Happy Canada Day!

We can wave the flag this weekend without worries about being associated with any political movements.

We're assigning reading on energy

We're taking on a thorny subject this weekend. Achieving Global NetZero 2050 (zero GHG growth by 2050) and Canada's place in that effort.

For a refresher on the NetZero Global concept, we feature the Paris based Intl Energy Agency (IEA) Road Map report series. Not to be confused with the UN's Intergovernmental Panel On

Climate Change (IPCC), the IEA represents Europe's thinking on the subject. The IEA is oft featured by policy makers in Canada. In May 2021, the IEA generated '*Net Zero by 2050 A Roadmap for the Global Energy Sector*'. In the IEA's words it was their flagship work. The findings were based on 2019 to 2021 data, spanning the COVID-19 pandemic.

https://www.iea.org/reports/net-zero-by-2050

The IEA clearly supports and promotes their *'Path to NetZero'.* We must clarify their reports are predictions of what they believe must happen, not of what will happen.

One of the IEA's key assumptions of achieving NetZero2050 is that global energy consumption intensity will decline significantly. This view is shared by the IPCC and others.

From the May/2021 IEA report:

"In the net zero emissions pathway presented in this report, the world economy in 2030 is some 40% larger than today ***but uses 7% less energy"****.* Not a lower energy intensity, less energy total. A 2030 global economy that is 40% larger than 2021 using 7% less energy than 2021, implies a dramatic reduction in total energy use intensity. How dramatic?

The IEA's generated a supplementary May 18, 2021 report *Net Zero by 2050: a Roadmap for the Global Energy Sector* abbreviated summary presentation.

https://iea.blob.core.windows.net/assets/84c1a929-670a-4321-b7fd-a681f60ebe8e/NZE2050_launch_slides.pdf

Slide 2 (presentation page 3) projects global GDP energy intensity by 2030 (not 2050), defined as megajoules (MJ) of energy per USD at Purchasing Power Parity. The slide notes a 4% per year decline in energy consumed per unit of GDP by 2030. The decline in energy intensity falling from 4.5 units to 3 units equates to a 33% decline in energy intensity over 9 years. This implies an equal improvement in productivity to achieve the goal. This is a road map, not a prediction.

From the IEA's *'Updated NetZero2050 pathway 2022'*: (NZE = Net Zero Emissions)

https://iea.blob.core.windows.net/assets/830fe099-5530-48f2-a7c1-11f35d510983/WorldEnergyOutlook2022.pdf

"In the NZE Scenario, energy intensity improvements to 2030 are nearly three times faster than over the past decade. In 2030, energy savings from energy efficiency, material efficiency, and behavioural change amount to around 110 EJ, ***equivalent to the total final consumption of China today."***

By 2030 energy intensity improvements equate to China's total consumption in 2022. We must stress not hydrocarbon consumption, all energy consumption. Recall that productivity improvements tend to come in leaps with new discoveries. The 'low hanging fruit' effect means early gains are exponential while following gains are incremental.

To envision this process unfolding, think about the transition from horse-drawn transportation to gasoline powered cars and trucks. Many in the horse industry doubted the efficacy of cars. That proved to be a lack of imagination. Less horses meant less farm acreage required to feed them, redirecting that energy used to grow human food. The gains in

farming productivity were exponential. Cars and trucks carry far more weight per vehicle than a team of horses, reducing the number of vehicles required to move products.

A team of draft horses pulls a wagon at 2-3 miles per hour. The Ford Model T, introduced in 1908 (without government subsidies!) cruised at 20-30 MPH with a top speed around 45 MPH. In 1928 the Ford Model A was introduced with cruising speed at 40-50 MPH and a top speed of 60 MPH. By the late 1930's, horse drawn transport had largely disappeared. A Model A can still negotiate city streets and survive (barely) on a modern highway. The gains in human health and condition from 1908 to the 1950's were exponential. Since the 1950's, subsequent gains in both transportation technology and the average North American's lived experience have been incremental. We're all better off.

