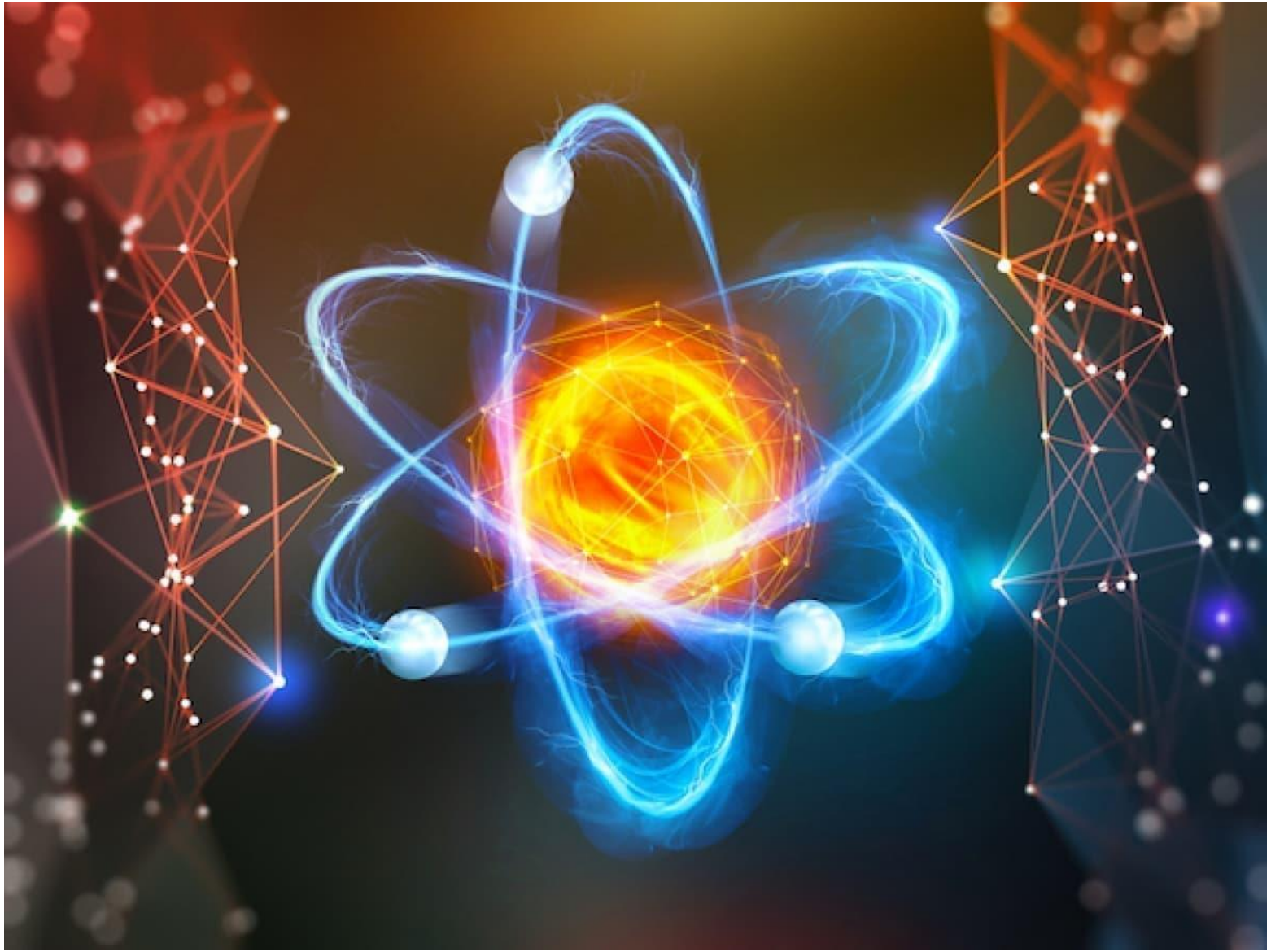
Energy Opportunities in a Net Zero World

Bryan Helfenbaum
Executive Director, Advanced Hydrocarbons

March 6 2023

ALBERTA INNOVATES



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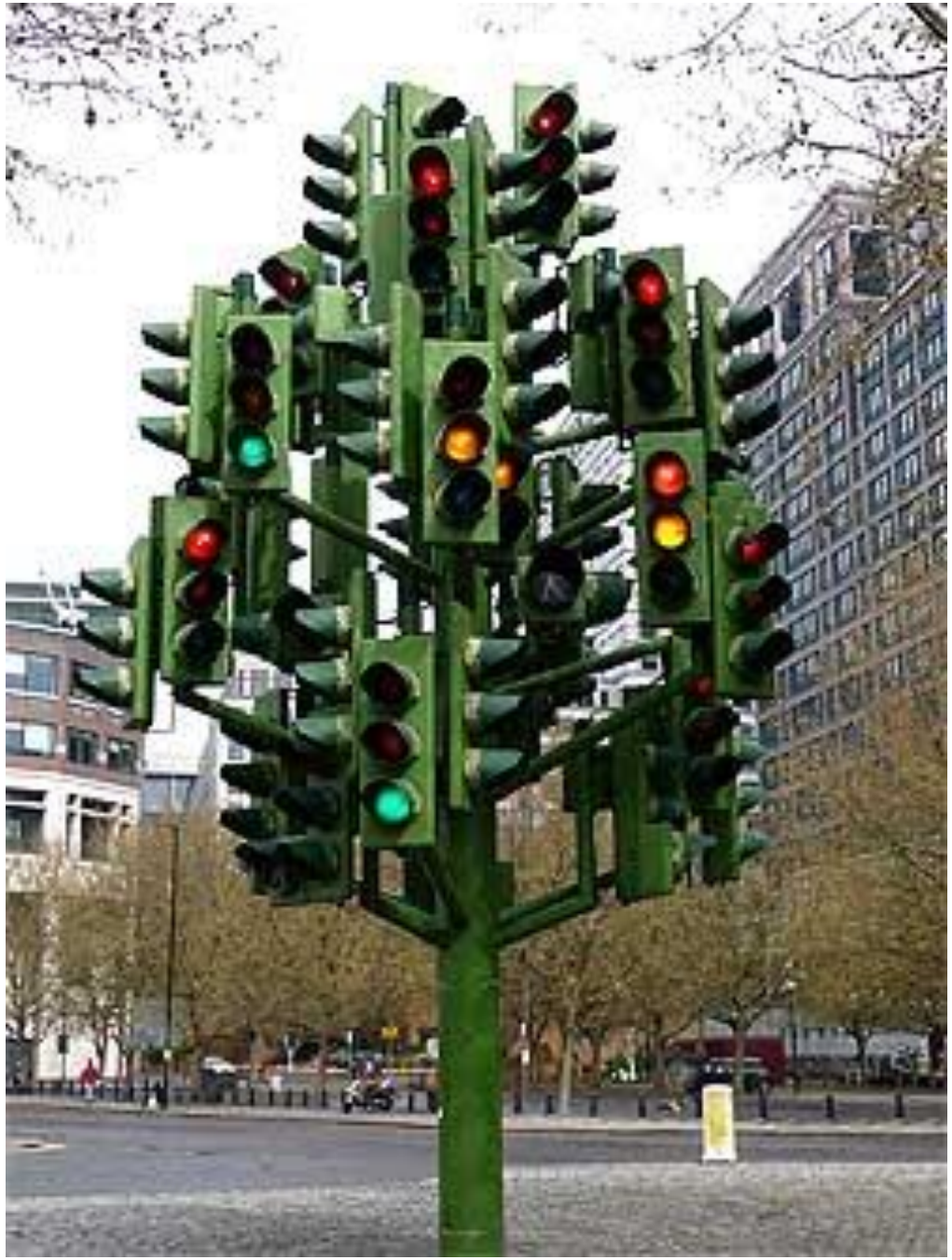

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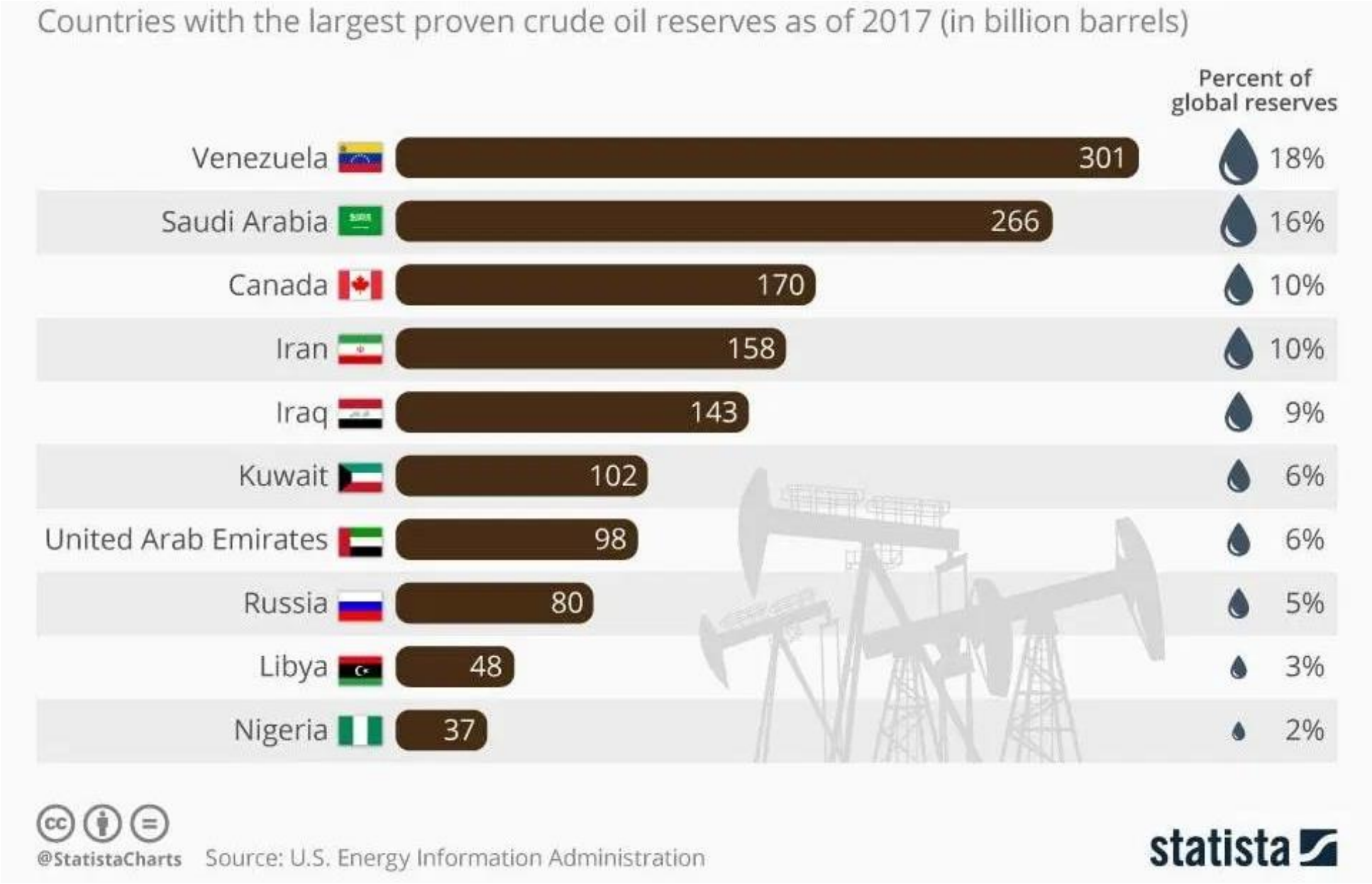
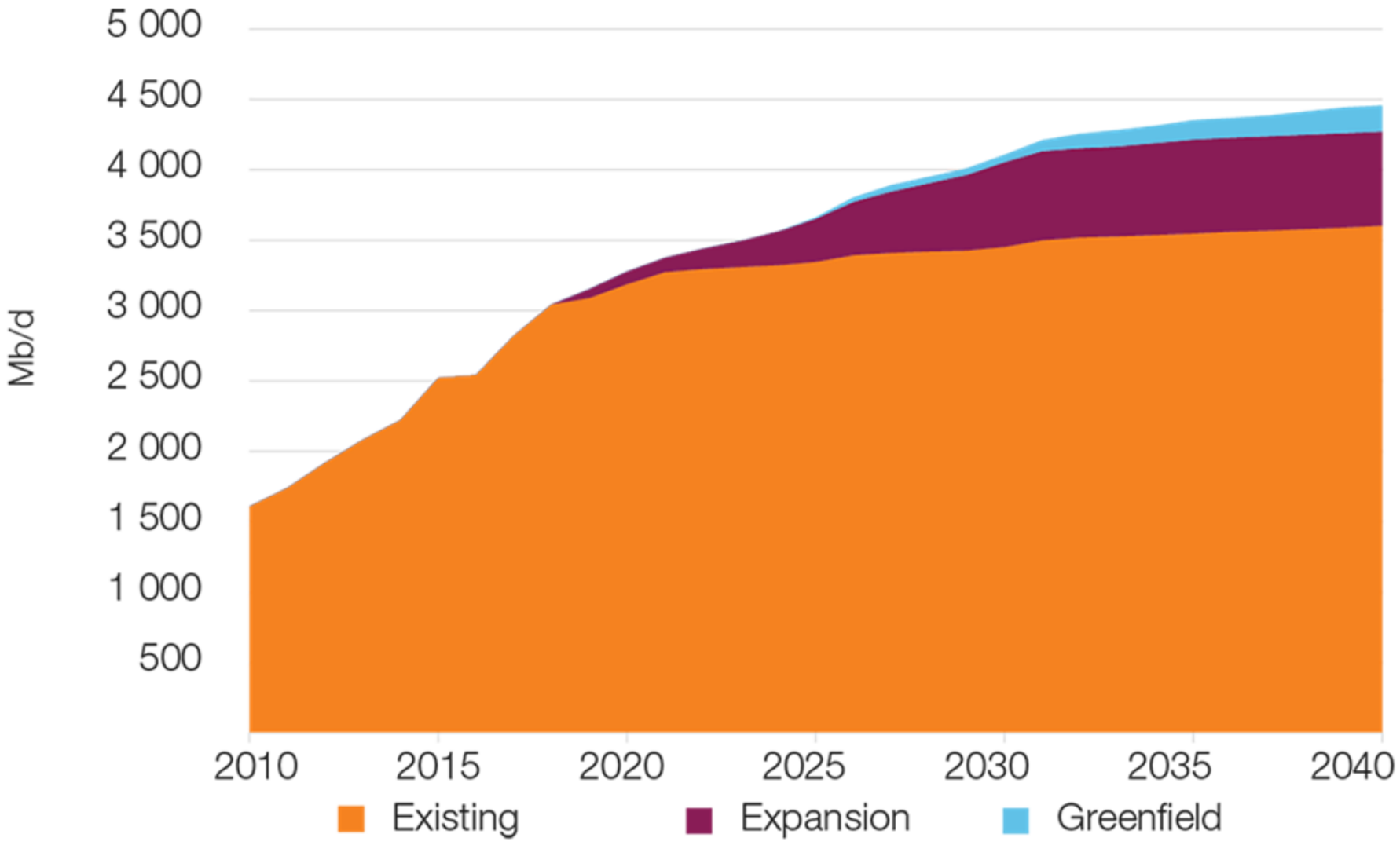

