



Perkins White Paper:

# Hybrid and Electric Solutions

---

Copyright © Proprietary Information of Perkins Engine Company Limited 2019  
All Rights Reserved.

[www.perkins.com/hybrids](http://www.perkins.com/hybrids)

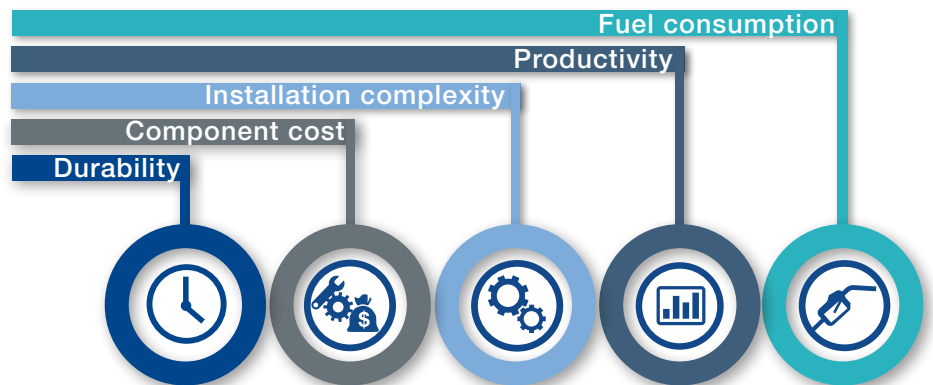
 **Perkins**<sup>®</sup>  
THE HEART OF EVERY GREAT MACHINE

## Hybrid and electric technologies - what is the optimum solution?

Perkins has worked with many Original Equipment Manufacturers (OEMs) to understand both the operating cycle of real customer machines and the space available in these machines for power systems.

What is clear from this work is that there are multiple possible technology configurations for off-highway machines. The optimum solution for installation complexity, component cost, durability, productivity and fuel consumption will vary considerably by machine type and use.

The quantity of energy storage and how quickly energy can be released are critical characteristics. How much energy recovery is both technically possible and economically viable is also a key consideration.



## Will automotive or marine technology be transferable?

In the automotive industry, the most progress for electric and hybrid technology has been in light duty vehicles in urban driving cycles. However, the duty cycles of off-highway machines, and particularly those in construction and agriculture, present very different opportunities for fuel saving or performance improvement to automobiles, buses or trucks. Therefore, it is not likely the solutions that we have seen in on-highway will translate directly to off-highway machines.

Off-highway machine economics are often different to those on-highway. Diesel fuel for example, is less expensive in many countries for off-highway than on-highway, whilst other inputs, such as grid electricity, servicing or diesel exhaust fluid can be considerably more expensive. As there are a great variety of off-highway operating cycles, there is not a single preferred solution. Different applications will have different optimum hybrid or electric technology solutions.



Marine power systems have similar limitations for technology transfer. The charging cycle, load profile, battery cooling and vibration are much easier to manage in a marine application than in a construction or agricultural machine.



## Will electricity replace diesel?

A number of technology demonstrator machines have been proposed by OEMs and it could be said that many of these projects have solved the easy part of the puzzle, which is the replacement of diesel with batteries, controls and electric motors. The difficult, but equally critical, parts of the puzzle have yet to be fully addressed. In particular, challenges persist in areas like recharging logistics, cost and battery life.

The economic business case for fully electric-powered machines is limited at current prices of diesel, batteries and grid electricity. There are clearly some niches, where we expect electric machines to find a place in the immediate future. One example is micro-excavators where the electric machines could work in environments not accessible by diesel machines, thus expanding the market. The technology cost will also change as automotive adoption of full electric increases and this will lead to an increasing market.

The transition to future power solutions is likely to happen first in those machines where the practical considerations have been addressed and the economic benefits are obvious or where local conditions encourage it either via regulation or incentive.



