Every motor vehicle engine operates within a specific speed range which is limited by the idle speed and the maximum speed. Power and torque are not offered uniformly and the maximum values are only available in partial ranges. Transmissions therefore convert the engine torque and the engine speed in accordance with vehicle traction requirements in such a way that the power remains roughly constant. They also allow the different directions of rotation for forward and reverse travel.

Transmissions in the Drivetrain

Internal-combustion engines do not have a constant torque and power characteristic over the speed range available to them (idle to high idle speed). The optimum "elastic" speed range lies between maximum torque and maximum power (Figure 1). For this reason, a vehicle cannot start off from a state of rest where the engine is stopped. To do this, it requires a power take-up element (e.g. clutch).

Furthermore, the available engine torque is not sufficient for gradients and powerful acceleration. For this purpose, a suitable gear ratio for adapting traction and torque and for optimizing fuel consumption must be made available.

Engines only have one direction of rotation as well, with the result that they require a changeover facility for forward and reverse travel.

As Figure 2 shows, the transmission is situated in a central position on the drivetrain and thus substantially influences the drivetrain's effectiveness.

In addition, an analysis of the losses that arise in the drivetrain show that, after the engine, it is the transmission which offers the most possibilities for optimization based on NEFZ driving cycle (Figure 3).
Benz patent motor carriage from 1886 with belt and chain drives
When Daimler, Maybach, and Benz launched their first road vehicles, pioneers of motive power engineering had already developed the machine parts required for power transmission to a considerable extent. Names such as Leonardo da Vinci, Dürer, Galileo, Hooke, Bernoulli, Euler, Grashof, and Bach had played a significant role in these developments.

Power transmission in an automobile must guarantee the functions of starting and engine-speed and torque conversion for forward and reverse travel. These functions call for actuators and shifting elements which intervene in the power-flow and perform engine-speed and torque conversion.

The first operational Benz patent motor carriage appeared in 1886. It was the first three-wheel vehicle to be conceived in its entirety specifically for motorized road traffic. It may well have had just one gear, but it did not have a start-up clutch. In order to get the carriage moving at all, it was necessary to push it or crank it with the flywheel.

A single-cylinder four-stroke engine with a displacement of 984 cc and a power output of 0.88 HP (0.65 kW) served as the drive unit for this Benz three-wheeler.

Benz utilized the following machine parts to transfer the motive force of his engine to the road:

The end of the engine’s crankshaft held the flywheel, which ensured that the engine ran more smoothly and which could also be used to crank the engine. Since the engine was built over the rear axle, a bevel gear arranged at right angles transmitted power in a small space to a belt drive, which reduced the rotational speed slightly to an intermediate shaft. Finally, a chain drive reduced the speed further to the powered axle.

The belt and chain drives dating from the origins of the automobile were gradually replaced by a gear train. But, today, they are experiencing a renaissance in the form of the continuously variable transmission (CVT). A CVT transmission consists of a variator with two V-pulleys and a flexible steel push-belt. As soon as the pressure of the transmission oil displaces the moving V-pulley halves, this changes the position of the steel push-belt between the two pulleys and with it the gear ratio. This technology allows continuous adjustment of the gear ratio without interrupting the power transmission and operation of the engine in its most favorable power range.