Countries with the largest proven crude oil reserves as of 2017 (in billion barrels)
Percent of global reserves
Venezuela 301 18%
Saudi Arabia 266 16%
Canada 170 10%
Iran 158 10%
Iraq 143 9%
Kuwait 102 6%
United Arab Emirates 98 6%
Russia 80 5%
Libya 48 3%
Nigeria 37 2%
@StatistaCharts
Source: U.S. Energy Information Administration
statista


TARSANDS = DIRTIEST
OIL ON EARTH
STOP TAR SANDS NOW
STOP TAR SANDS NOW
STOP TAR SANDS NOW

New vs. Existing Oil Sands Production



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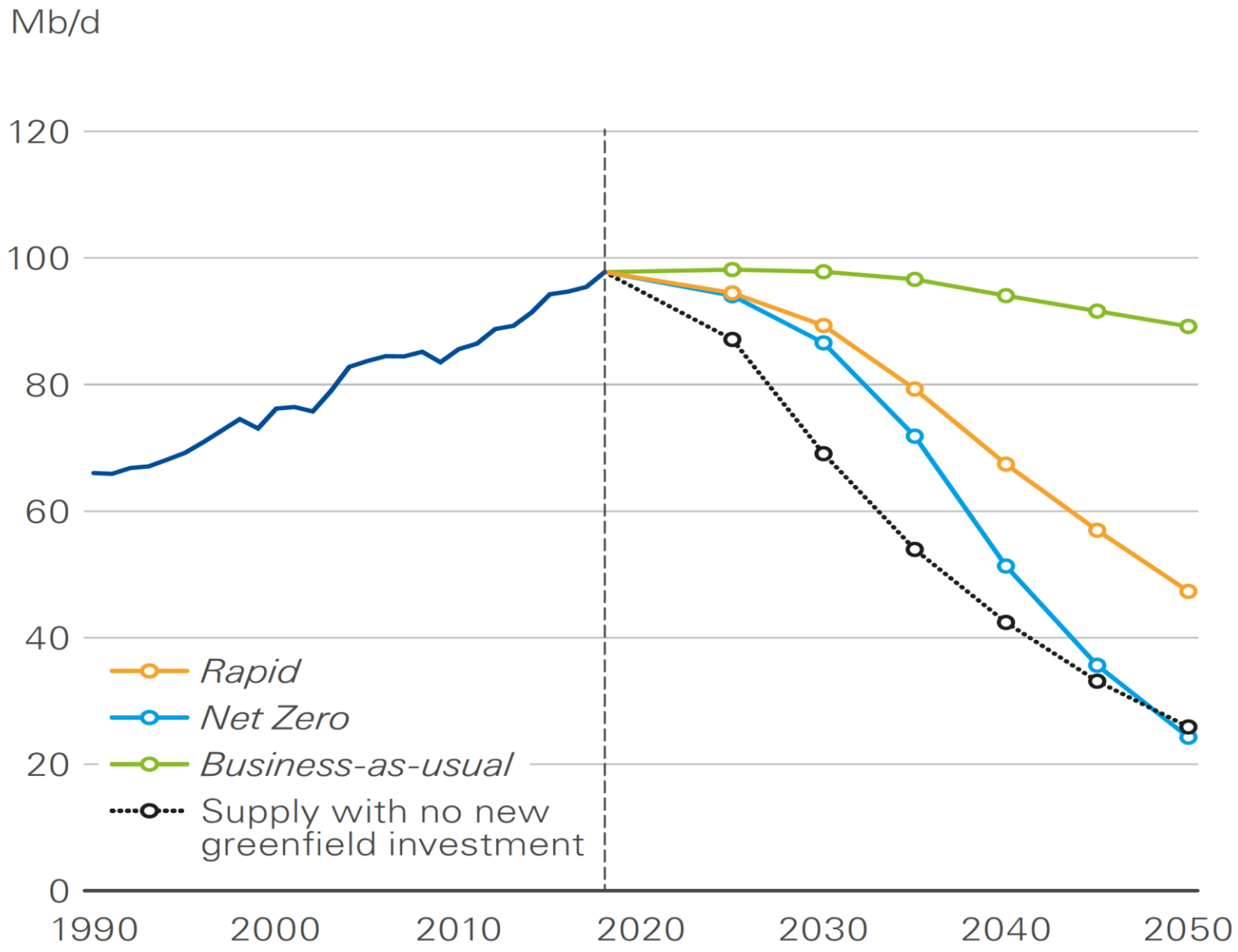
Source: RBN Energy

Canada's new climate plan calls for 42% cut in emissions from oil and gas sector

Calgary-based oilsands producer Cenovus aims for ‘net zero’ GHG emissions by 2050

Oil and gas giant sets big target of net zero oilsands emissions

SHELL ACCELERATES DRIVE FOR NET-ZERO EMISSIONS WITH CUSTOMER-FIRST STRATEGY



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Source: BP World Energy Outlook 2020

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Global Coal Use in 2022 at an All-Time High

BY IER

JANUARY 4, 2023


Huh?

Alberta non-renewable resource revenue forecast to hit record high of $27.5-billion

EMMA GRANEY > ENERGY REPORTER

PUBLISHED YESTERDAY

UPDATED 9 HOURS AGO

March 1, 2023


NET
ZERO

Can we maintain our prosperity while moving to a Net Zero World?


INNOVATION


Coal
Wood


Coal
Wood


Image courtesy of: Suncor

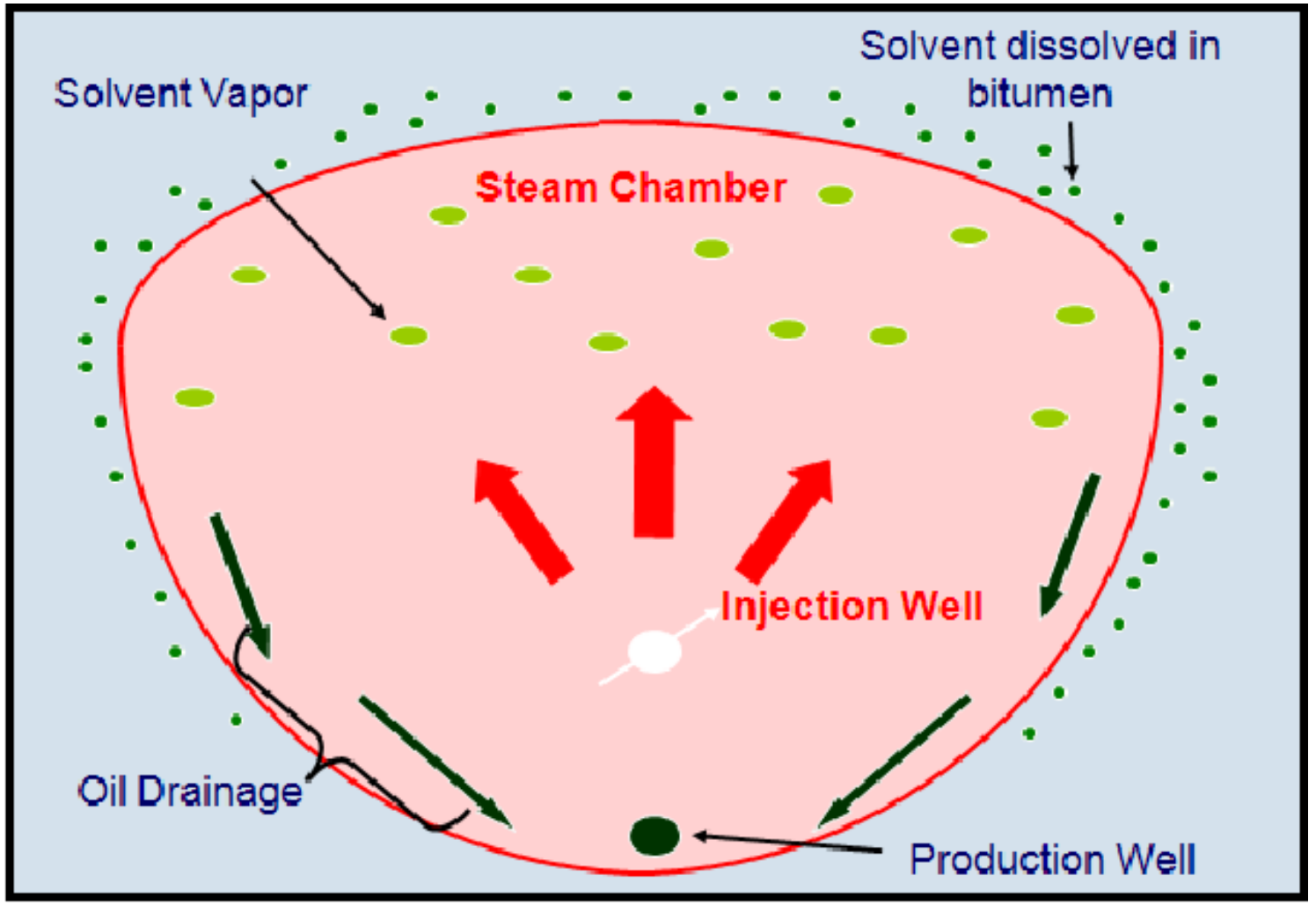
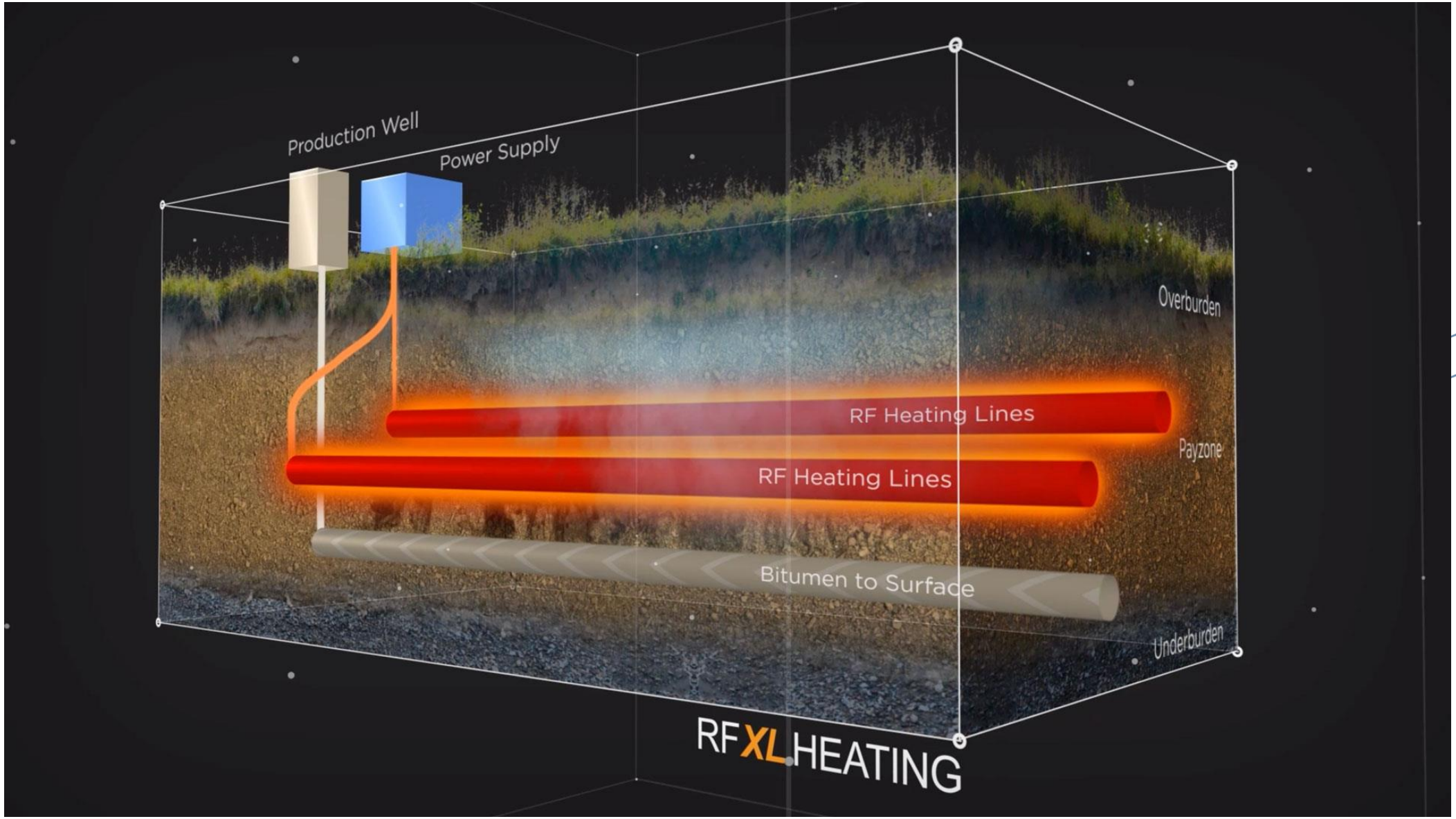