Are we on the cusp of an equally profound improvement? Are those challenging this notion failing from that same horse drawn lack of imagination?

The NetZero 2050 targets significantly less absolute primary energy consumption. The transition from horses to internal combustion engines dramatically increased core energy consumption. Human history does not support the idea of falling energy consumption…without declining population.

Here is the IEA's summary of individual behavioural changes required. Examples: Avg building cold weather heating falls to 19-20 C (66-68 F). Avg summer cooling temp rises to 24-25C (75-77 F). Eco-driving is enforced and highway speed limits capped a 100 KM/H / 62 MPH. The highway speed limit in parts of Texas is 85 MPH (1\36 KMPH). Typical driving behaviour is '10 over'.

With the above pathway predictions in mind, how do we determine where we are today and recent energy trends? Who is doing what and where?

I've found searching for the data frustrating. Those leaning in favor of the IEA's predictions tend to obfuscate or ignore challenging data, while those against, emphasize the negatives and dismiss positive technological outcomes.

Finally! An exhaustive source of macro trends for energy sources, production, consumption and trends all in one, free-access location.

'2023 Statistical Review of World Energy' – Energy Institute

From the website:

The Energy Institute Statistical Review of World Energy™ analyses data on world energy markets from the prior year. Previously produced by BP (British Petroleum- SH), *the Review has been providing timely, comprehensive and objective data to the energy community since 1952*.

https://www.energyinst.org/statistical-review

Takeaways for those pondering Canada's energy policies and place on the global energy stage.

'Primary Energy Consumption' Table Page 8.

Clarification: Energy consumption of all kinds in exajoules. Economic output requires energy. Increased economic output requires more of it. Improving productivity typically reduces energy intensity, (good). Productivity improvements have yet to equate to less total energy consumed. History says flat-to-falling energy consumption is a sign of a stalled economy. Note that this data series ends in the tail of the COVID-19 Pandemic. A return-to-normal could see much higher consumption for all entries.

- **Canada:** 2.3% of total global consumption. 10-year total growth ½% (flat).
- USA: 15.9% of total. 10-year total growth: +6.3%.
- All of Europe: 13.2% of total. 10-year growth: -8.6% (!!). That can't be good
- All of Africa: 3.4% of total (barely above Canada). 10-year growth: +20% (low base).
- Asia Pacific: 46% of total. 10-year total growth rate: +30% (!).
- OECD: 38.8% of total – 10-year growth: 0.86%. Stagnate?
- Non-OECD: 61.2% of total – 10-year growth: +25%
- EU: 9.6% of total. 10-year growth -8%

CONCLUSIONS: The future of global energy consumption will not be determined in Canada

Primary Energy Consumption by Fuel 2022 – Table page 9

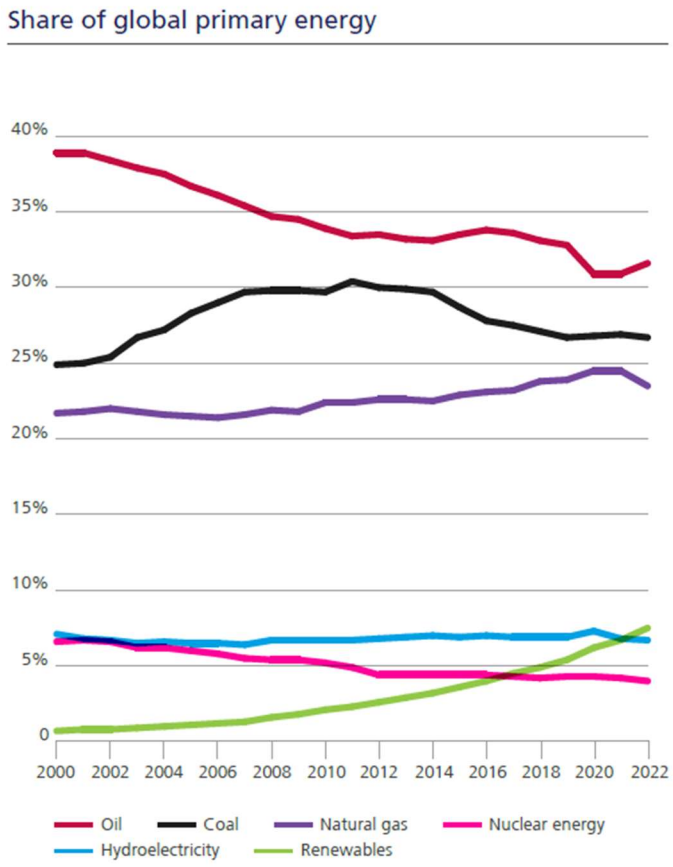
Canada's consumption mix:

