Total power, controller losses and motor losses

The power that can be used by the solar car:
280 RWE solar cells with each an area of 30,18 cm^2 and an average efficiency of 30%. 2578. Emcore solar cells with each an area of 27,56 cm^2 and an average efficiency of 24,5%. [1]
If we assume the intensity of the sun on the solar cells is $1000W/m^2$.[2]
*$P_{remaining}$=(0,003018*280*0,3+0,002756*2578*0,245)*1000 = 1994,23W*
Losses = 76%

Controller losses:
Controller efficiency = 99%
*$P_{remaining}$=0,99*1994,23W=1974,3W*
Losses=0,251%

Motor losses:
Motor efficiency = 95%
*$P_{remaining}$= 0,95*1974,3W=1875,57W*
Losses = 1,2%

Aerodynamic drag, rolling resistance losses and friction of ballbearings

Both depend from the speed of the vehicle. The top speed can be defined by searching the speed at which the sum of the aerodynamic drag and the rolling resistance power losses is equal to the total remaining power.

Aerodynamic drag power losses:
$A_{frontal}=0,81m^2$
Coëfficiënt of drag= C_x=0,077 [3]
Atmospheric density = ρ_{air}= 1,2 kg/m^3
v_{max}=?
$P_{loss\ aero}= A_{frontal}*C_x*v^3*\rho_{air}/2$

Rolling resistance power losses:
Total weight of car =m_{tot}= 225kg
$g=9,81m/s^2$
C_{rr}=rolling resistance coefficient=0,0025 [4]
v_{max}=?
$P_{loss\ roll}=m_{tot}*v*g*C_{rr}$

Power losses due to ball bearings:
The speed at the ballbearing is r_{tyre}/ r_{axis} times smaller than the speed of the car.
Diameter of the car tire = 0,4 m
Diameter of the axis = 0,037m
Total weight of car =m_{tot}= 225kg

[1] Data from Emcore and RWE datasheet and in the Excel file 'umicardata' on toledo
[2] 'Hoofdstuk 2: zonlicht, kenmerken en beschikbaarheid' on Toledo
[3] Datasheet 2 on Toledo
[4] Material from datasheet on Toledo
Value for the resistance coefficient on Wikipedia (http://en.wikipedia.org/wiki/Rolling_resistance)

$g=9{,}81 m/s^2$
f_w= coefficient for friction losses due to ballbearings = 0,001
$P_{loss\ ballbearing} = g*m*f_w*v*r_{axis}/r_{tire}$

Calculations for maximum speed

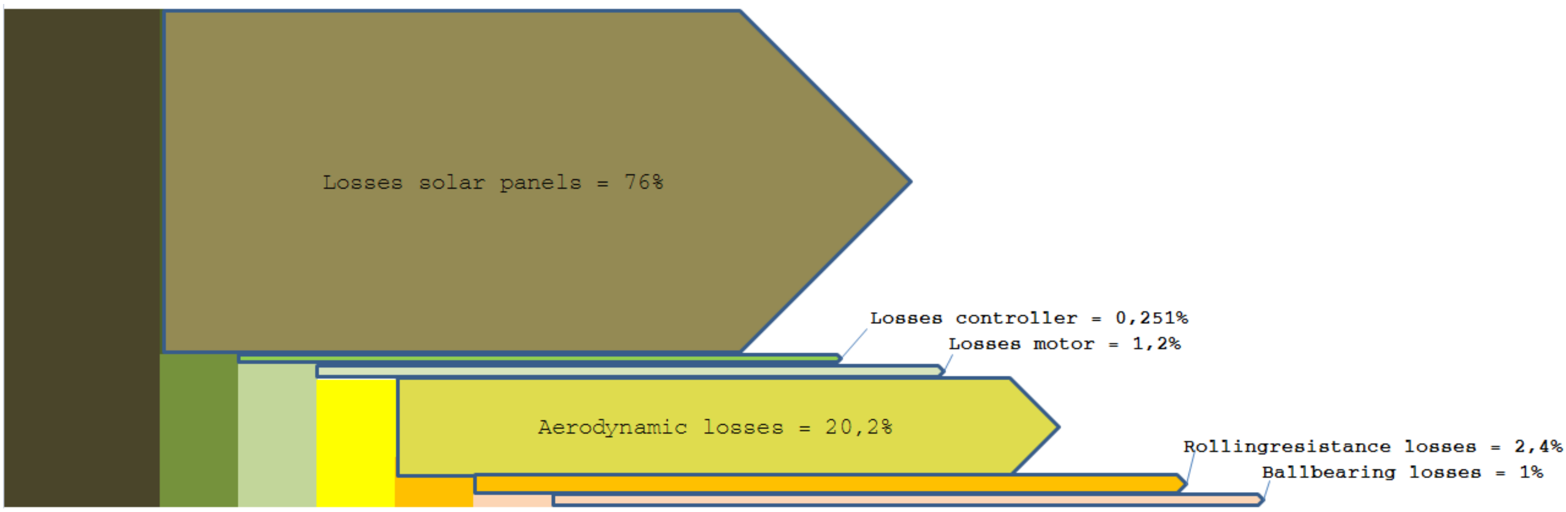
Max speed is reached when all power losses are equal to the power delivered.