Figure 4 – Illustration of ES-SAGD concept.



ALBERTA INNOVATES

acceleware®

$700-million Travers Solar Project largest farm ever built in Canada

Grant Cameron September 20, 2021

Pipeline giant TC Energy to build $146-million solar farm in southern Alberta

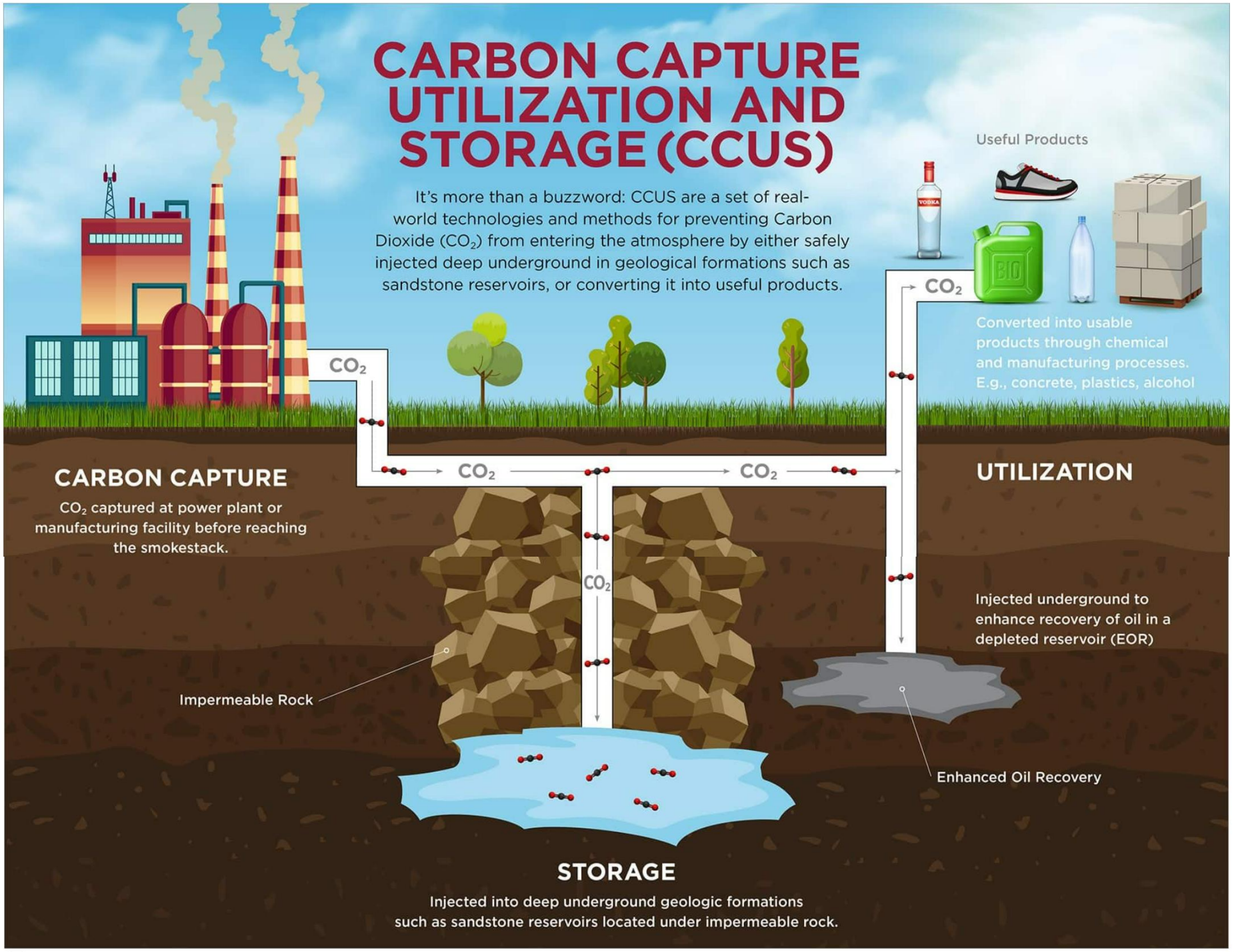
Saddlebrook Solar Project will be company's first solar power project, with a capacity to generate 81 megawatts

Meghan Potkins
Oct 04, 2022 • 6 days ago • 2 minute read • 34 Comments

Canada's wind and solar build set for 'five-fold' boom fuelled by oil-rich Alberta: S&P

Research house forecasts North American nation will install some 5.5GW of new clean energy plant, up from 1GW in 2021, as Ottawa's net zero ambitions start to see traction

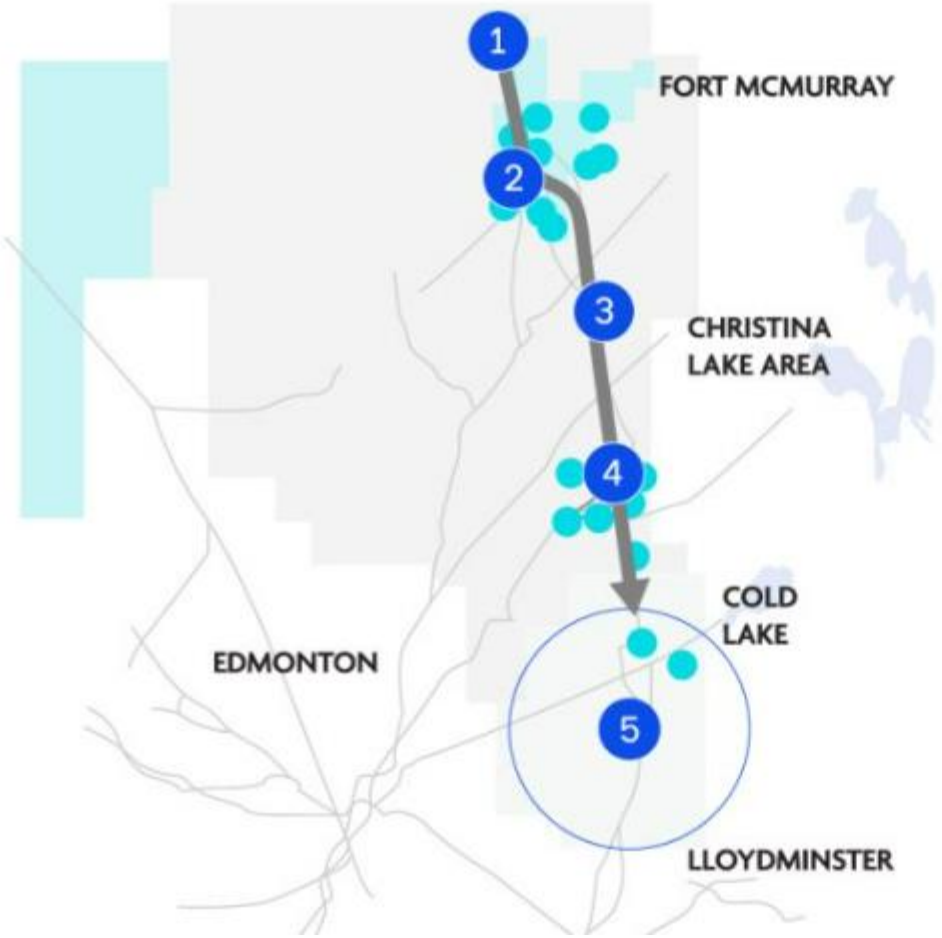

Ferdi Rizkiyanto


CARBON CAPTURE UTILIZATION AND STORAGE (CCUS)
It's more than a buzzword: CCUS are a set of real-world technologies and methods for preventing Carbon Dioxide (CO_2) from entering the atmosphere by either safely injected deep underground in geological formations such as sandstone reservoirs, or converting it into useful products.
Useful Products
CO_2
Converted into usable products through chemical and manufacturing processes. E.g., concrete, plastics, alcohol
CARBON CAPTURE
CO_2 captured at power plant or manufacturing facility before reaching the smokestack.
UTILIZATION
Injected underground to enhance recovery of oil in a depleted reservoir (EOR)
Impermeable Rock
Enhanced Oil Recovery
STORAGE
Injected into deep underground geologic formations such as sandstone reservoirs located under impermeable rock.

