Exhaust Streams and Component Heat Protection

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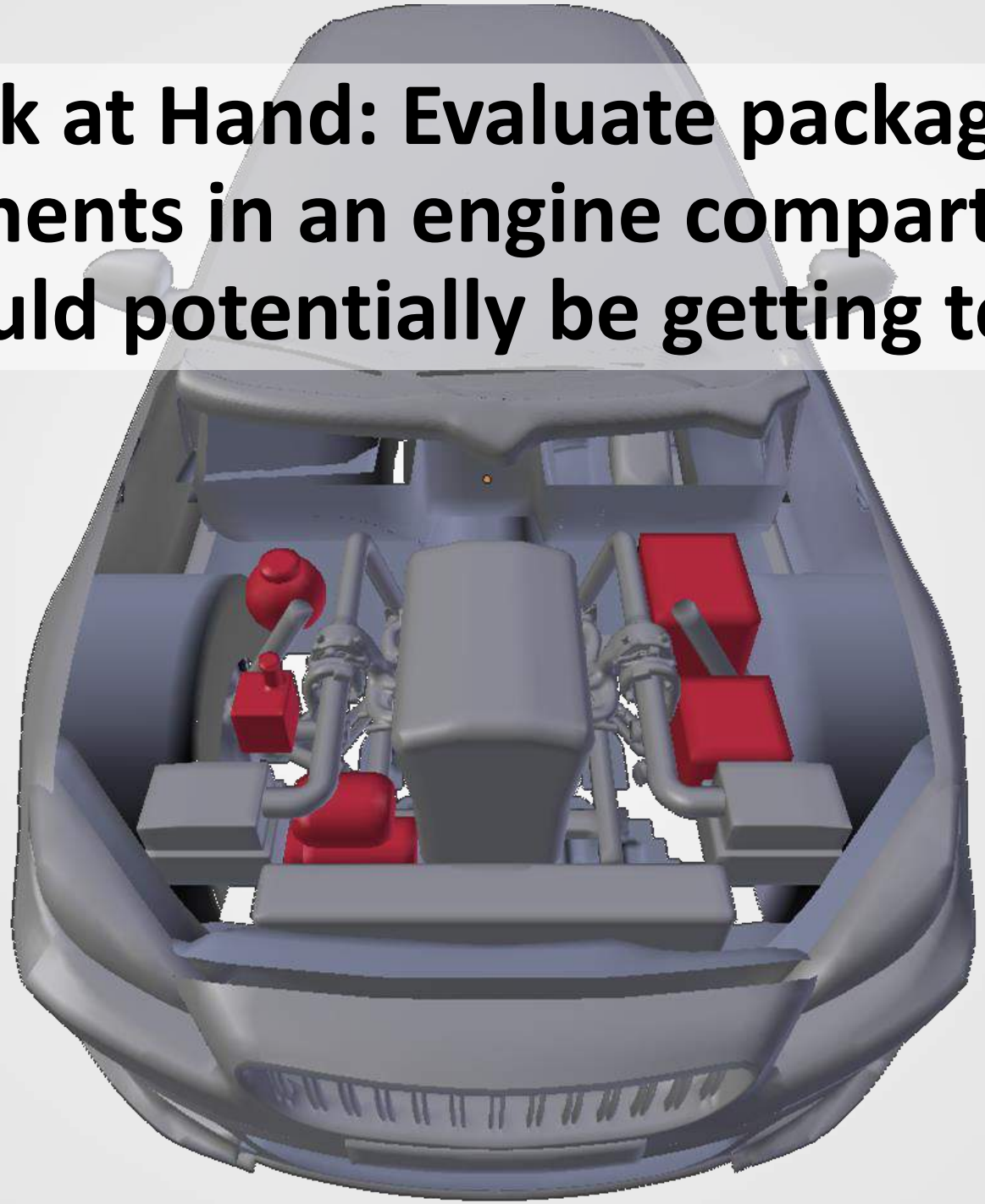
ThermoAnalytics®

Exhaust Streams and Component Heat Protection

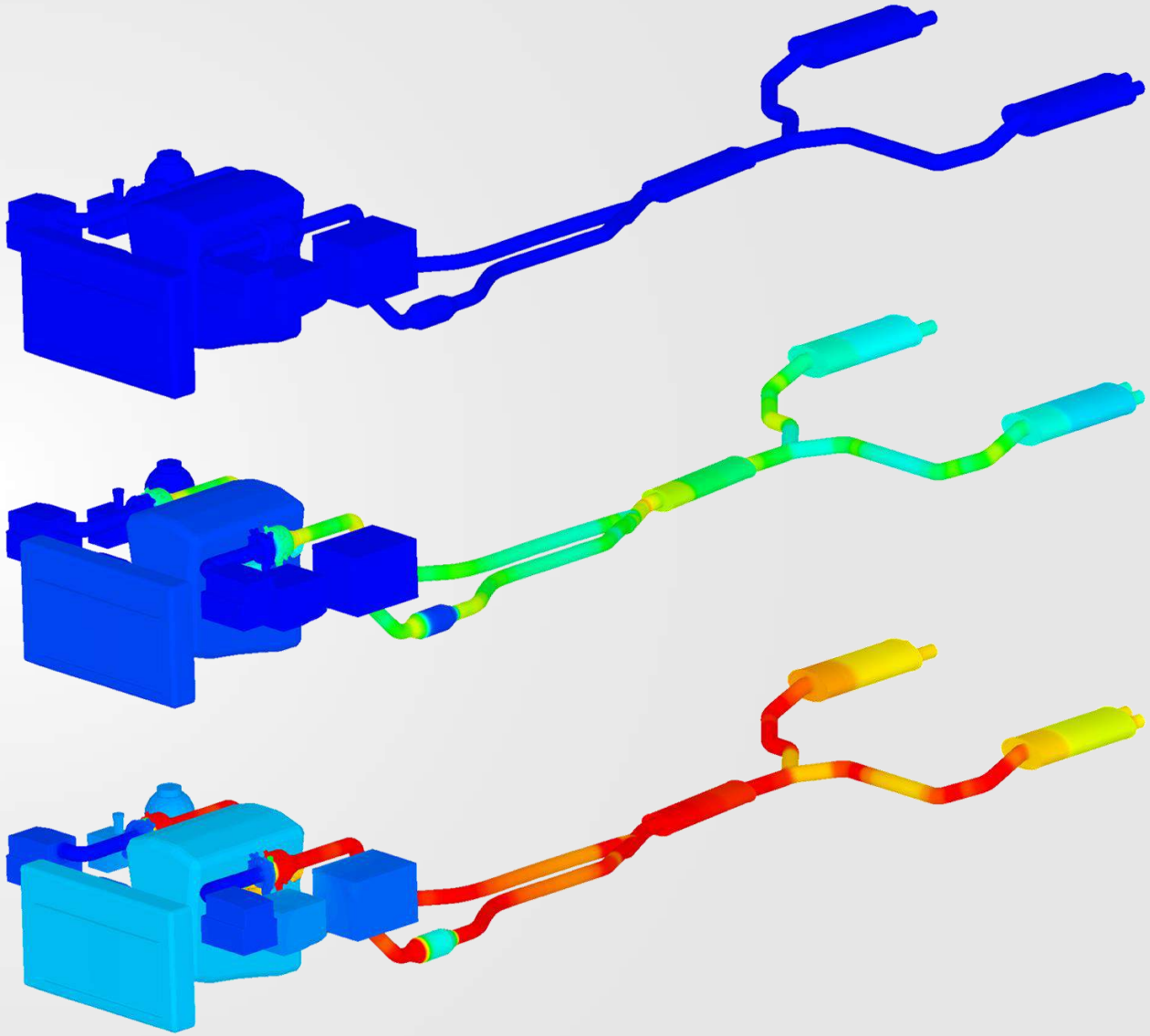
- Exhaust Stream Feature
- Hot components in an engine compartment
- Updates from 12.4 to 12.5 ease exhaust stream setup
- Implement a fix to resolve the issue
- Unrealized effects of the implemented fix

