internal resistance model, where we model battery voltage as a function of SoC, and battery losses as I^2 * internalResistance.

In addition to the efficiency maps, users can now implement both storage and deployment derate conditions, which will limit the charging or discharging power of the battery according to temperature and SoC. These conditions can also be extended to other variables, clients should contact Canopy do discuss their needs.

Parameter	Definition
EHarvestMax	Maximum allowable energy harvest per stint/lap.
EDeplomentMax	Maximum allowable net energy deployment per stint/lap.
EDeplomentRegulatoryMax	Maximum allowable net energy deployment per stint/lap, taking account of regulatory efficiency, eRoundTripRegulatory.
eStoreEfficiency	Efficiency of energy storage into the battery, implemented either as a scalar or as a flexible map.
eDeployEfficiency	Efficiency of energy storage from the battery, implemented either as a scalar or as a flexible map.
eRoundTripRegulatory	Allows us to simulate the FE regulation: "braking regen added to allowable energy delivery based on factor of 0.75".
EBatteryMaxCapacity	Maximum rated battery capacity.
rBatteryRatedEfficiency	The rated capacity is measured at some discharge rate. We want to know the true internal charge. Rated efficiency = EBatteryMaxCapacity/True internal charge.
rStateOfChargeInitial	Initial SoC at start of stint/lap.
rStateOfChargeMinimum	Minimum allowable SoC.
Battery storage derate conditions	Conditions defining battery scharge power according to SoC and temperature.
Battery deployment derate conditions	Conditions defining battery discharge power according to SoC and temperature.
PBatteryMax	Maximum instantaneous power output from the battery.
thermalBoundaryConditions	Defines whether the boundary conditions are periodic (start and end temperatures equal) or with a fixed initial temperature.

Transmission

The transmission model is primarily concerned with determining the overall gear ratio between the engine and the diff output shafts. The user has two main options for transmission simulation:

1. **CVT**: continuously variable transmission, where the engine is always run at the speed corresponding to maximum power, and the gear ratio chosen to make this consistent with the rotational velocity of the road wheels.
2. **VShift**: A transmission model which closely approximates a conventional n-speed gearbox, but which slews smoothly between gear ratios at gear changes, rather than making a discontinuous gear change.

By default VShift will choose the gear at every point which delivers maximum power; this is the optimal gear shifting pattern. If you wish, either due to a physical constraint on the gearbox or driven by a desire to exactly match some driver behaviour, you may enter upshift engine speeds for all but the final gear in *nEngineUpshift*. These upshift speeds can be applied in two ways (determined by *upshiftApplication*); either as an upper bound on engine speed in that gear, in which case VShift will select the gear which gives maximum power unless it exceeds the upshift speed for that gear in which case it will select the gear above; or as a fixed upshift point, in which case VShift will remain in each gear until the upshift engine speed is reached, at which point it will shift up.

A gearbox efficiency map can be specified instead of a fixed efficiency. In this case the efficiency can depend on *nInputShaft* (this is either *nMotor* or *nEngine* depending on whether an ICE or electric motor powertrain is used), *TGearBox* (to set this up see Cooling) and *MCrankShaft*.

The transmission parameters are listed in the table below:

Parameter	Definition