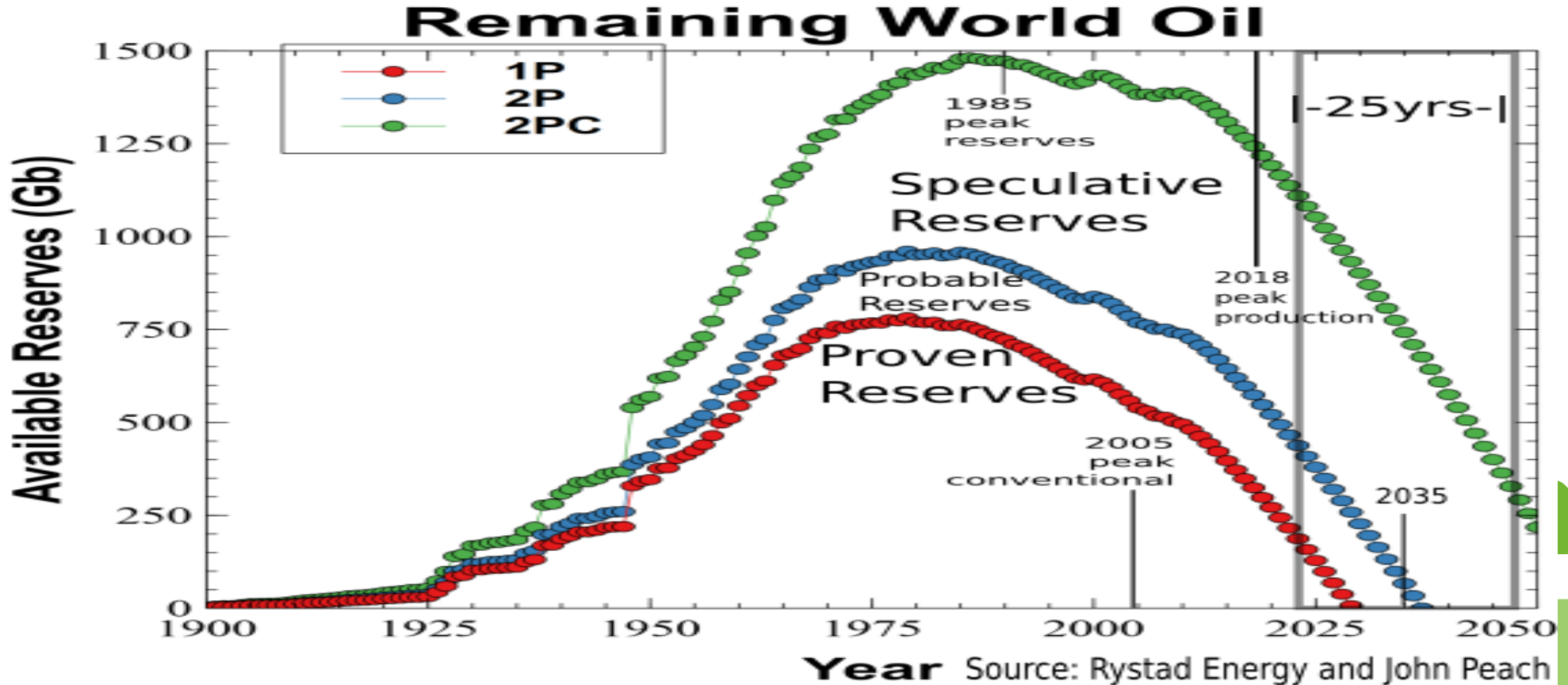


# Peak Oil and Rural Transition

- By Andrii Zvorygin of Owen Sound, Grey County



# Rystad Energy's 2022 global recoverable oil resources outlook

Billion barrels of oil

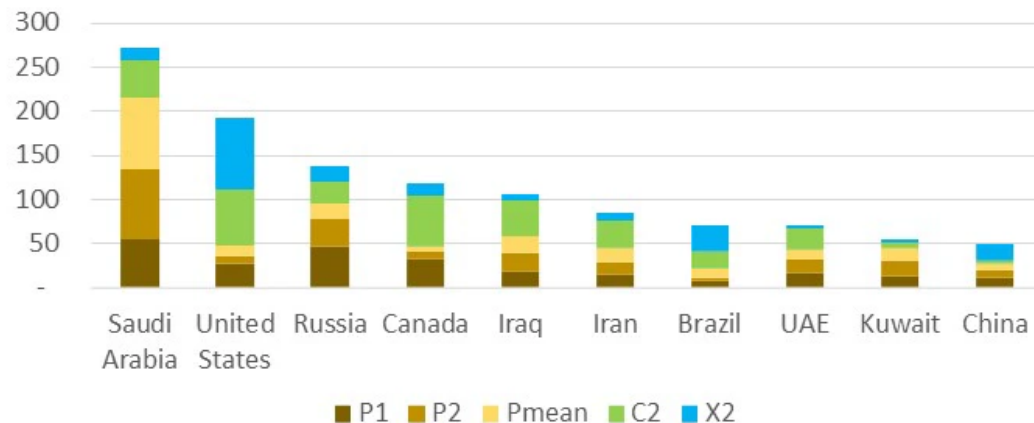


RYSTAD ENERGY

	1P	2P	2PC	2PCX	Added	mmbblid*	1P life	2PCX life	BP SR**	BPSR vs. 1P	BPSR vs. 2PC
<b>Non-OPEC</b>	<b>165</b>	<b>256</b>	<b>589</b>	<b>891</b>	<b>-6</b>	<b>50.4</b>	<b>9.0</b>	<b>48</b>	<b>518</b>	<b>313%</b>	<b>88%</b>
Russia	45	78	120	137	-2	10.2	12.2	37	108	237%	90%
United States	27	36	112	193	8	12.1	6.1	44	69	255%	61%
Canada	32	41	104	118	-1	4.6	19.2	70	168	521%	162%
Brazil	7	11	41	71	-4	3.2	5.9	61	12	174%	29%
China	10	19	31	49	-1	4.0	7.0	33	26	253%	84%
Qatar	6	10	34	37	1	1.3	12.0	77	25	437%	73%
Kazakhstan	8	12	27	32	-1	1.9	12.3	47	30	355%	110%
Mexico	3	6	15	26	-2	1.8	5.0	39	6	182%	41%
Norway	5	7	12	17	-1	1.8	7.6	26	8	163%	67%
Argentina	1	2	6	22	-0	0.6	6.1	106	2	201%	45%
Australia	1	1	3	22	-0	0.3	5.5	181	2	354%	76%
Guyana	1	1	10	12	2	0.2	7.1	131		0%	0%
United Kingdom	1	3	8	10	-1	0.8	5.0	34	3	173%	31%
Azerbaijan	2	3	5	10	-0	0.7	9.4	38	7	287%	130%
Other Non-Opec	12	20	55	127	-2	7.0	4.9	50	52	415%	93%
<b>OPEC</b>	<b>133</b>	<b>292</b>	<b>629</b>	<b>682</b>	<b>-21</b>	<b>31.6</b>	<b>11.5</b>	<b>59</b>	<b>1,215</b>	<b>915%</b>	<b>193%</b>
Saudi Arabia	56	136	262	275	5	10.8	14.2	70	298	529%	114%
Iraq	19	39	99	105	-1	4.9	10.5	59	145	779%	147%
Iran	14	29	76	84	-13	3.3	11.3	71	158	1165%	207%
UAE	17	31	67	70	1	3.4	13.1	56	98	592%	147%
Kuwait	12	30	51	53	2	2.8	11.7	53	102	860%	198%
Venezuela	2	4	23	27	-10	0.8	7.2	99	304		
Nigeria	3	5	17	18	-2	1.7	5.5	30	37	1093%	215%
Libya	3	6	14	18	-1	1.1	8.0	45	48	1478%	351%
Algeria	4	6	9	13	-0	1.2	8.7	31	12	325%	139%
Angola	2	3	8	10	-0	1.1	5.6	24	8	341%	96%
Congo	1	1	3	4	0	0.3	6.5	36	3	446%	95%
Gabon	0	1	1	2	-0	0.2	6.8	30	2	473%	178%
Equatorial Guinea	0	0	1	1	-0	0.1	4.4	14	1	597%	216%
<b>World Total Oil</b>	<b>298</b>	<b>548</b>	<b>1,218</b>	<b>1,572</b>	<b>-27</b>	<b>82.0</b>	<b>10.0</b>	<b>53</b>	<b>1,732</b>	<b>581%</b>	<b>142%</b>
Natural Gas Liquids						11.8					
Other liquids						6.0					
<b>World Total Liquids production 2022e</b>						<b>99.8</b>					

