

# Energy Return on Investment: A Critical Problem For Modern Efforts to Meet the Climate Challenge

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## ABSTRACT:

Energy return on investment (EROI) refers to the calculation of how much energy is required to operate energy production systems. EROI can be calculated for all different energy sources, like oil, coal, wind, hydroelectric, geothermal, etc. Traditionally calculated in a ratio that compares energy required to energy obtained, EROI is a measure of the efficiency of a certain energy system. Present literature reveals that less energy is being produced from the energy we invest into energy systems. This principle does not only apply to fossil fuels; the main energy systems proposed by the green growth narrative (i.e. wind, solar, hydropower, etc.) also seem to be losing efficiency and may not be able to produce enough energy to satisfy the current levels of overconsumption. EROI data predicts that, eventually, current energy production infrastructure will become obsolete—as the amount of energy required will exceed the amount of energy produced. A proposed alternative to green growth is a movement called “degrowth”. Degrowth entails a widespread reduction of energy consumption by increasing mindfulness of consumption, and reducing frivolous energy consumption. Current materialistic and capitalistic values have led people to perceive energy as limitless, and subsequently allow people indulge in the overconsumption that supports constant manufacturing. Degrowth calls for members of society to adjust their values away from frequent consumption and towards community based values. This switch would decrease the amount of energy required for society to operate. While this may seem unattainable, research supports the idea that current communities in a degrowth system often rate higher on happiness and quality of life scales than those that participate in an overly materialistic society. Changing the public’s perception of energy consumption and psychological worldviews is integral to achieving degrowth.

## DEFINITIONS

- EROI- The calculated ratio that compares the energy output from a technology to the energy required to obtain and distribute that energy.
- Green Growth- An alternative energy program that continues economic growth while trying to protect natural resources.
- Degrowth- An alternative energy program that approaches the climate crisis by slowing economic growth to lessen energy demands and increase community values.

## ADDITIONAL INFORMATION

- EROI values like coal and gas have declined over recent decades.
- Many renewable energy sources have lower EROI than traditional fossil fuels, thus continued economic growth proposed by Green Growth may be unrealistic.

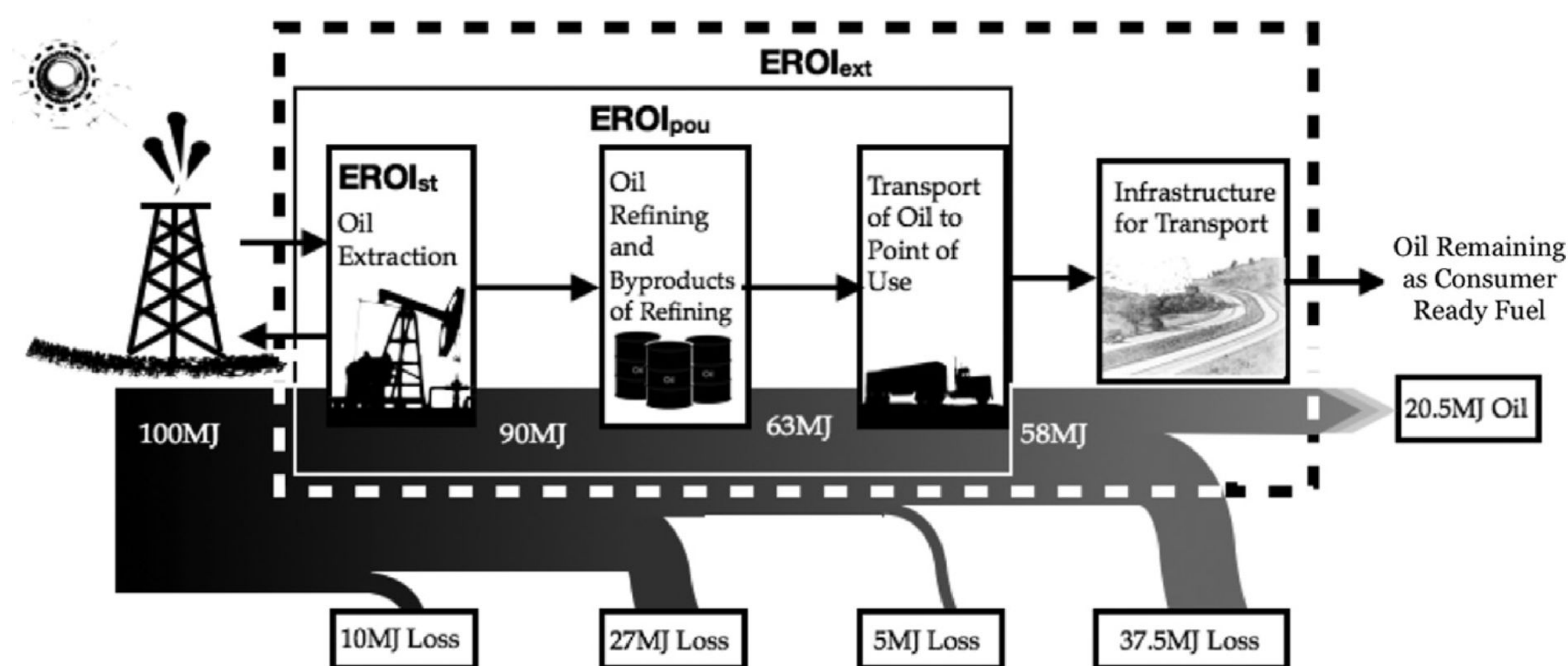
## CONCLUSIONS

- EROI is crucial to making informed economic and social decisions about energy consumption.
- Green Energy systems often have lower EROI values than traditional fossil fuel values with the exception of hydroelectric, but the availability of new hydroelectric dam locations is very low.
- All values for EROI decline over time, due to maintenance costs and lowering availability of resources
- Green Growth will likely not sustain continued economic growth. Data suggests that the lifestyle proposed by the Degrowth Narrative (i.e. less consumerism and individual energy use, etc.) can promote greater wellbeing.