$P_{remaining} = P_{loss\ aero} + P_{loss\ roll} + P_{loss\ ballbearing}$
$P_{remaining}=0{,}037422*v^3+5{,}518125*v+0{,}51*v=1875{,}57W$
$v_{max} = 35 m/s$

$P_{loss\ aero} = 1604{,}47W$
Losses = 20,2%

$P_{loss\ roll} = 193{,}13W$
Losses=2,4%

$P_{loss\ ballbearing} = 77{,}25W$
Losses = 1%



Sankey Diagram for maximum speed

Calculations for half the maximum speed

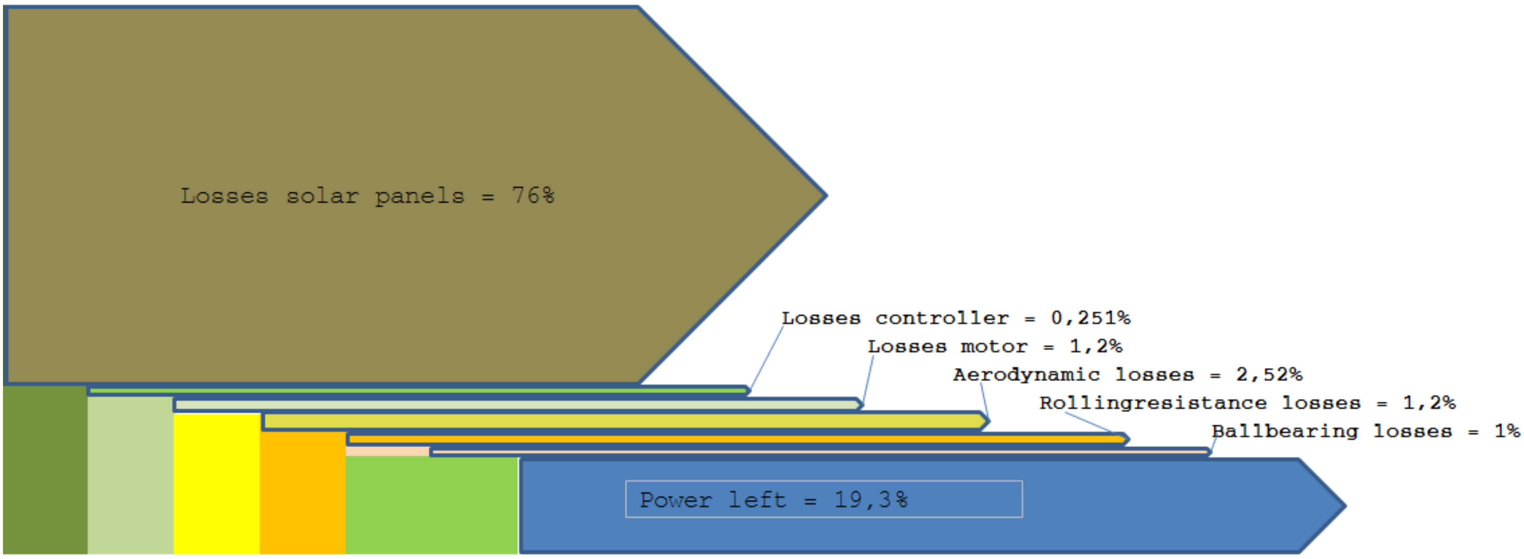
$v = 17{,}5 m/s$

$P_{loss\ aero} = 200{,}55W$
Losses = 2,52%

$P_{loss\ roll} = 96{,}56W$
Losses=1,2%

$P_{loss\ ballbearing}$ = 38,63W
Losses = 0,5%

There's still 1539,83W power left on this speed, so it would be possible to accelerate.



Sankey Diagram for half the maximum speed