
- **TCG Global, LLC utilizes patented technology to design, build, own, operate, and market gasification plants**
- **Patents of Thermo Technologies, LLC are exclusively licensed to Thermo Conversions, LLC and TCG operates using this technology**
- **Ohio Valley University has an operating permit for a plant from Thermo Conversions**



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# US Coal Map



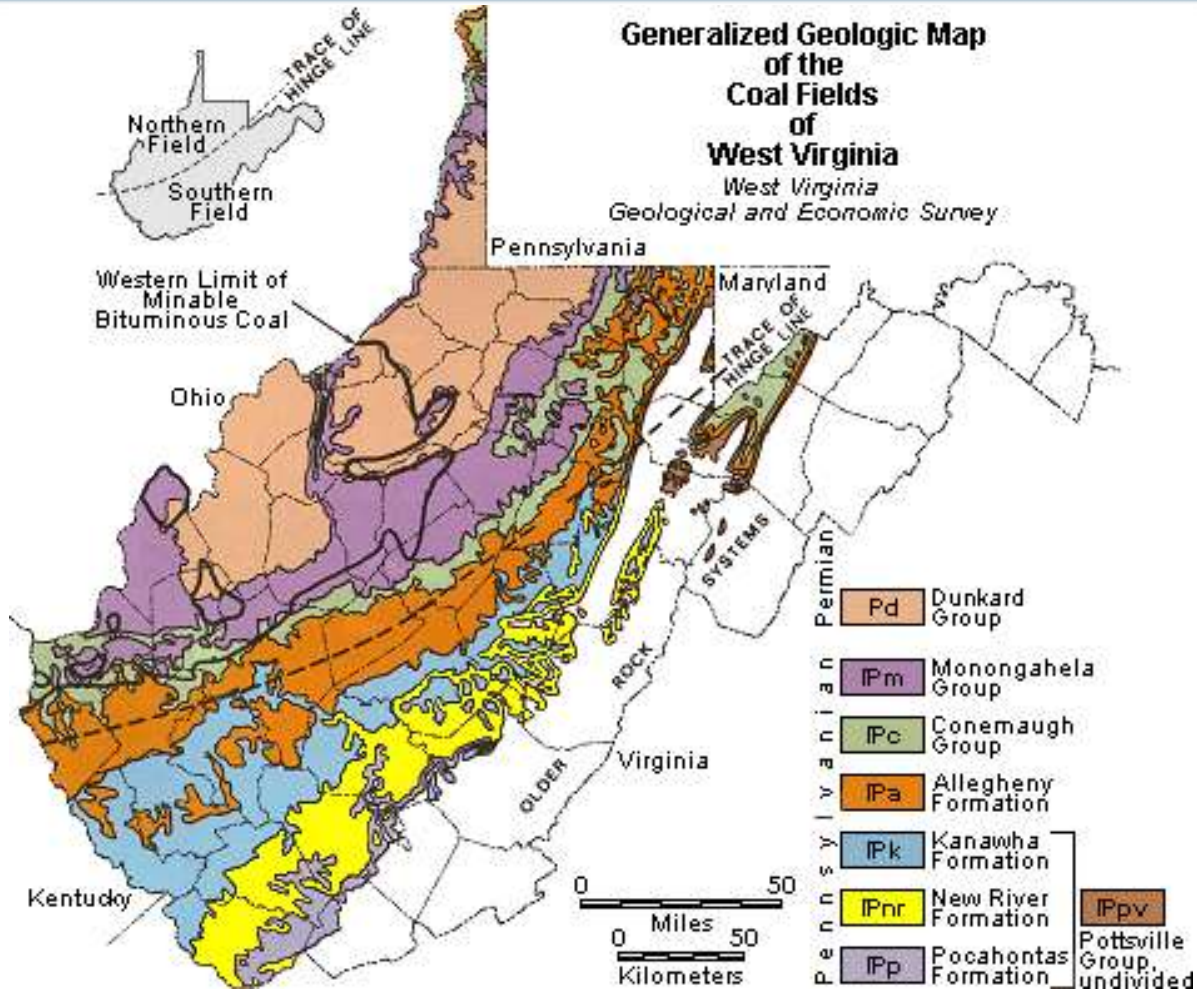
As of January 1, 2015,  
EIA estimated that the  
remaining U.S.  
recoverable coal  
Reserves totaled over

**255 billion short tons**

[http://pubs.usgs.gov/of/1996/of96-092/other\\_files/us\\_coal.pdf](http://pubs.usgs.gov/of/1996/of96-092/other_files/us_coal.pdf) - [www.eia.gov/coal/reserves/](http://www.eia.gov/coal/reserves/)



# West Virginia Coal Map



2009 Estimated Recoverable Resources equals **51 billion tons**

<http://wvges.wvnet.edu/>

<http://www.wvminesafety.org/PDFs/resources2009.pdf>





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# Ohio Valley University



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**Chartered in 1958 as a private, independent, regional, faith-proclaiming, liberal arts university**



**Annually recognized as one of the nation's best comprehensive baccalaureate universities in *U.S. News & World Report's America's Best Colleges Guide***

**LEARNING.  
FAITH.  
LIFE.**





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# OVU Location



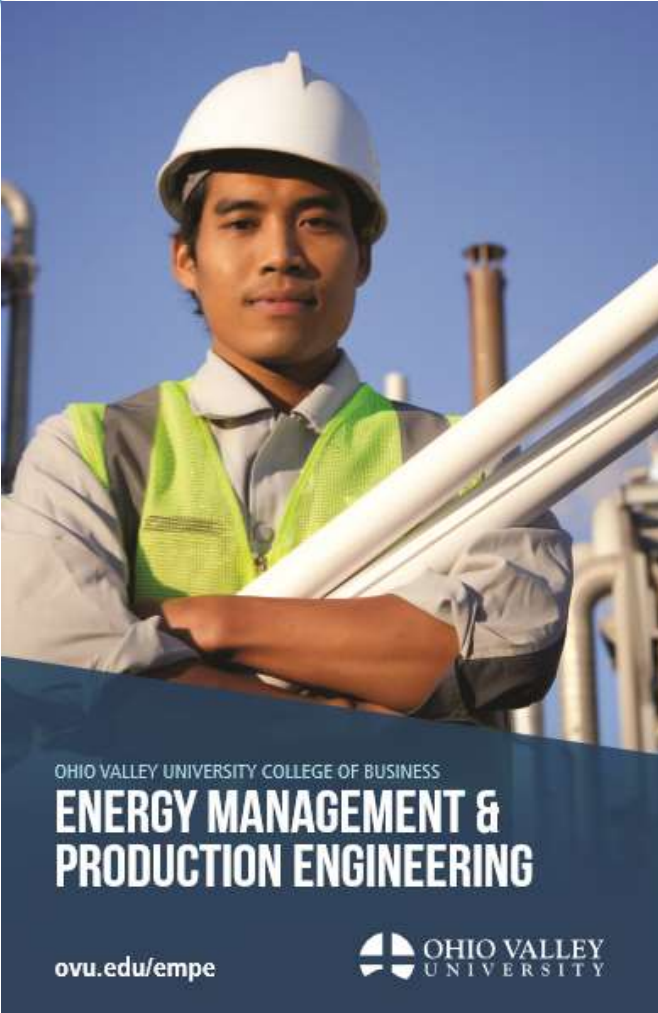
**Located in Vienna, Wood County, West Virginia in the Ohio River Valley, a community of approximately 80,000 OVU is situated above the valley on 266 wooded acres**





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# Energy Management and Production Engineering



Ohio Valley University's Bachelor of Science degree in Energy Management & Production Engineering (EMPE) is designed to provide students with entry-level capabilities to manage operations within the energy industry.