Oil & Gas / FP Energy / Commodities

Trudeau proposes tax credit to cover 50% of carbon capture technology cost

The credit would reduce the large, upfront capital costs involved in constructing carbon capture, utilization and storage



1 Oil sands mining and in situ area

2 Oil sands upgraders

3 400km CO_2 transportation line

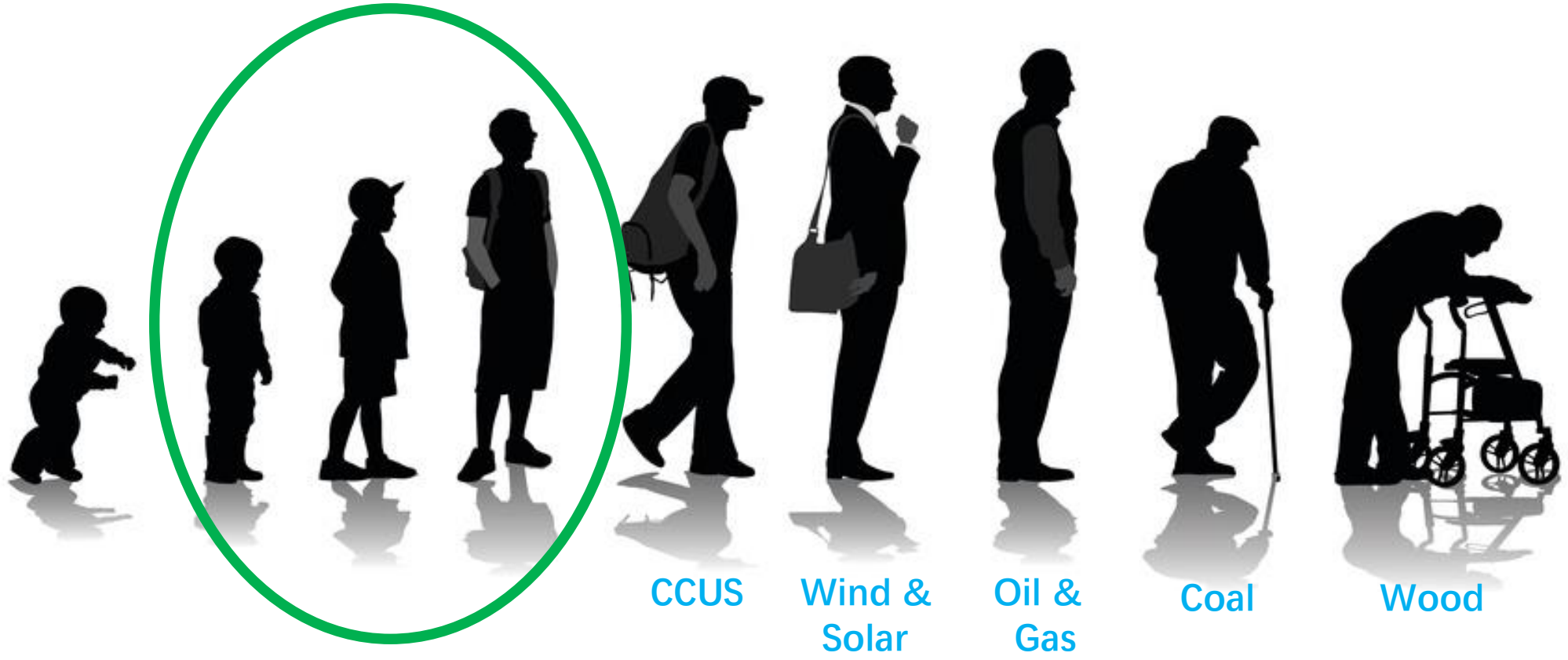
4 Oil sands in situ recovery area

5 Joint carbon storage hub

Emissions source

CO_2 Transportation line

Source: Pathway Alliance, 2022



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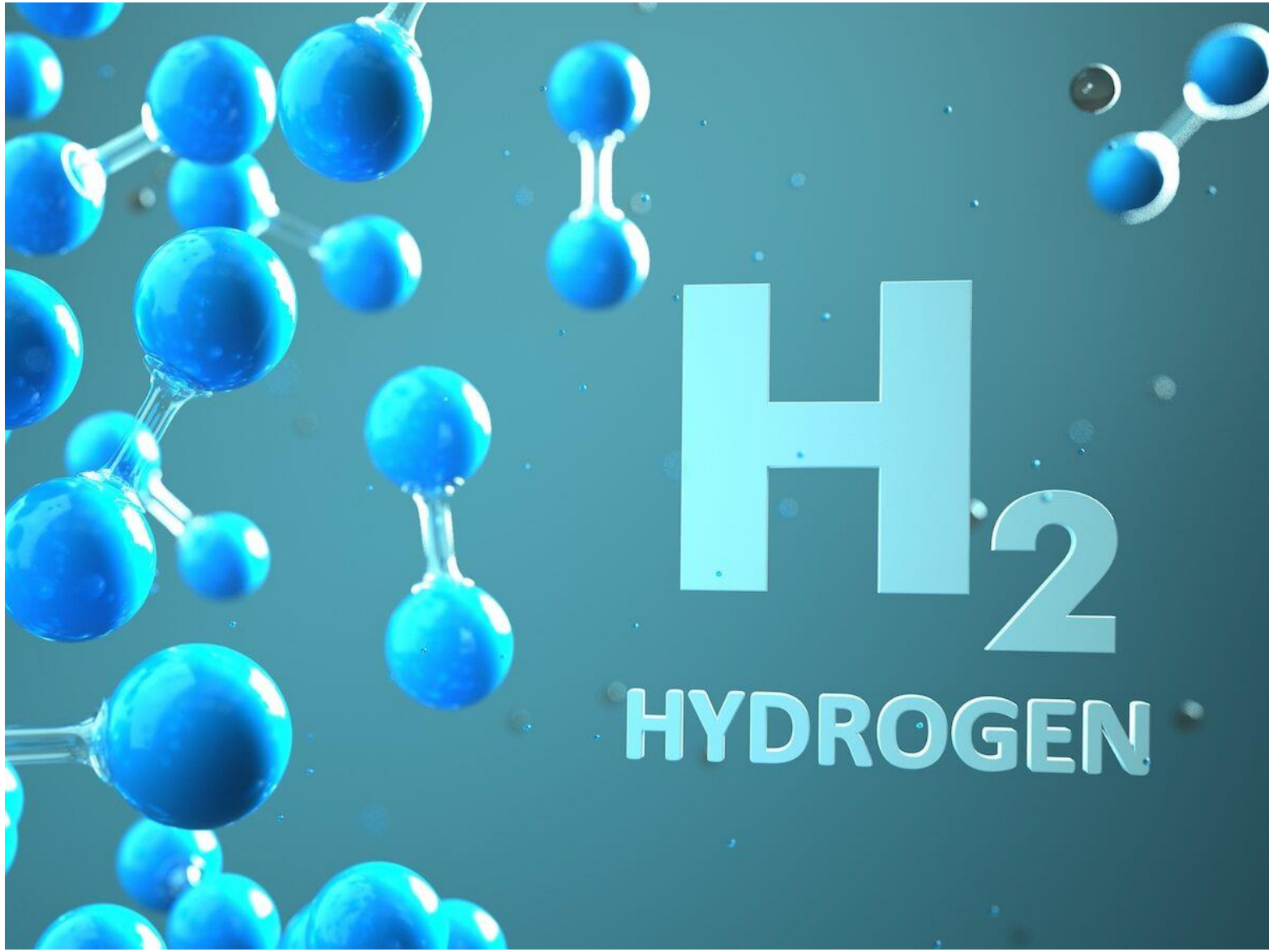
H2
HYDROGEN

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FCV
ZERO EMISSION
TOYOTA
HINO
PROFIA

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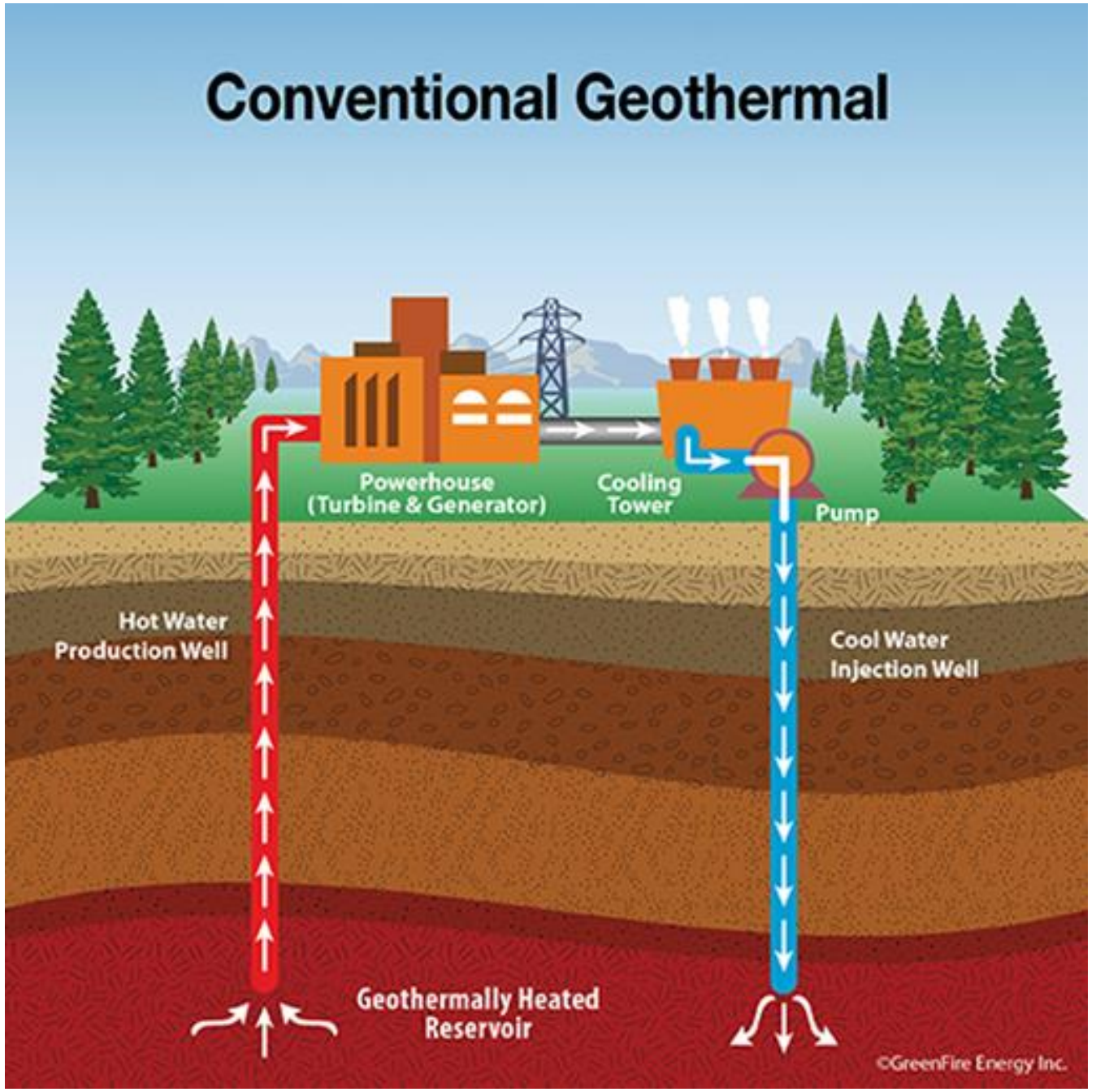
Alberta
Alberta's
Hydrogen Centre
of Excellence



