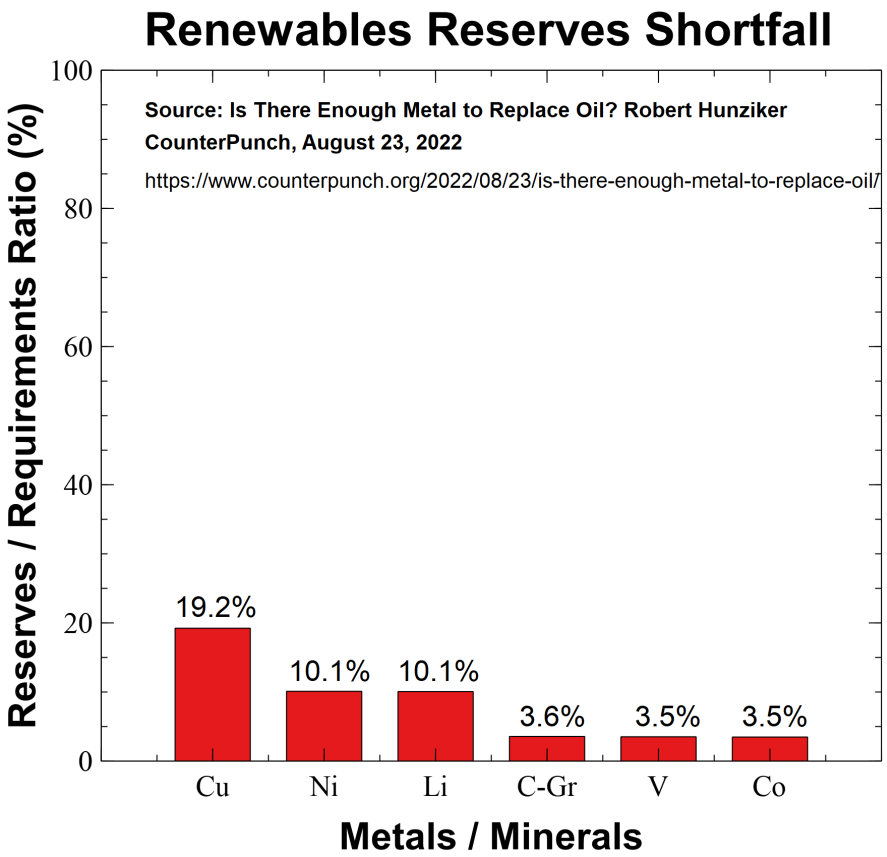
December Peak Oil Chat

John Peach

12/4/2024

Renewable Ore Reserves and Rates



Simon P. Michaux
Associate Professor Mineral Processing & Geometallurgy

Table 39. Total metal quantity required to manufacture one generation of technology units to phase out fossil fuels compared to 2019 global production

Metal	Element	Total metal required produce one generation of technology units to phase out fossil fuels (28 days buffer) (tonnes)	Total metal required produce one generation of technology units to phase out fossil fuels (48 hours + 10% buffer) (tonnes)	Global Metal Production 2019 (tonnes)	Ye 2
Aluminium	Al	305 344 528	305 344 528	63 136 000	
Copper	Cu	4 730 043 227	563 781 004	24 200 000	
Zinc	Zn	36 945 387	36 945 387	13 524 000	
Magnesium Metal	Mg	500 400	500 400	1 120 000	
Manganese	Mn	235 494 311	31 793 521	20 591 000	
Chromium	Cr	7 011 364	7 011 364	37 498 478	
Nickel	Ni	970 817 173	149 281 798	2 350 142	
Lithium	Li	976 274 657	95 404 313	95 170	
Cobalt	Co	225 653 328	26 680 148	126 019	
Graphite (natural flake)	C	9 280 273 442	872 181 376	1 156 300	
Graphite (synthetic)	C			1 573 000 ◆	
Molybdenum	Mo	1 140 617	1 140 617	277094 ‡	
Silicon (Metallurgical)	Si	51 345 993	51 345 993	8 410 000	
Silver	Ag	150 790	150 790	26282 ‡	
Platinum	Pt	2 682	2 682	190 ‡	
Vanadium	V	704 448 633	55 349 535	96021 ‡	
Zirconium	Zr	2 614 126	2 614 126	1 338 463 ‡	
Germanium	Ge	4 163 162	4 163 162	143	
Rare Earth Element	-				
Neodymium	Nd	983 617	983 617	23 900	
Lanthanum	La	5 970 738	5 970 738	35 800	
Praseodymium	Pr	238 605	238 605	7 500	
Dysprosium	Dy	198 027	198 027	1 000	
Terbium	Tb	17 370	17 370	280	
Hafnium	Hf	224	224	66	
Yttrium	Y	224	224	14 000	