## How Perkins can help OEMs develop future power solutions

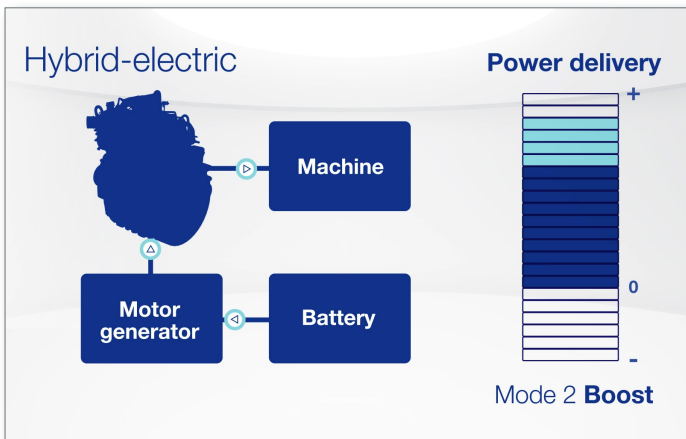
Alternative power technologies are not new to Perkins; research and development in this field has been a sustained focus for more than 10 years. This work has resulted in a set of tools that analyse alternative power solutions for a target machine and provide comparisons of benefits, cost and risks.

OEM's research and development teams are already under intense pressure from machine development priorities and a limitation on available resources, tools and facilities. It can be hard to see how to manage the additional burden of research into future power solutions, especially given the complexity of this subject and the new skills and facilities it requires.

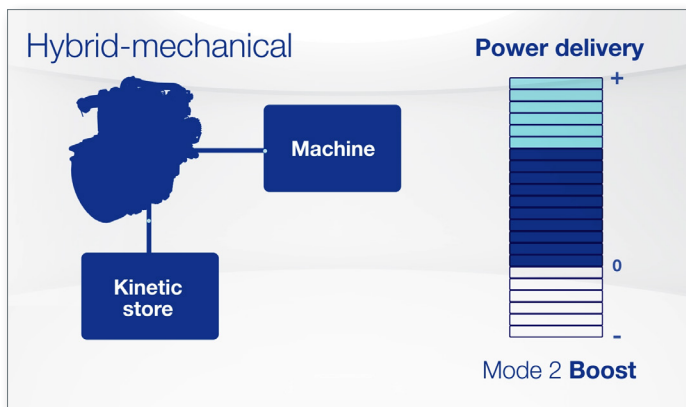
Perkins will offer hybrid and electric technologies across its power range from 8 to 800 hp (6 to 597 kW). The first technology solutions to be released are hybrid-electric, hybrid-mechanical and hybrid-hydraulic, all of which complement our existing range of 0.5-18 litre diesel engines.



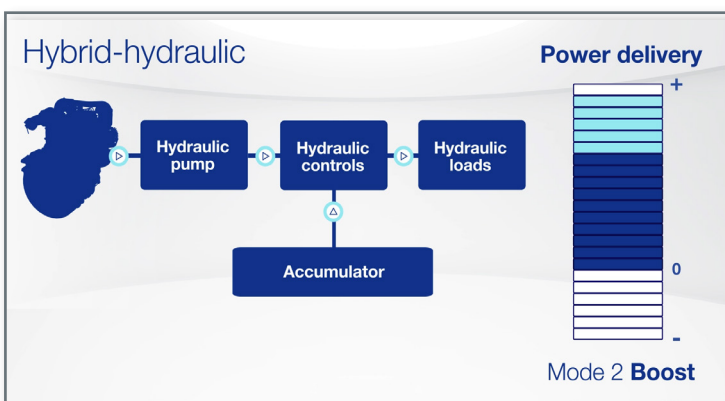
**Hybrid-electric:** Stores energy in ruggedised lithium ion batteries. Long duration energy storage makes it suitable for machines with less predictable operating cycles. 48-volt electrics provide wider integration opportunities and fuel saving.



**Hybrid-mechanical:** Optimised for machines with short and repeated operating cycles such as loading. Rapid release of stored energy. This solution offers an attractive path to engine downsizing as it takes less space than other solutions.



