

The Transition to Electric Vehicles: Longer Than You Thought

Steve LeVine

Battery Council International Convention

May 2, 2022

The usual story of the Industrial Revolution

Newcomen ✓



Savery



The Electric

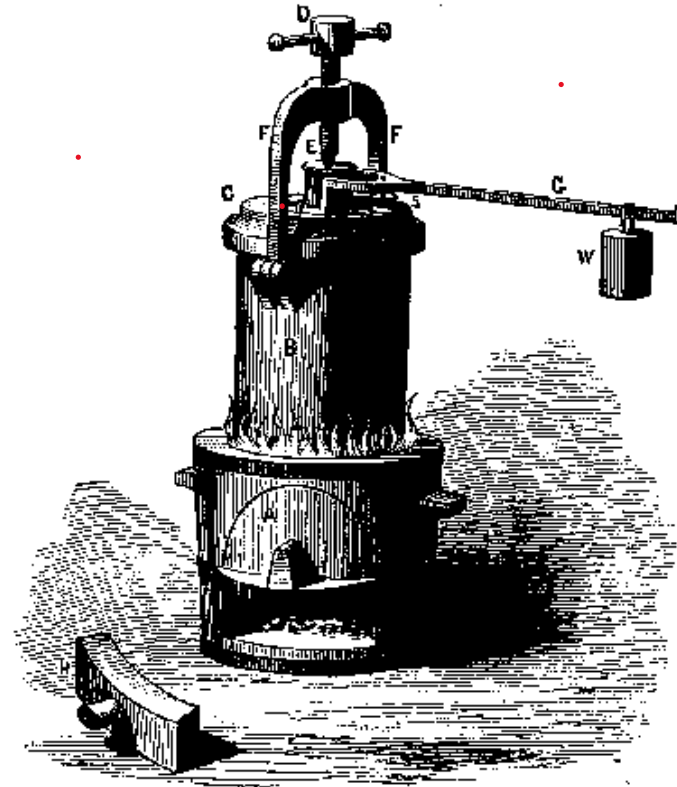
Lost to the ages



Papin

The Electric

The Steam Pressure Cooker History of the Industrial Revolution



The Electric

343 years later, Papin's brainchild

Midea 美的官方旗舰店 天猫双11礼遇季

6L大容量
7段调压

- 12菜单
- 24小时预约

一锅双胆

黄晶内胆 黑晶内胆

到手价
¥299

加购/收藏抽iPhone 13Pro

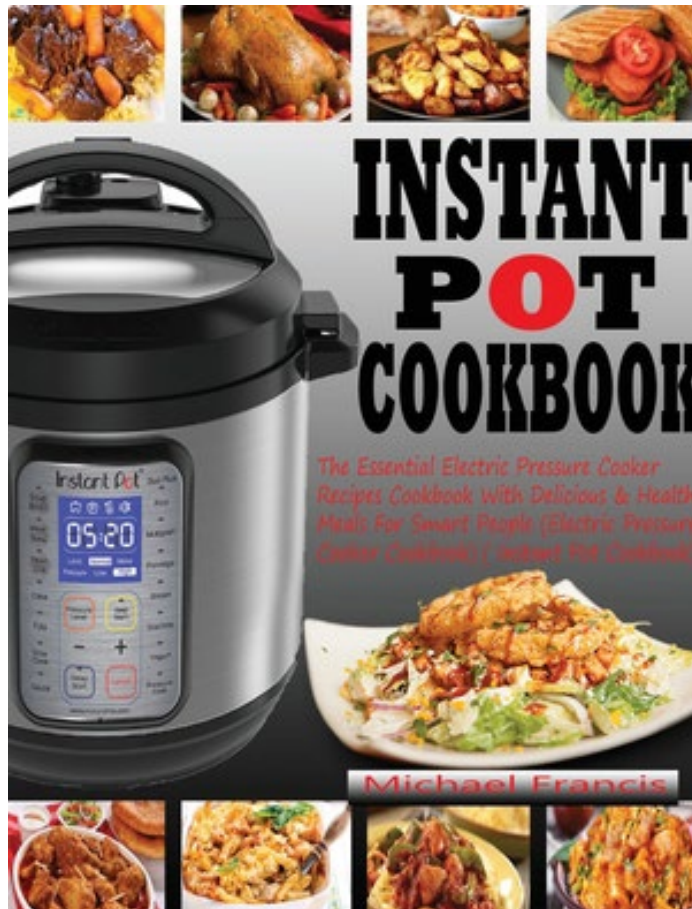
365天换新机

A red Midea electric pressure cooker with a black lid and a digital display on the front. The display shows '8:38' and various cooking settings. The cooker has two handles on the sides and a control panel with multiple buttons and a digital display.

INSTANT POT COOKBOOK

The Essential Electric Pressure Cooker Recipes Cookbook With Delicious & Healthy Meals For Smart People (Electric Pressure Cooker Cookbook) (Instant Pot Cookbook)

Michael Francis

The cover of the 'Instant Pot Cookbook' features a central image of a silver Instant Pot with its digital display showing '05:20'. Surrounding the central image are several smaller photos of various dishes, including soups, stews, and roasted meats. The title 'INSTANT POT COOKBOOK' is prominently displayed in large, bold, black letters, with 'POT' in red. Below the title, the subtitle reads 'The Essential Electric Pressure Cooker Recipes Cookbook With Delicious & Healthy Meals For Smart People (Electric Pressure Cooker Cookbook) (Instant Pot Cookbook)'. The author's name, 'Michael Francis', is at the bottom.

María del Pozo

La olla lenta regional

78 recetas de cocina tradicional para slow cooker

VERGARA

The cover of 'La olla lenta regional' features a large, dark blue ceramic slow cooker pot in the center. The pot is surrounded by various fresh ingredients, including carrots, onions, and mushrooms. The title 'La olla lenta regional' is written in a large, elegant, yellow script font. Above the title, the author's name 'María del Pozo' is written in a smaller, white, sans-serif font. Below the title, the subtitle '78 recetas de cocina tradicional para slow cooker' is written in a white, sans-serif font. The publisher's name 'VERGARA' is at the bottom right.