- \* Global oil production 2022, excludes natural gas liquids, biofuel and refinery gains
  - \*\* Reserve estimate from national authorities 2020, as reported in BP Statistical Review 2022
  - 1P** Proved oil reserves (as of 1.1. 2022), conservative estimate in existing fields
  - 2P** Proved+Probable oil reserves, most likely estimate in existing fields
  - 2PC** Proved+Probable oil reserves plus mean contingent recoverable oil resources in yet undecided projects/discoveries, including noncommercial volumes
  - 2PCX** Most likely estimate for existing fields, plus contingent resources in discoveries, plus risked prospective resources in yet undiscovered fields
  - Grey boxes indicates which PRMS category appear closest to official estimates
  - Red boxes indicates official estimates are higher than any PRMS category
- The above classification scheme is aligned with the PRMS standard from the Society of Petroleum Engineers "Oil" is crude oil + lease condensate. Note BP Statistical Review includes Natural Gas Plant Liquids

Top 10 countries by oil reserves and oil resources (billion barrels)



Source: Rystad Energy UCube, Rystad Energy research and analysis

# Recoverable oil by country and resource classification

Billion barrels of oil

	IP	2P	2PC	2PCX	Mbb/d*	IP life	2PCX life	Upstream emissions kgCO2/bbl
<b>Non-OPEC</b>	183	306	646	928	52.4	9.6	48.5	22
United States	41	55	122	192	12.9	8.8	40.6	13
Russia	43	65	126	143	10.6	11.2	37.2	23
Canada	35	49	114	127	4.7	20.5	73.8	53
China	12	29	58	75	4.1	7.9	50.0	17
Brazil	7	23	41	65	3.4	5.9	52.2	16
Qatar	5	12	33	36	1.3	11.2	74.3	18
Kazakhstan	10	16	27	33	1.9	15.1	47.4	17
Mexico	3	7	16	23	2.0	4.4	32.4	25
Australia	1	1	3	22	0.3	4.9	209.4	35
Argentina	2	3	7	19	0.7	7.8	76.0	31
Norway	4	8	11	16	1.9	5.9	23.0	9
Guyana	1	5	10	14	0.4	4.9	96.4	29
United Kingdom	1	3	7	9	0.7	4.7	32.3	27
Other non Opec	16	32	71	153	7	6	57	25
<b>OPEC</b>	102	199	638	696	30.5	9.2	62.6	23
Saudi Arabia	33	62	257	271	10.4	8.6	71.2	9
Iraq	17	37	100	107	4.5	10.4	65.3	26
Iran	15	28	80	88	3.3	12.7	73.4	37
UAE	14	25	69	72	3.2	11.5	61.2	10
Kuwait	6	14	48	51	2.4	6.7	57.2	12
Venezuela	2	5	23	27	0.8	6.7	94.2	98
Libya	4	8	15	20	1.3	8.6	42.9	70
Nigeria	3	6	17	19	1.5	6.1	36.0	38
Algeria	4	6	8	13	1.1	8.6	31.9	50
Angola	3	4	8	13	1.1	6.7	32.4	21
Congo	1	1	3	5	0.3	6.5	51.3	48
Gabon	0	1	1	3	0.2	5.9	41.4	51
Equatorial Guine	0	0	1	1	0.1	4.5	16.5	35
<b>World Total Oil</b>	285	505	1,283	1,624	82.9	9.4	53.7	
Natural Gas Liquids					12.0			
Other liquids					6.3			
<b>World Total Liquids production 2023e</b>					<b>101.2</b>			

Source: UCube by Rystad Energy

Decline from 2022:  
1P 13Gb, 2P: 43Gb

1P = Proven 90% recoverable

2P = Probable 50% recoverable

2PCX = 10-30% recoverable

\* Global oil production 2023, excludes natural gas liquids, biofuel and refinery gains

**IP** Proved oil reserves (as of 1.1. 2023), conservative estimate in existing fields

**2P** Proved+Probable oil reserves, most likely estimate in existing fields

**2PC** Proved+Probable oil reserves plus mean contingent recoverable oil resources in yet undecided projects/discoveries, including noncommercial volumes

**2PCX** Most likely estimate for existing fields, plus contingent resources in discoveries, plus risked prospective resources in yet undiscovered fields

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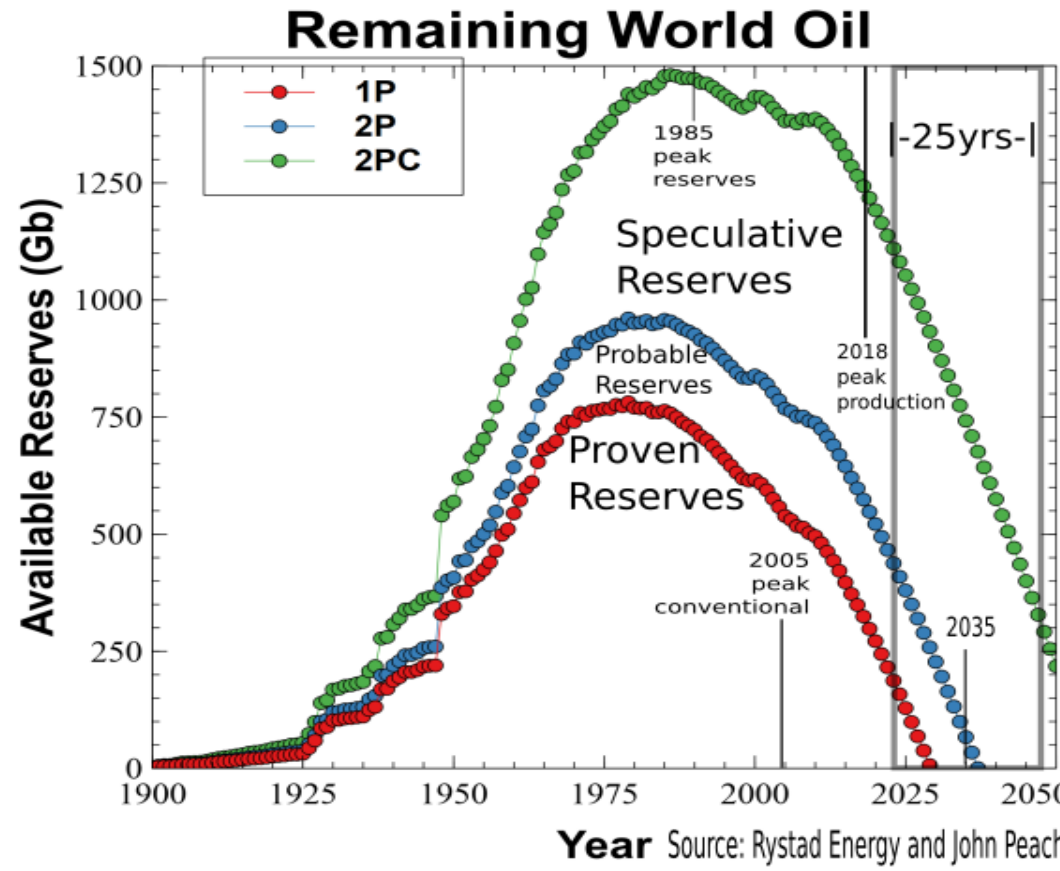
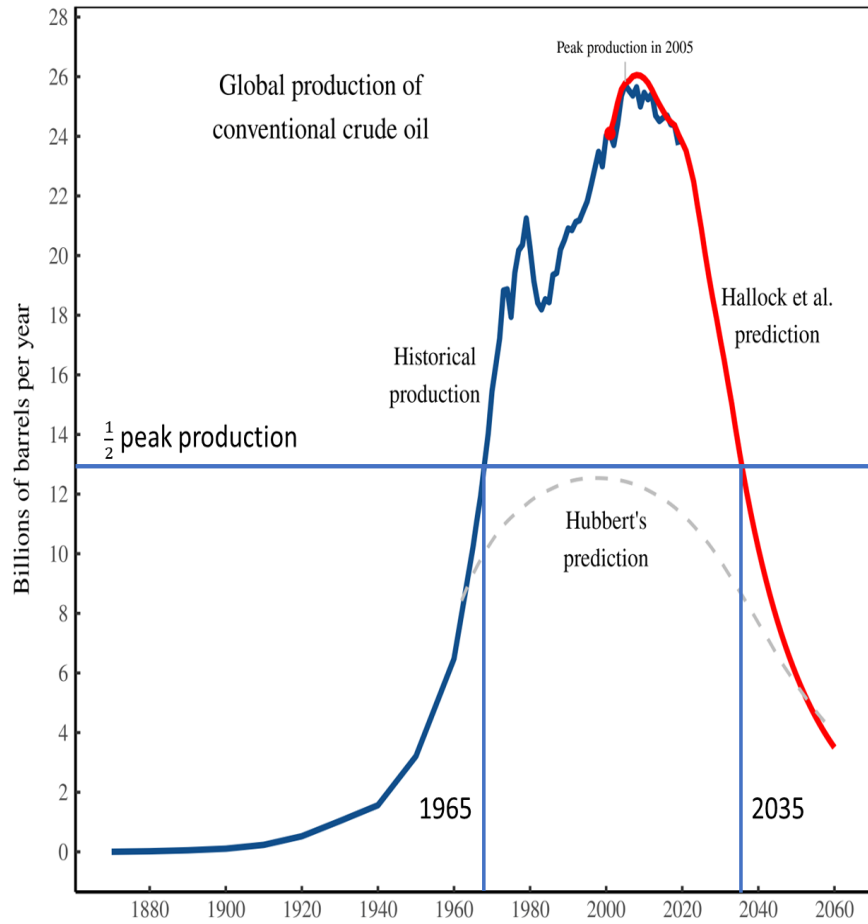
"Oil" is crude oil + lease condensate.