‡ Estimated from mining production. All other values are refining production values.

◆ Natural flake graphite and synthetic graphite was combined to estimate total production

Renewable Energy Rates

Energy Source	EROI
Oil	20.4
Coal	46.3
Natural Gas	7.0
Tar Sands	3.5
Shale Oil	7.5
Wind	20.8
Solar	9.3
Nuclear	13.9
Hydro	84.0
Geothermal	9.0

EROI =

Energy output = Energy rate Lifetime

Ref: **EROI of different fuels and the implications for society**
Hall, Lambert, Balogh. Energy Policy, Jan 2014.

Renewable Energy Rates

Energy Source	EROI	Lifetime
Oil	20.4	0.5
Coal	46.3	0.5
Natural Gas	7.0	0.4
Tar Sands	3.5	0.5
Shale Oil	7.5	0.5
Wind	20.8	25.0
Solar	9.3	25.0
Nuclear	13.9	50.0
Hydro	84.0	75.0
Geothermal	9.0	35.0

- Time from source to endpoint very short
- Energy input mostly transportation, refini

- System lifetimes long
- Energy input mostly during construction

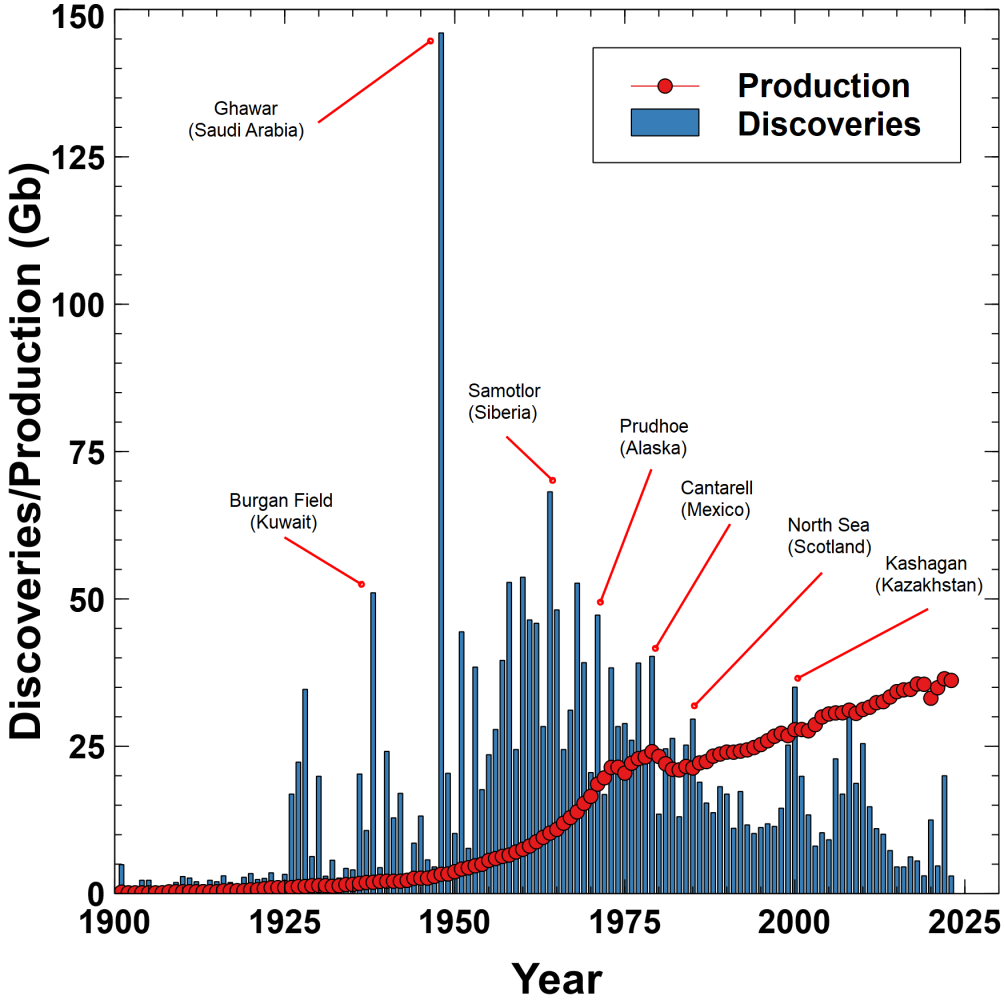
Renewable Energy Rates

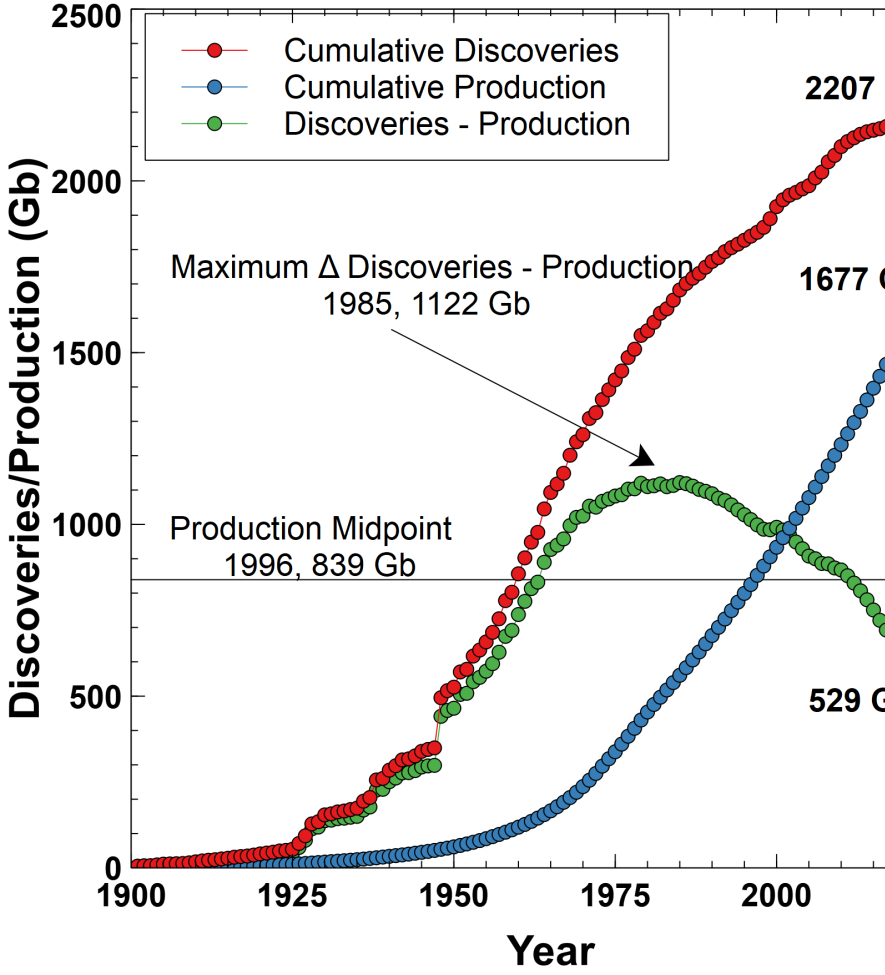
Energy Source	EROI	Lifetime	EROI Rate
Oil	20.4	0.5	37.8
Coal	46.3	0.5	92.5
Natural Gas	7.0	0.42	16.5
Tar Sands	3.5	0.54	6.4
Shale Oil	7.5	0.54	13.9
Wind	20.8	25.0	0.8
Solar	9.3	25.0	0.4
Nuclear	13.9	50.0	0.3
Hydro	84.0	75.0	1.1
Geothermal	9.0	35.0	0.3