<https://ovu.edu/images/academics/empe/2015%20EMPE%20Program%20Guide.pdf>





# Alternative Clean Energy Project

- **Development of a fully commercial scale coal to liquids facility in Vienna/Parkersburg, WV owned by OVU-ACE Foundation**
- **Establish a training center and expand the curriculum to include operation and maintenance of a clean energy production facility**
- **Revenue from operations net of debt service would be used to fund OVU and other Universities' general expenses thus lowering costs for students**
  - **Goal is to have students graduate with zero debt**
  - **Work study and intern opportunities for students**
- **Future college of engineering in alternative energy**
- **Host site for multiple projects demonstrating CO<sub>2</sub> utilization**



# Why ACE at OVU?

- **Leadership**
  - Education and business expertise
- **Place where innovation happens**
  - Stretch goal to graduate students debt free
- **No faculty, administration, trustee conflicts**
- **Fit with the University's Strategic Plan**
- **Agility**
  - “Turn on a dime”



# OVU-ACE Project Objectives

- **Demonstrate conversion of coal into clean energy products**
- **Support OVU operating budget and act as a model for other institutions**
- **Serve as an educational resource for Energy Management & Production Engineering degree program**
- **Host site for other clean energy technology demonstrations**
- **Research site for other coal related by-products such as recovery of rare earth elements from coal ash**



# Why Coal?

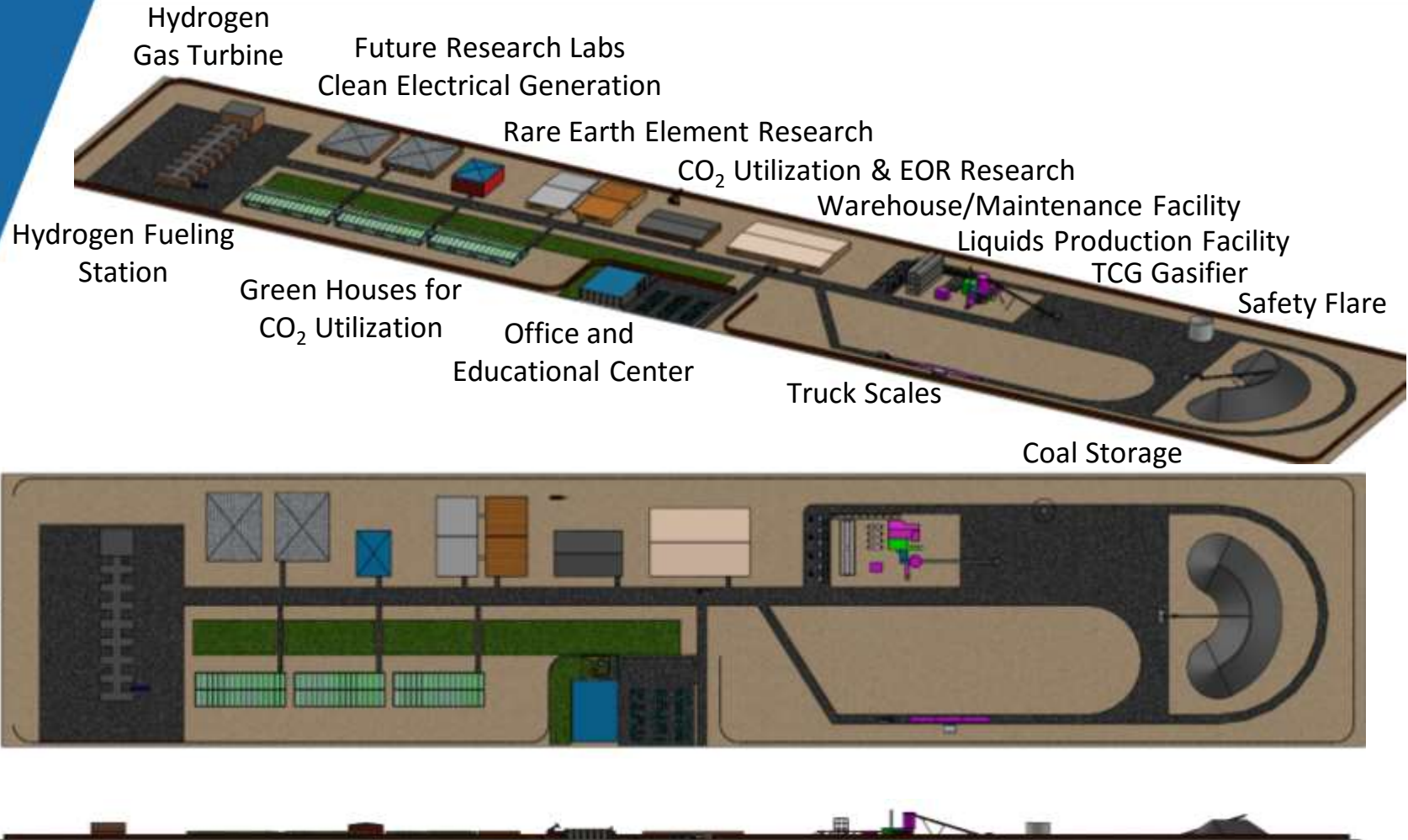
- **Abundant domestic and world wide energy resource**
- **Coal pricing is relatively stable compared to other forms of energy**
- **Supports an industry vital to West Virginia**
- **Compelling economics when converting to clean energy products**
- **Coal has highest energy per unit of volume of any fossil fuel**
- **Technology exists to utilize coal with potentially zero Carbon Dioxide, Sulfur, NOx and Mercury emissions**





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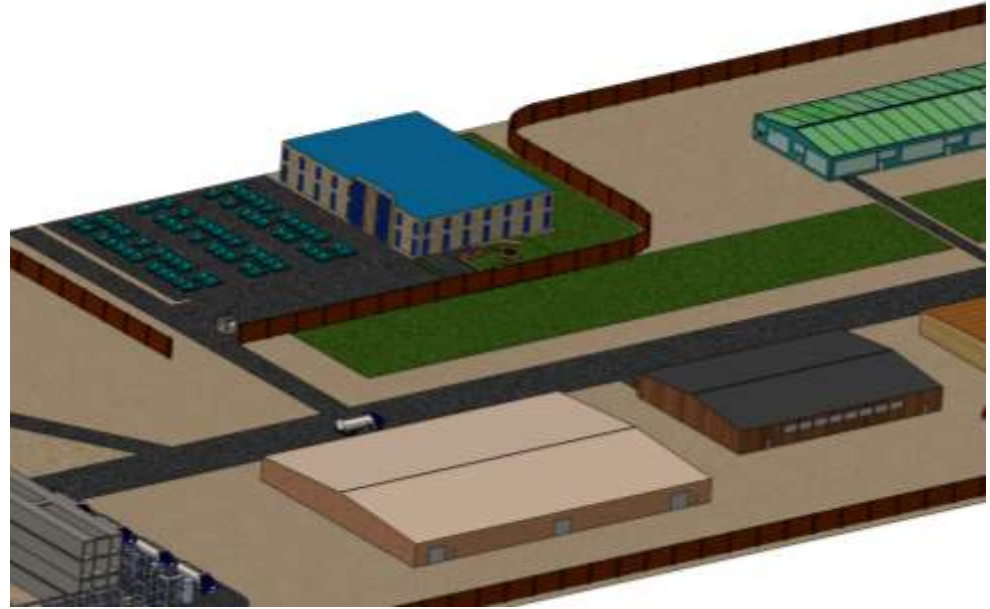
# OVU-ACE Facility Concept