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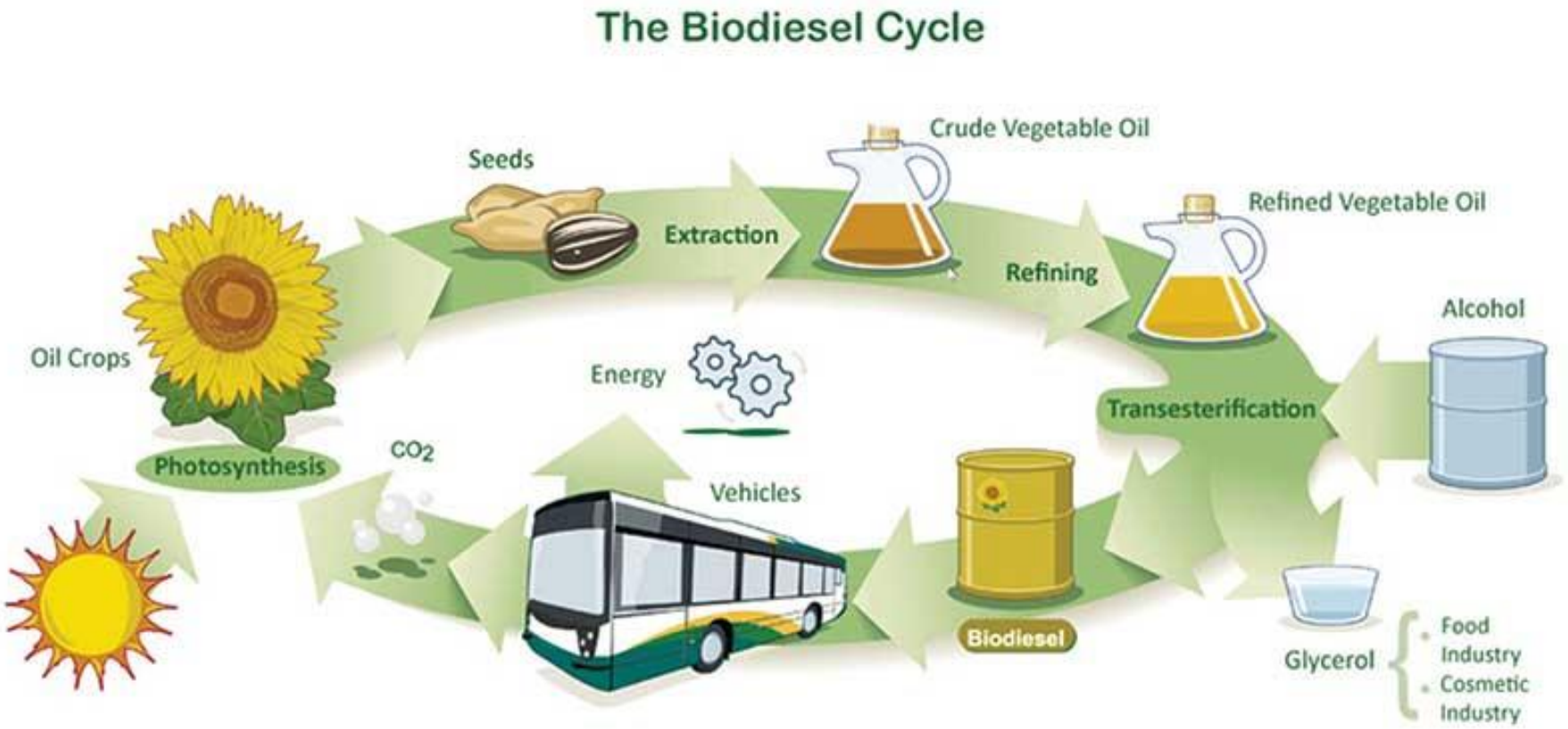
Eavor

BOREALIS GEOPOWER

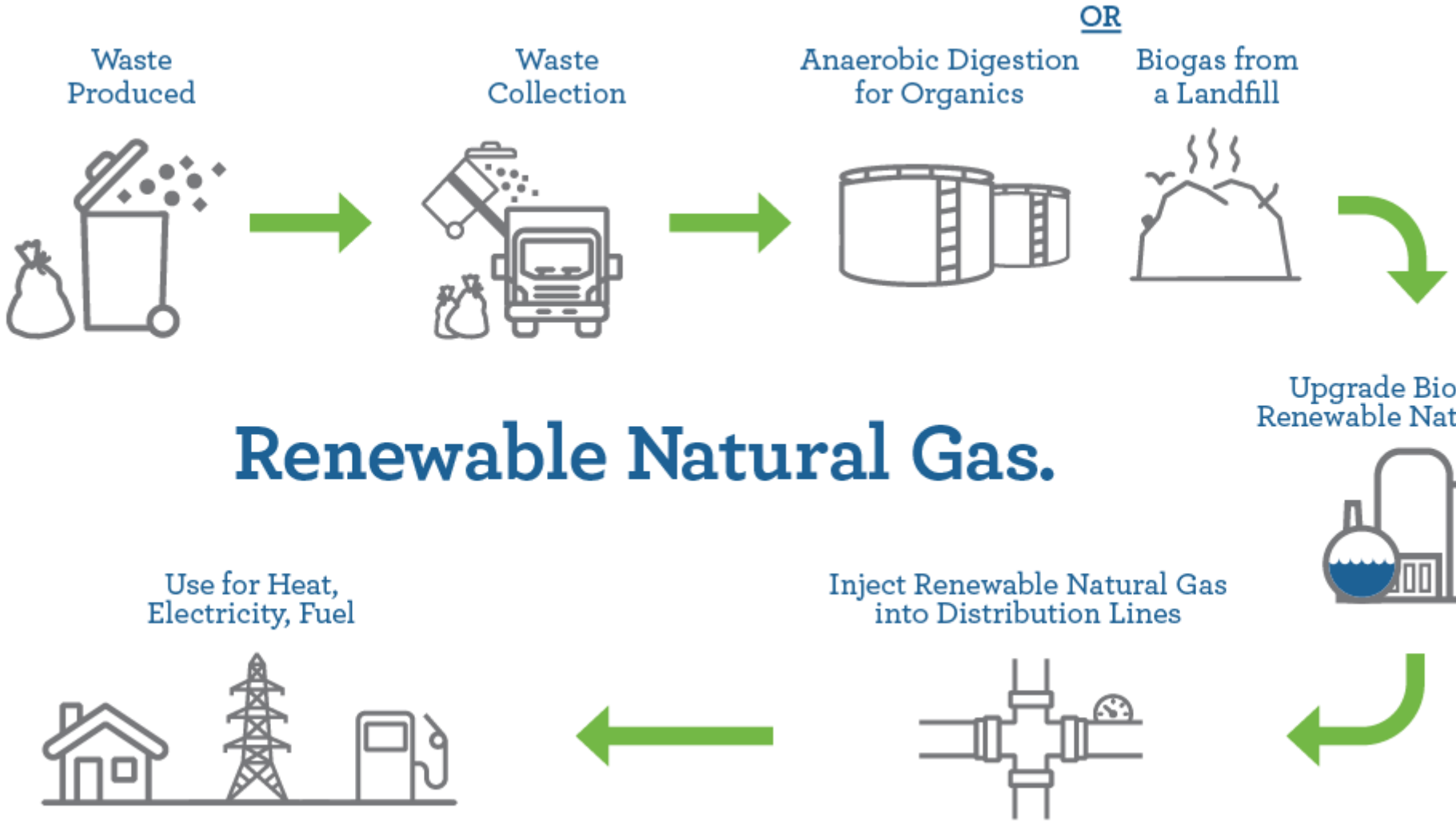
DEEP CORP.

KITSELAS GEOTHERMAL INC.

Plants used as a biofuel production



Renewable Natural Gas.



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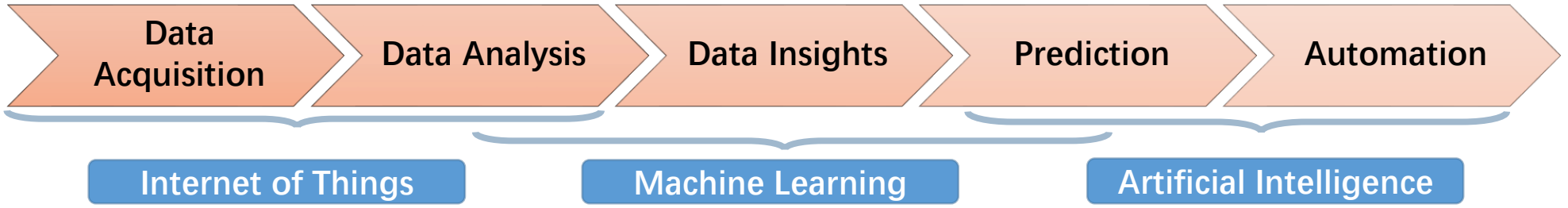
Alberta and three other provinces release strategic plan on small modular reactors

Mar 28, 2022 | 2:42 PM

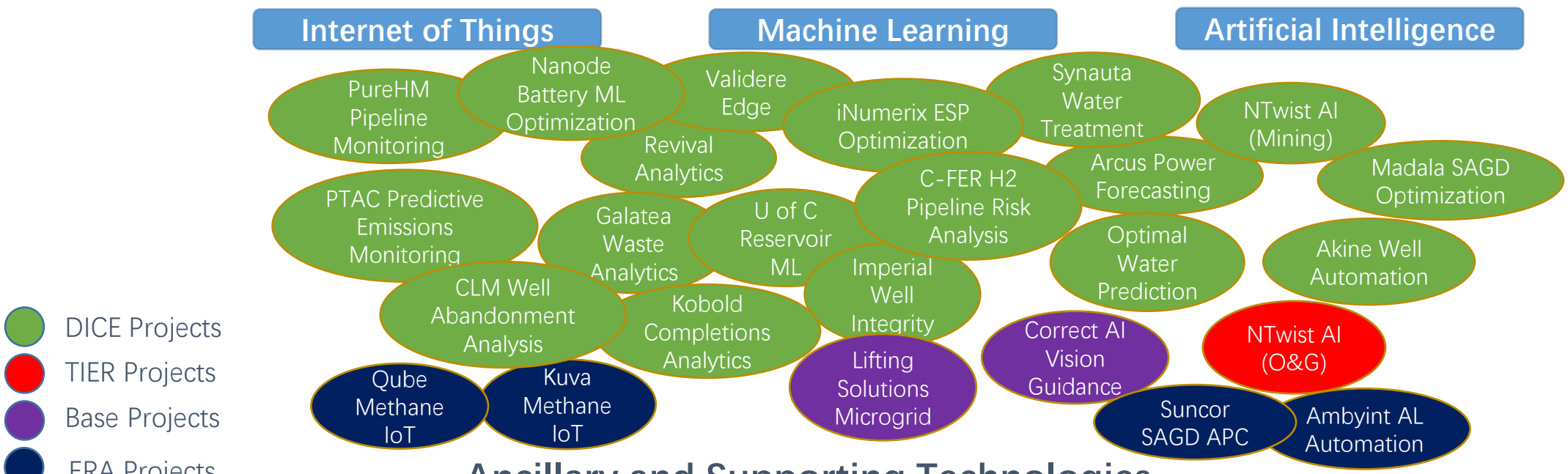
Data Value Chain



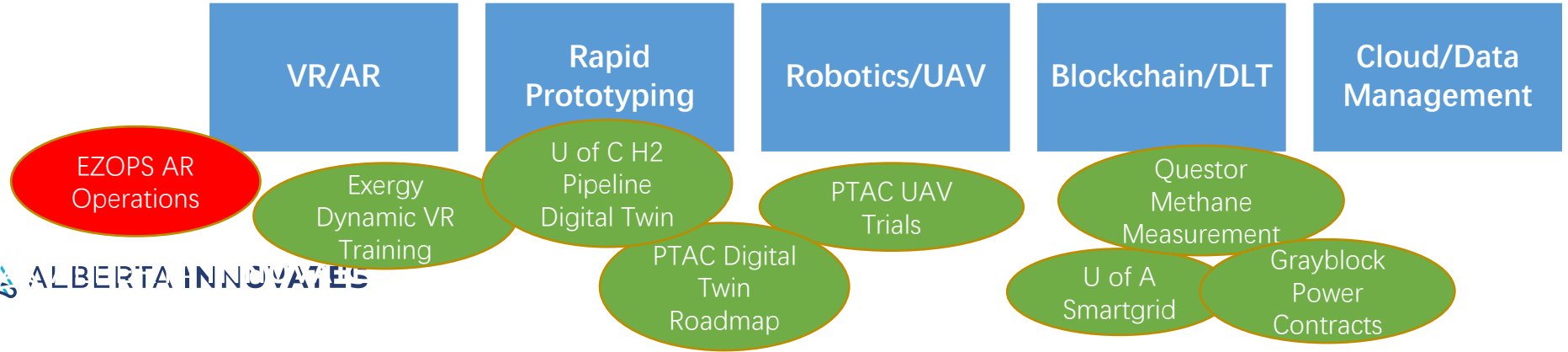
Ancillary and Supporting Technologies

VR/AR | Rapid Prototyping | Robotics/UAV | Blockchain/DLT | Cloud/Data Management