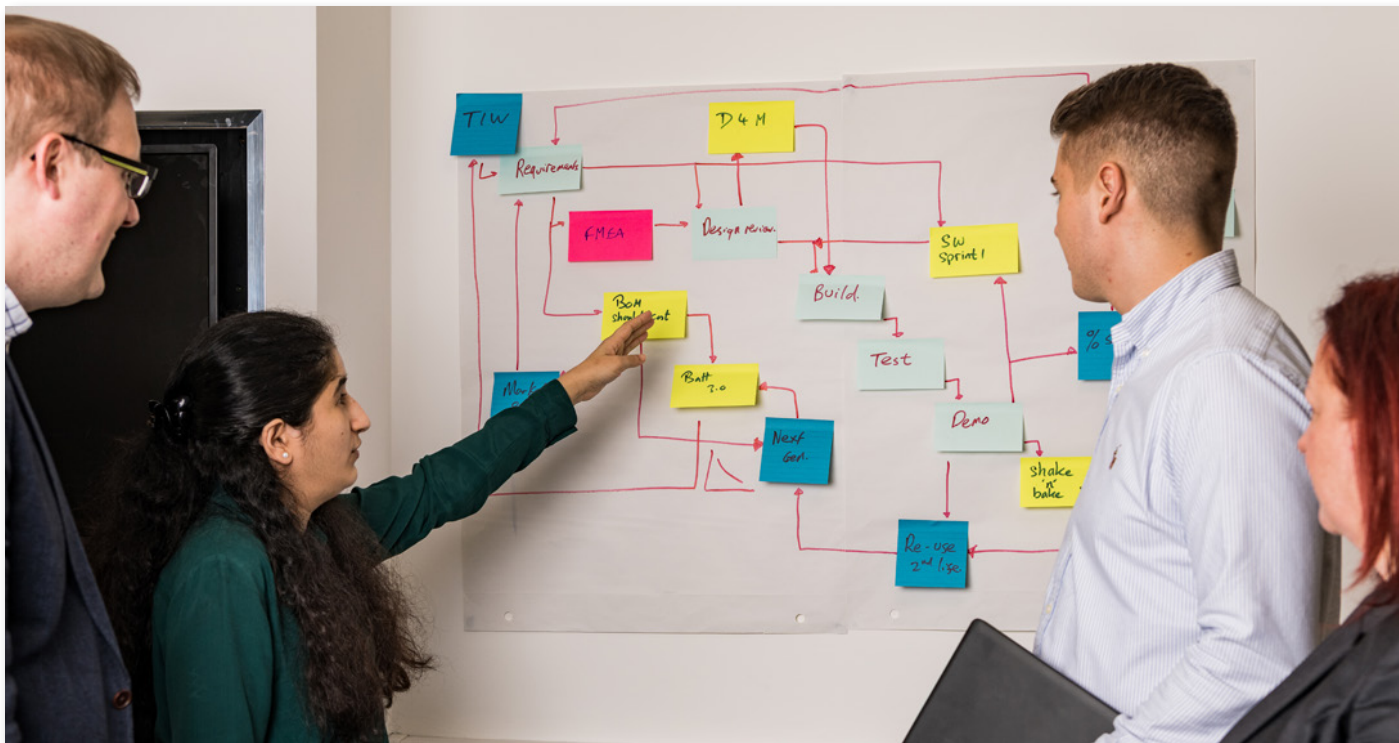
**Hybrid-hydraulic:** Stores excess energy from the engine, and recovered energy from machine systems, in a hydraulic accumulator. Offers rapid release of stored energy and leverages existing machine hydraulics. Service network friendly.



Perkins is focused on helping OEMs through this challenge and has brought together a group of experienced engineers to form the Perkins Extended Offering Product Team. This new team will have a set of engineering and simulation tools to enable OEMs to evaluate multiple technology sets and configurations, allowing the OEM to get a better outcome, faster and at lower development cost. This approach is an evolution of our customer integration programme.

The new Perkins team offers more than just engineering tools and consultancy. We will collaborate with OEMs on prototype machine design, build and validation at our well-equipped facilities.

The challenges of volume manufacturing and product support are also being considered, and Perkins will offer a flexible approach that gives the OEM the support they need to be successful in the commercial implementation of these new technologies.



## Can we help?



Are you a machine manufacturer who is thinking about adding hybrid or electric-powered machines to your range? We would like to chat. Contact us at [www.perkins.com/hybridscontact](http://www.perkins.com/hybridscontact)

## Want more information?

For the latest information on Perkins hybrid and electric solutions visit [www.perkins.com/hybrids](http://www.perkins.com/hybrids)