The Task at Hand: Evaluate packaged components in an engine compartment that could potentially be getting too hot



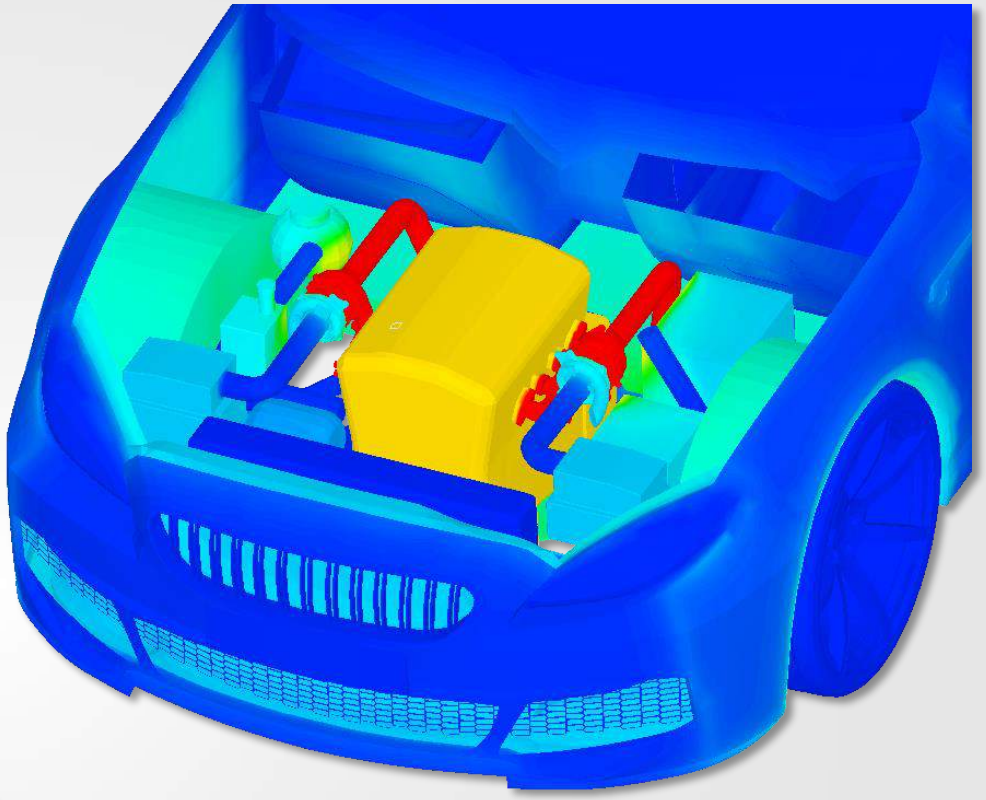
Model Scenario

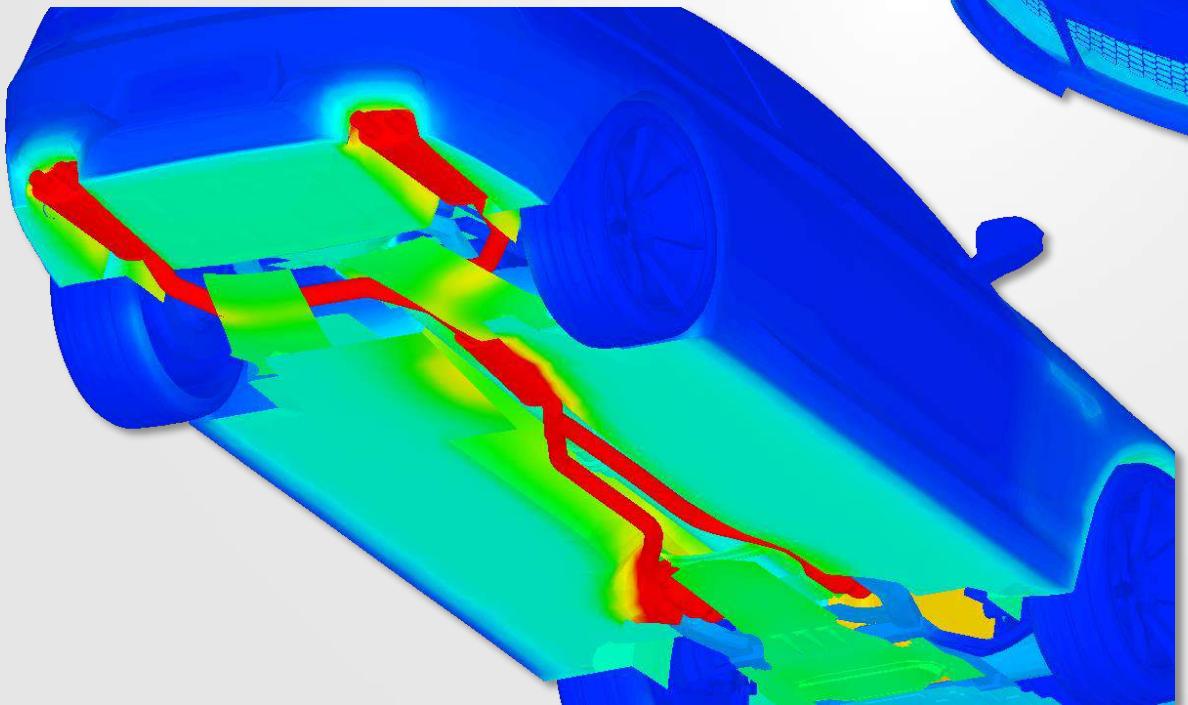
1. From a cold/off state of 20°C
2. The vehicle turns on
3. Set to run for a 30 minute transient case @ 120 kph



