SuperTurbo® for Engine Downsizing

Engine Expo

June 2012

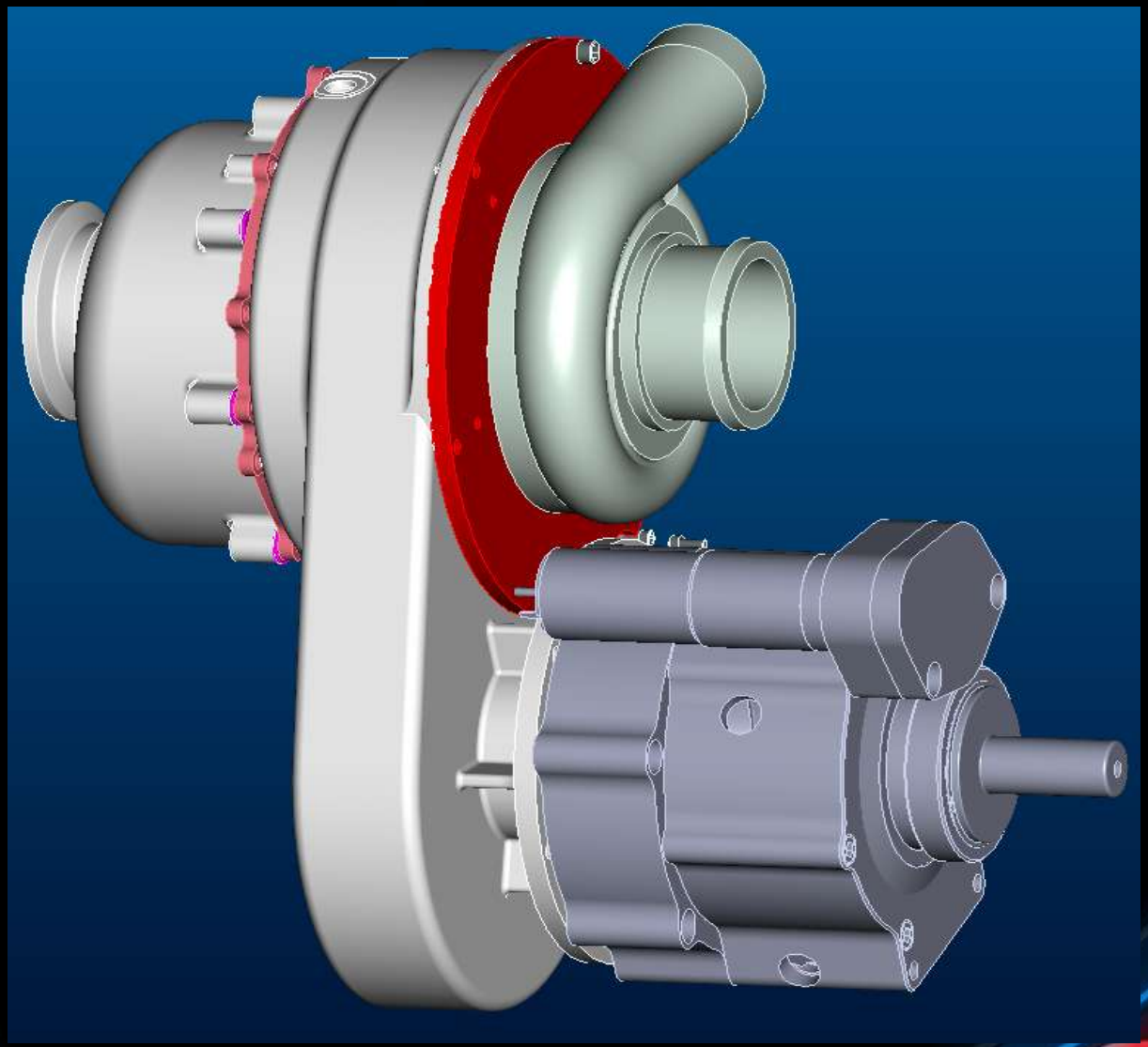
SuperTurbo Movie

Large Diesel SuperTurbo

Three Functions in One Device

VanDyne SuperTurbo, Inc.