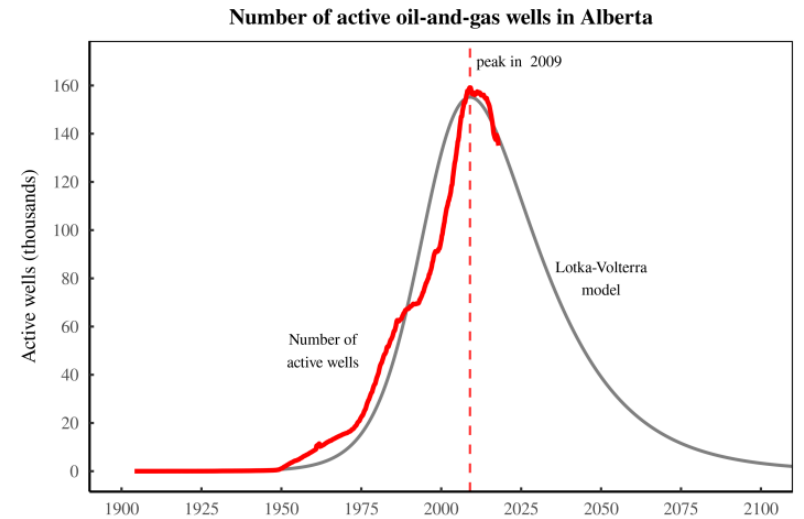
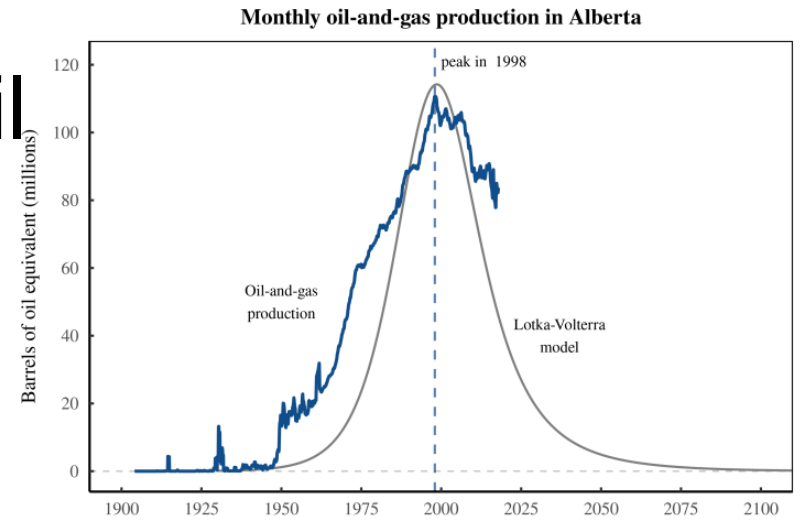
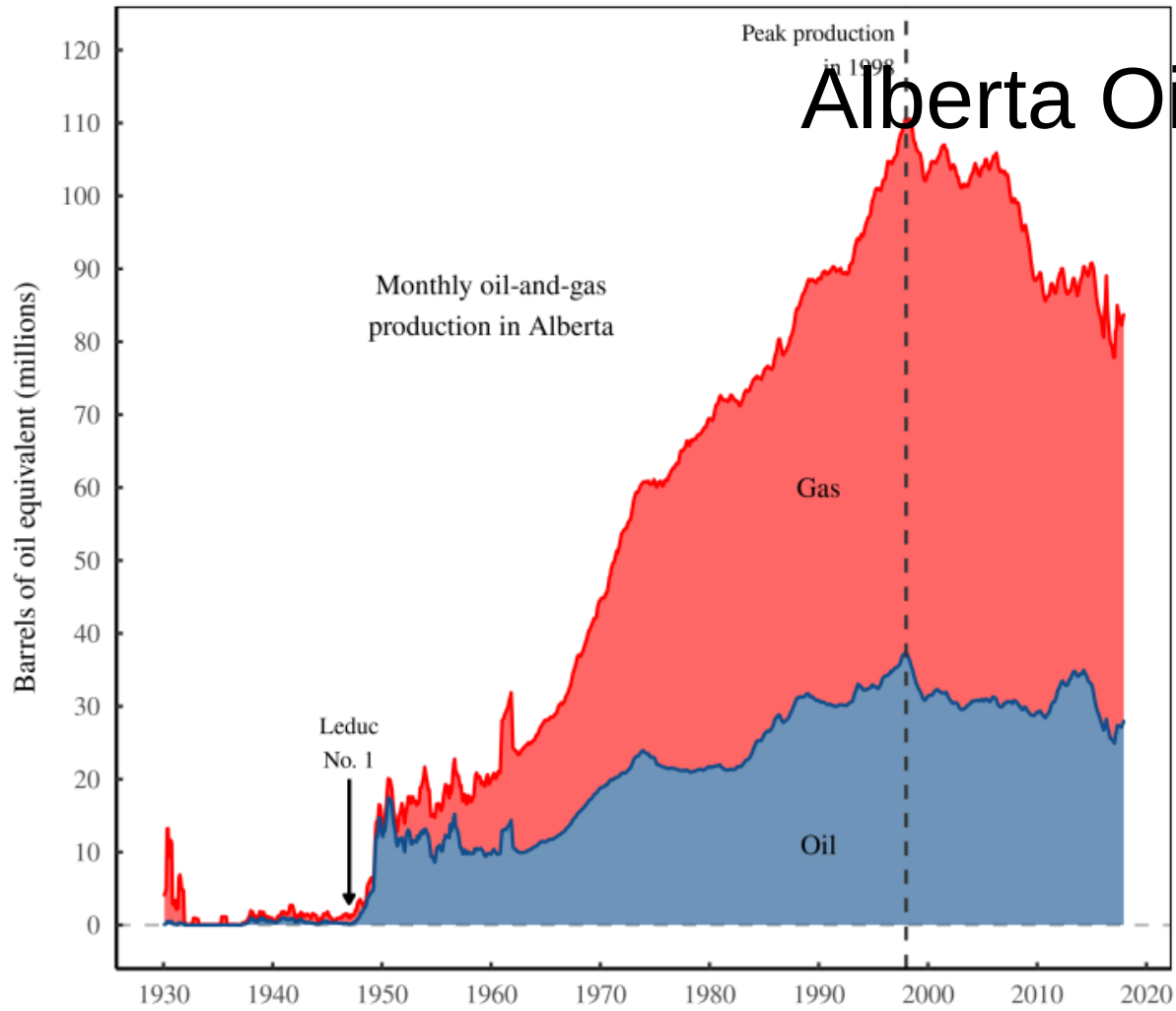
30 Billion barrels consumed per annum