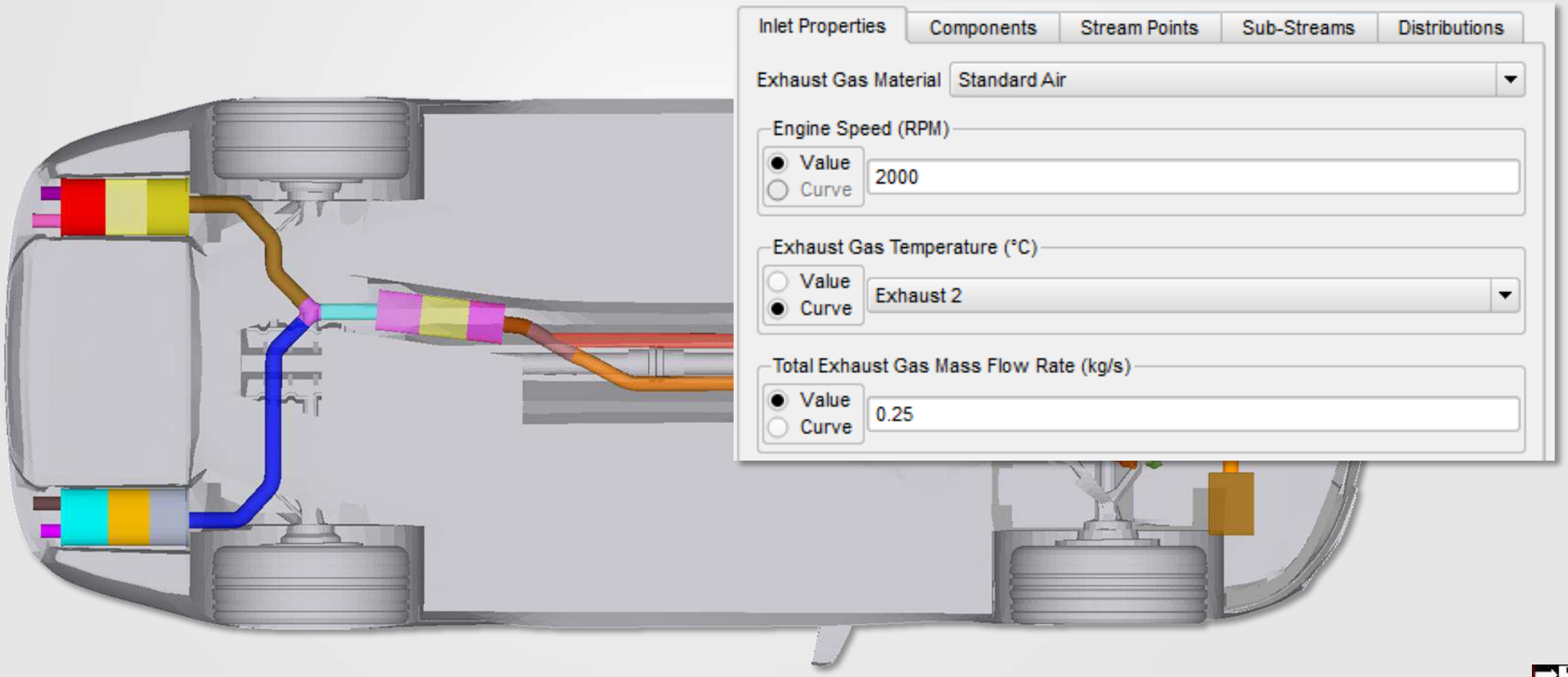
Thermal Model Heat Contributors

- Engine
- Cooling pack
- Transmission
- Exhaust components



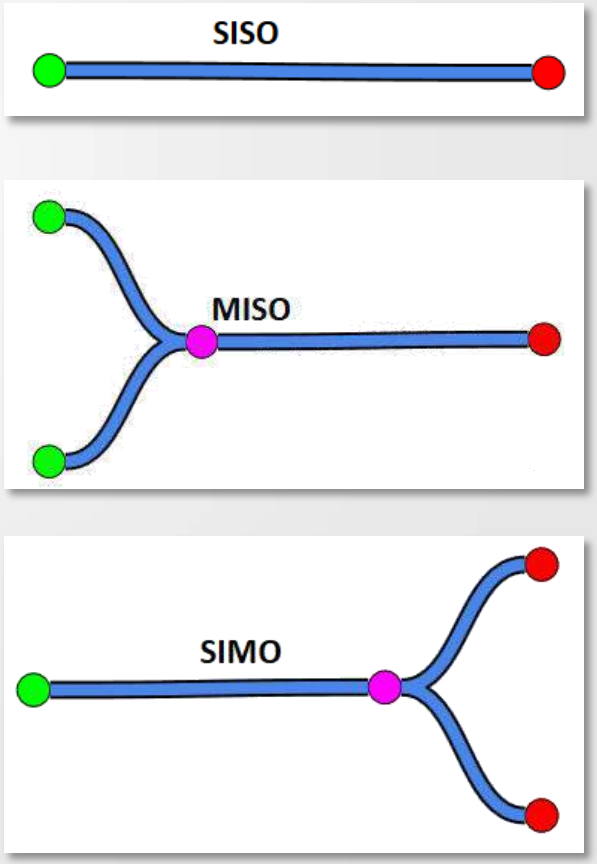


ThermoAnalytics' exhaust stream feature is used to model convection correlations and heating within the exhaust components



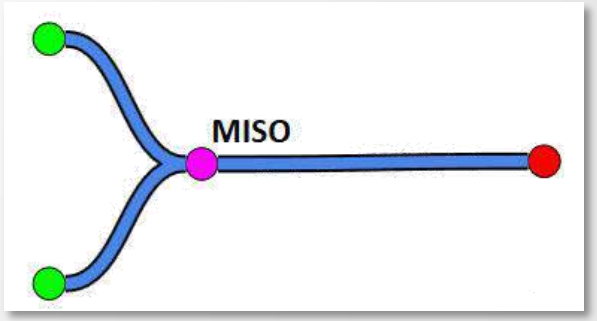
Exhaust Tool Improvements from 12.4 to 12.5

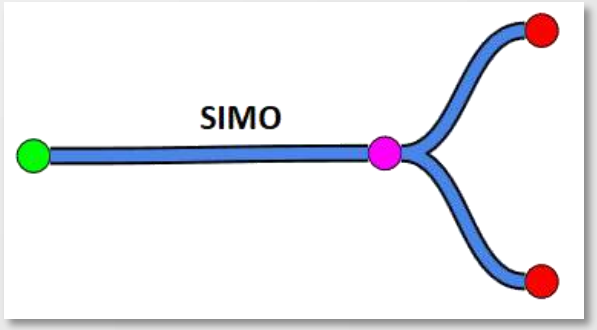
- Sub-streams can now be categorized as being one of three types:
  - Single inlet, single outlet (SISO)
  - Multiple inlet, single outlet (MISO)
  - Single inlet, multiple outlet (SIMO)



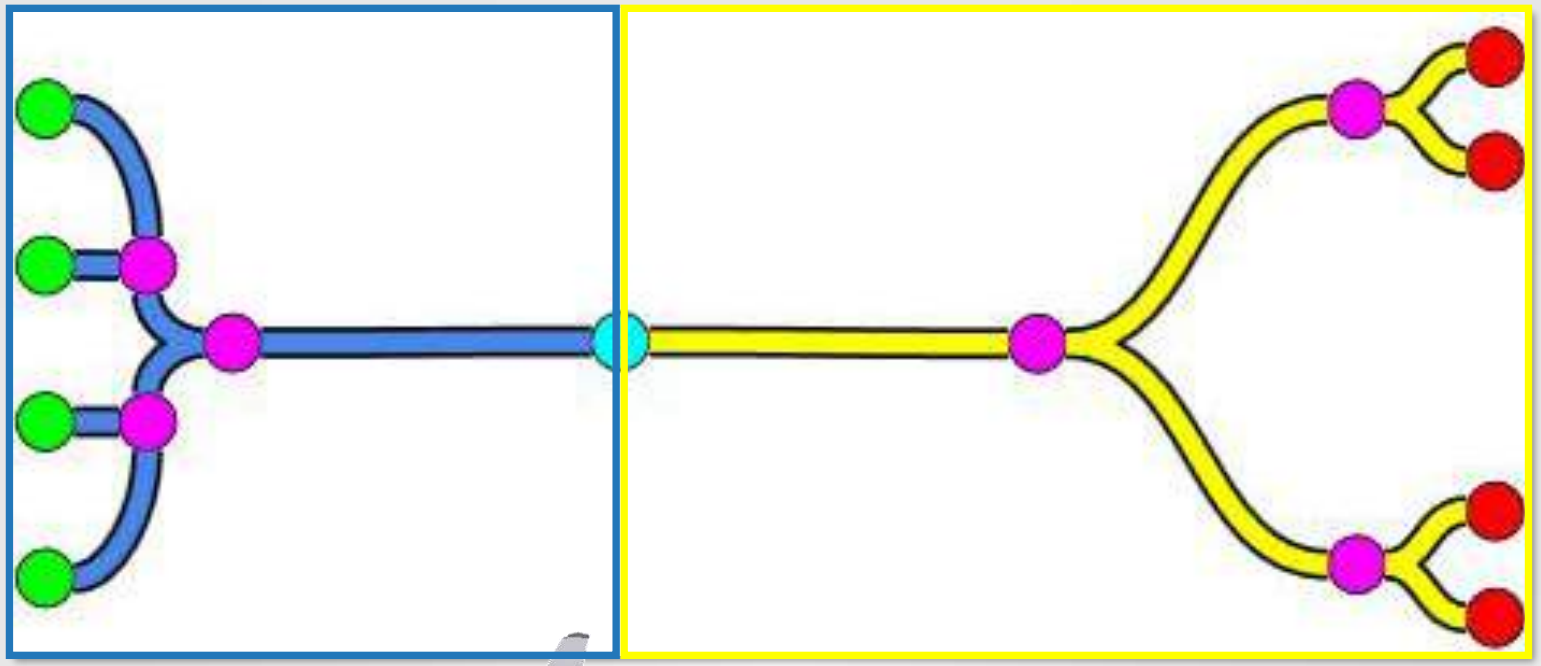
Exhaust Stream Updated Model Setup

- Model setup is simplified with the feature improvements
  - Components: 18 > 11
  - Stream points: 22 > 13
  - Number of Sub-Streams:17 > 2
- Model now only requires 2 Sub-Streams
  - 1 MISO
  - 1 SIMO