Minimum EROI rate ~ 20-30?

Not long-term viable energy sour

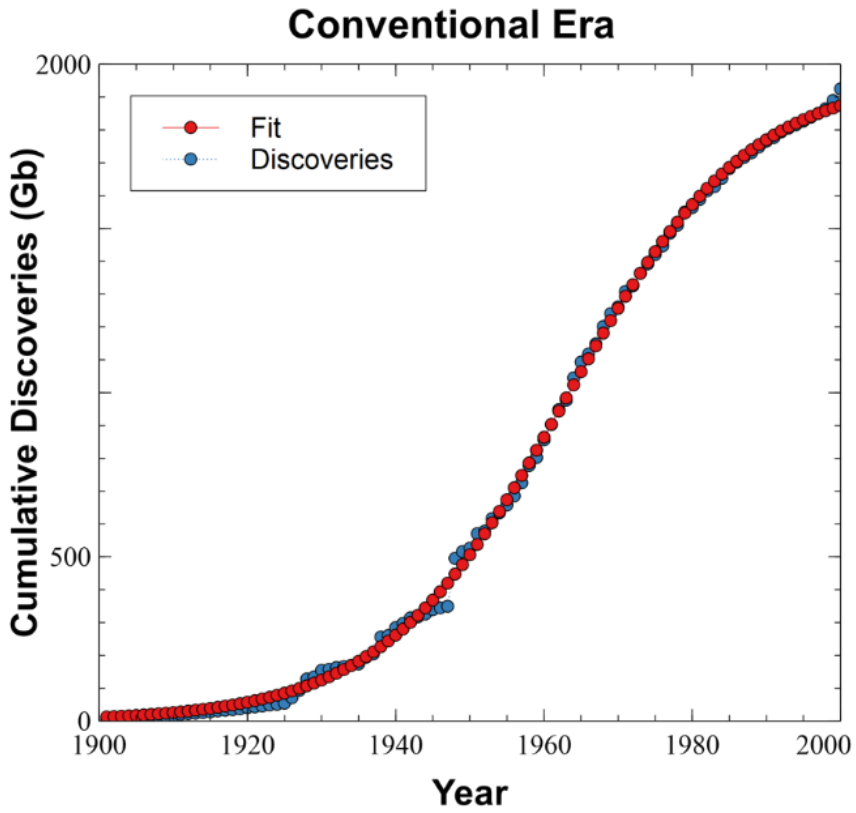
Oil Discoveries and Production

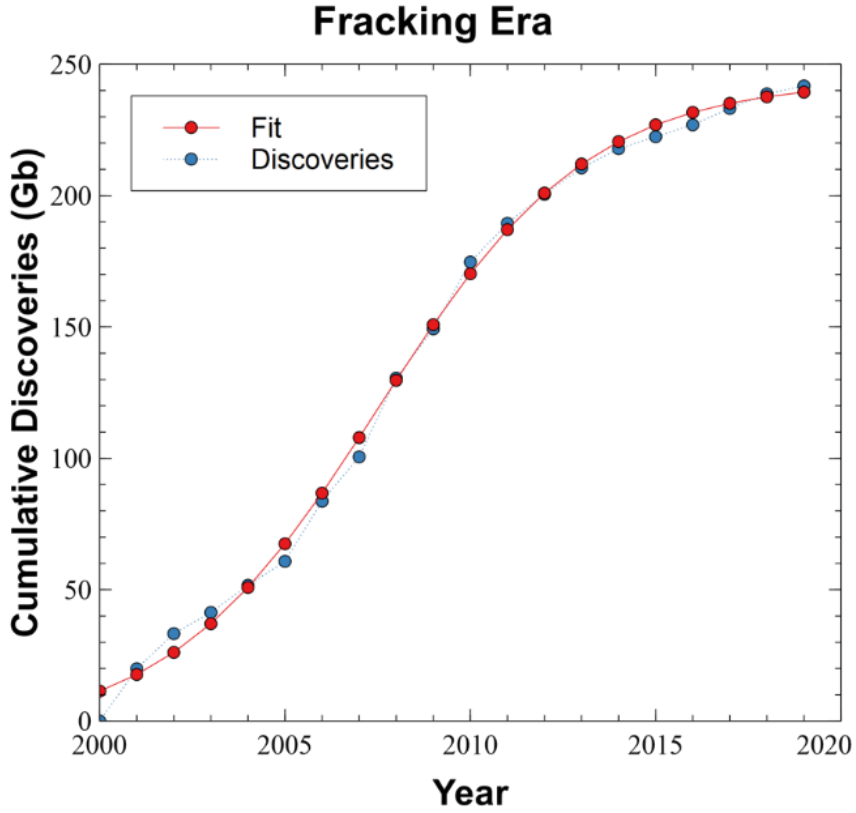




Ref: How much oil remains for the world to produce? Comparing assessment methods, and separating fact from fiction
Laherrere, Hall, Bentley, Current Research in Environmental Sustainability, Vol 4 2022.