Automotive SuperTurbo



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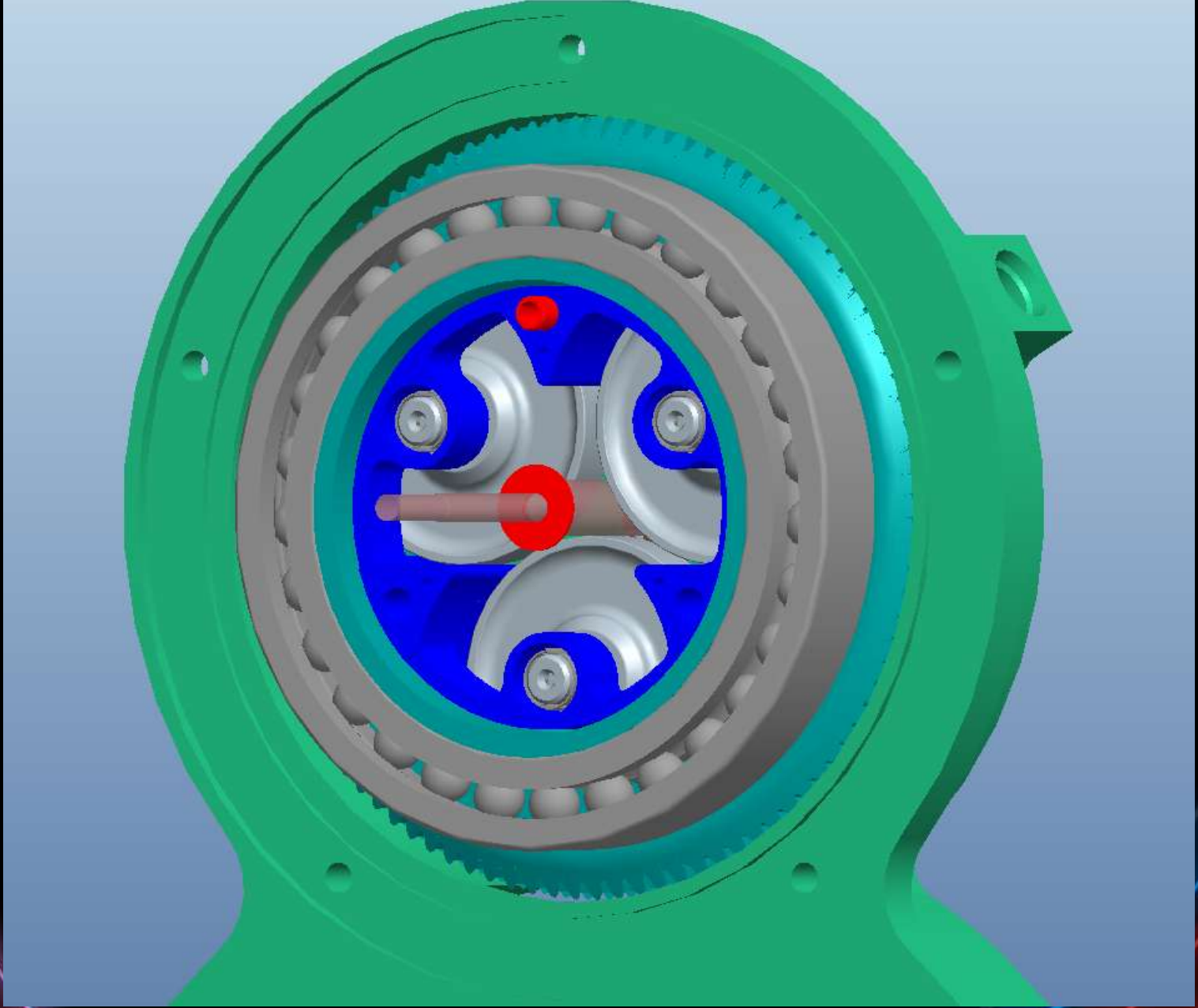