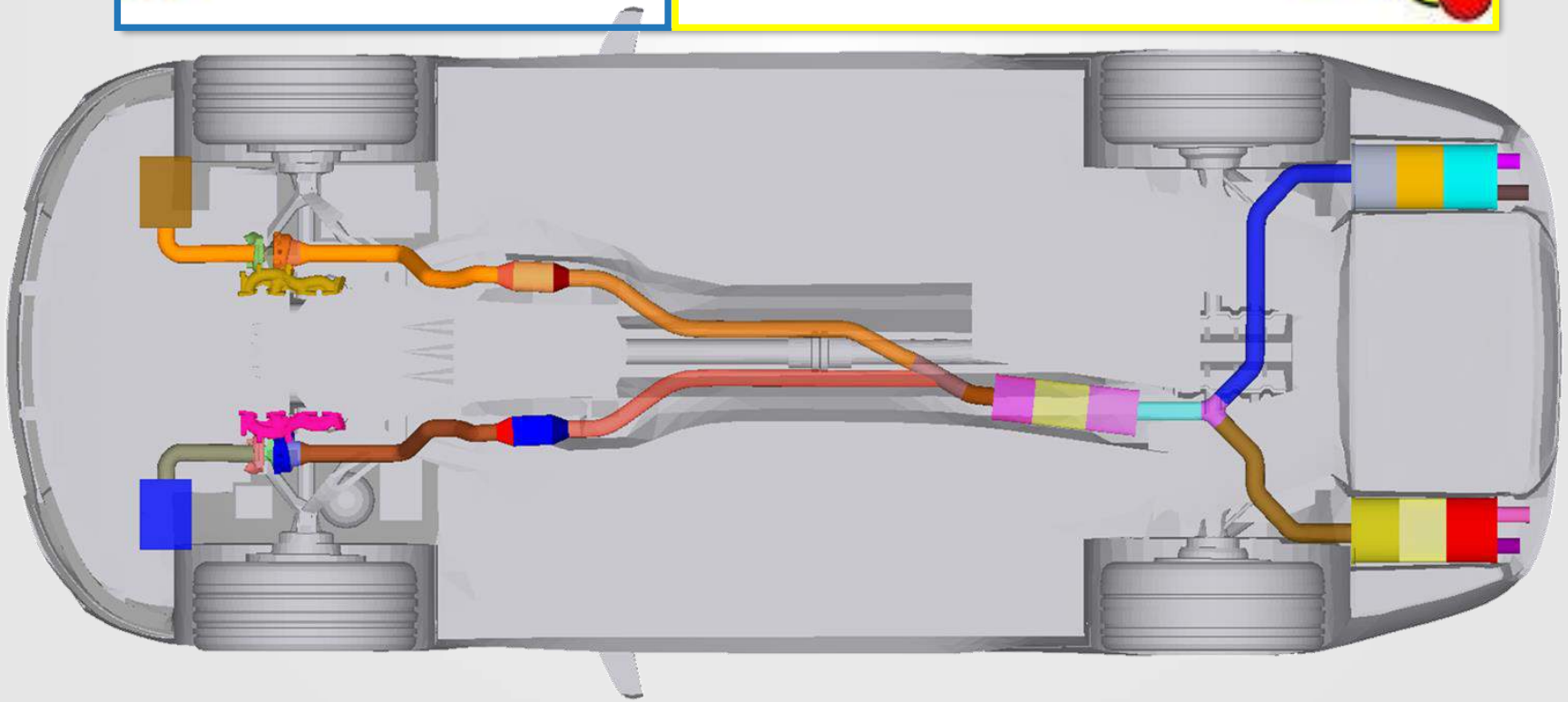


MISO



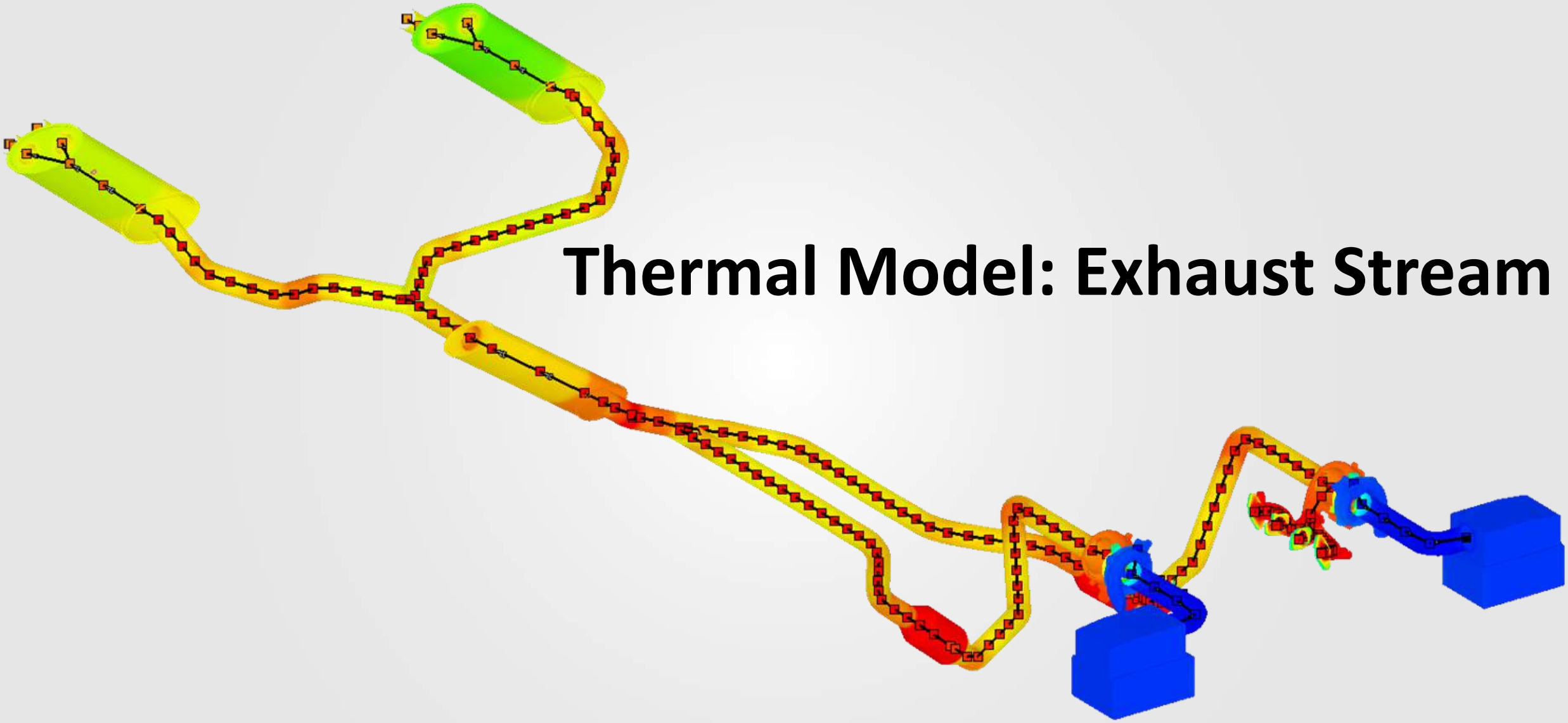
SIMO

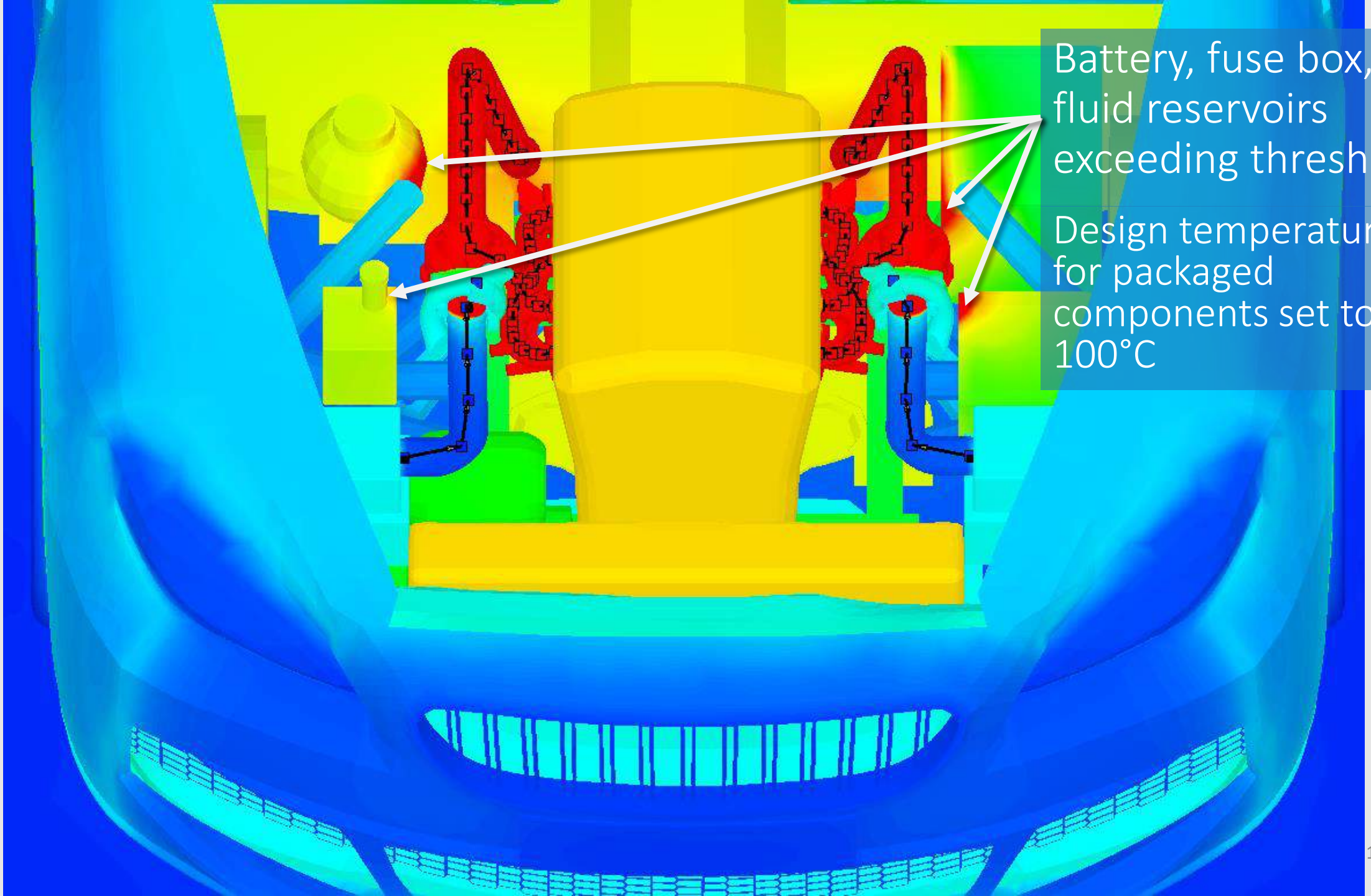
Front



Rear

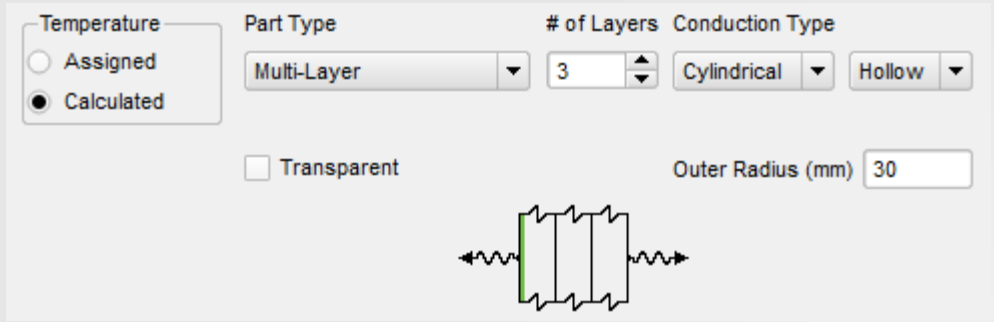