AI-CR Digital Portfolio



Ancillary and Supporting Technologies



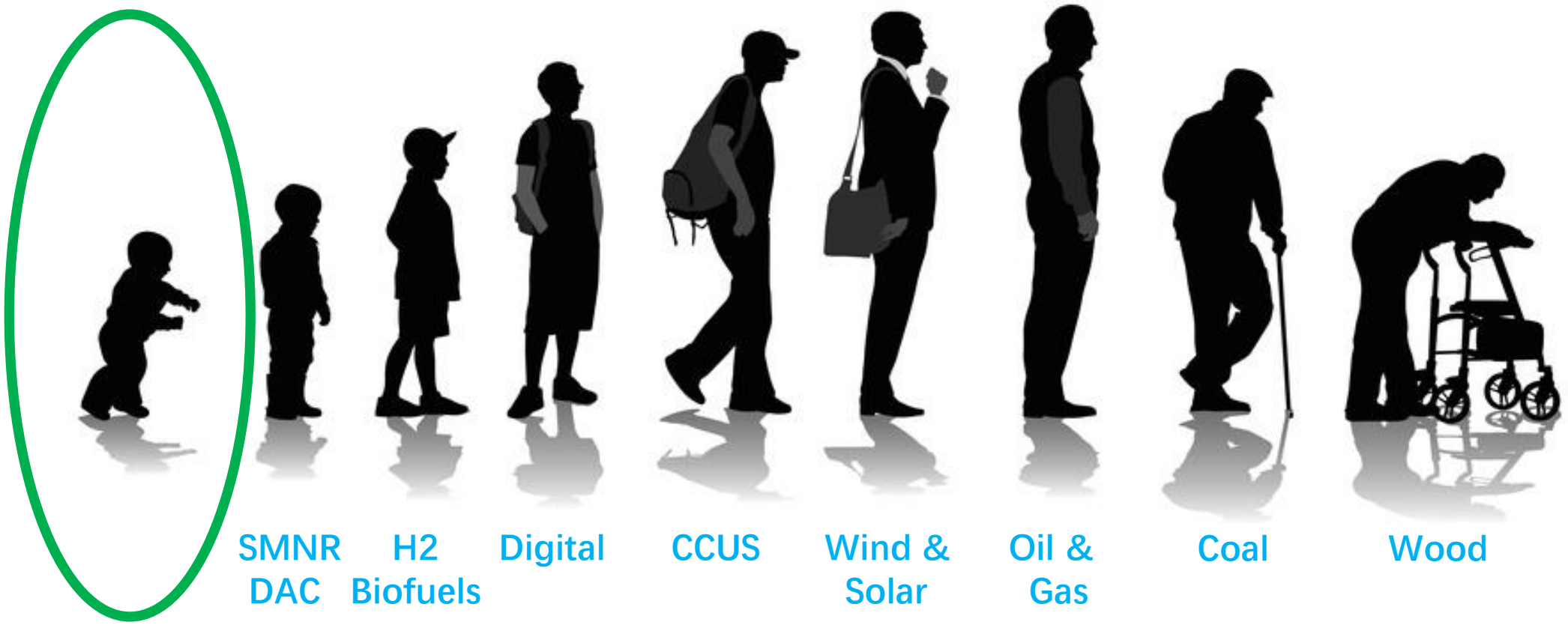
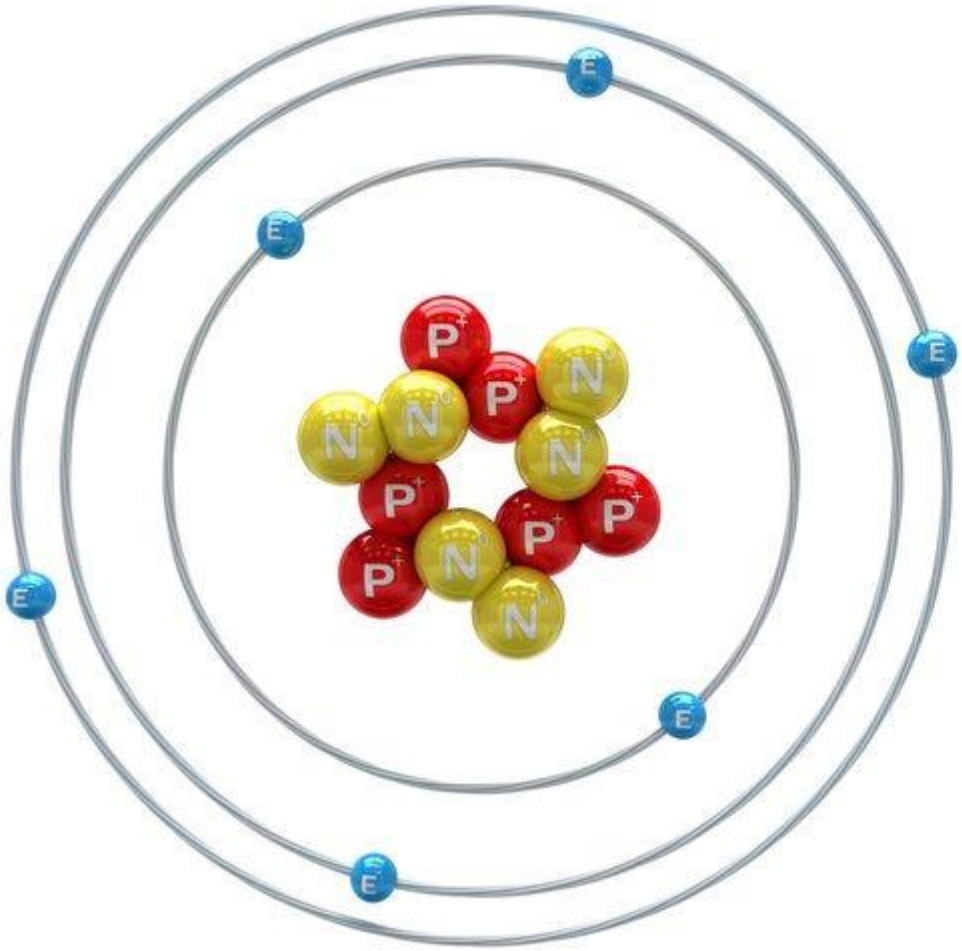

SMNR
DAC
H2
Biofuels
Digital
CCUS
Wind &
Solar
Oil &
Gas
Coal
Wood


Image courtesy of: Suncor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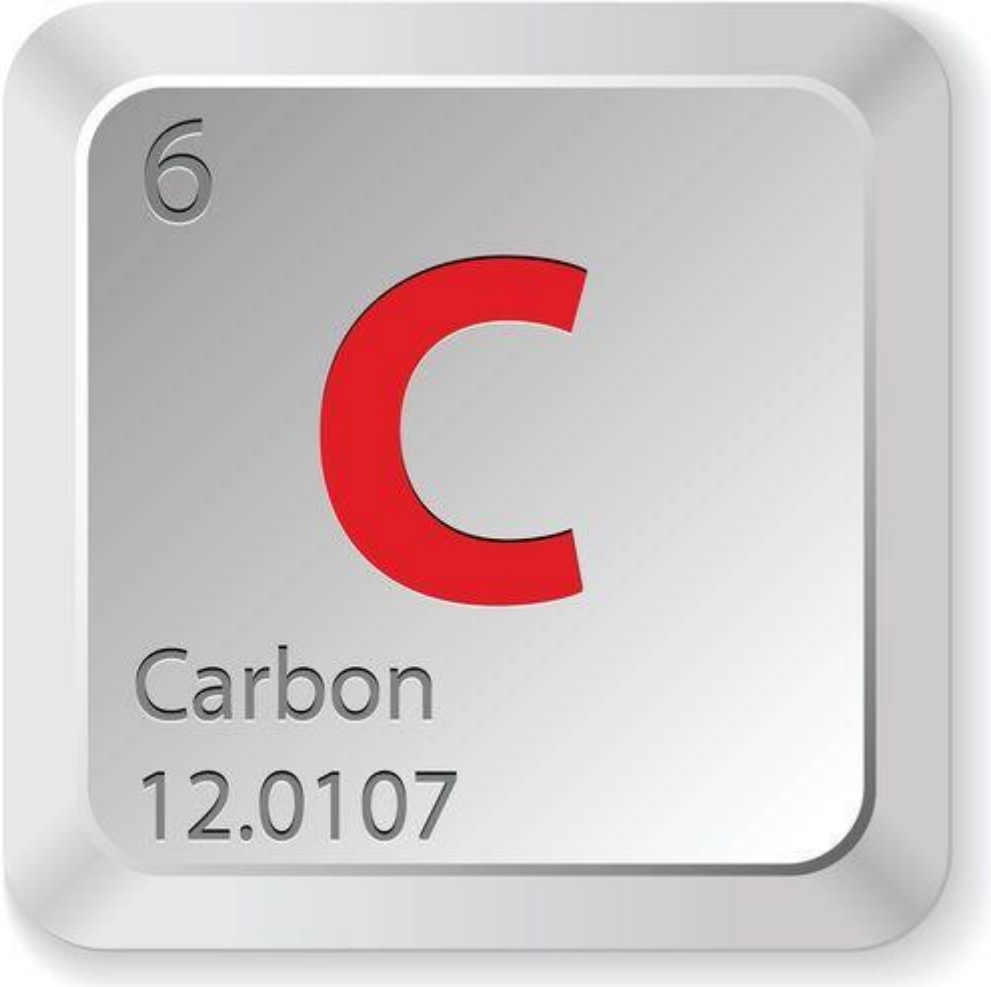
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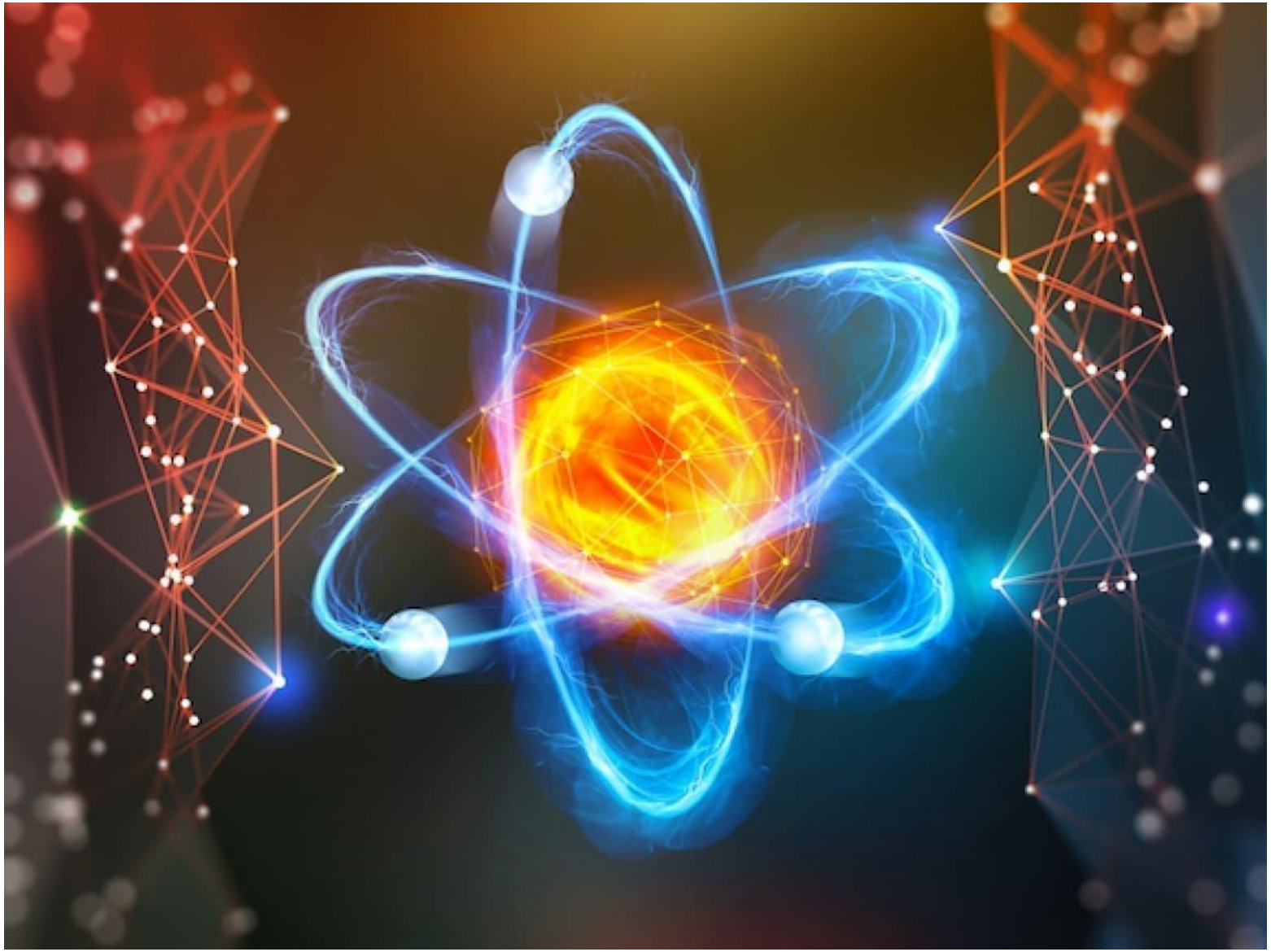
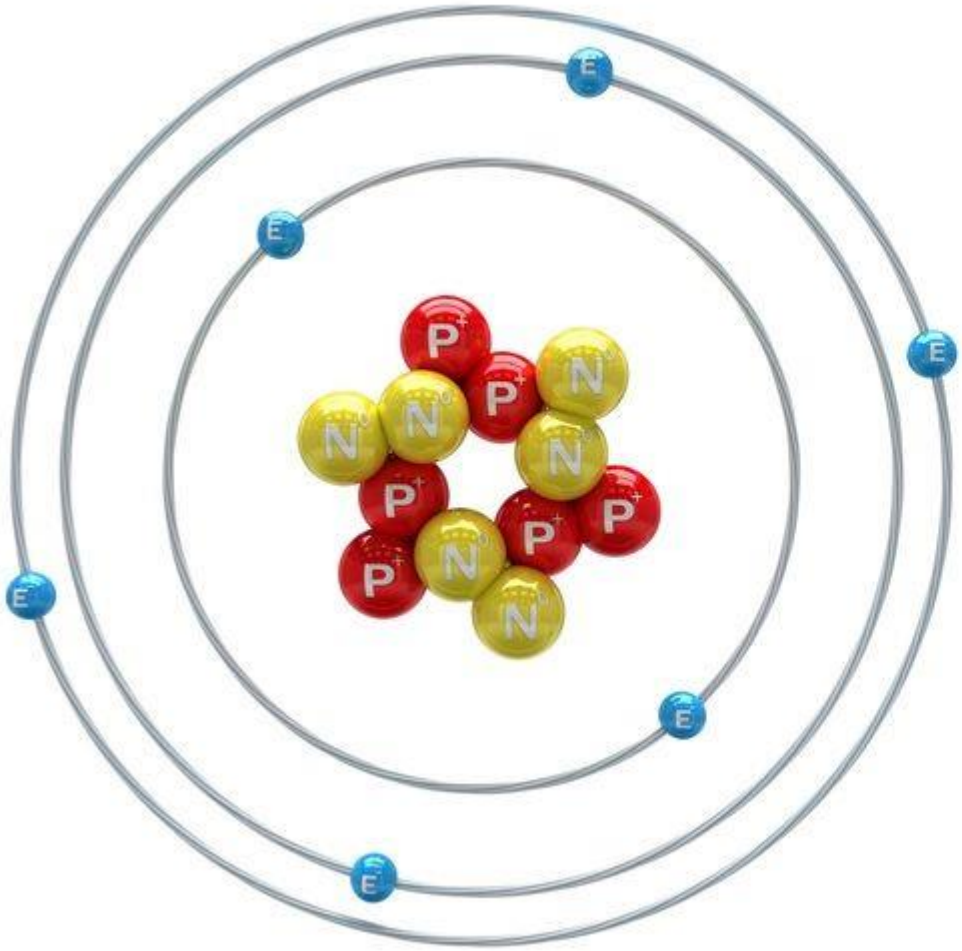
C
Carbon
12.0107