1P =  $(285 \times 0.9) / 30 = 8.55$  years remaining

2P =  $(505 \times 0.5) / 30 = 8.41$  years remaining

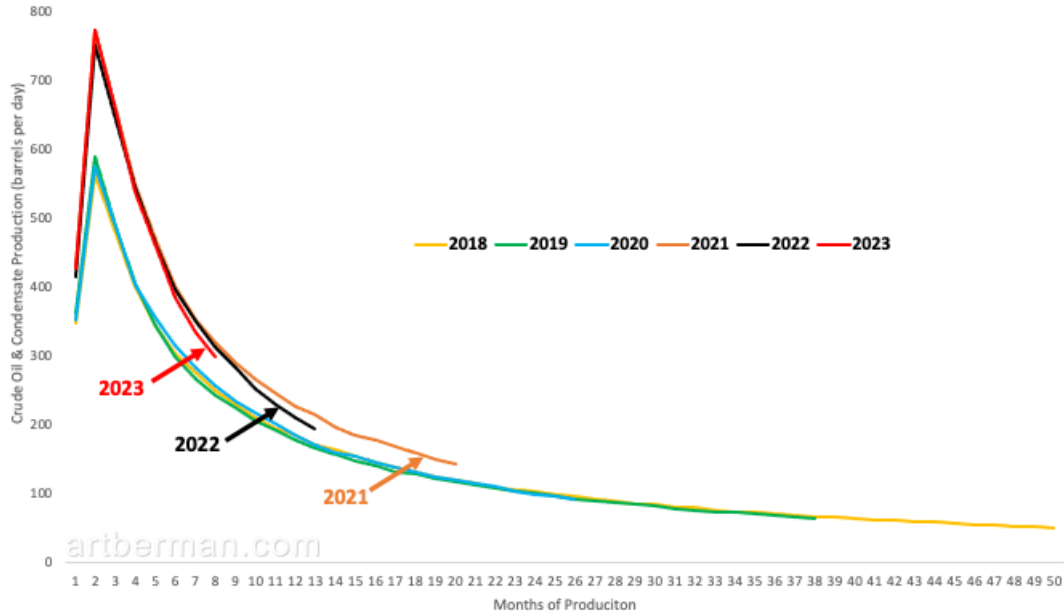
2PCS = 5-16 years remaining





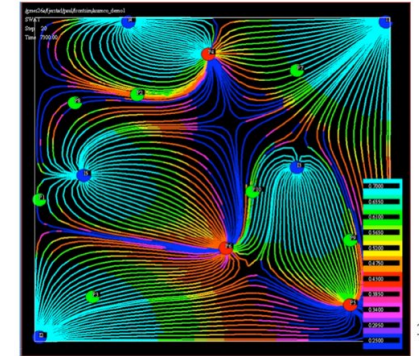
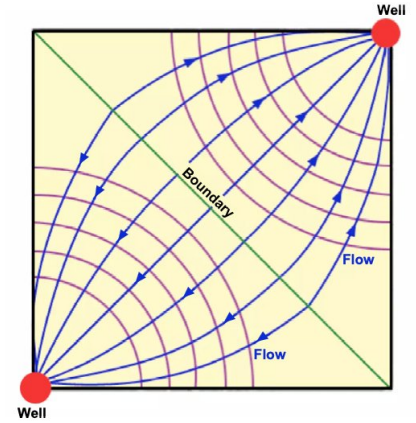
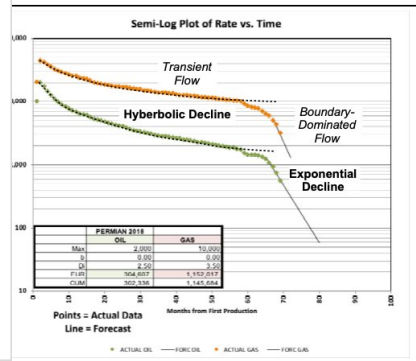
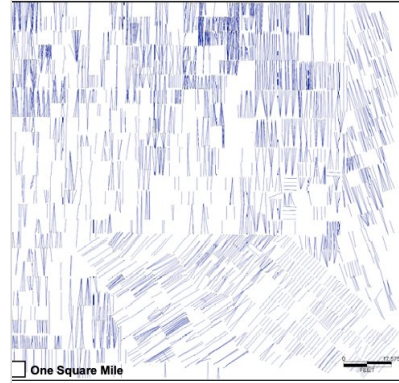
# U.S. Shale Oil

2023 and 2022 Permian production rates are already lower than 2021 rates

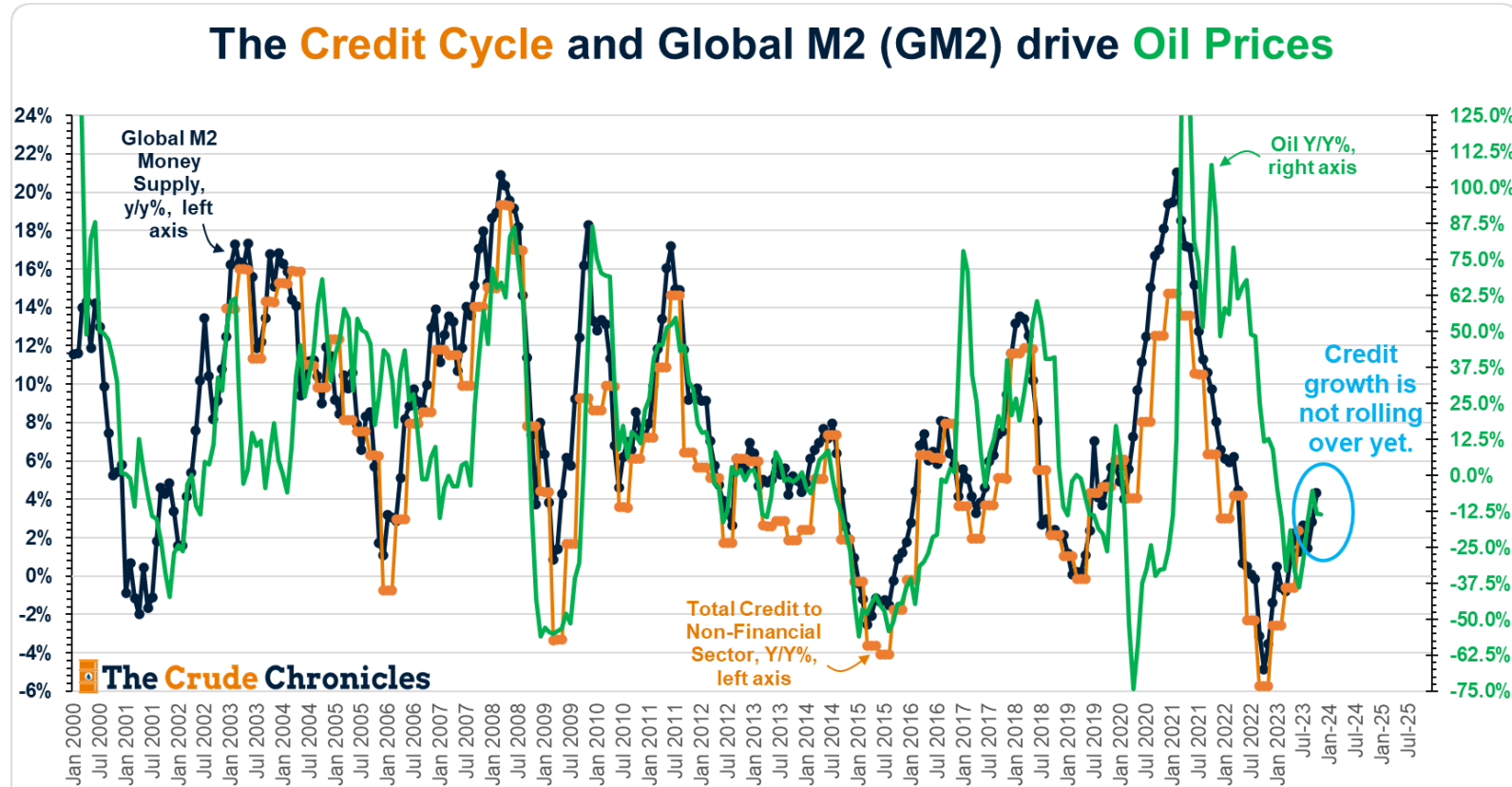


Source: Enverus & Labyrinth Consulting Services, Inc.