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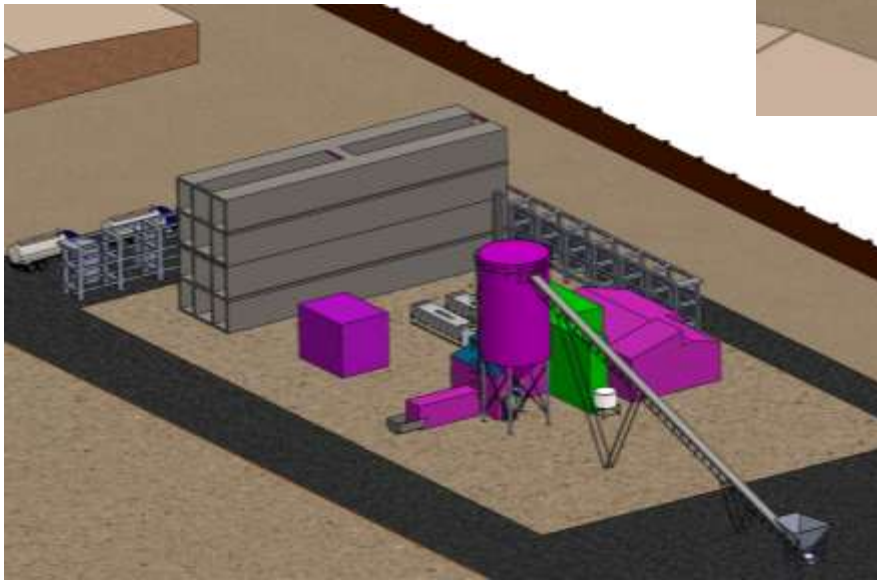
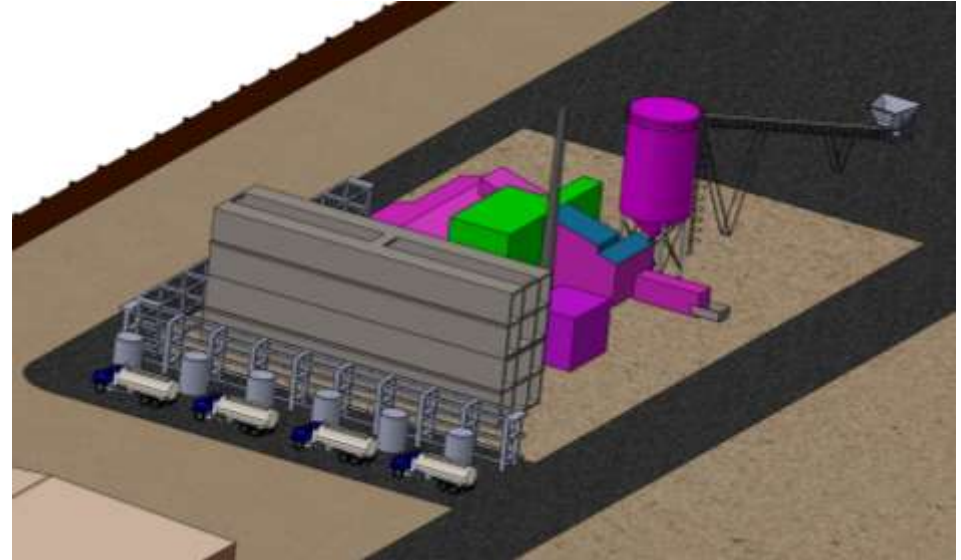
# Office and Educational Center





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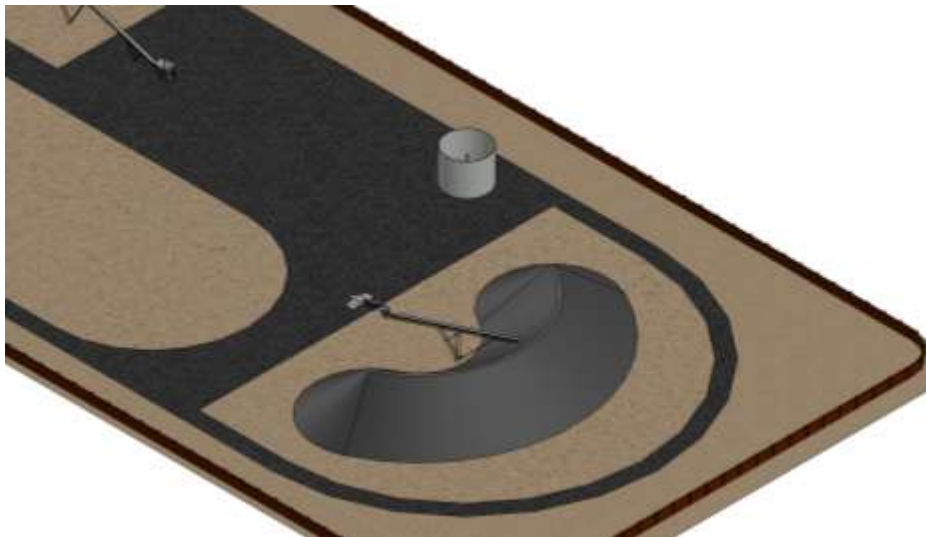
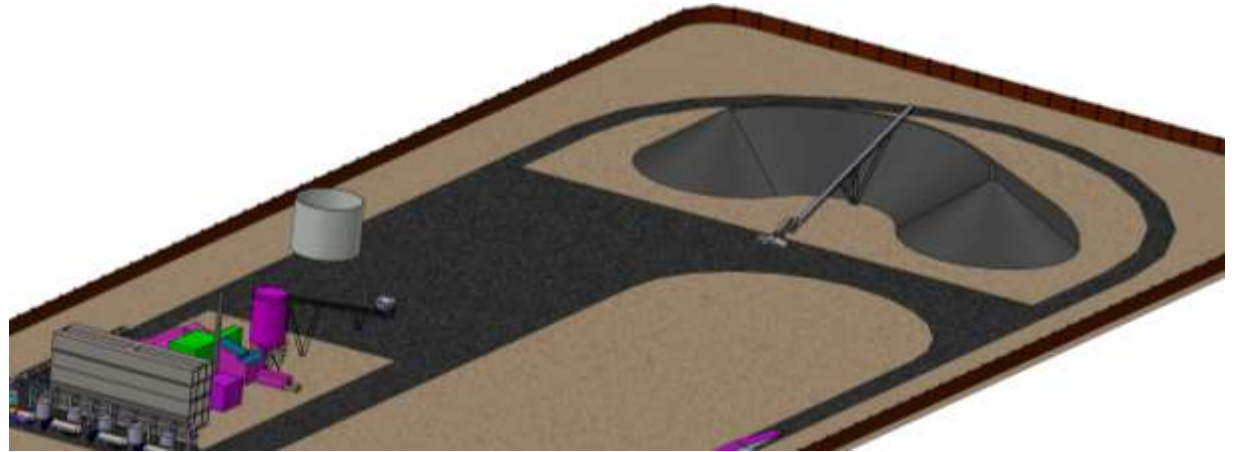
# Liquids Production Facility with TCG Gasifier





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# Coal Storage

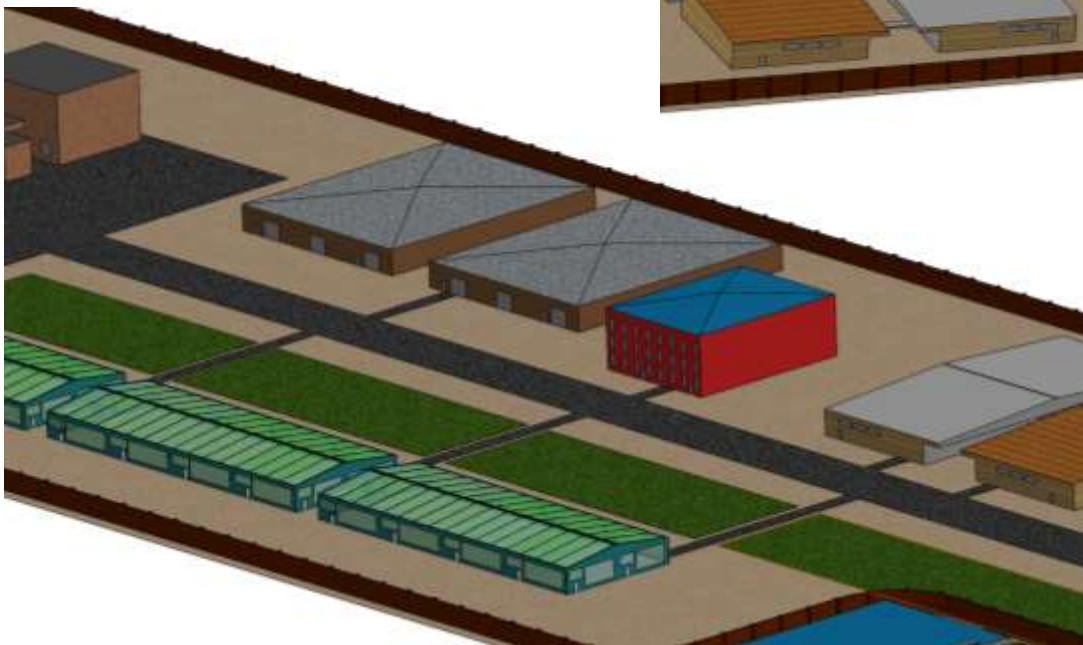
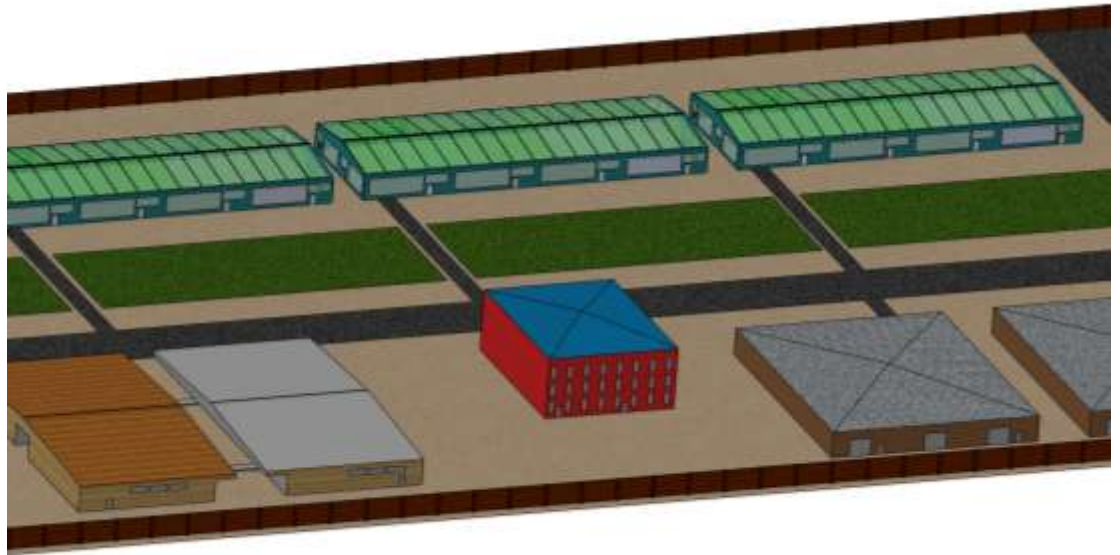