- Housing
- Roads
- Infrastructure
- Consumer Goods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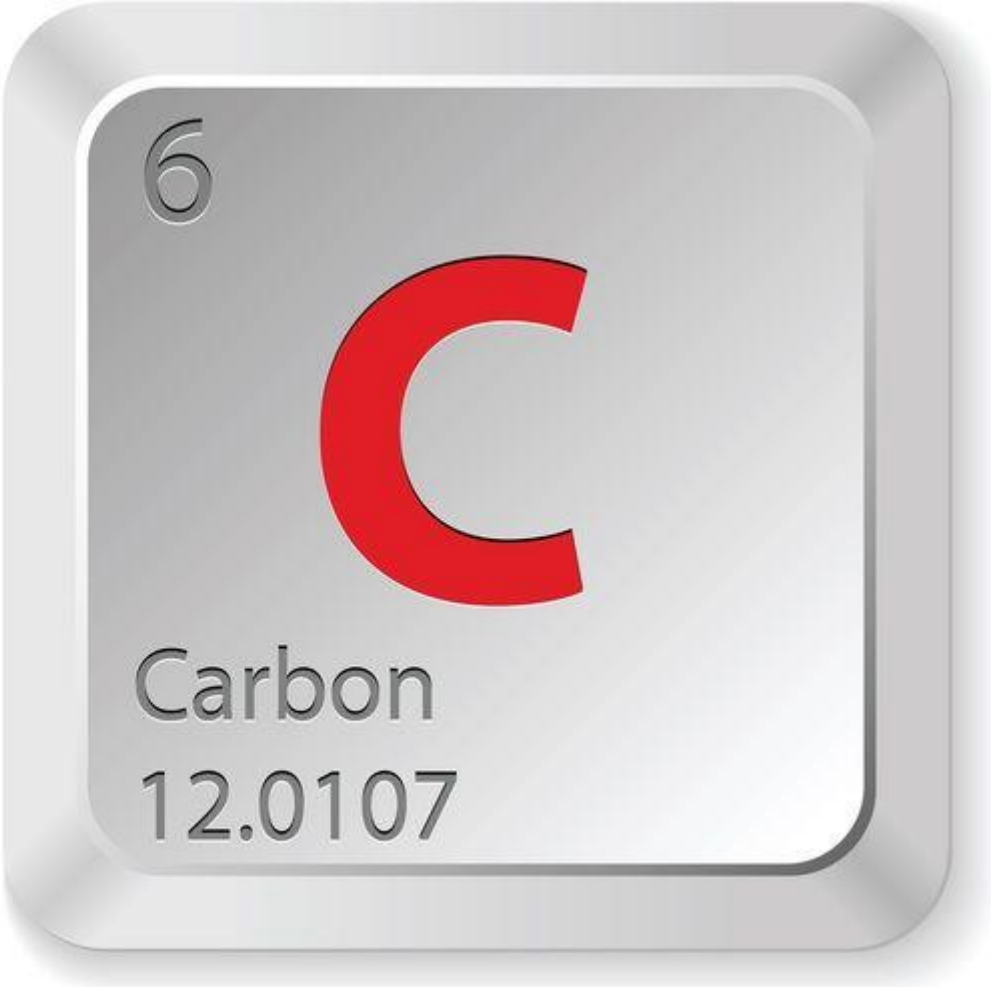
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Carbon
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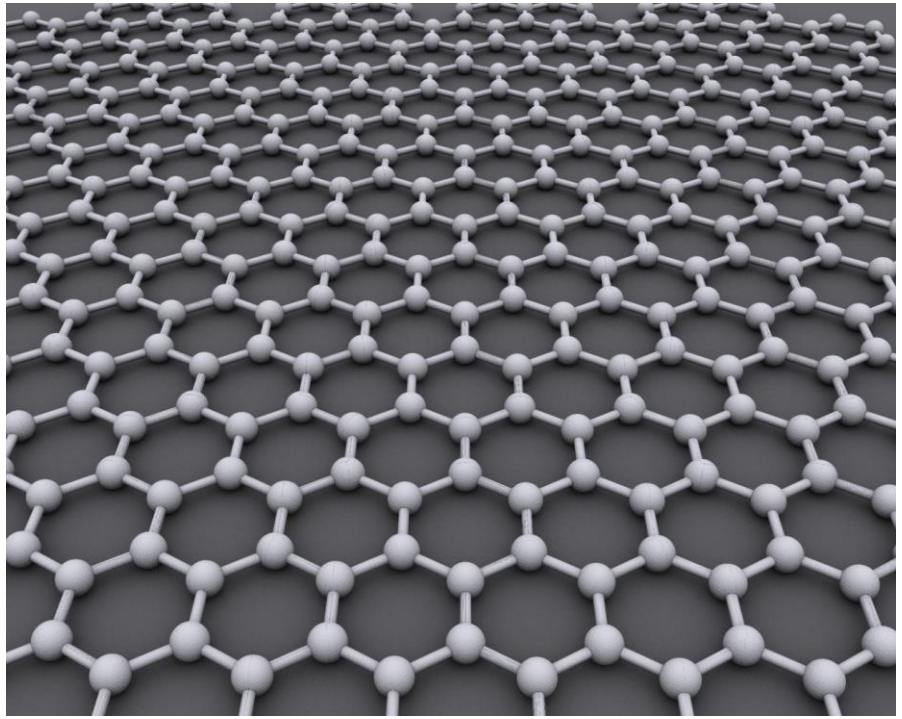
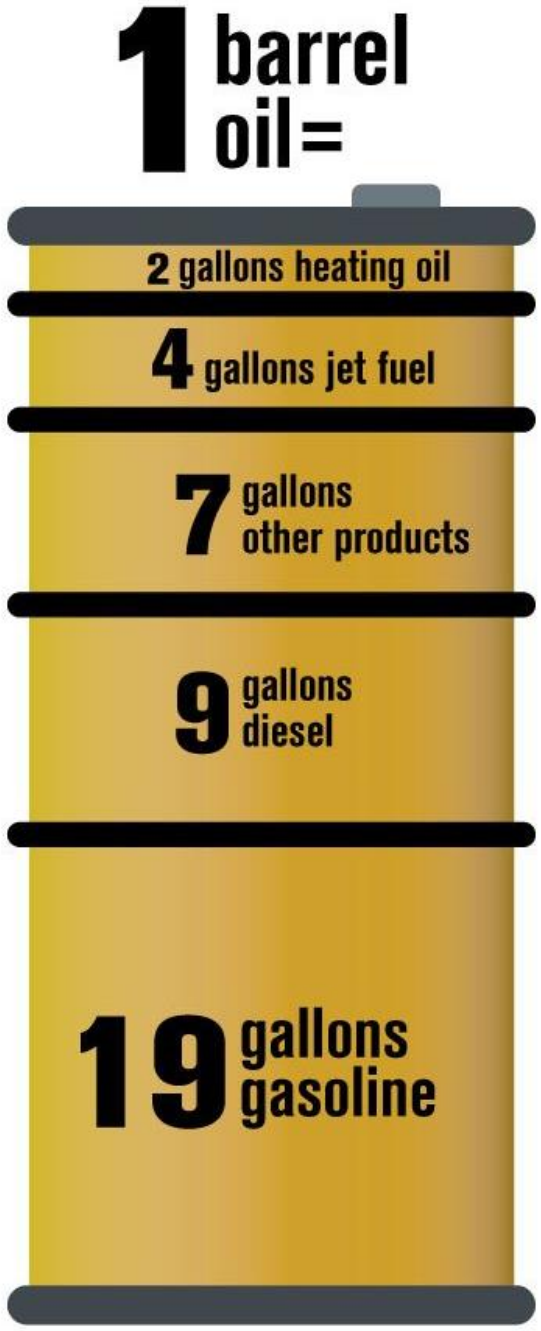
Can we turn oil sands' high carbon intensity (molecular basis) from a vulnerability into a strategic advantage?