- Oil, Gas & Coal: 9 exajoules = 64% of Canada total energy consumption in 2022
- Hydro-electricity: 3.74 exajoules = 26.4% of total Canadian energy consumed.
- Renewables+ 0.59 exajoules = 4.17% of total consumed.
- US 2022 Coal consumption exceeded Canada's entire hydrocarbon use.
- China's coal consumption was 6.25 X all of Canada's hydrocarbon use.

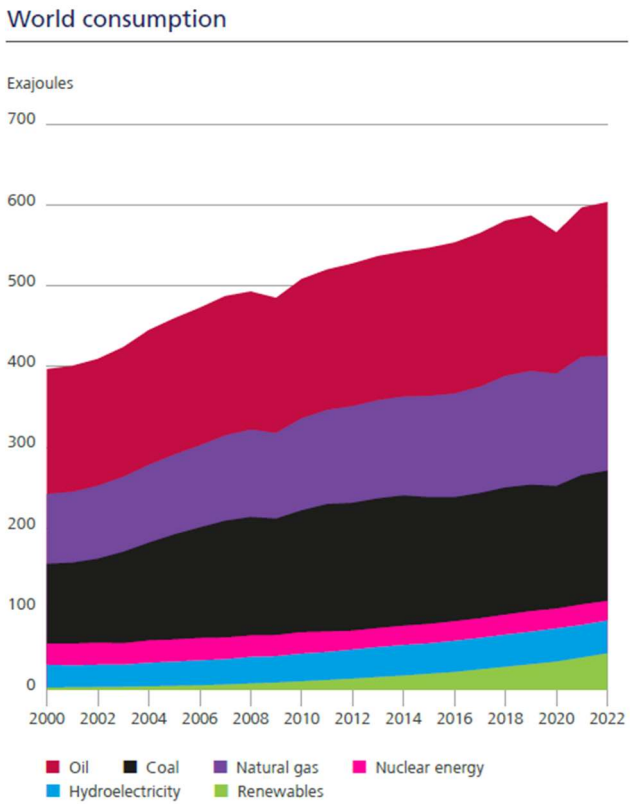
Primary Energy Consumption by Fuel - Table Page 10

Global Consumption Mix:

The combined share of global primary energy consumption met by oil (red), coal (black), and natural gas (purple), has declined from 84% in 2000 to 83% today. Nuclear (pink) is down, hydro (blue) is flat while renewables (green) have been climbing. The last is a good thing.



Coal's share of global consumption (black line above) has fallen over the past decade. The next chart clarifies total hydrocarbon consumption including coal, continues to rise. (red, purple, black). The trend slope (ending in early post-COVID) isn't abating…yet. It might.



Consumption Per Capita – Table page 11

Per-capita energy consumption divides all energy consumed nationally by population. Canada's per-capita energy consumption ranks among the highest. This is a shame talking point for activists. Note that the table says Trinidad and Tobago has a higher rate. The highest per-capita rates are in the Middle East, a function of their modest populations and huge energy outputs (OPEC). Canada's small population, cold climate, long distances and intensive per-capita industrial output plus well-developed energy generation (all forms), means our 'per-capita consumption' is higher. That doesn't say much about how individual Canadian's consume energy and even less about what matters. Per-capita consumption in China is 1/3rd of Canada's. India 1/14th. China and India = 32% of global energy consumption. Canada's per-capita consumption is not a shame we need to address. It is a sign of Canada's success and wealth distribution. It is a red herring.