PERMIAN CURRENT/PERMIAN DEC 2023



# Oil Price depends on Money Supply

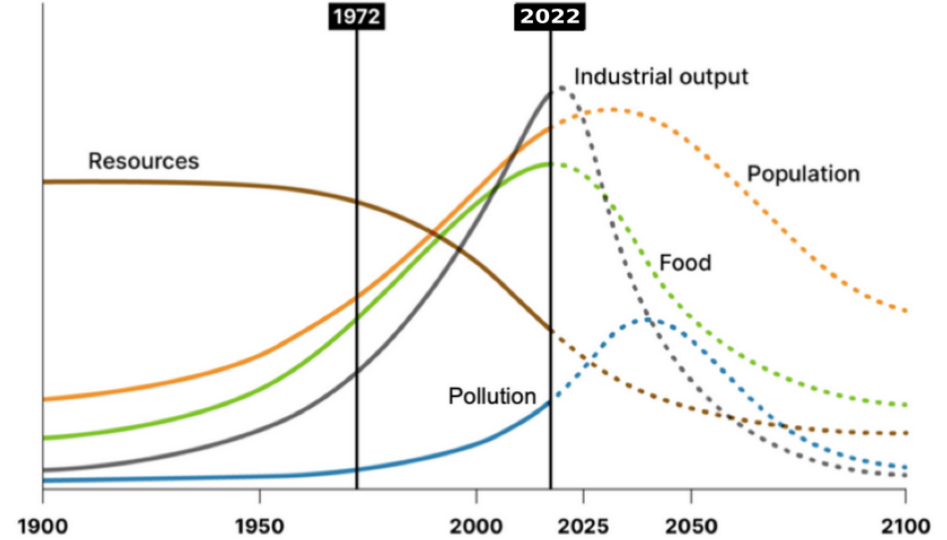
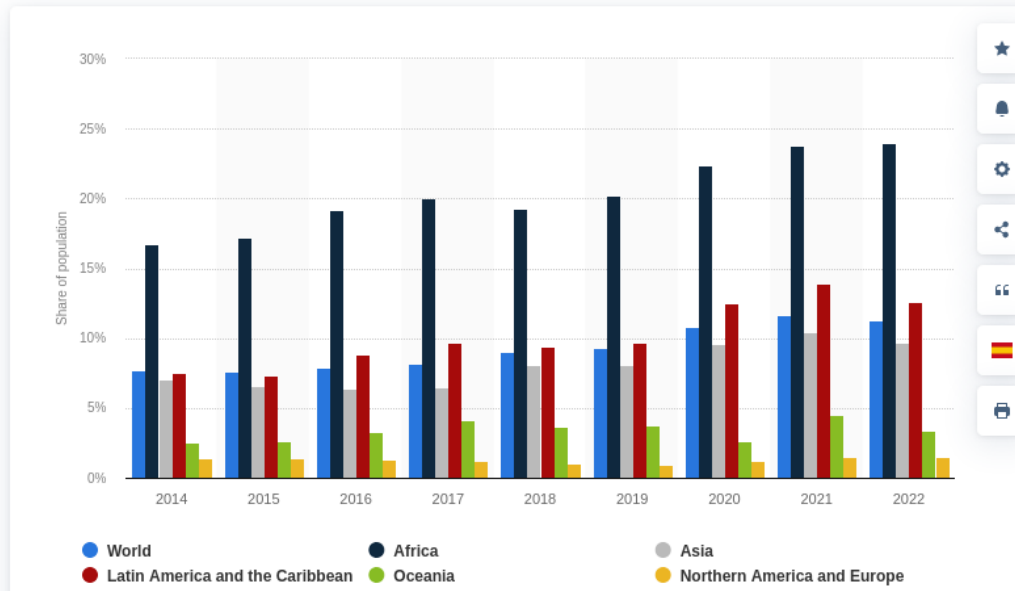


M2 includes Argentina, Australia, Brazil, Canada, Chile, China, Euro Area, India, Indonesia, Japan, S. Korea, Poland, Saudi Arabia, Sweden, Switzerland, Thailand, Turkey, UK & US translated to USD. GM2 and credit to non-financial sector are the same. I show both because Global credit growth data comes from the BIS with the latest figure a/o 2Q23. GM2 is more timely with the latest figure as of Oct-2023



# Limits to Growth

Prevalence of severe food insecurity worldwide from 2014 to 2022



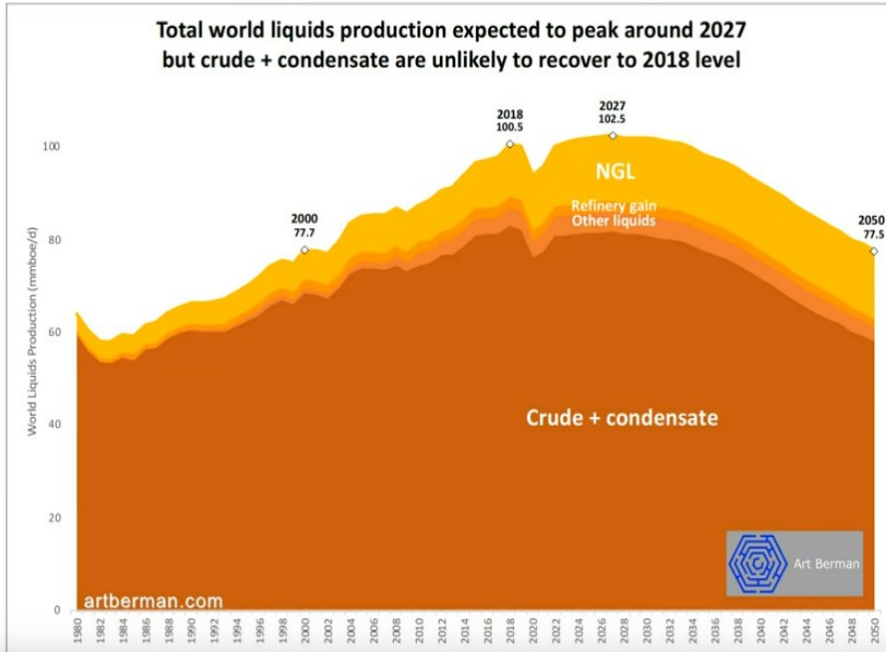
This figure shows the BAU 1 scenario which had tended to follow the data relatively well. Source: Meadows et al (1972), Earth4all



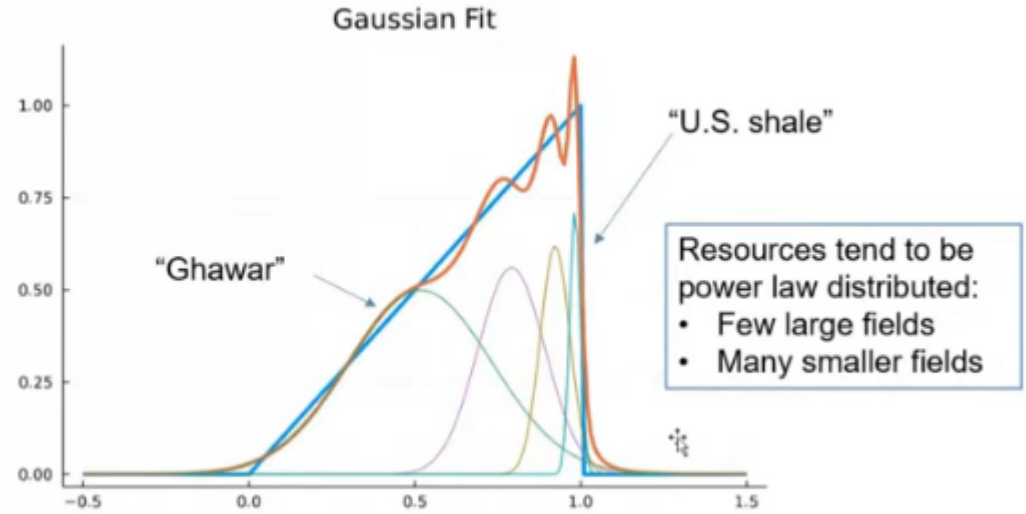


# NGL and Decline Slope

Oils ain't oils....



