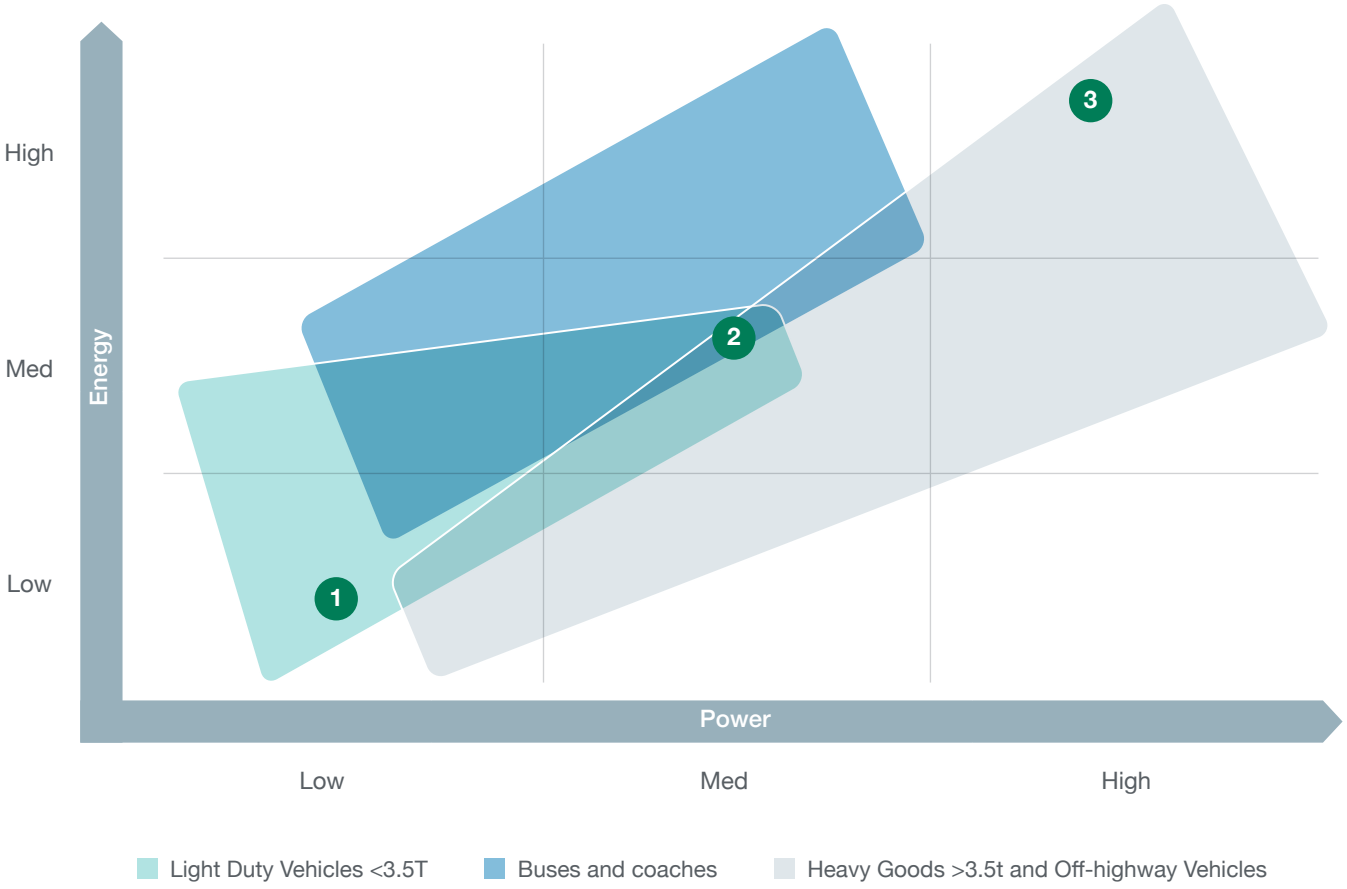
Energy-power spectrum across applications

Propulsion systems are tailored to specific power and energy demands, based on their use case and duty cycle. The graph below presents an outline of principle mass market products.