Conclusions: The fate of the planet's GHG footprint is in non-OECD, particularly Asia's, hands. Given their behaviour to date, what is the likelihood of those countries and thus the globe achieving NetZero?

The data confirms Canada's contribution to global GHG emissions is miniscule. Our policy decisions will have little effect on global GHG emissions. If so, where should we be focusing our efforts? We agree reducing Canadian-sourced GHG emissions is a laudable goal. Is Canada better served focusing our regulatory efforts and limited financial resources on

climate-change impact mitigation strategies? Should we prioritize the risk of wild fires, floods, droughts to our energy supplies, water, food and infrastructure?

For a sense of the potential scale of the climate-change mitigation problem, we assign viewing the **BC Highway 8 Nov/2021 flood damage flyover.** Highway 8 connects Spence's Bridge to Merritt. The devastation to the rural residents and communities along the route, received little airtime nationally and none internationally. 21 locations were destroyed, entire valley bottom sections of the highway gone. Residents were trapped in both directions. Highway 8 finally reopened in late 2022 and remains compromised.

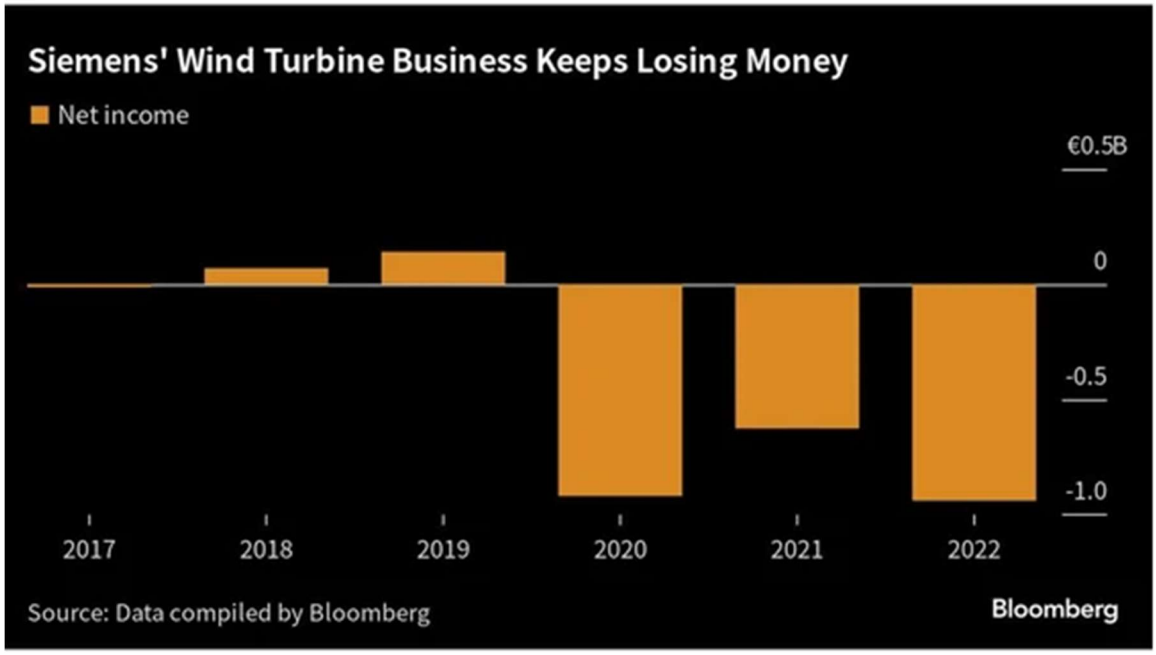
BC Highway Cam survey Nov/2021 flood damage flyover

https://www.youtube.com/watch?v=teqFZCEsez0

The IEA's NetZero2050 pathway includes a major edition to wind powered turbines. The devil is always in the details.