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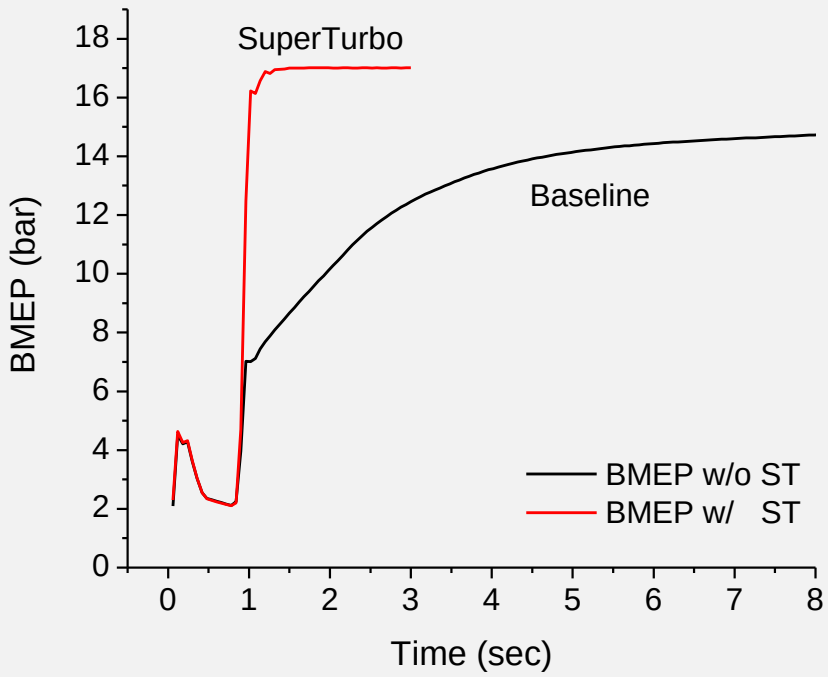
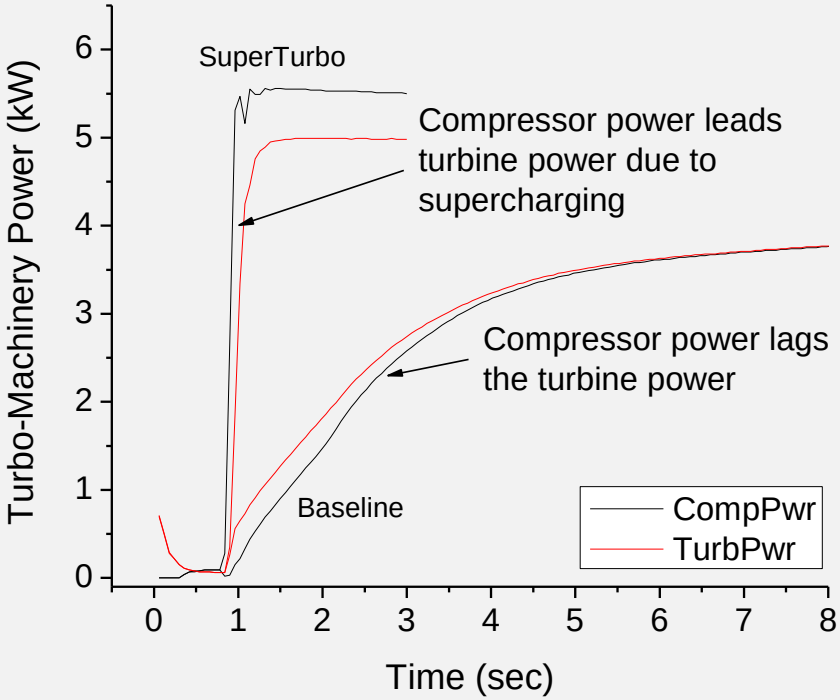