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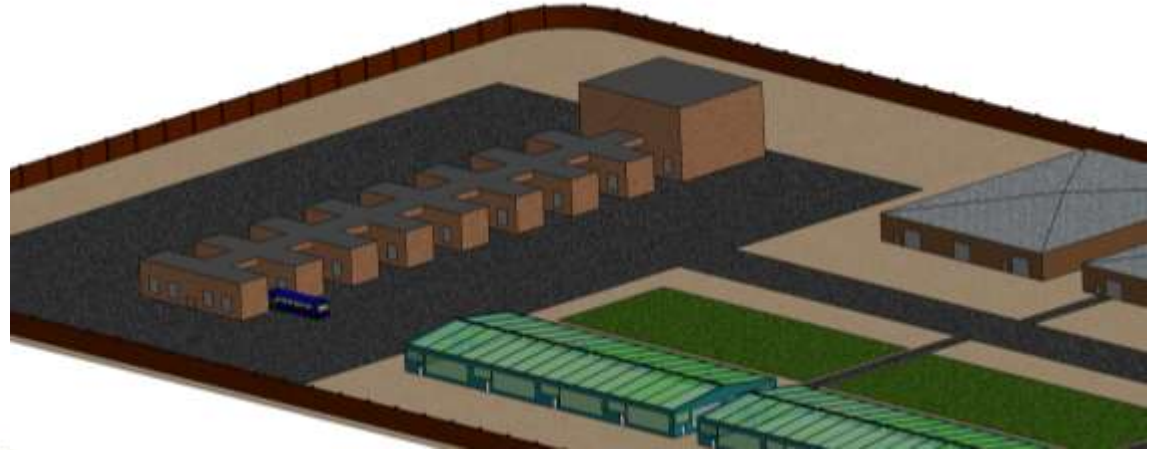
# Future Research Labs and CO<sub>2</sub> Utilization Green Houses





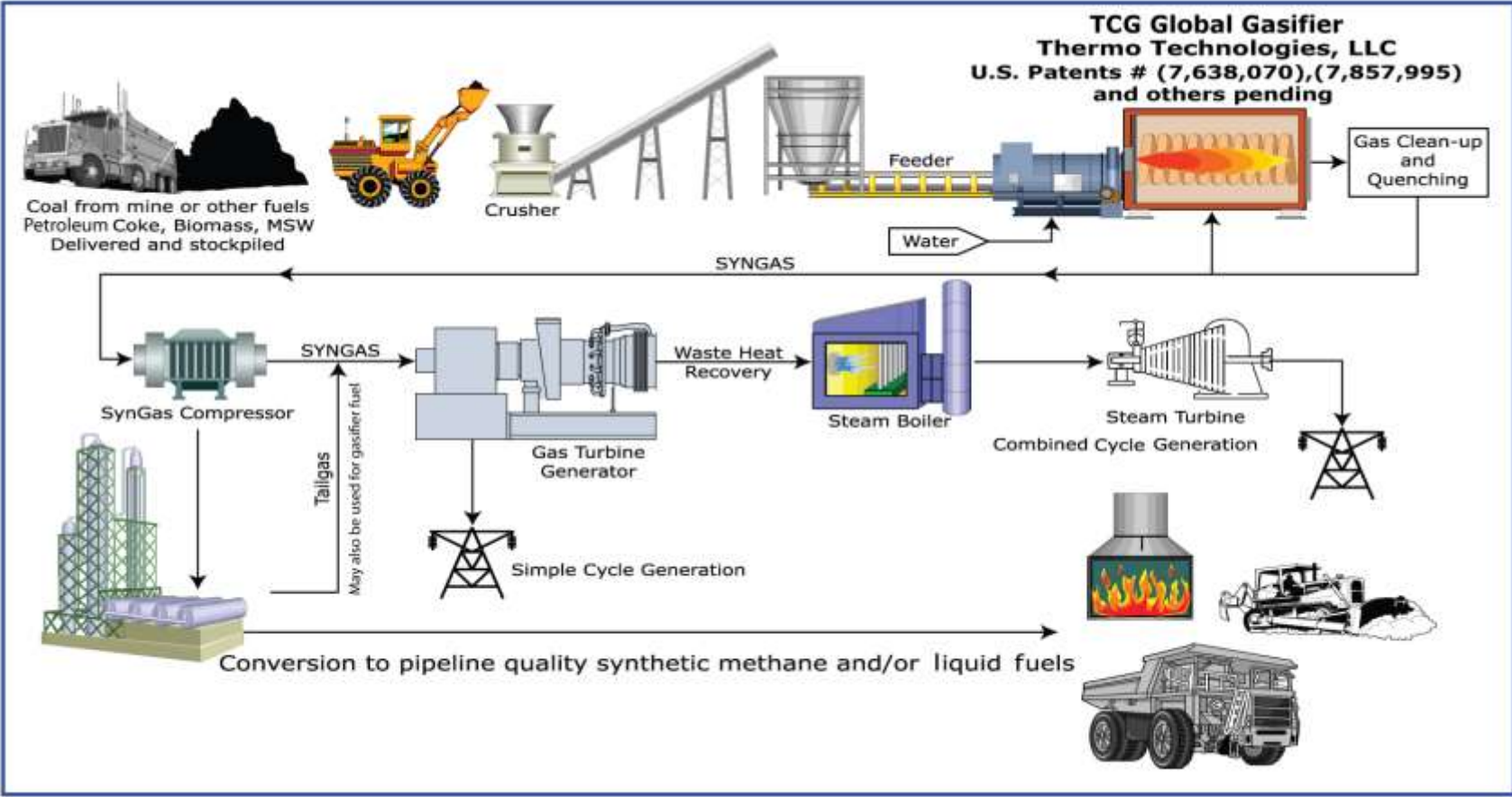
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# Hydrogen Fueling Station and Hydrogen Turbine