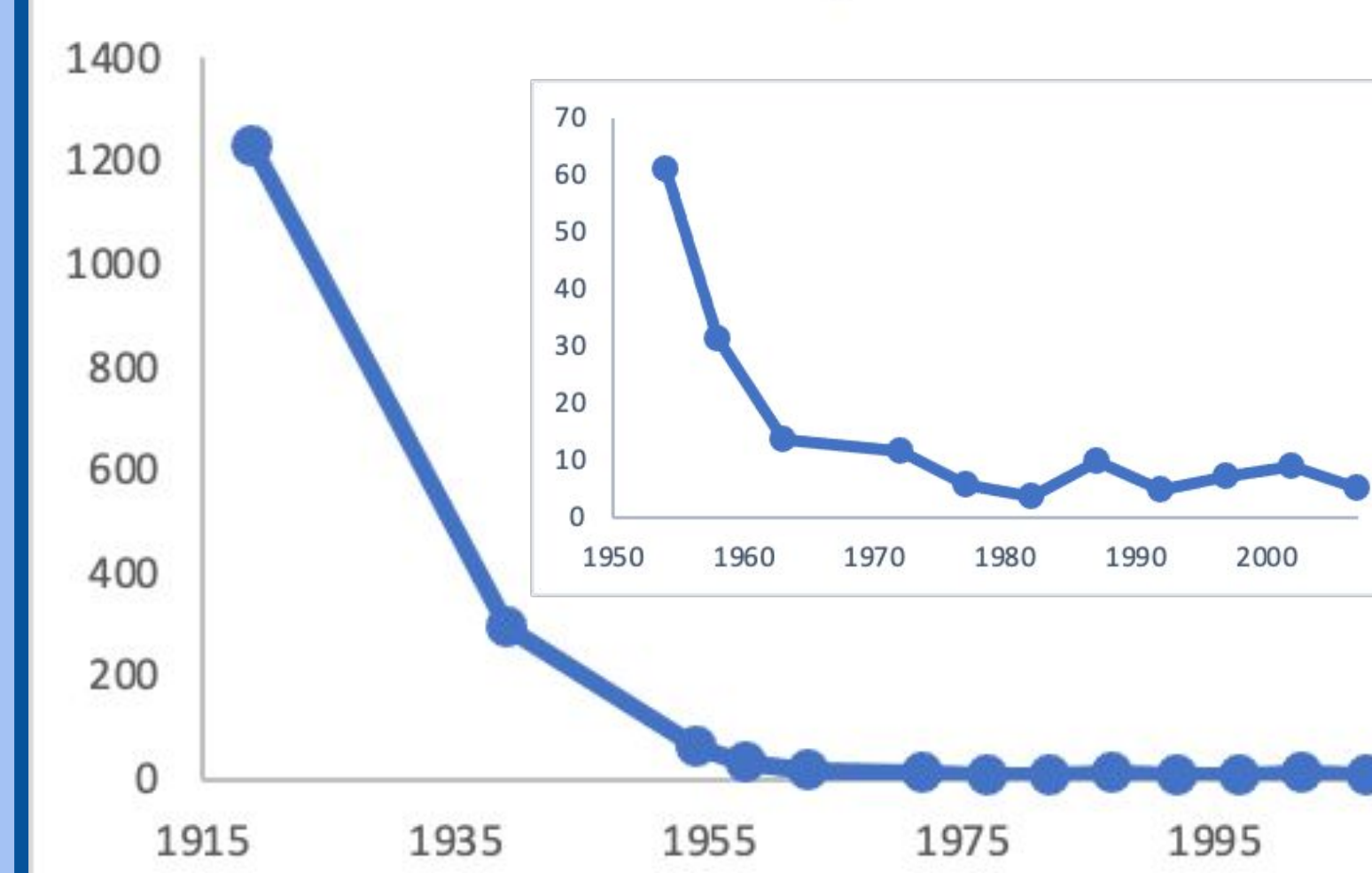
## EROI DATA

EROI is a ratio of energy returned:energy required. In order for an energy source to be considered viable it must have a ratio of 3:1 or greater.

- Coal - 46:1
- Oil and gas - 20:1
- Nuclear - 14:1
- Geothermal - 9:1
- Ethanol from biomass - 5:1
- Tar sands and shale - 4:1
- Hydroelectric - 84:1
- Photovoltaic - 10:1
- Wind - 18:1



EROI of Energy Discovered by U.S. Oil and Gas Industry Over Time



EROI for Production of the U.S. Oil and Gas Industry



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