Thermal Model: Exhaust Stream



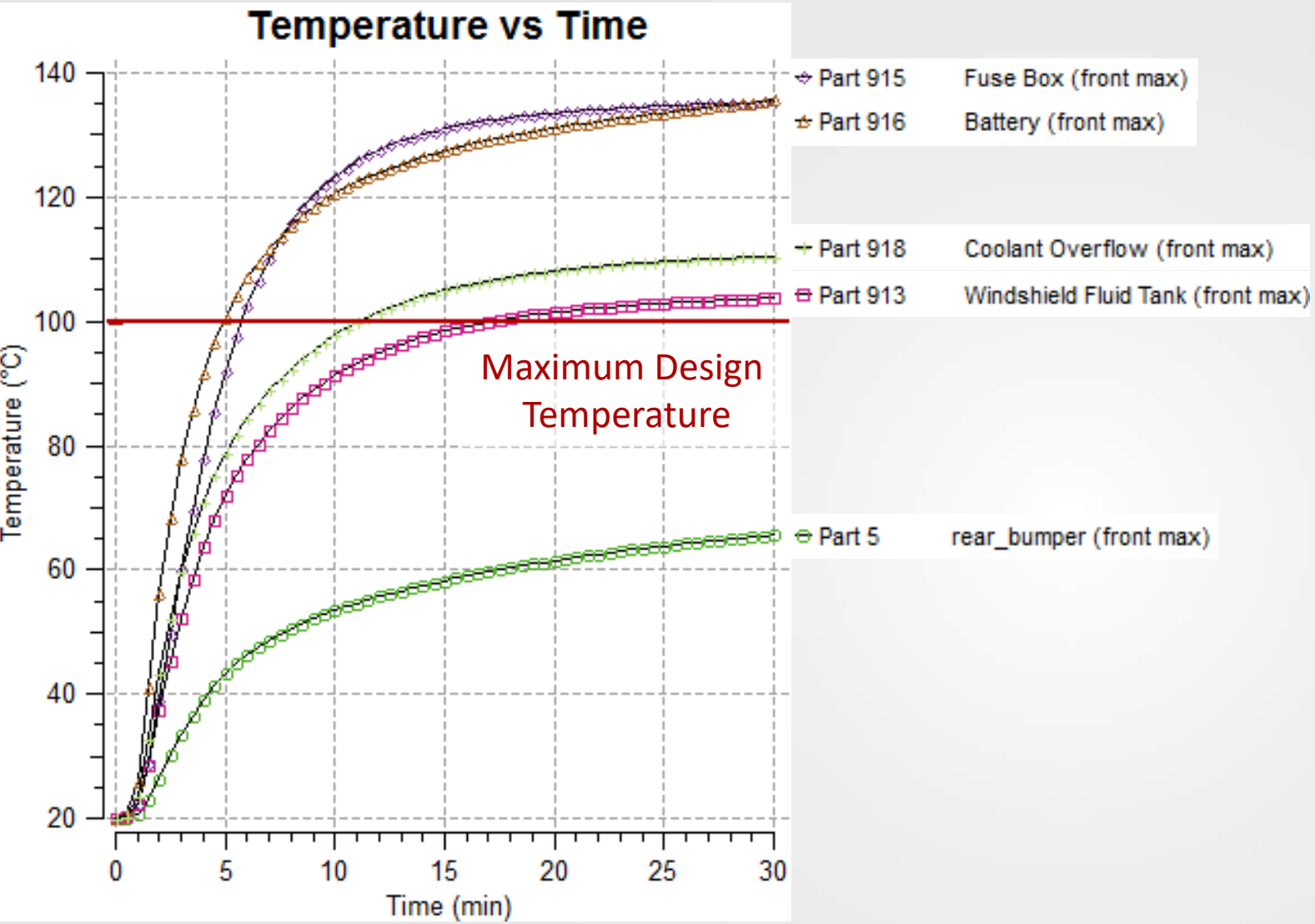


Battery, fuse box, and fluid reservoirs exceeding threshold

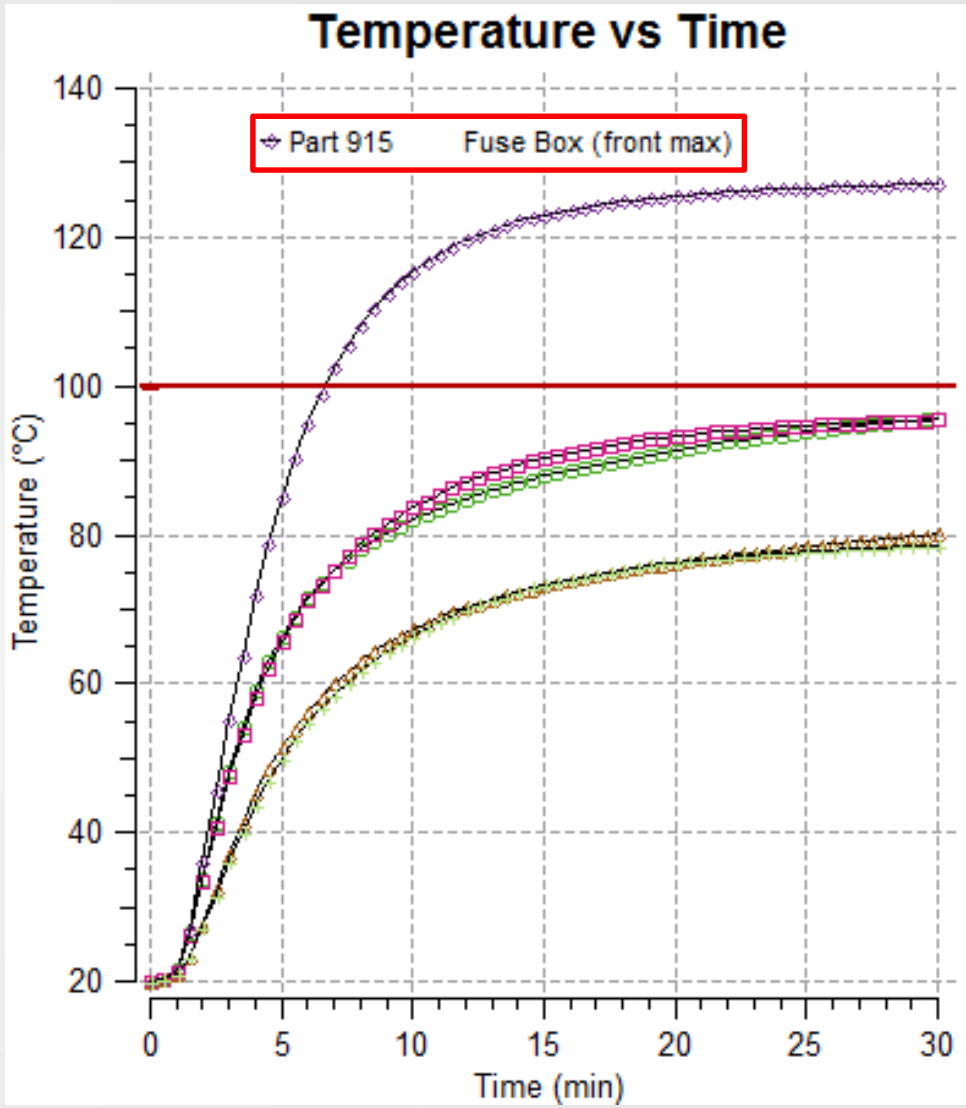