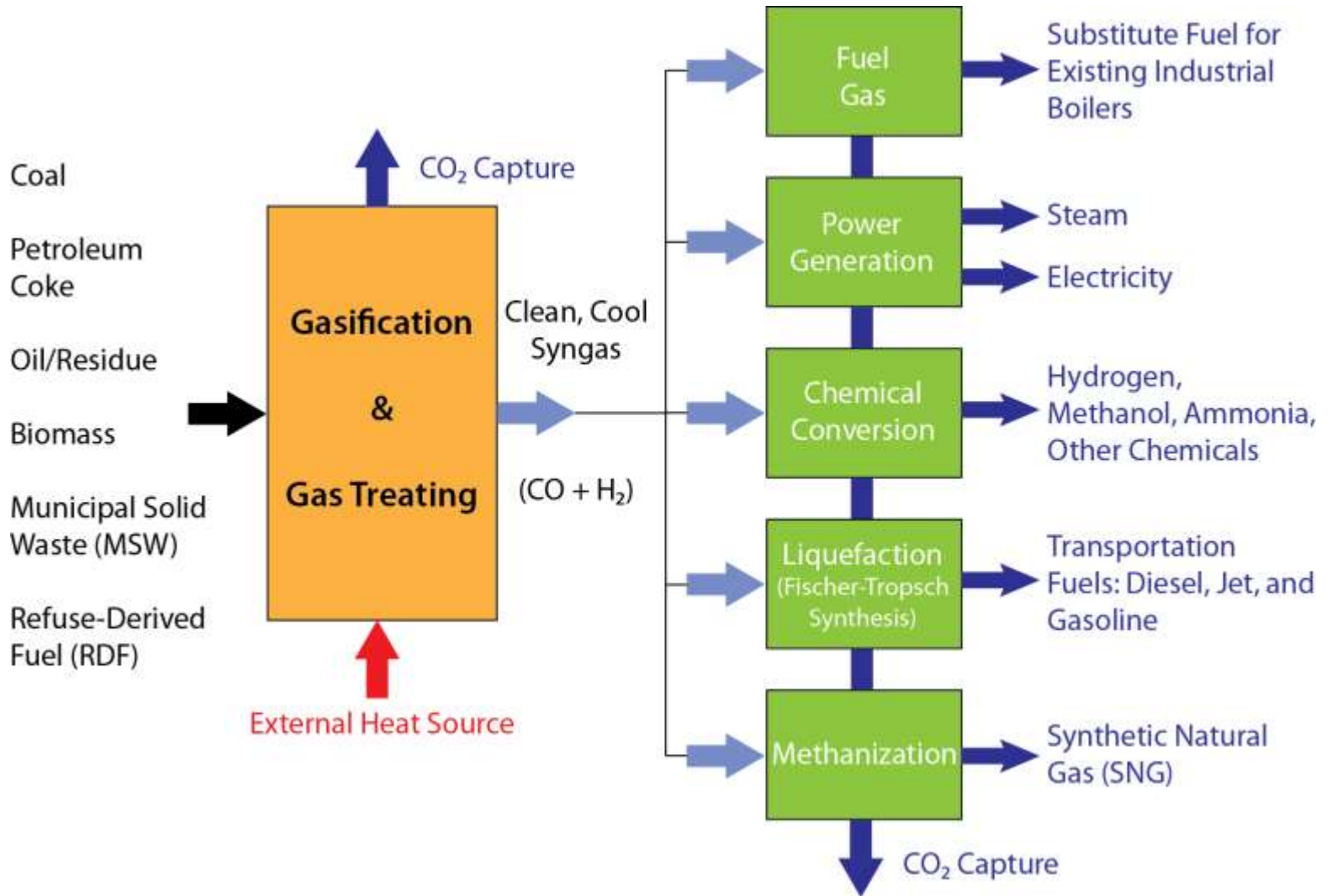
# Technology Platform







# Product Options





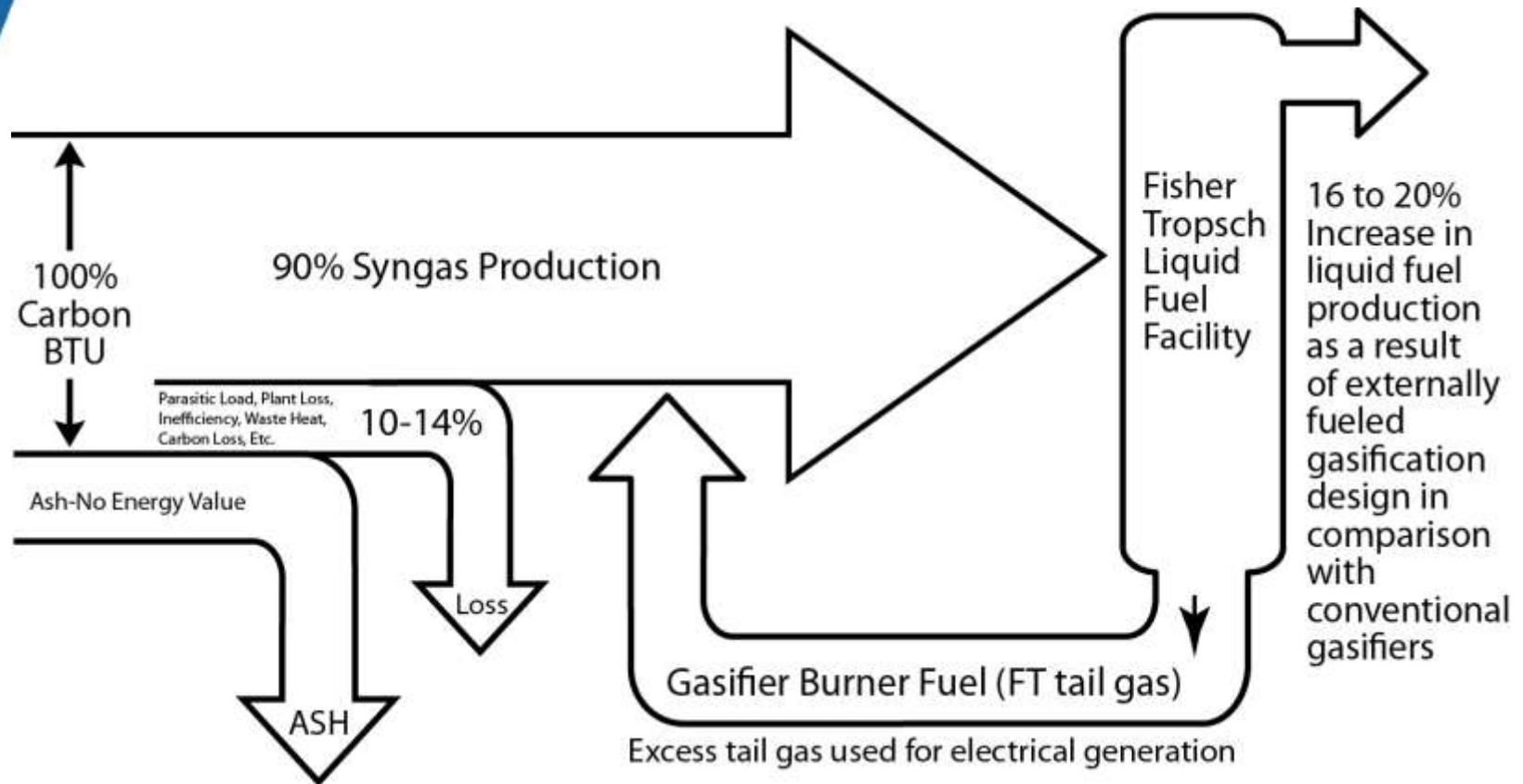


# Production Products

- **The OVU-ACE facility can produce a variety of products from the coal derived clean syngas**
  - Diesel
  - Mixed Alcohols
    - Methanol
    - Ethanol
    - Propanol
  - Fischer Tropsch waxes
  - Electricity
  - Carbon Dioxide
  - Hydrogen
- **Rare Earth Elements can be recovered from the coal ash**