## Sum of Gaussians



Early large fields followed by many small fields lead to sharp decline



# Green Transition Not-Enough-Minerals

Table A9. Total metal quantity required to manufacture one generation of technology units, with a 28 day power buffer for wind and solar to phase out fossil fuels compared to 2019 global production

Metal	Element	Total including 28 day buffer stationary power storage (million tonnes)	Global Metal Production 2019 (million tonnes)	Years to produce metal at 2019 rates of production (assuming the 28 day buffer) (years)
Aluminium	Al	353.5	63.14	5.6
Copper	Cu	6 161.1	24.20	254.6
Zinc	Zn	48.2	13.52	3.6
Magnesium Metal	Mg	0.5	1.12	0.4
Manganese	Mn	306.0	20.59	14.9
Chromium	Cr	9.2	37.50	0.2
Nickel	Ni	1 251.2	2.35	532.4
Lithium	Li	1 274.2	0.095	13 388.3
Cobalt	Co	292.9	0.126	2 324.6
Graphite ♦	C	11 466.2	2.73	4 201.2
Molybdenum	Mo	1.5	0.277	5.4
Silicon (Metallurgical)	Si	67.35	3.43	19.7
Silver	Ag	0.198	0.03	7.5
Platinum	Pt	0.0027	0.000190	14.1
Vanadium	V	923.96	0.096	9 622.4
Zirconium	Zr	2.61	1.34	2.0
Germanium	Ge	4.16	0.000130	32 024.3
<b><u>Rare Earth Element</u></b>				
Neodymium	Nd	1.14	0.024	47.8
Lanthanum	La	5.97	0.036	166.8
Praseodymium	Pr	0.265	0.0075	35.4
Dysprosium	Dy	0.212	0.0010	212.1
Terbium	Tb	0.023	0.00028	81.4
Hafnium	Hf	0.000293	0.000066	4.4
Yttrium	Y	0.000293	0.014	0.0

# Where are we? Scarcity Industrialism

- Scarcity Industrialism characterized by energy conservation.
- Slow deterioration of services as society grinds to a halt.
- EU is ahead of the curve, over 55,000 companies closed in 2023 in France alone.
- Most heavy industry has shut off, and medium industry is shutting down as well.
- In Canada people can't afford housing and are living in the tents.



# EROI Basics, Service decline

- EROI 14, enough to pay for arts (90s)
- EROI 12, enough to pay for healthcare (2010s)
- EROI 9, enough to pay for a school system (2020s?)
- EROI 7, enough to pay truck drivers, farmers (2030s?)
- EROI 5, enough to truck commodities other than fuel (2040s?)
- EROI 3, enough to truck the fuel
- EROI 1, enough to dig a hole to look at fuel

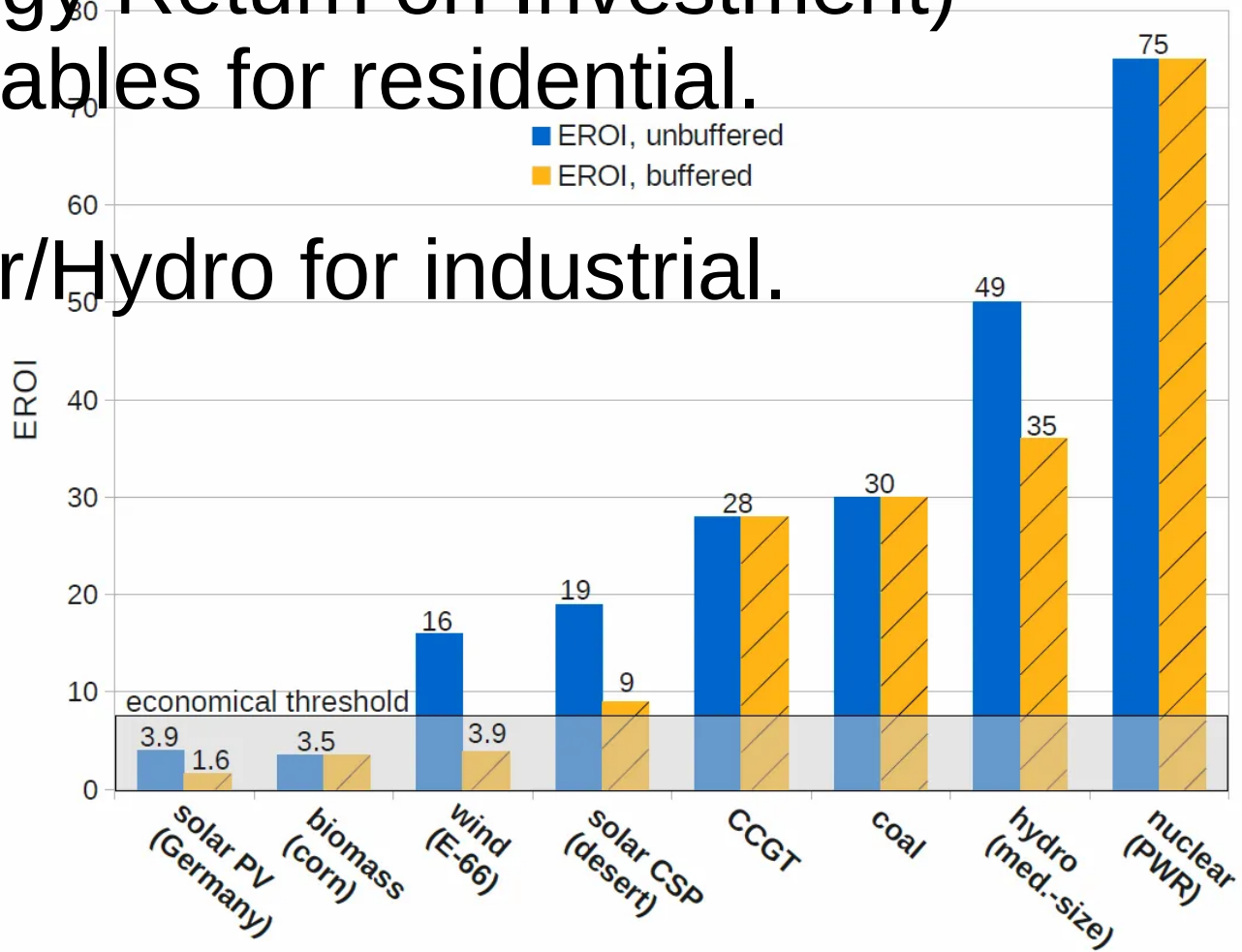
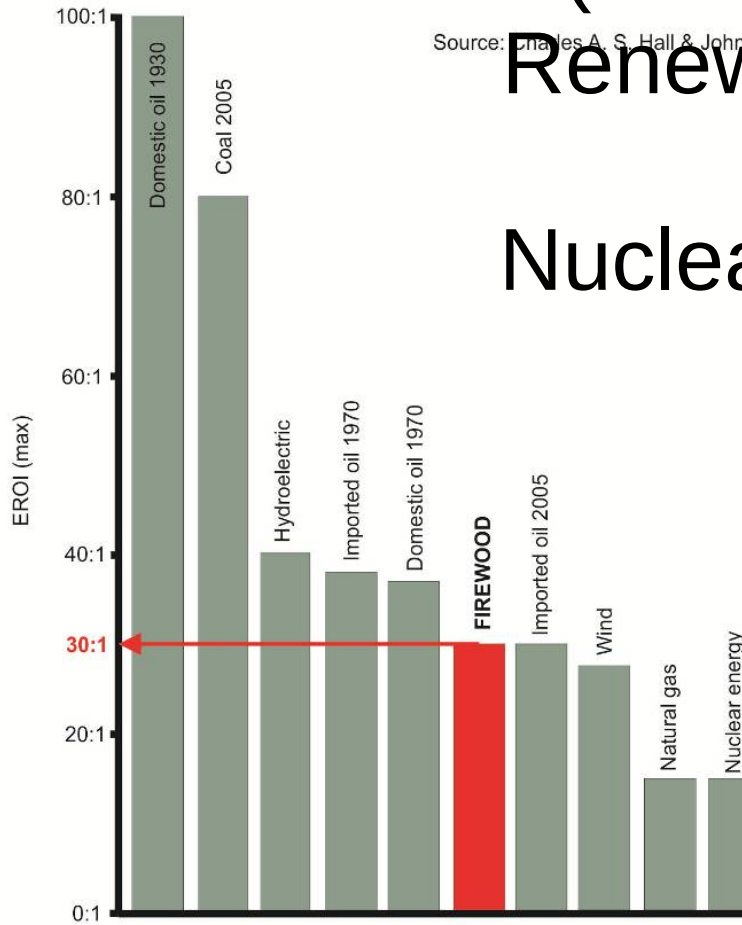


# EROI (Energy Return on Investment)

Source: Charles A. S. Hall & John

## Renewables for residential.

## Nuclear/Hydro for industrial.



# Where are we headed? Salvage Economy

- In Salvage economy most energy is embedded energy. So wrecking crews taking apart sky scrapers and landfills are some of the more profitable ventures.
- Unless there is land distribution crime will continue to increase as people are unable to meet their needs in urban areas.
- It is good idea to promote local scrapyards, recycling, and accumulation of high energy metals for the future salvage economy
- Mass Dreams of Future: 4 lifestyles: Urban, Rustic, Indigenous, Sylvan



# Urban Lifestyle: Salvage post collapse



Urban Timeline dystopic underground military bases (fill 54 yo)