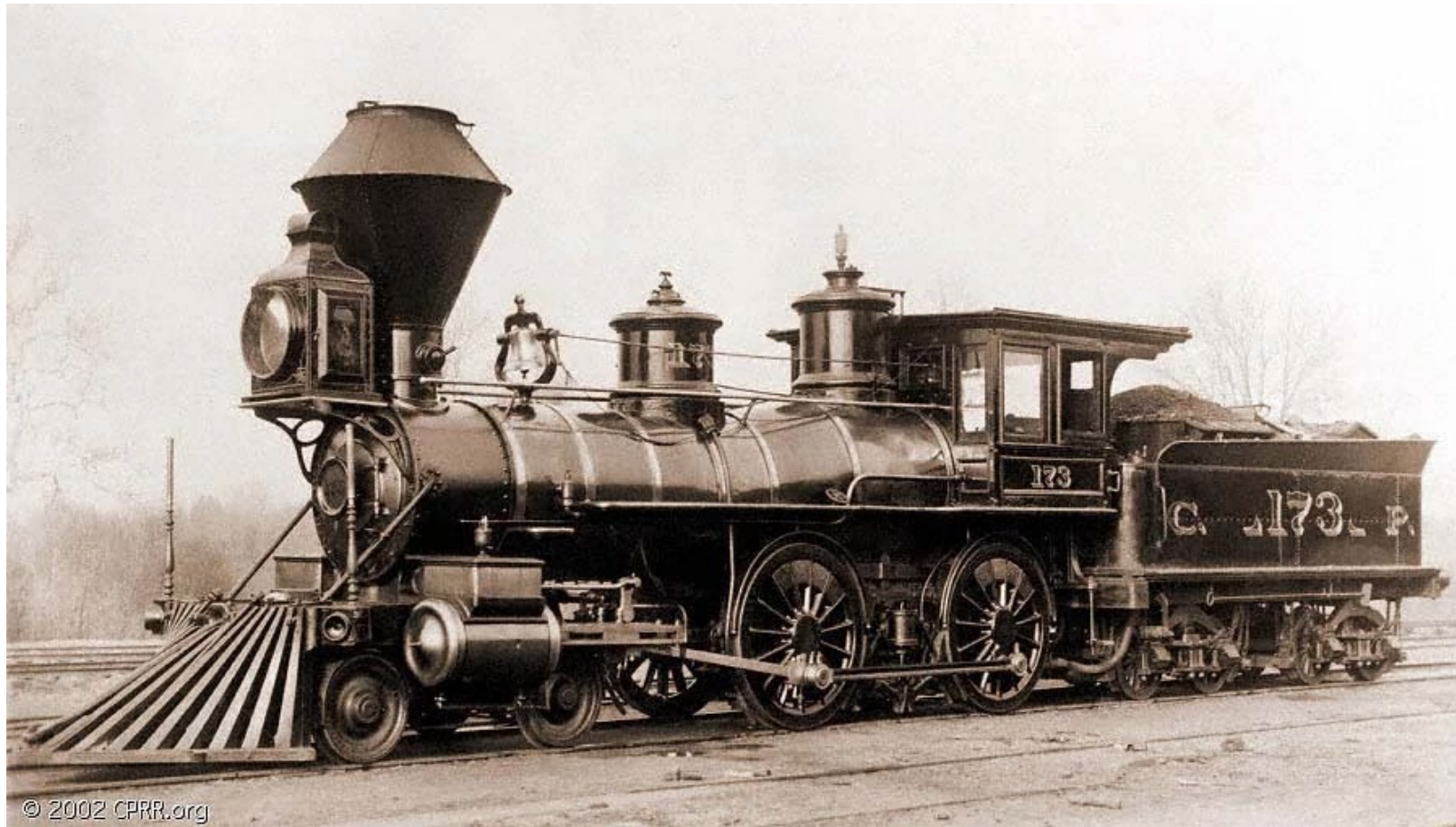
The 2,000-year run of the watermill persisted



Jean-Pol Grandmont

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Finally ... steam takes the lead



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Diesel and electric enter the picture in the 1920s and 1930s