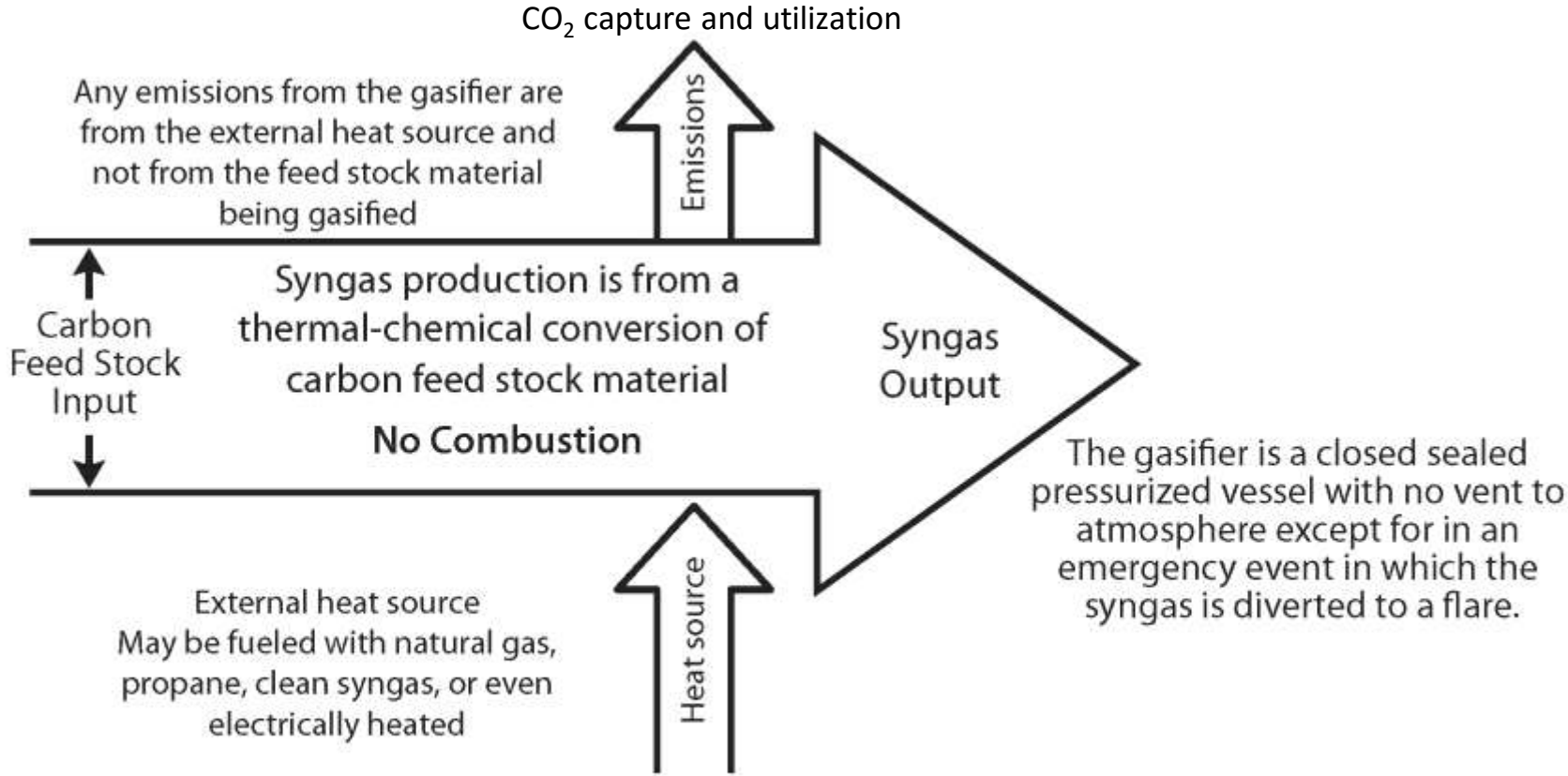


# Efficient Design for Liquids Fuel Production





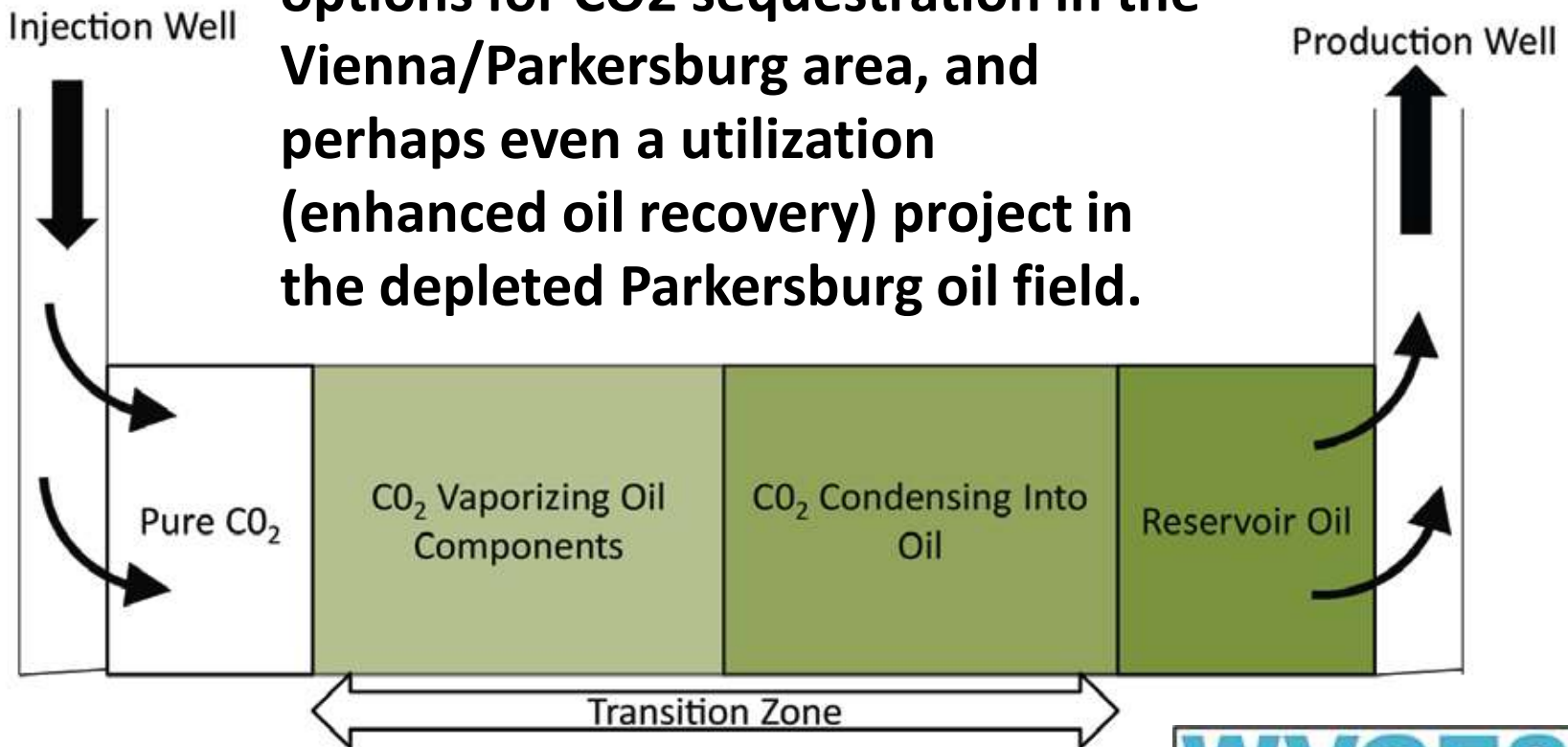
# Clean Emissions & CO<sub>2</sub> Capture





# WV Geological & Economic Survey

WVGES has offered to assist OVU-ACE in the development of several options for CO<sub>2</sub> sequestration in the Vienna/Parkersburg area, and perhaps even a utilization (enhanced oil recovery) project in the depleted Parkersburg oil field.