Remember: “Low Carbon Economy” refers to carbon in the atmosphere



Bitumen Beyond Combustion (BBC)



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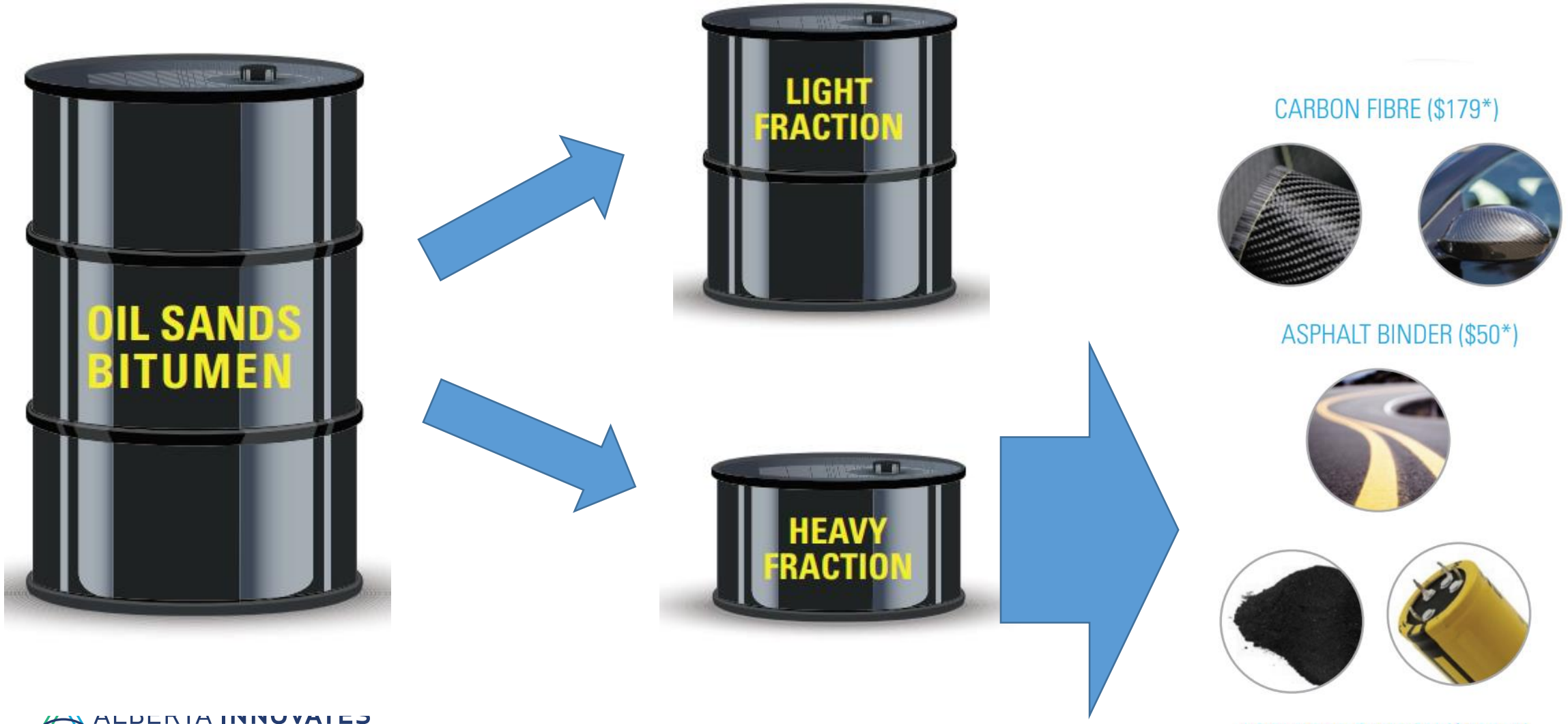
Bitumen as Feedstock for Materials



ALBERTA INNOVATES

Lithium mine production (tonnes)

Rank	Country	Year				
		2018[2]	2019[3]	2020[4]	2021[4]	2022[5]
1	Australia	51,000	45,000	39,700	55,000	61,000
2	Chile	16,000	19,300	21,500	26,000	39,000
3	China	8,000	10,800	13,300	14,000	19,000
4	Argentina	6,200	6,300	5,900	6,200	6,200
—	United States	—	—	—	5,000[a]	—
5	Brazil	600	2,400	1,420	1,500	2,200
6	Zimbabwe	1,600	1,200	417	1,200	800
7	Portugal	800	900	348	900	600
8	Bolivia	—	700[8]		540[9]	—

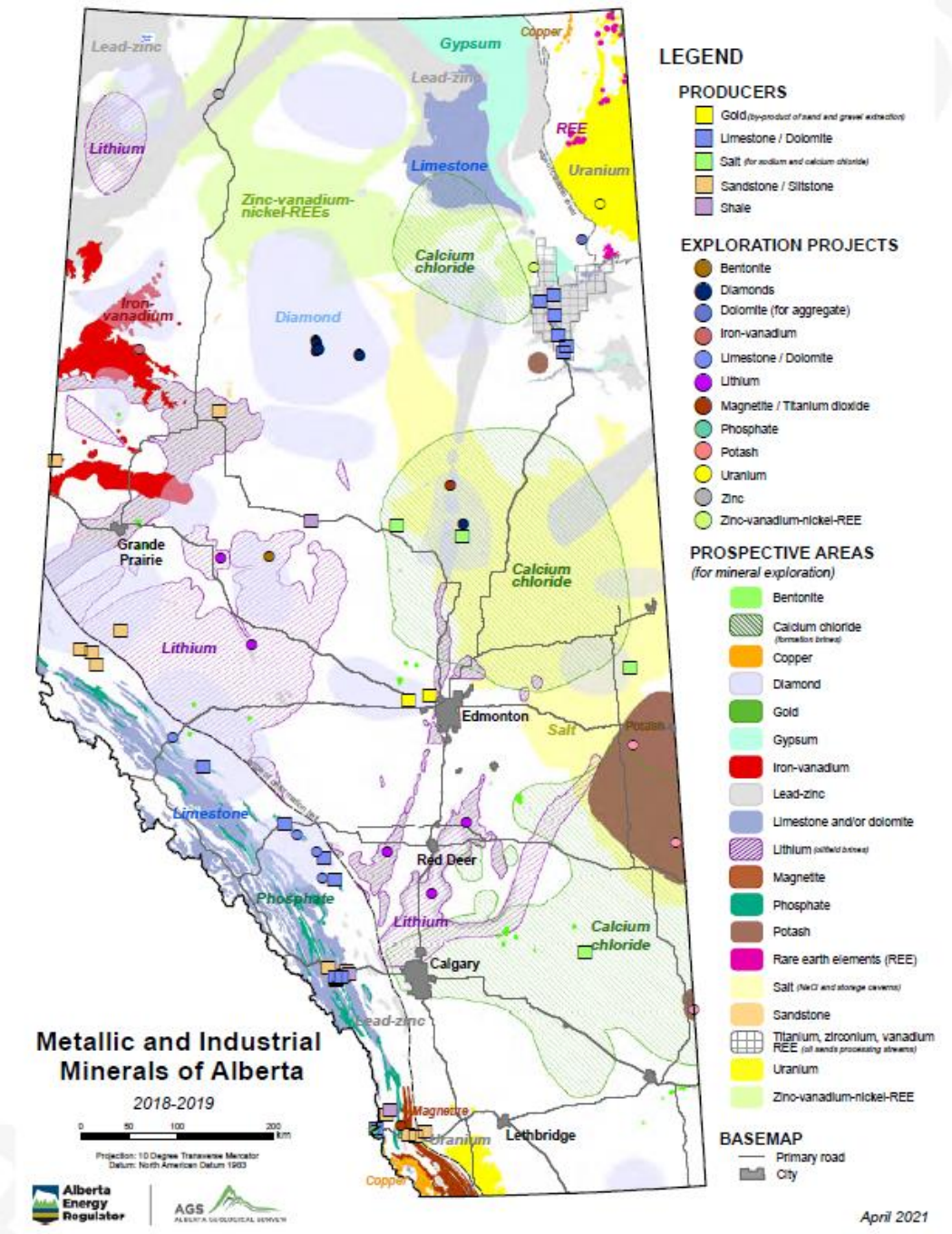


Figure 1: Metallic and Industrial Minerals of Alberta (Source: Alberta Geological Survey, 2021)

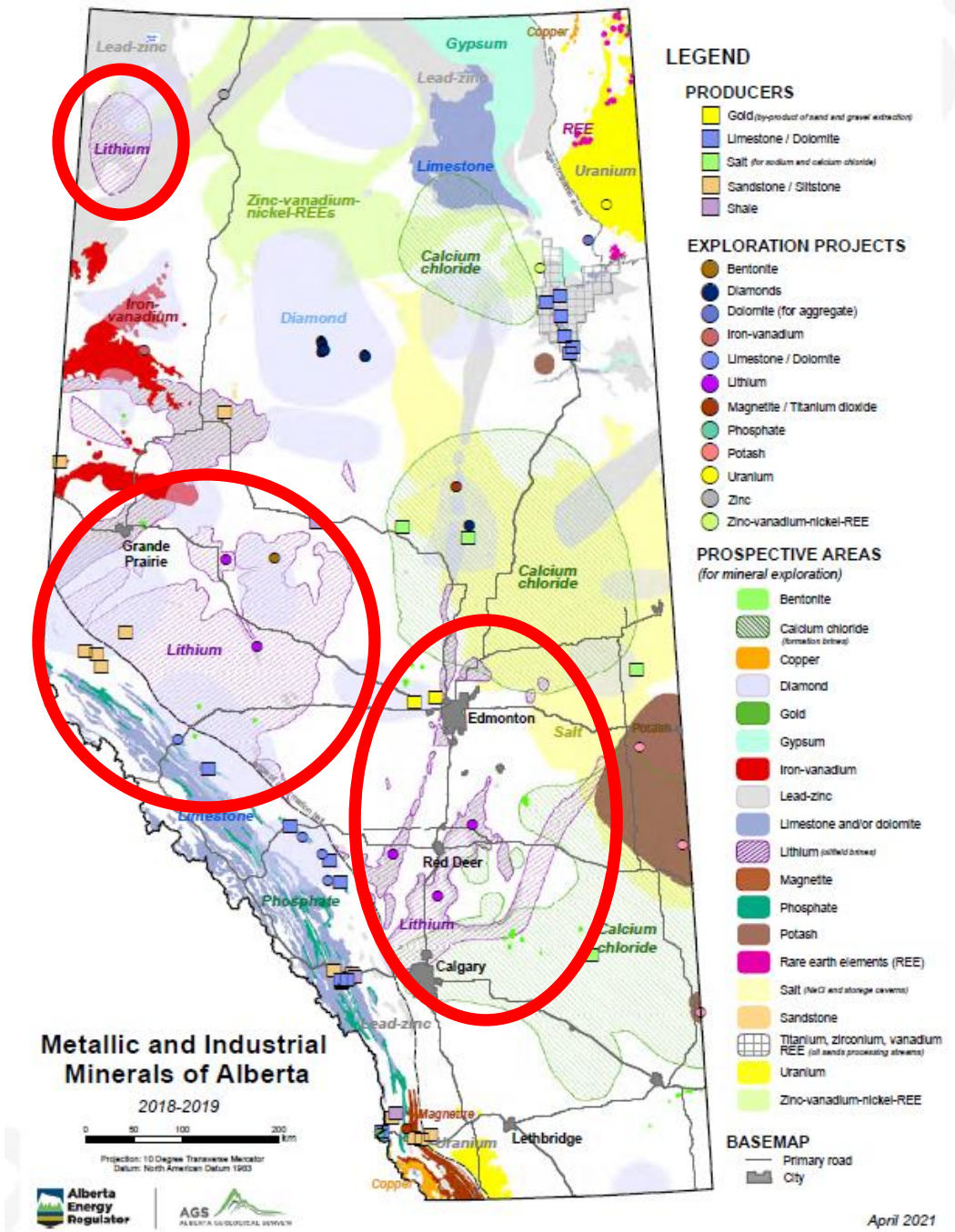


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Figure 1: Metallic and Industrial Minerals of Alberta (Source: Alberta Geological Survey, 2021)

- Low concentration feedstock
- Energy management
- Water management


E3 LiTHIUM


SUMMIT
NANOTECH


BBC Lithium
SMNR DAC
H2 Biofuels
Digital
CCUS
Wind & Solar
Oil & Gas
Coal
Wood


NET
ZERO

Thank you!

- **Smart Manufacturing Technology Conference**, Red Deer, April 4-5, 2023 https://www.smartmtx.ca/
- **Canadian Hydrogen Convention**, Edmonton, April 25-27, 2023 https://www.hydrogenexpo.com/
- **Upperbound**, Edmonton, May 23-26, 2023 https://upperbound.ai/
- **Inventures**, Calgary, May 31-June 2, 2023 https://inventurescanada.com/
- **Global Energy Show**, Calgary, June 13-15 2023 https://www.globalenergyshow.com/
- **Alberta Energy Efficiency and Innovation Summit**, Edmonton, June 20-21, 2023 https://www.energyefficiencysummit.ca/
- **Carbon Capture Canada**, Edmonton, September 12-14, 2023 https://www.carbonexpocanada.com/
- **World Petroleum Congress "The Path to Net Zero"**, Calgary, September 17-21, 2023 https://www.24wpc.com/