Design temperatures for packaged components set to 100°C



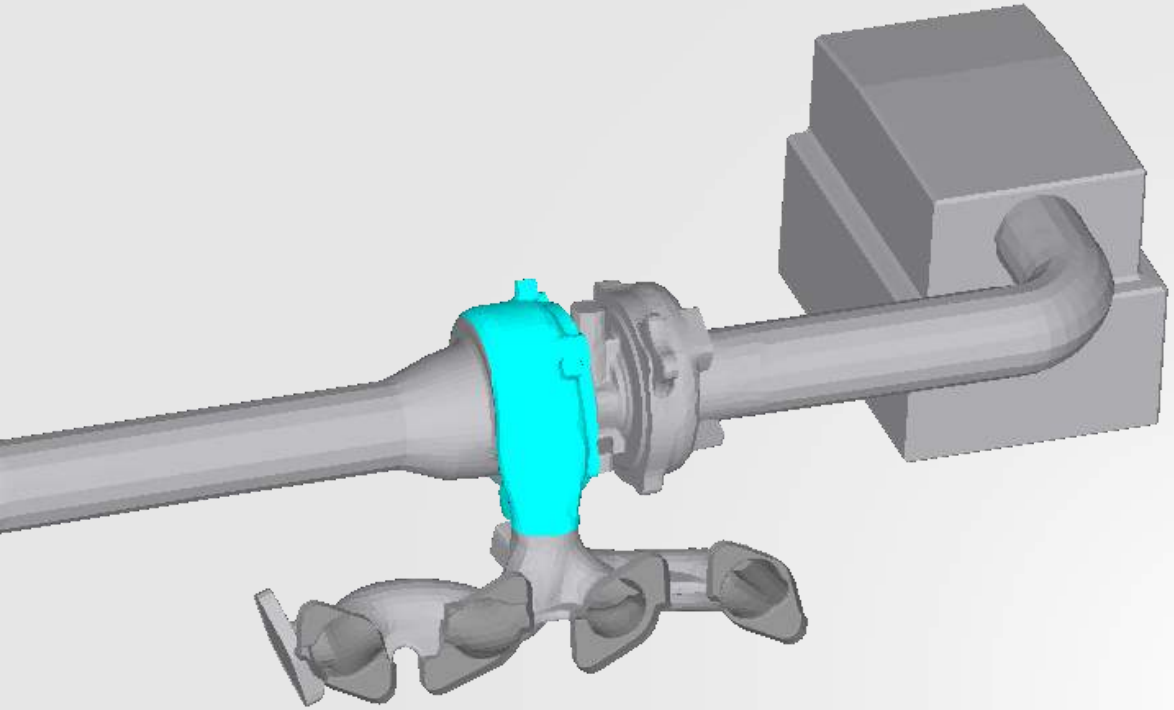
Substitute a double-walled exhaust pipe from the turbos to the catalytic converters