'Wind Turbines That Shake and Break Cost Their Maker Billions' – Financial Post Jun 29, 2023

Wind turbines make money when they spin. But when they shake, it can cost billions.



https://financialpost.com/pmn/business-pmn/wind-turbines-that-shake-and-break-cost-their-maker-billions

This could simply be teething problems. On the other hand, "…*Siemens AG late Wednesday said it cut its stake in Siemens Energy by 6.8% to 25.1%, after flagging last month it'll "very likely" exit in the long term."*

We continue to stand aside from direct investments in wind-energy manufacturing.

On the question of electric vehicles (EV) regulations and subsidies…

Don't Outlaw Private Cars, Target EV Subsidies Better – Alan Brooks June 24, 2023

We are in the Fourth Industrial Revolution claims Klaus Schwab, founder of the World Economic Forum (WEF). Therefore, we should "take dramatic technological change as an invitation to reflect about who we are and how we see the world." Such a guiding principle is driving the green revolution, including banning internal combustion engine (ICE) vehicles because they dump tailpipe emissions into the atmosphere. We should only drive electric vehicles (EV), and they should be powered by the grid of the future fueled only by wind and solar.

A year ago, the WEF produced a paper about building a circular economy to reduce the need for a 500% increase in critical minerals to support the green energy revolution. Buried in the paper was the idea that people should cease owning vehicles and switch to vehicle-use services. Fewer vehicles being driven more miles might help speed up the emissions reduction effort. Some commentators jumped on the WEF's idea as a justification for banning the private ownership of vehicles, a heavy-handed government intrusion into people's lives, as if telling the people what kind of car they may buy isn't. Support for this idea has split along political lines.

Mr. Brooks' commentary is not anti-climate change policies nor anti-EV. He provides a measured, rationale examination of the facts, backed by data that is so often sadly lacking in the discussion.

Clarification: A **plug-in hybrid** relies on a battery pack backed by an onboard power generator. Current technology has that generator powered most often by an internal combustion engine (ICE) and more rarely by a hydrogen fuel cell. Toyota has devoted attention to hydrogen fuel cells. Once battery range is exceeded, the on-board generator kicks in extending driving range indefinitely. A **hybrid electric** does not rely on a large battery pack. It has an onboard engine (typically ICE) to generate electricity driving the wheels via a much smaller battery. Hybrid electrics weigh much less. Hybrids attempt to improve total energy efficiency available from hydrocarbon fuels which is of course the main challenge of an ICE powered car and a prime argument in favor of BEV's. 12-30% of the energy put into an ICE car is used to move it down the road. The remaining 70% is lost to heat, friction and weight. Current hybrids deploy 21-40%. This is a significant gain., but…BEV's employ 77 to 100% of the energy stored in the battery to move the car. In that sense BEV's are more efficient. But wait…BEV's weigh more taking more energy per carried kilo to move. The longer the range the bigger and heavier the battery. Do you have a headache yet?

For more detail on how energy is used to move cars see this US Govt data source.

'Where the Energy Goes' US Dept of Energy

https://www.fueleconomy.gov/feg/atv.shtml

In Mr. Brooks' commentary regards purely battery-powered EVs (BEV - IE Tesla) vs. hybrid EVs (HEV - Toyota Prius), he notes there may be a policy shift in favor of hybrids. Given the importance of government policies (and subsidies) a shift could have material outcomes for investors.

"Embracing such a policy shift would be to acknowledge that Toyota Motor Corporation President Akio Toyoda is right that HEVs are more effective decarbonization tools than BEVs. As he stated earlier this year, BEVs "are not the only way to achieve the world's carbon neutrality goals." He explained the overall emissions advantages of HEVs when he stated, "The amount of raw materials in one long-range battery electric vehicle could instead be used to make 6 plug-in hybrid electric vehicles or 90 hybrid electric vehicles." He went on to point out that "The overall carbon reduction of those 90 hybrids over their lifetimes is 37 times as much as a single battery electric vehicle." That is a very powerful fact that should be given greater weight to how to create government policy for cutting emissions.