The 2020 roadmap provides values for (1) Cost effective, high volume indicators.

Values for (2) Power dense, high performance and (3) High power, ultra-high efficiency applications will be developed with industry due course.

1 Cost effective, high volume orientated:

Achieving economies of scale at a low cost is paramount for these products. Applications include high volume passenger car and delivery vans (majority 400V).

2 Power dense, high performance orientated

High power densities are required with cost a less decisive factor. Applications include performance passenger cars, buses and some medium duty vehicles (800V prevalent).

3 High power, ultra high efficiency orientated

High power densities and reliability are needed for these applications but efficiency is key to maximise energy use. Applications include 44 tonne trucks and large, off-highway vehicles (700-1,200V).

Technology indicators for cost effective, high volume applications

Technology indicators that industry is likely to achieve in a mass-market competitive environment. All the cost and performance metrics are ambitious, but relate to the same technology.

		2020	2025	2035
Inverter Indicators	Cost ($/kW)	3.5	2	1.7
	Volumetric Power Density (kW/l)	17	25	35
	Gravimetric Power Density (kW/kg)	13	20	25
	WLTP Average Efficiency	93%	95%	97%

		2020	2025	2035
DC-DC Converter Indicators	Cost ($/kW)	50	40	35
	Volumetric Power Density (kW/l)	1.2	1.75	3
	Gravimetric Power Density (kW/kg)	0.75	1.2	2.5
	Peak Efficiency	95%	96%	97%

		2020	2025	2035
Single Phase, On-Board Charger Indicators	Cost ($/kW)	80	65	50
	Volumetric Power Density (kW/l)	0.5	1	1.5
	Gravimetric Power Density (kW/kg)	0.8	1.2	1.75
	Peak Efficiency	93%	95%	97%

The below table represents the indicator specifications used for the roadmap. These are for reference only, and do not reflect a target spec.

Inverter Indicators Spec	2020	2025	2035
Peak Power	100kW	100kW	100kW
Continuous Power	50kW	50kW	70kW
Input voltage (min)	250V	250V	500V
Input voltage (nominal)	400V	400V	800V
Output current (max)	450A rms	450A rms	225A rms
Coolant inlet temperature	65°C	65°C	65°C
Production volume	>100k	>100k	>200k

DC-DC Indicators Spec[1]	2020	2025	2035
Peak Power	3kW	3kW	4kW[2]
Continuous Power	3kW	3kW	4kW
Input / output voltage (nominal)	400V	400V	800V
Output / input voltage (nominal)	12V	12V	12V
Coolant inlet temperature	65°C	65°C	65°C
Production volume	>100k	>100k	>200k

OBC Indicators Spec[3]	2020	2025	2035
Peak Power	6.6kW	6.6kW	6.6kW
Continuous Power	6.6kW	6.6kW	6.6kW
Input / output voltage (nominal)	190/270V AC 45-60Hz	190/270V AC 45-60Hz	190/270V AC 45-60Hz
Output / input voltage (nominal)	400V	400V	750V
Coolant inlet temperature	65°C	65°C	65°C
Production volume	>100k	>100k	>200k

1. Unidirectional power flow and galvanic isolation assumed 2. Assumes increasing MaaS / infotainment functionality 3. Bidirectional power flow and galvanic isolation assumed

Roadmap 2020

Power Electronics

Technology Roadmap

Technology indicators for 2020-2035 can be seen on page 2

automotive council UK

ADVANCED PROPULSION CENTRE UK

This roadmap represents a snapshot-in-time view of the global automotive industry propulsion technology forecast for mass market adoption. Specific application-tailored technologies will vary from region to region.

Dark bar: *Technology is in a mass market application. Significant innovation is expected in this time frame*

Transition: *Transitions do not mean a phase out from market but a change of R&D emphasis*

Dotted line bar: *Market Mature – technology has reached maturity. Likely to remain in mass market until it fades out where it's superseded*