# Rustic Lifestyle: Amish/Mennonite

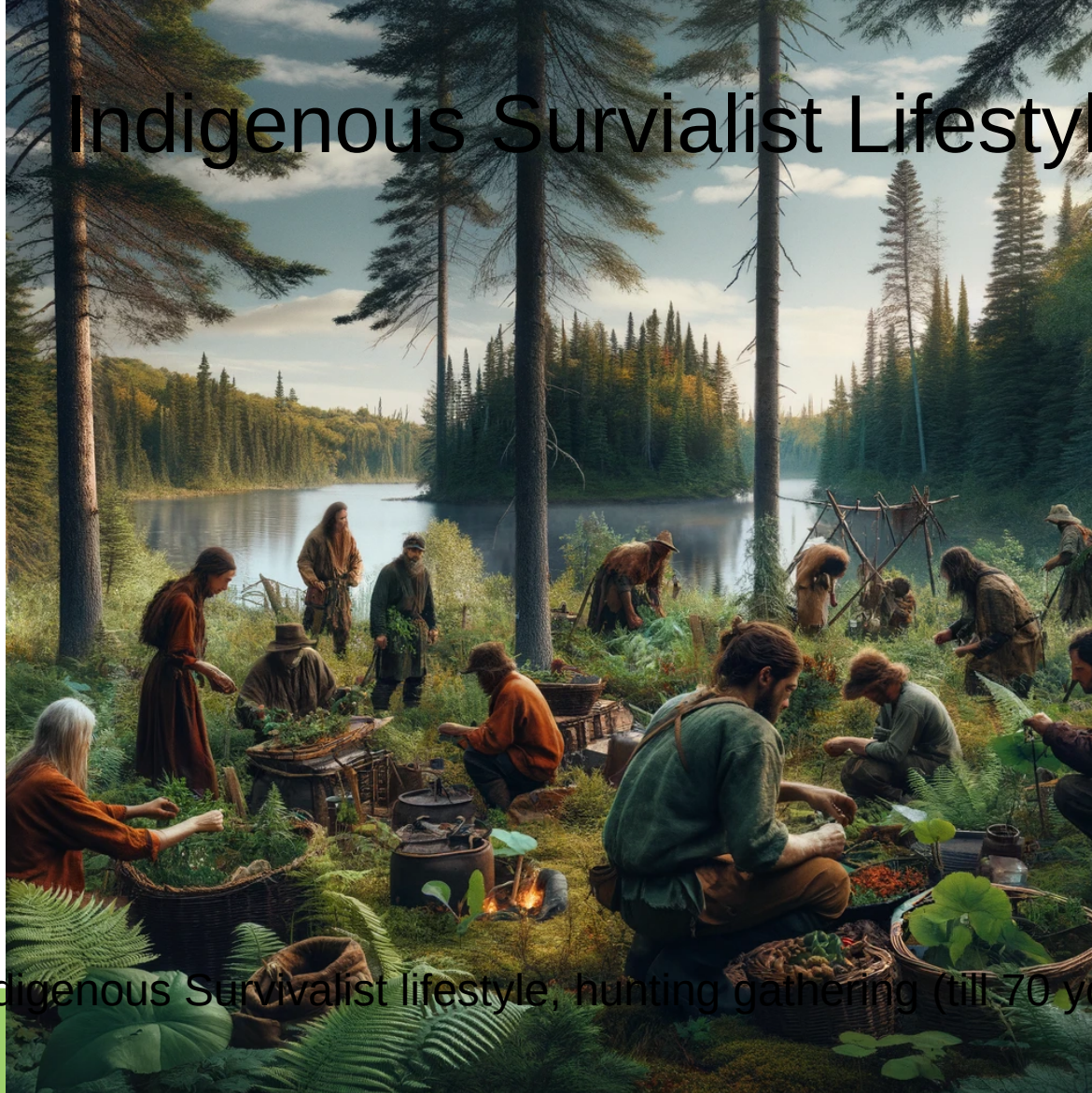


Amish Rustic timeline of horse and buggy annual till (till 56 yo)





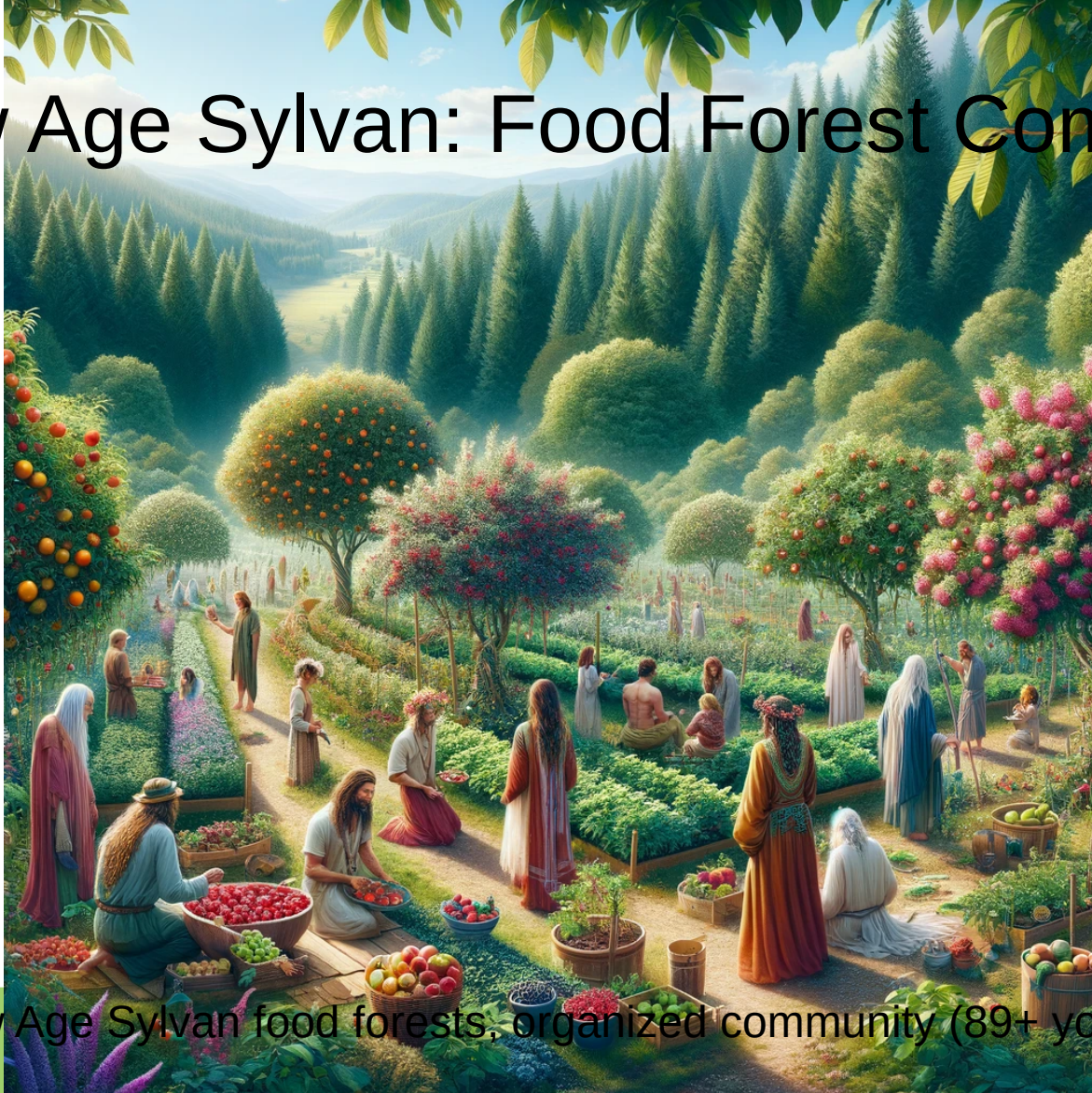
# Indigenous Survivalist Lifestyle



Indigenous Survivalist lifestyle, hunting gathering (till 70 yo)



# New Age Sylvan: Food Forest Communities



New Age Sylvan food forests, organized community (89+ yo)



# What Can Work?

- People homesteading, growing their own food and firewood with manual labour.
- A church of 60 people could support equine or bovine transport.
- A village of 360 could support a biogas vehicle, kiln or forge.
- A neighbourhood of 5,000 having farmers markets and store.
- A city of 55,000 having thorium reactor for industrial production.
- County of 700,000 having radio, internet and rail for connectivity.



# Family of 6 Homestead

- Carrying capacity in South Ontario is 1-2 hectare per capita.
- Family homestead of 6 would need 6-12 hectares.