We urge readers to add Mr. Brook's entire commentary to their Long Weekend reading list.

https://energy-musings.com/energy-musings-june-24-2023/

CONCLUSION: We continue to believe hybrids are potentially an easier replacement for long distance use ICE powered cars while plug-in hybrids with varying battery/generator ratios make sense for city use, explaining our investment in Toyota.

We view the 100% electrified/all-battery powered vehicle fleet as a challenge in developed countries and highly unlikely in the non-OECD. We remain cautious on investing in pure BEV manufacturing (we worry about Tesla shareholders). This view means oil & gas will be needed and valuable for longer than the current narrative holds out, explaining our continued positioning in conventional oil and gas. Our views are contrarian.

How will the demand for nuclear power change?

'Inflation Reduction Act: Why is the IRA a game changer for nuclear power?' Credit Suisse ESG Report Oct 26, 2022

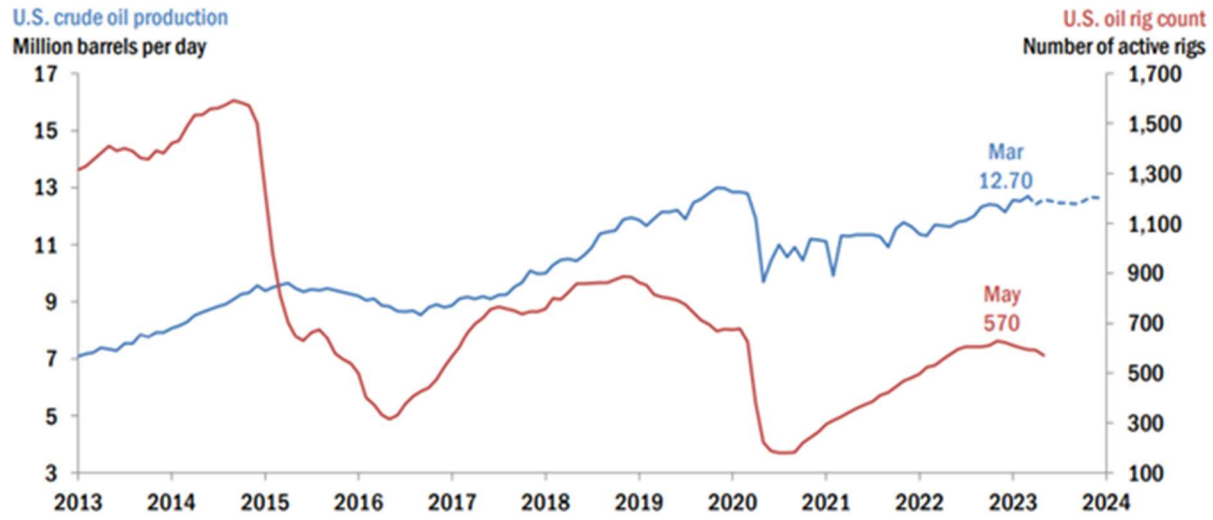
See the attached Credit Suisse report.

We have been studying nuclear power as an investment. We've researched Canadian uranium producer Cameco (CCO-TSX-$40.17) but can't get our head around the current 104 X trailing earnings valuations. We continue to follow the story.

If future hydrocarbon demand may be higher than predicted, what of supply?

The United States oil industry has been the source of largest marginal increase in global oil supplies, via shale oil, the majority from the Permian Basin in West Texas. Drilling predicts future supplies. Lower drilling means lower future supplies. US rig counts are down 50% over the past 10 years. Production is a bit higher. The employee head count confirms the drilling down trend. Increasing production from decreasing wells can't continue.