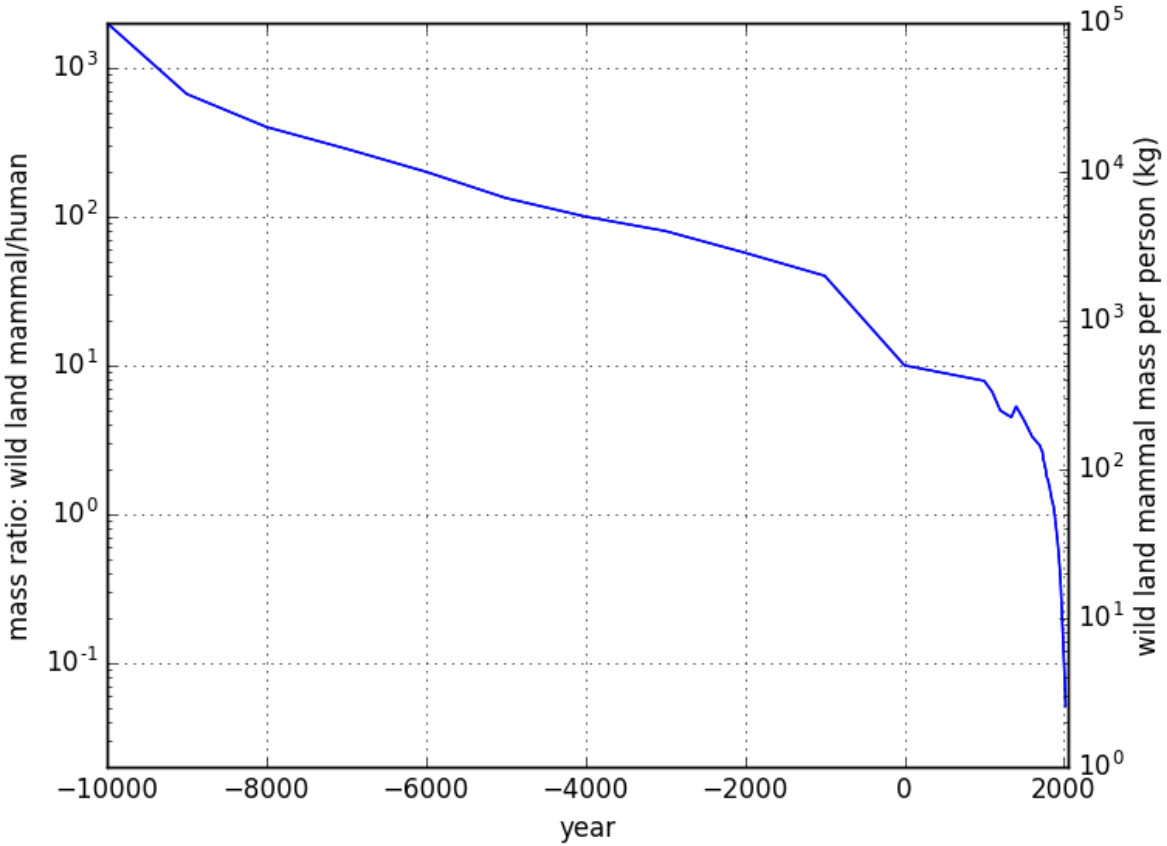
Logistic Discovery Model

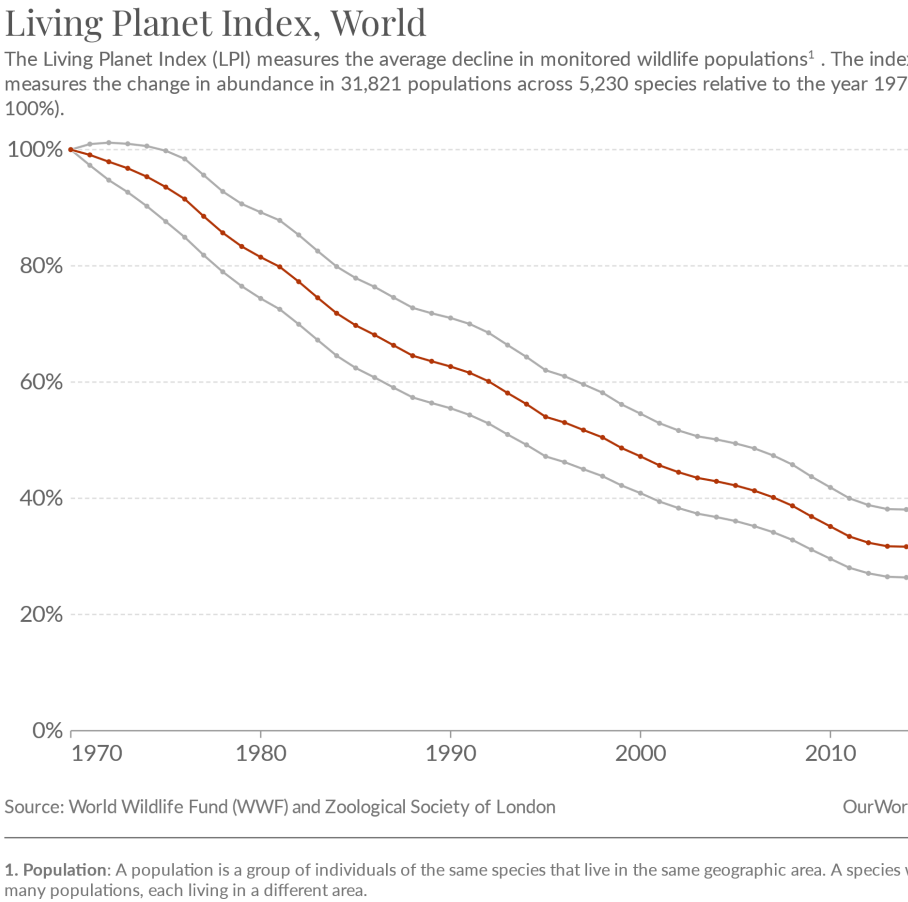




- Total projected discoveries = 2240 Gb
- Total discoveries to date = 2207 Gb
- Annual production ~ 36 Gb

Biodiversity





"We have used it [energy] to expand the human enterprise and population, knock down forests, destroy and fragment habitats, drive extinctions, and generally threaten the vitality of the planet" – Tom Murphy, UCSD Astrophysics.