Active 75kg human  
food ~4-5Gj/year

Core wood:  
Willow SRC 0.5gHa  
1 cord = ~15Gj

backup  
food 0.25  
~5-7Gj

core food  
0.25gHa  
~5-7Gj

Active 75kg human  
food ~4-5Gj/year

0.5gHa Wood Coppice ~15Gj

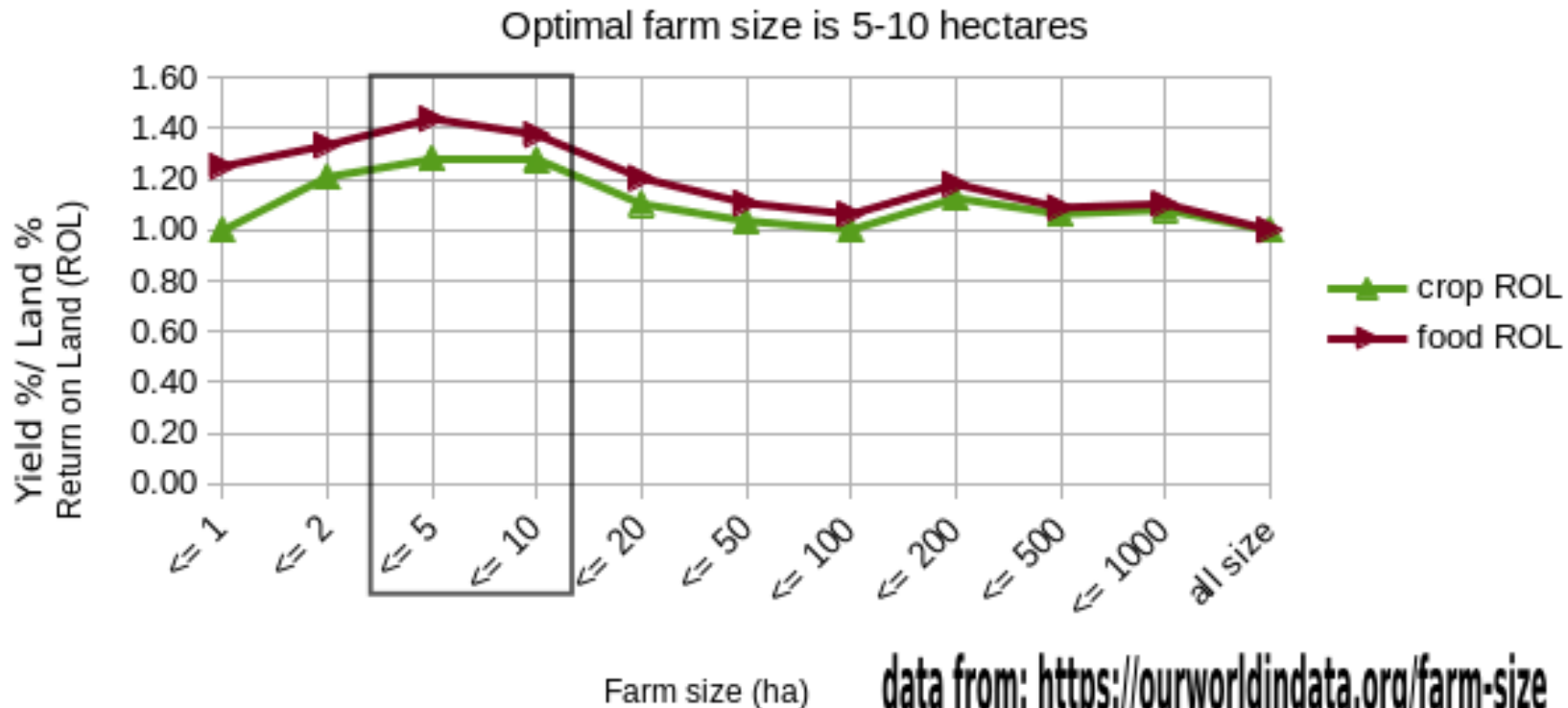
0.25gHa Food Forest 5-7Gj

core food  
0.25gHa  
~5-7Gj



# Optimal Farm Size: 5-10 hectares (12-25 acre)

Relationship between Farm Size and Yield



# Community Church of 60 with animal transport



# Village of 360 with BioGas production facility

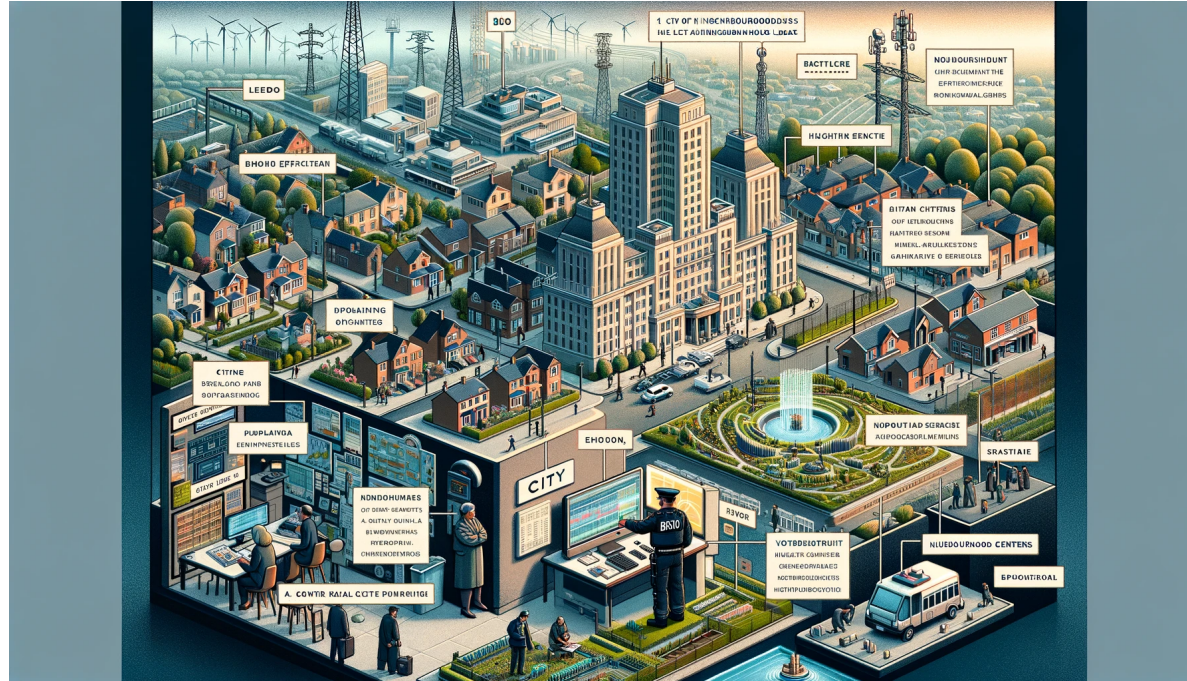


# Neighbourhood of 5040 with markets and stores





# City of 55,000 with thorium industrial manufacturing



# County of 720,720 with rail/road and communication networks



# Recommended Policies Federal

- Opening up crown land for homesteading of sustainable size lots 10-20 hectares. Allowing for waterway accessible lots.



# Recommended Policies Provincial

- Through WOWC and AMO can lobby for a Land Protection Act to set cap on per capita land ownership 10-20 hectares for South Ontario. Surplus sold to citizens on market or adding family onto title.



# Recommended Policies County

- Allowing/encouraging sustainable living practices, including rainwater collection, compost toilets, local building materials.
- Set maximum single family lot size to be in the 10-20 hectare range.
- 30-50m offset and hedge from road to avoid roving bandits.
- Support a county radio, fiber optic, and consider rail.
- Encourage sustainable rural homesteads and orchards



# Recommended Policies Municipal

- Set minimum lot size to be 1 hectare for single person occupancy.
- Affordable housing at sustainable density, of at least a hectare per capita.
- Allow temporary housing permits to enable residents to live on their land while they are building more permanent structures.
- Community Development Plans: Encourage the formation of community associations such as churches and villages in homestead areas to foster collaboration, resource sharing, etc.



# Grey County Collaboration

- How am I helping with the transition?
- I email County Councillors on Friday mornings.
- I attend county meetings, and am available for consultation.
- Further involvement? At councillors discretion.
- I run an IT business, and a proof of concept tree seedling business, selling at venues like Keady Farmers Market.
- I attend Glad Tidings Mennonite Fellowship in Tara.



# Rural Transition Discussion