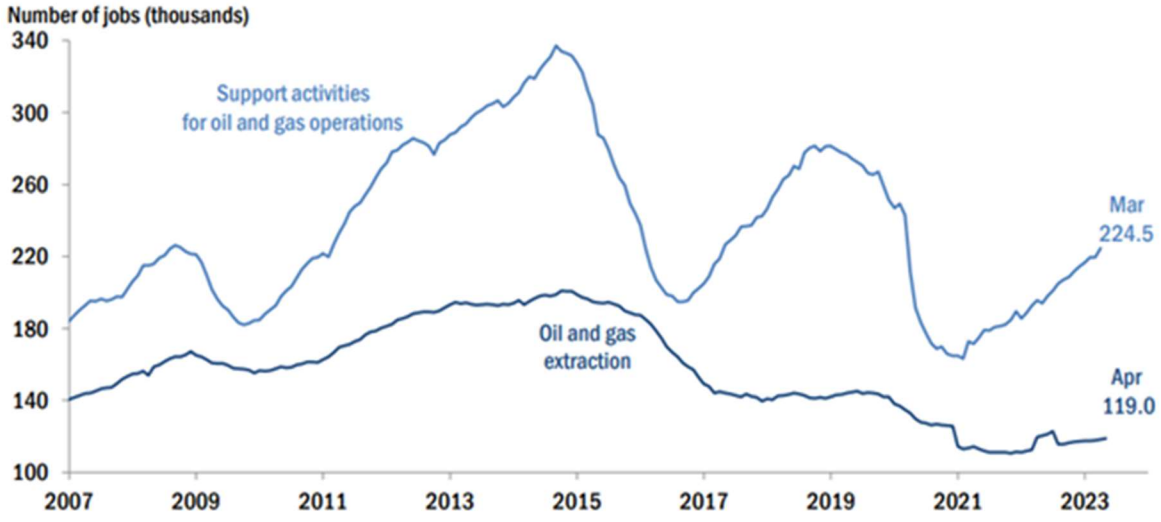
U.S. Oil Production & Rig Count



Federal Reserve Bank of Dallas

NOTES: Dashed line shows the forecast as of 05/09/23. Rig count series shows the last weekly count each month.
SOURCES: Baker Hughes; Energy Information Administration.

U.S. Oil & Gas Employment



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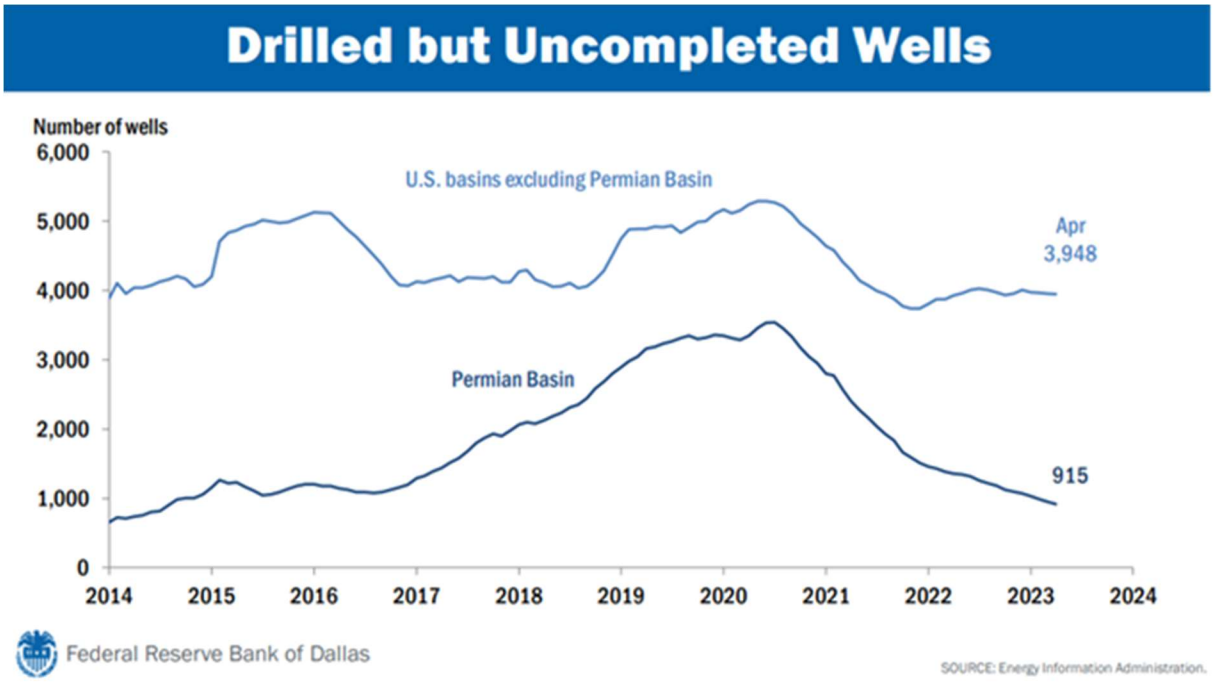
NOTE: Series are seasonally adjusted.
SOURCE: Bureau of Labor Statistics.