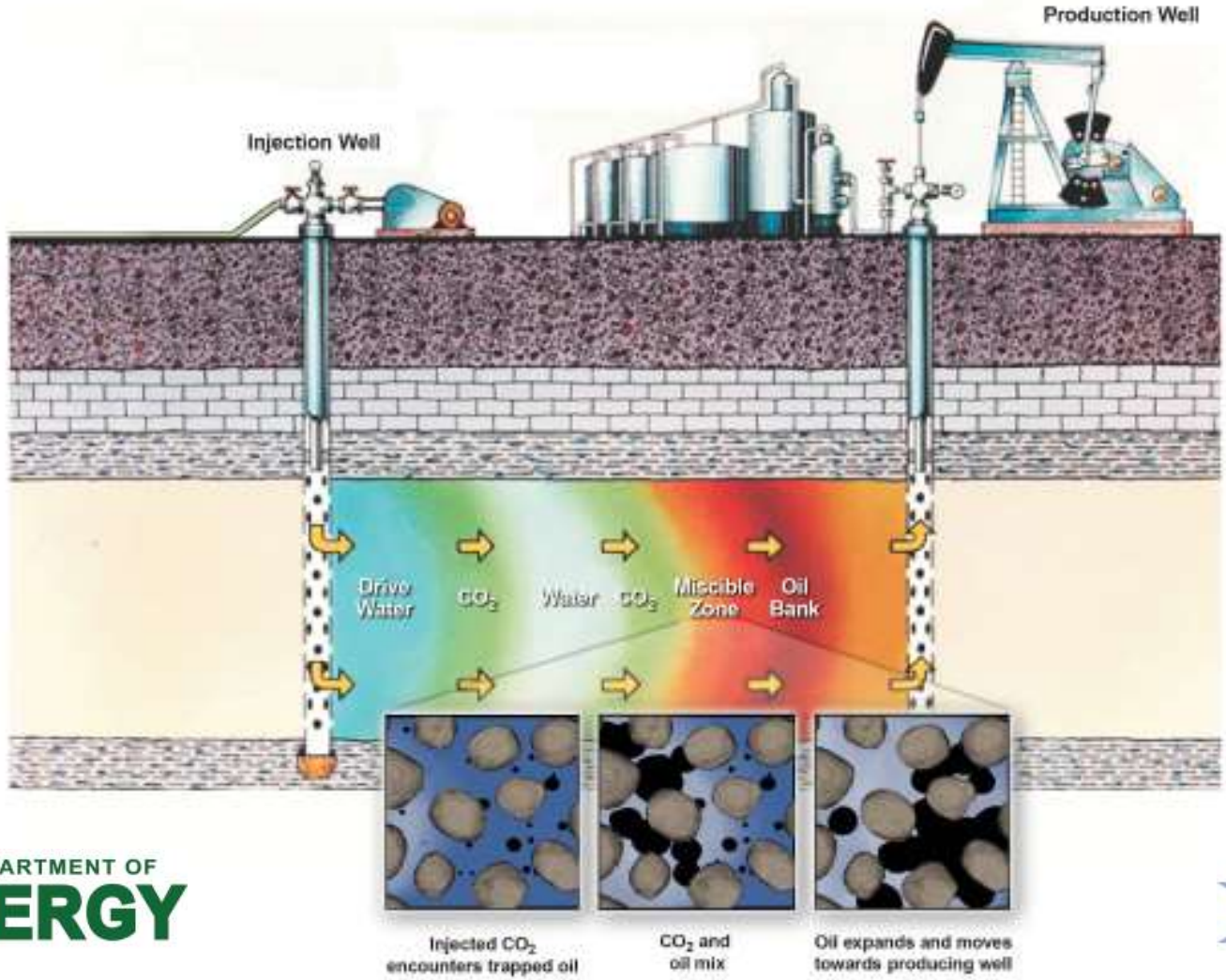






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# CO<sub>2</sub> Enhanced Oil Recovery



U.S. DEPARTMENT OF  
**ENERGY**



Source: <http://energy.gov/fe/science-innovation/oil-gas-research/enhanced-oil-recovery>

OVU-ACE, LLC



# WV Geological & Economic Survey

**WVGES would serve as Technical Advisor to Ohio Valley University for improved characterization of Rare-Earth/Strategic Element composition of WV Coals. Staff from the Coal Program would serve as advisory scientists and will provide guidance pertaining to:**

- General coal geology of West Virginia
- Location/characteristics of key mines/seams
- Relative concentration of REEs in coals and associated coal waste (fly ash)
- Integration of legacy data with newly-collected x-ray fluorescence (XRF) analyses

**This guidance would include compilation of relevant scientific literature, feedback pertaining to curriculum design, and hands-on, inquiry-based demonstrations**