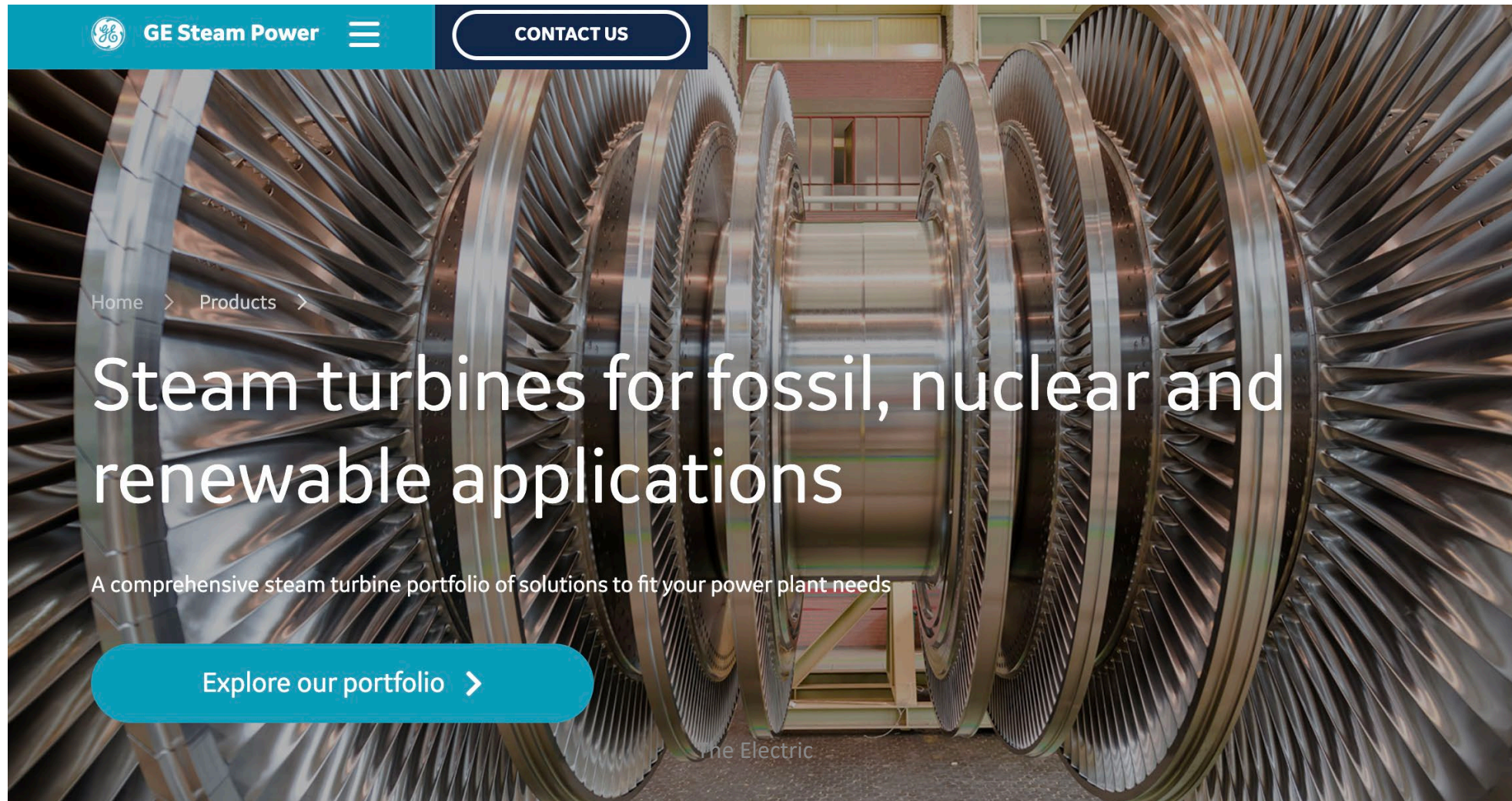
Operation Barbarossa, 1941



The last regularly scheduled steam train in Hokkaido, Japan



The modern steam turbine, commercialized first in the 1880s by George Westinghouse



Today ... the age of EVs



The Electric

2020s EV projections

- Last year: **4.6m EVs sold globally**
- 2022 projection: **7.7m**
- 2025: **10.7m**
- 2030: **40m+**

2020s raw materials supply projections

Available for 90kWh NMC811 batteries in 2022:

- **Supply:** 45.6kt lithium, 296kt nickel, 52kt cobalt
- **Formula/per battery:** 12.7kg li, 77kg ni, 9.7kg co

Desired EVs: 7.7 million

Actual EVs: 3.8 million

And so on through the decade

2025

Desired EVs: 10.7 million

Actual EVs: 6.3 million

2030

Desired EVs: 40+ million

Actual EVs: 15.6 million

One Wall Street opinion

“Near-term expectations for EV penetration may have to be lowered significantly due to a lack of critical electric metals. Short term, we’d encourage investors to categorically lower EV penetration forecasts for many OEMs, through mid-decade, that may not have secured the necessary physical materials/metals to make good on their EV forecasts.”