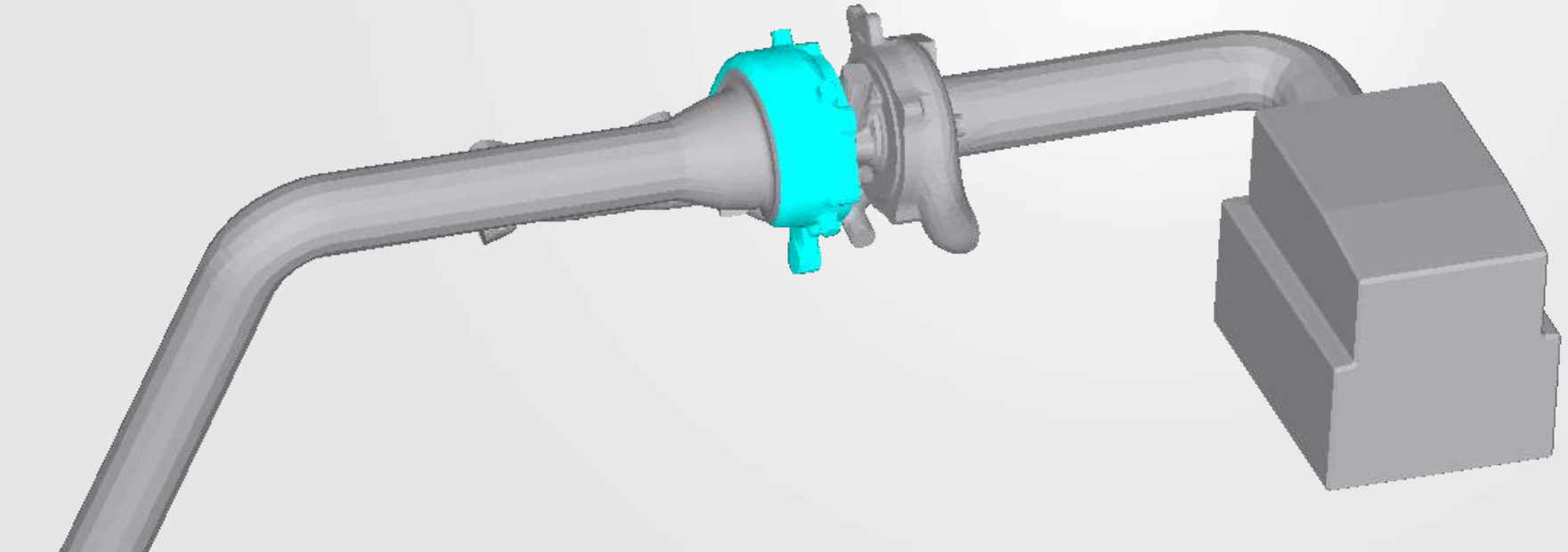


Baseline

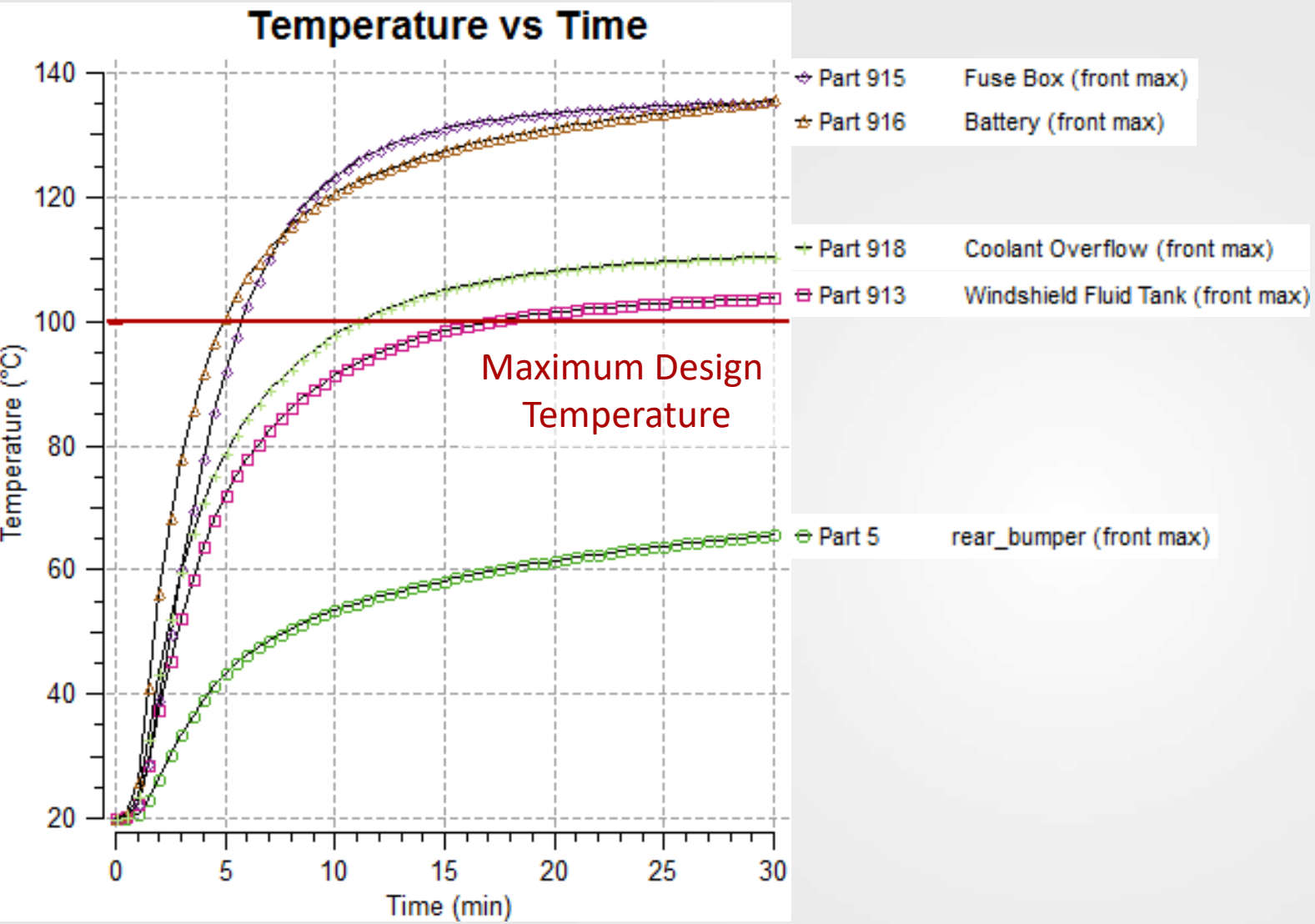


Double-walled exhaust pipe

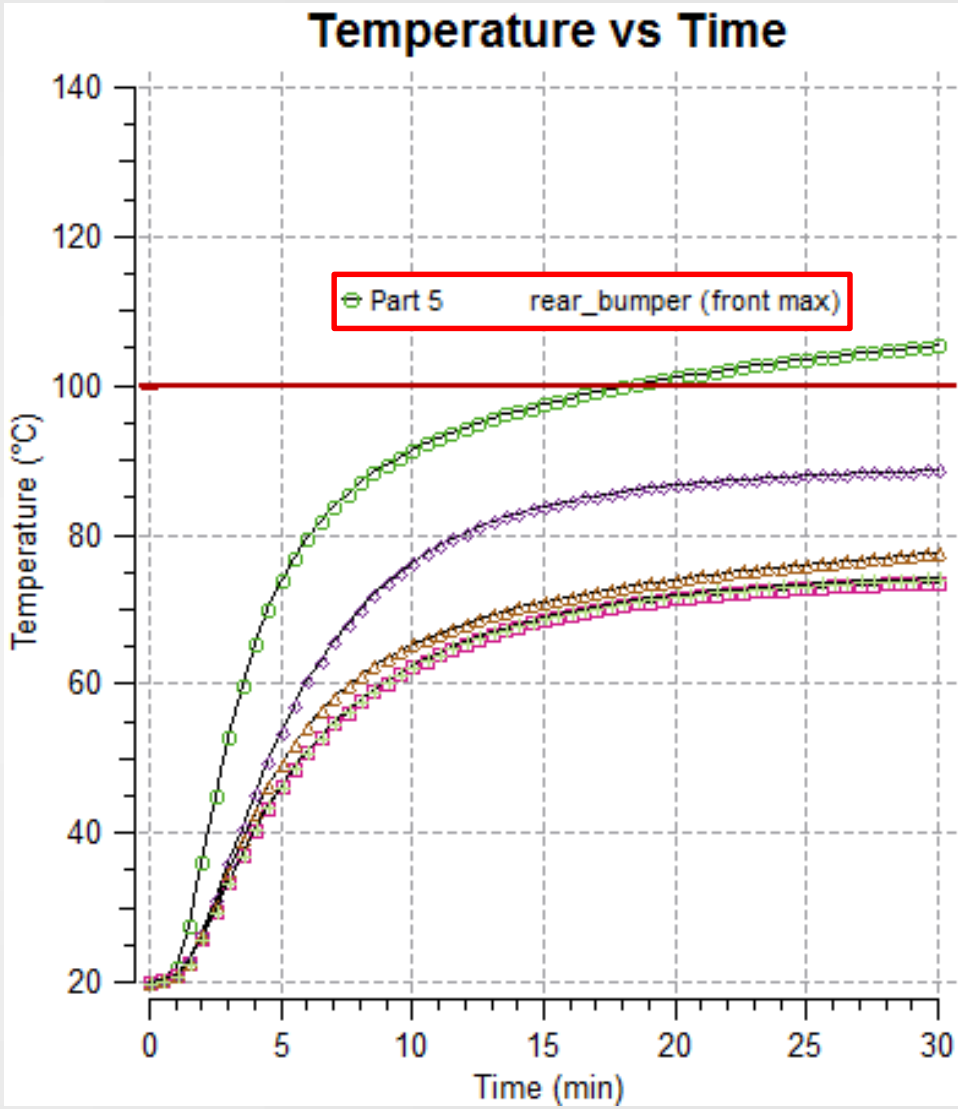




Add insulation to the hot side of the turbo

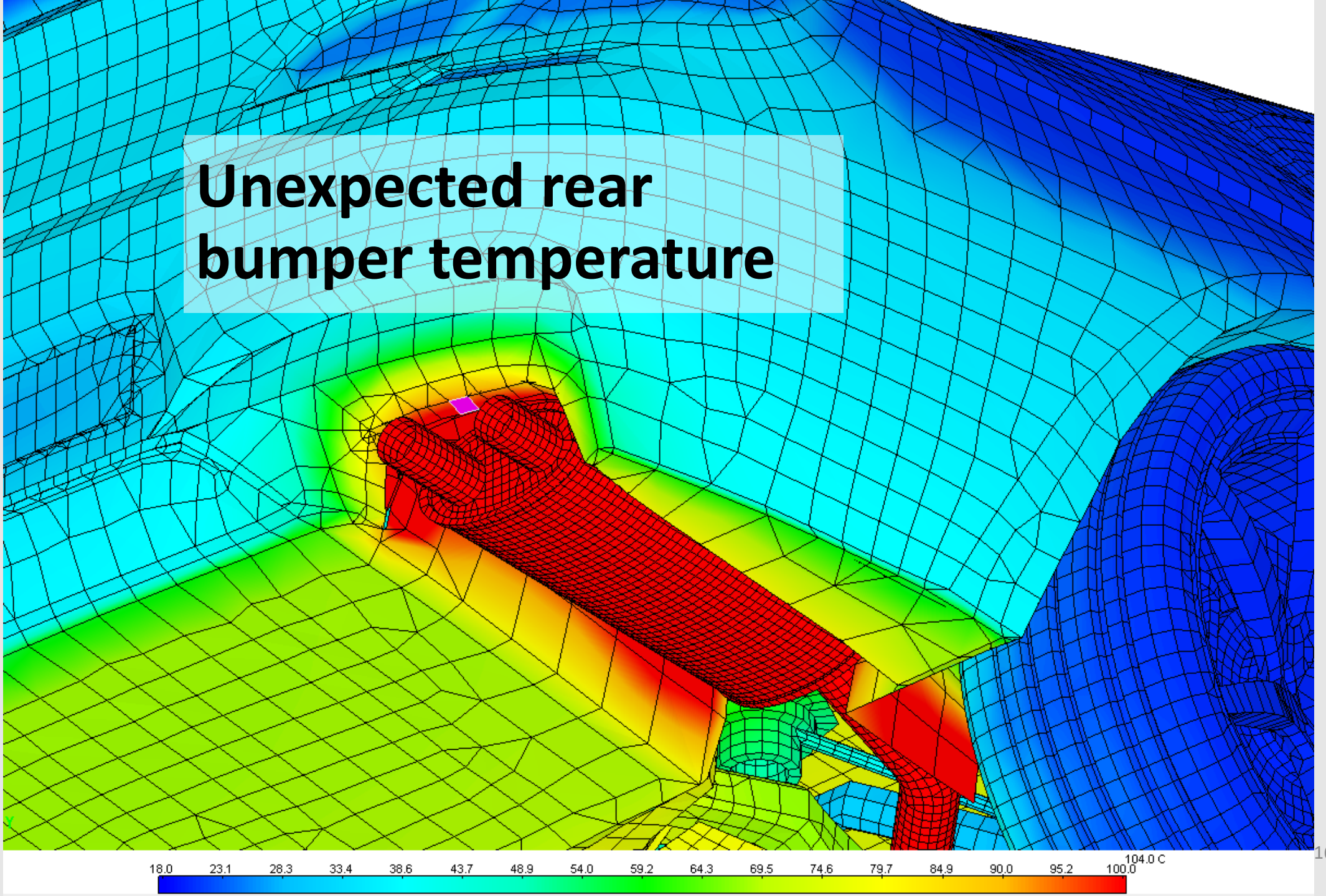


Baseline



Double-walled exhaust pipe w/ insulated turbo

Unexpected rear bumper temperature



Other Fixes to Consider

- Adding insulative layers was just one of many solutions
- Many others could easily be implemented
  - ✓Add double-walled exhaust pipe
  - ✓Insulate additional exhaust components
  - Re-direct ambient air flow
  - Change the surface emissivity of the components and/or exhaust
  - Change surface emissivity on the exhaust
  - Add shielding geometry
  - Translate critical components further from heat sources
  - Re-route exhaust pipe (would require geometry change)
  - Multiple fixes at once

Conclusions

- TAITherm is well suited to assess component temperatures in a vehicle model
- The exhaust stream feature can handle convective heating in an exhaust network with minimal required model setup
- Exhaust stream modeling has been **simplified**, resulting in easier model setup
- TAITherm 12.5 will be available December 12!
  - Advanced exhaust stream post processing features
  - Thermal links enhancements

Questions?

Thank you for attending!

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