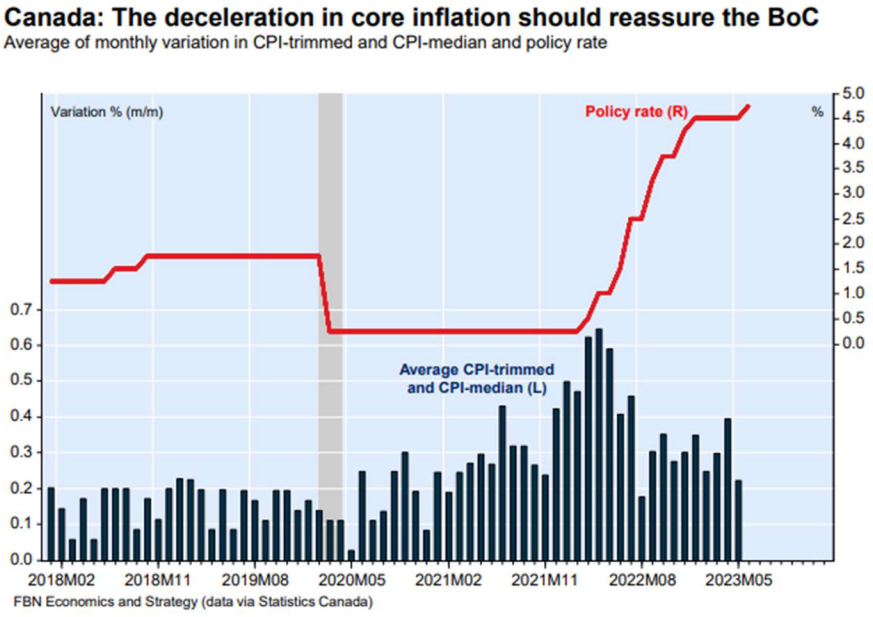


Most Of U.S. At Elevated Risk For Energy Shortfall This Summer: NERC RBN Energy

https://rbnenergy.com/analyst-insights/most-us-elevated-risk-energy-shortfall-summer-nerc

'Canada: A Welcomed deacceleration in core inflation' – NBF Economics

We've been saying Canadian inflation and interest rates have peaked (for now). Looks like the data is starting to support this idea.



https://nbf.bluematrix.com/sellside/EmailDocViewer?encrypt=e07b5b20-f120-4bc9-814b-03ffa165ea97&mime=pdf&co=nbf&id=steven.hilberry@nbc.ca&source=mail

After wading through all the numbers here's our conclusions:

The world needs more Canada. It is a great place to invest and a better place to live!!

Happy Canada Day!

Steve & Anna Hilberry

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FOR THE RECORD June 30, 2023

DOW INDUSTRIALS:	34,310
S&P 500:	4,439
S&P/TSX COMP:	20044
WTI:	$70.69
LOONIE IN $USD:	$0.7553 $US

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