—Adam Jonas, managing director, research, Morgan Stanley

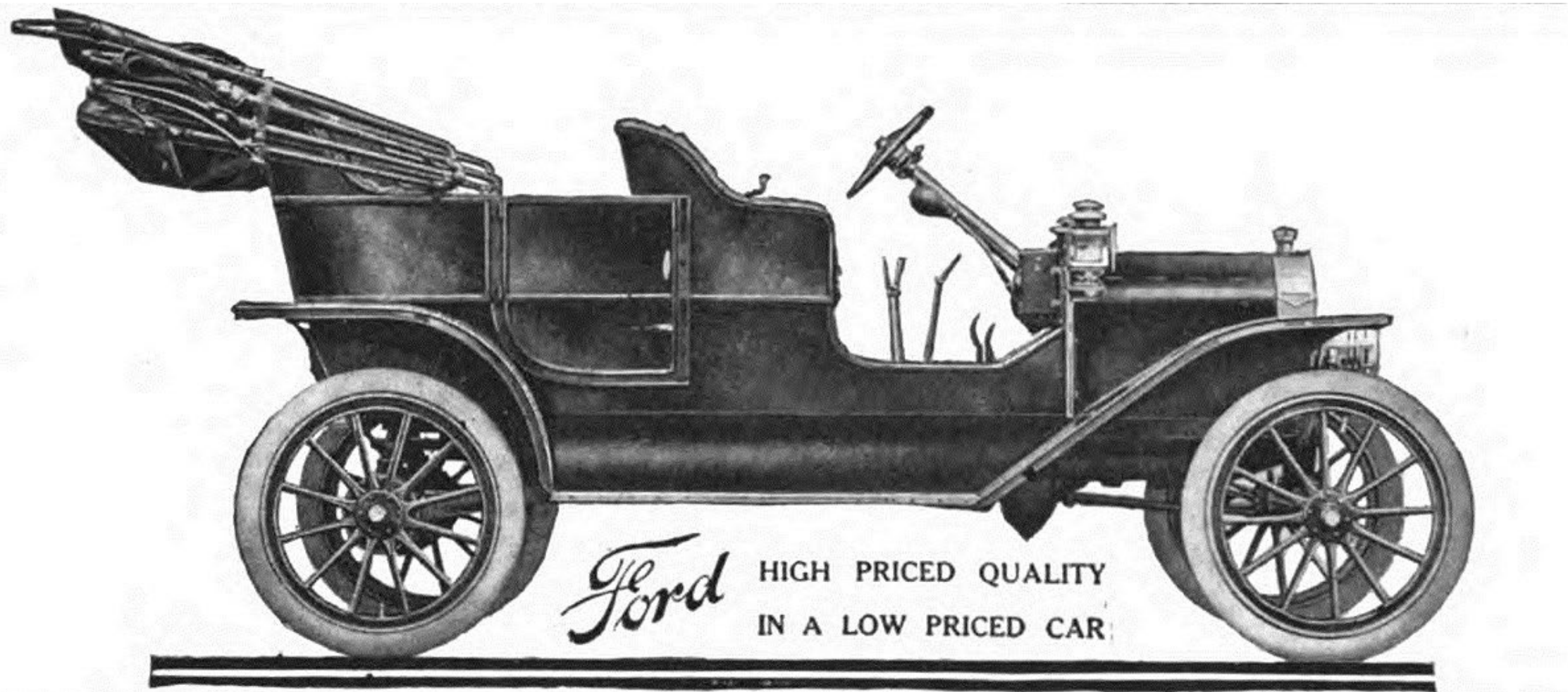
The high gasoline-high EV price calculus

- Average U.S. gasoline price: **\$4.18/gallon**
- Average new vehicle price (ICE and EV): **\$47,000**
- Average EV price paid: **\$66,000**

A return to the familiar

- Hyundai Ioniq hybrid (59 mpg): **\$23,600**
- Prius (56 mpg): **\$24,600**
- Ford Maverick ICE pickup (37 mpg): **\$20,000**

The longer combustion era



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