# Rare Earth Elements

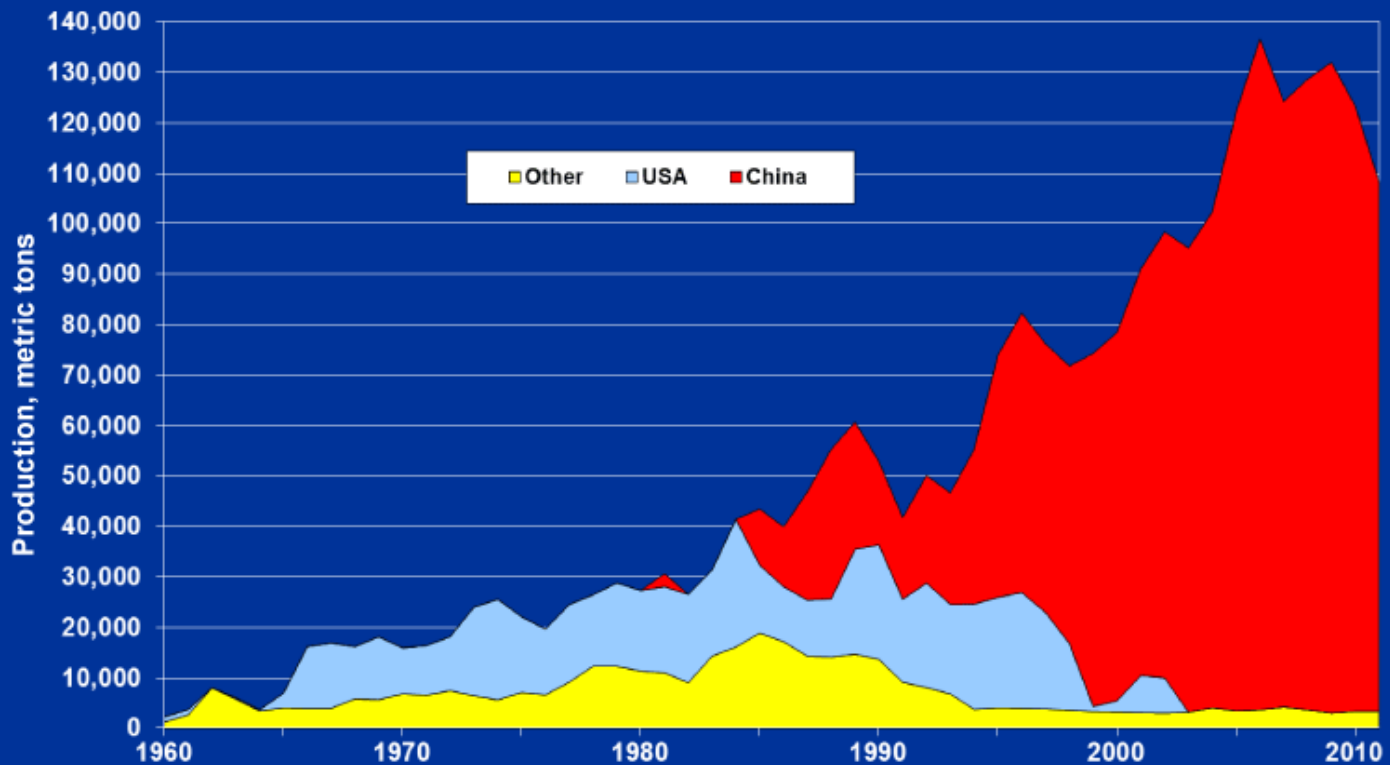
## Rare Earth Elements

1 1,008* <b>H</b> väte																	18 4,003 <b>He</b> helium		
3 6,94* <b>Li</b> litium	4 9,012 <b>Be</b> beryllium	<b>Rare Earth Elements</b>												5 10,81* <b>B</b> bor	6 12,01* <b>C</b> kol	7 14,01* <b>N</b> kväve	8 16,00* <b>O</b> syre	9 19,00 <b>F</b> fluor	10 20,18 <b>Ne</b> neon
11 22,99 <b>Na</b> natrium	12 24,31* <b>Mg</b> magnesium													13 26,98 <b>Al</b> aluminium	14 28,09* <b>Si</b> kisel	15 30,97 <b>P</b> fosfor	16 32,06* <b>S</b> svavel	17 35,45* <b>Cl</b> klor	18 39,95 <b>Ar</b> argon
19 39,10 <b>K</b> kalium	20 40,08 <b>Ca</b> kalcium	21 44,96 <b>Sc</b> skandium	22 47,87 <b>Ti</b> titan	23 50,94 <b>V</b> vanadin	24 52,00 <b>Cr</b> krom	25 54,94 <b>Mn</b> mangan	26 55,85 <b>Fe</b> järn	27 58,93 <b>Co</b> kobolt	28 58,69 <b>Ni</b> nickel	29 63,55 <b>Cu</b> koppar	30 65,38* <b>Zn</b> zink	31 69,72 <b>Ga</b> gallium	32 72,63 <b>Ge</b> germanium	33 74,92 <b>As</b> arsenik	34 78,96* <b>Se</b> selen	35 79,90* <b>Br</b> brom	36 83,80 <b>Kr</b> krypton		
37 85,47 <b>Rb</b> rubidium	38 87,62 <b>Sr</b> strontium	39 88,91 <b>Y</b> yttrium	40 91,22 <b>Zr</b> zirkonium	41 92,91 <b>Nb</b> niob	42 95,96* <b>Mo</b> molybden	43 [98] <b>Tc</b> teknetium	44 101,1 <b>Ru</b> rutenium	45 102,9 <b>Rh</b> rodium	46 106,4 <b>Pd</b> palladium	47 107,9 <b>Ag</b> silver	48 112,4 <b>Cd</b> kadmium	49 114,8 <b>In</b> indium	50 118,7 <b>Sn</b> tenn.	51 121,8 <b>Sb</b> antimon	52 127,6 <b>Te</b> tellur	53 126,9 <b>I</b> jod	54 131,3 <b>Xe</b> xenon		
55 132,9 <b>Cs</b> cesium	56 137,3 <b>Ba</b> barium	57-71 <b>Lanthanides</b>	72 178,5 <b>Hf</b> hafnium	73 180,9 <b>Ta</b> tantal	74 183,8 <b>W</b> volfram	75 186,2 <b>Re</b> rhenium	76 190,2 <b>Os</b> osmium	77 192,2 <b>Ir</b> iridium	78 195,1 <b>Pt</b> platina	79 197,0 <b>Au</b> guld	80 200,6 <b>Hg</b> kviksilver	81 204,4* <b>Tl</b> tallium	82 207,2 <b>Pb</b> bly	83 209,0 <b>Bi</b> vismut	84 [209] <b>Po</b> polonium	85 [210] <b>At</b> astat	86 [222] <b>Rn</b> radon		
87 [223] <b>Fr</b> francium	88 [226] <b>Ra</b> radium	89-103 <b>Actinides</b>	104 [267] <b>Rf</b> rutherfordium	105 [268] <b>Db</b> dubnium	106 [269] <b>Sg</b> seaborgium	107 [270] <b>Bh</b> bohrium	108 [269] <b>Hs</b> hassium	109 [278] <b>Mt</b> meitnerium	110 [281] <b>Ds</b> darmstadtium	111 [281] <b>Rg</b> röntgenium	112 [285] <b>Cn</b> copernicium	113 [286] <b>Uut</b> ununtrium	114 [289] <b>Fl</b> flerovium	115 [288] <b>Uup</b> ununpentium	116 [293] <b>Lv</b> livermorium	117 [294] <b>Uus</b> ununseptium	118 [294] <b>Uuo</b> ununoctium		
57 138,9 <b>La</b> lantan	58 140,1 <b>Ce</b> cerium	59 140,9 <b>Pr</b> praseodym	60 144,2 <b>Nd</b> neodym	61 [145] <b>Pm</b> prometium	62 150,4 <b>Sm</b> samarium	63 152,0 <b>Eu</b> europium	64 157,3 <b>Gd</b> gadolinium	65 158,9 <b>Tb</b> terbium	66 162,5 <b>Dy</b> dysprosium	67 164,9 <b>Ho</b> holmium	68 167,3 <b>Er</b> erbio	69 168,9 <b>Tm</b> tulium	70 173,1 <b>Yb</b> ytterbium	71 175,0 <b>Lu</b> lutetium					
89 [227] <b>Ac</b> aktinium	90 232,0 <b>Th</b> torium	91 231,0 <b>Pa</b> protaktinium	92 238,0 <b>U</b> uran	93 [237] <b>Np</b> neptunium	94 [244] <b>Pu</b> plutonium	95 [243] <b>Am</b> americium	96 [247] <b>Cm</b> curium	97 [247] <b>Bk</b> berkelium	98 [251] <b>Cf</b> californium	99 [252] <b>Es</b> einsteinium	100 [257] <b>Fm</b> fermium	101 [258] <b>Md</b> mendelevium	102 [259] <b>No</b> nobelium	103 [262] <b>Lr</b> lawrencium					



# Rare Earth Elements

## Global Rare Earth Oxide Mine Production







# WV Geological & Economic Survey

## Development and Implementation of a Training Curriculum for Rare Earth Processing of West Virginia Coals

### Project Goals:

- workforce development related to next-gen coal technologies
- filling a critical gap in development of a domestic source of strategic minerals
- promotion of green technologies through processing of materials traditionally thought of as waste products







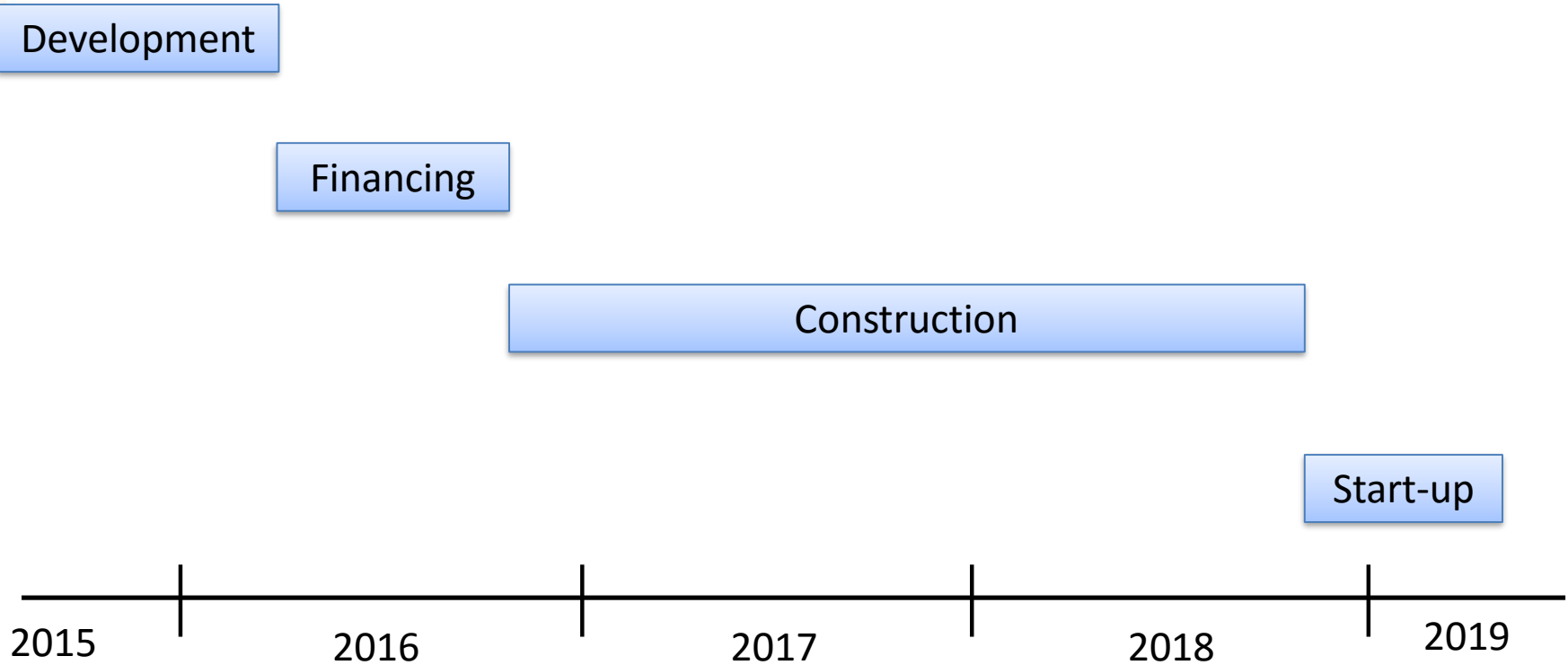
# Project Status

- ✓ **OVU retained AAIG and North Slope Capital for Overall Project Funding**
- ✓ **Secured additional development funding**
- ✓ **Site acquisition documents executed**
- ✓ **Preliminary engineering and budgeting completed**
- ✓ **Supply and Offtake agreements underway**
- ✓ **Permitting implemented**
  - **Final engineering design**
  - **Financial close**
  - **Permit issuance**
  - **Construction**
  - **Operation**



# Project Timeline

## Operational Late 2018





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# Questions?



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North  
Slope  
Capital  
Advisors



All American  
Investment Group



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