Chart of the Week #2024-24
Octane vs Compression Ratio

Energy Policy Research Foundation

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June 19, 2024
Washington, DC

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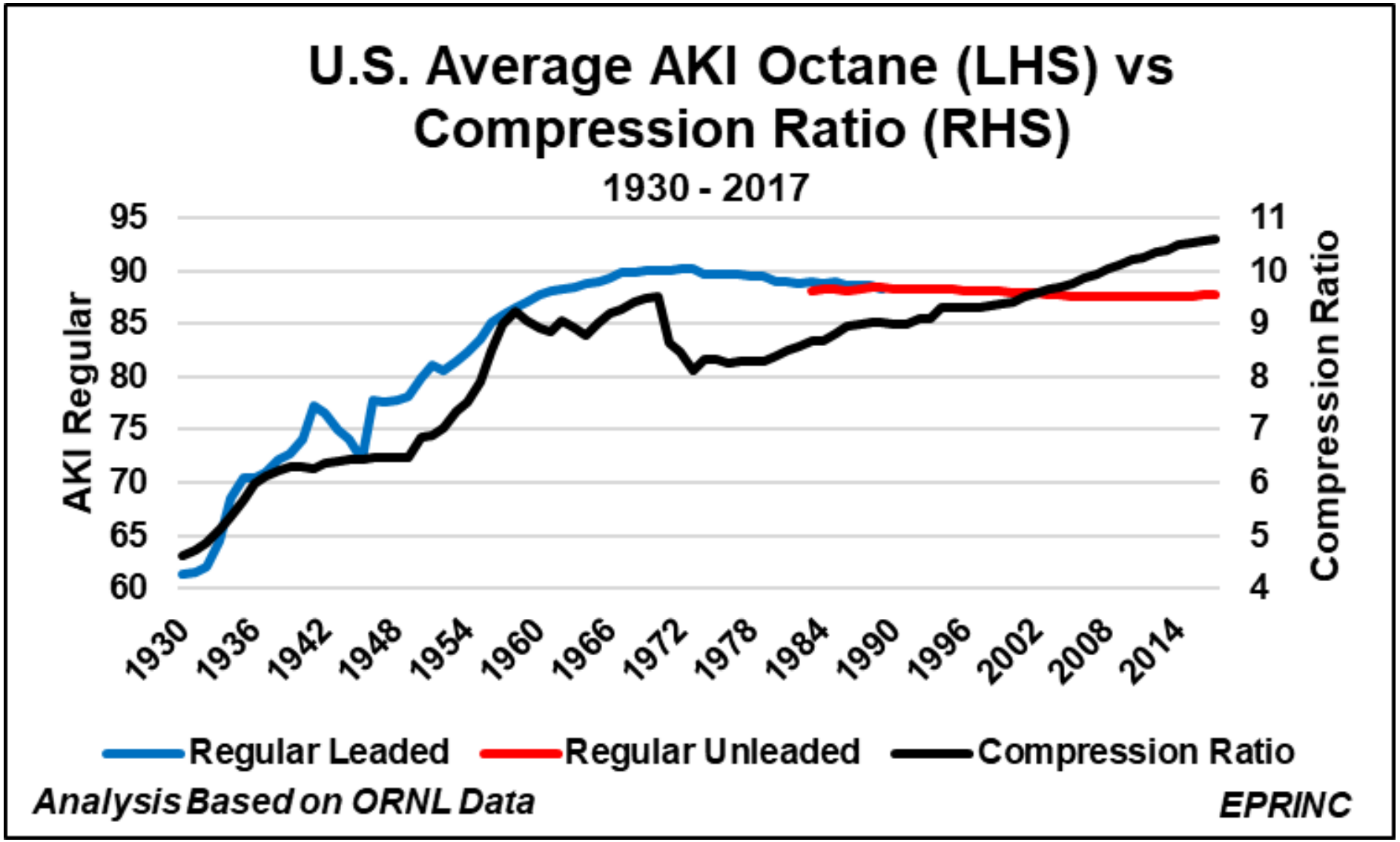

Octane vs Compression Ratio

- **Increasing Demands for Power Drove Octane and Compression In Tandem; but power, pollution control, and efficiency gains are being derived through other means.**
- **From the 1930s through the mid-1970s, compression ratios of gasoline-powered vehicles rose to an average approximately 10.5-to-1 and have stayed at these levels since. Octane levels of gasoline have dovetailed with these increases.**

Compression ratio and power

- **When gasoline-powered motor vehicles first came into widespread use, the compression ratio of their engines averaged 4-to-1. (A compression ratio in an engine is the ratio of the cylinder's combustion chamber divided by the total volume of the cylinder).**
- **Demand for vehicle power and speed increased quickly. There are three ways to increase a vehicle's power: increase the number of cylinders; adjust and/or expand the gearing of transmissions; and increase the compression ratio.**
- **With increased compression, first formulations of gasoline would prematurely combust from compression alone (commonly referred to as "pinging" or "knocking"), causing engines to overheat, deliver less power, and potentially become damaged and unusable. To mitigate and eliminate knocking, gasoline required something to suppress compression-ignition and force combustion from the electric spark alone. The solution was to blend in octane to control the gasoline's combustibility,**
- ***… continuing (1)***

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… continuing (1)

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Octane

- **Originally, octane components had a molecule of eight carbon atoms (hence "oct"). Octane components can either be sourced from petroleum refining processes or from non-petroleum-based additives. Of the latter, they can either be oxygenates or metallic. These additives behave like the original octane components, but do not necessarily have any sort of chemical formulation comprised of eight carbon atoms.**
- **Through the mid-1970s, the dominant octane enhancer was lead, most often in the form of tetraethyl lead (TEL), With the advent of increasingly stringent motor vehicle pollution control systems lead was outlawed and other octane components gained prevalence.**
- **A gasoline's octane number or rating is a representation of how much gasoline can be compressed before it spontaneously ignites unassisted by a timed spark. There are two principal octane-rating methodologies in use: RON (Research Octane Number) and MON (Motor Octane Number). RON measures a gasoline's capability to resist knocking while accelerating; MON calibrates its rating based on the simulation of high-speed driving.**
- **In the U.S., the octane-rating that is posted on gasoline pumps is the average of the RON and MON numbers; this average is also referenced as the AKI (anti-knock index). The earliest posted AKI measures were in 1930 when regular gasoline had an AKI of 61 and premium gasoline had an AKI of 71. This compares with 87 and 93 AKI, respectively, for current formulations of gasoline.**
- **… continuing (2)**

Octane vs Compression Ratio
… continuing (2)

- **Developing and implementing octane additives in compliance with new pollution regulations is costly and adds to the price of the fuel. With the shift away from lead, octane levels have been unchanged since the 1970s. Increasingly stringent pollution control, fuel efficiency, and higher power in gasoline-powered vehicles continue to be achieved through technological innovation and more computerization of a vehicle's fuel, timing, and exhaust systems.**
- **This slide deck is available at: https://eprinc.org/chart-of-the-week/**
- **For more information on these charts, please contact Max Pyziur (maxp@eprinc.org).**