Range Extenders and Plug-in Hybrids: Why High-Efficiency Engines and Larger Batteries Are Shaping the Next Hybrid Wave

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Image: Pixabay

Electrification is accelerating, but the global transition is not linear. Markets are moving at different speeds, infrastructure readiness varies widely, and customers are increasingly optimizing for what works under real-world constraints: cost, range confidence, charging access, and daily usability.

A recent industry update linked to a ResearchAndMarkets report highlights a clear direction of travel for plug-in hybrids (PHEVs) and range-extended electric vehicles (REEVs): **higher thermal efficiency on the combustion side and larger traction batteries on the electric side**—paired with strong market momentum and growing international interest.

Market momentum: Plug-in hybrids are reshaping the hybrid landscape

The data points in the update underline how quickly the hybrid mix is evolving:

- **Hybrid vehicles (PHEVs + REEVs + HEVs)** reached **around 9 million units in 2023**, representing **10.1% of total vehicle sales**, and are expected to exceed **12 million units in 2024** (>13.5%).
- **PHEVs and REEVs** alone reached **around 4 million units in 2023** (up **49.8% year-on-year**) and are estimated to climb to **around 6 million units in 2024**, supported by strong Chinese market growth.
- From **January to September 2024**, global sales of **PHEVs & REEVs surpassed HEVs for the first time**, with the expectation that PHEVs and REEVs will become the **mainstream hybrid choice in 2025**.

For decision-makers, this is a useful signal. The market is not simply choosing "electric vs. combustion." It is increasingly choosing **hybrid architectures that maximize CO_2 impact per euro under current constraints**—and that can scale without waiting for perfect infrastructure.

Technology direction 1: High thermal efficiency becomes a differentiator

One of the most striking technical claims in the text is that **engine thermal efficiency for PHEV/REEV applications in China has reached ~46%**.

The update links this progress to:

- **Hybrid-optimized thermodynamic cycles** (Miller/Atkinson) that can improve efficiency by shifting the relationship between compression and expansion.
- **Control strategies** that keep the engine operating closer to efficient regions (avoiding inefficient idling/low-speed operation), enabled by electrified drivetrain architectures.
- A strong R&D push from major OEMs such as **BYD, Geely, Dongfeng, GAC, Great Wall Motor and Chery**, with expectations of **~45% thermal efficiency engines reaching industrial application from 2025**.

Why does this matter? Because in plug-in hybrids and range extenders, the combustion engine increasingly becomes a **system component designed for efficiency and predictability**, not peak mechanical performance. If the engine

runs less often—but runs closer to its best efficiency point—overall energy use and emissions can improve materially, especially in mixed-use driving and in regions with limited charging access.

Technology direction 2: Larger batteries—more electric driving, fewer compromise points

The second major trend is the rapid increase in battery capacity in Chinese PHEVs and REEVs. According to the update, capacities moved from roughly **~15 kWh to ~30 kWh** between 2023 and 2024, with popular long-range versions exceeding **43 kWh**.

The text frames larger batteries as a route to:

- **Longer EV-mode range**, which increases the share of kilometers driven electrically.
- **Potential longevity benefits** (fewer full charge/discharge cycles for a given driving profile) and improved performance under comparable power demand due to lower effective discharge rates.

At the same time, it explicitly notes the trade-off: bigger batteries add **weight and cost**, so “bigger is not always better,” and OEMs are actively calibrating battery size versus engine/motor pairing.

From a system perspective, that’s the core engineering challenge of the next hybrid wave: **choose a battery large enough to deliver substantial real-world electric kilometers, while keeping the vehicle cost-competitive and operationally efficient**.

The “2,000 km” narrative: range confidence as a sales driver

The update also points to a competitive narrative emerging in China: plug-in hybrids and REEVs targeting **around 2,000 km total driving range**, supported by larger fuel tanks and the hybrid system’s efficiency.

A specific example cited is **BYD DM 5.0**, described as achieving **>2,100 km** comprehensive range and positioned with a low price point (as stated in the update).

Regardless of how individual test conditions differ by standard, the strategic

takeaway is clear: consumers and fleets continue to value **range confidence and operational flexibility**, particularly where charging access is uncertain or where duty cycles are hard to electrify fully today.

Why REEVs are getting attention—at home and abroad

REEVs are described as having a relatively **simple structure and high "plasticity"** compared to PHEVs, and as being popular in higher-end segments. The update states there are **about 25 REEV passenger car models on sale**, with leading brands including **Li Auto, AITO and Leapmotor**; typical configurations are **mid-size to large vehicles**, around **~40 kWh battery capacity**, and **>200 km EV-mode range**.

Importantly, the text argues that REEVs have "huge potential" to expand internationally and lists several global OEMs reportedly planning or launching REEV approaches (including **Hyundai, Mazda, Stellantis, Nissan, BMW, and Volkswagen Scout**). It also claims that **a large share of consumers selected an extended-range edition of VW Scout** in North America following an October 2024 launch (as reported in the update).

The implication for Europe and other regions is not that REEVs replace BEVs, but that they can **fill an adoption gap**where charging infrastructure, customer acceptance, or operating profiles make pure battery-electric deployment slower than climate targets require.

Hybrid Alliance perspective: focus on scalable CO_2 reductions, not labels

The overarching message aligns with a pragmatic principle: the transition decade will be **multi-solution**, and the best pathway is the one that delivers **measurable CO_2 reductions at scale** under real constraints.

PHEVs and REEVs are evolving rapidly:

- Engines are being optimized for **efficiency-first operation**.
- Batteries are scaling to enable **meaningful electric driving**.
- Market adoption is accelerating, especially where cost and infrastructure realities demand flexible solutions.

For policymakers, fleets, and industry, the right question is therefore not "Which technology wins?" but:

Which mix of technologies delivers the fastest, most reliable CO_2 reduction — route by route, market by market — starting now?

That is precisely where advanced hybrid architectures can contribute: as an accelerator of decarbonisation while the broader ecosystem—grid, charging, supply chains, and affordability—continues to mature.

Read more: researchinchina.com/Htmls/Report/2024/77041.html