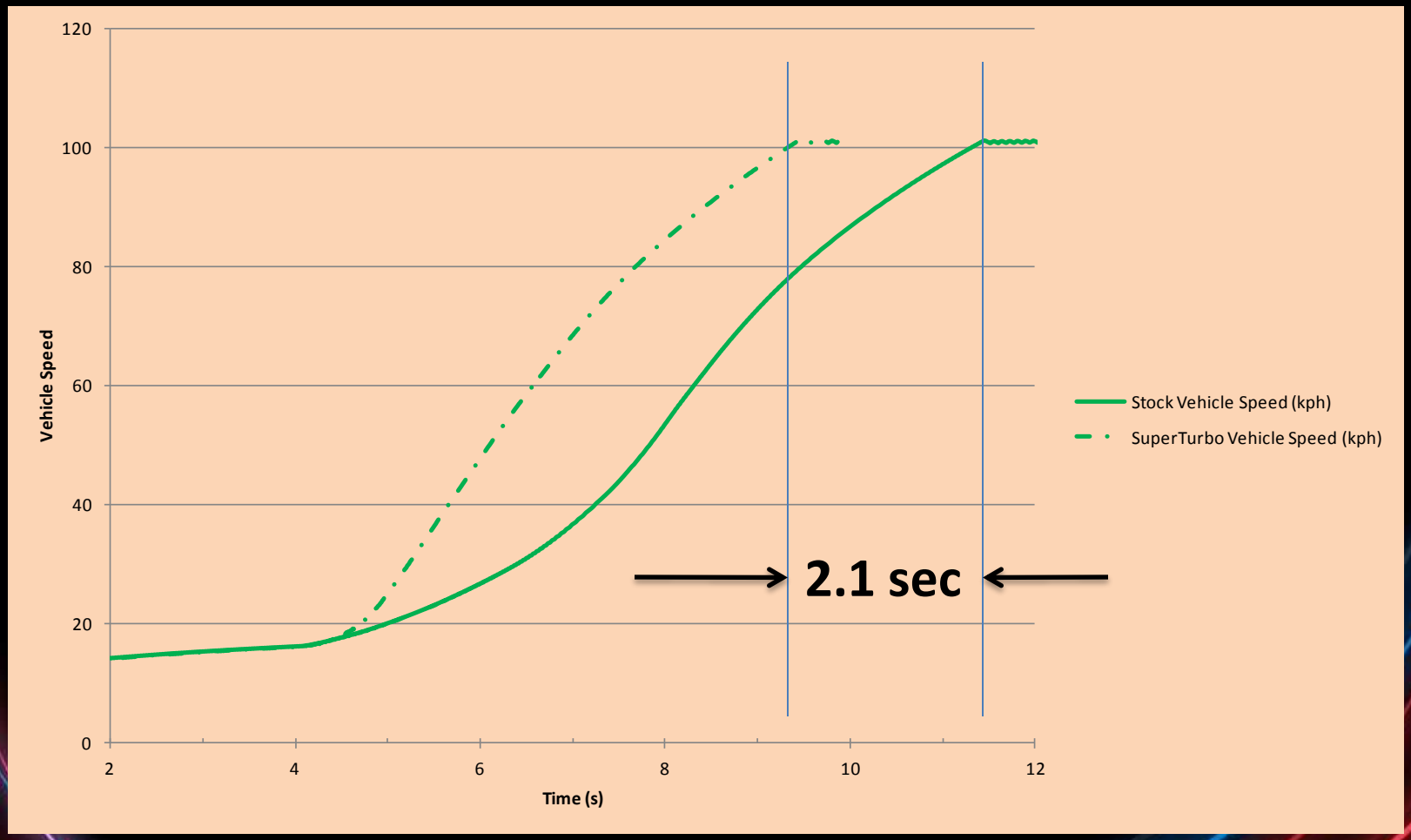
Transient Supercharging





250,000 rpm/second

One Gear 15 to 100 KPH Time



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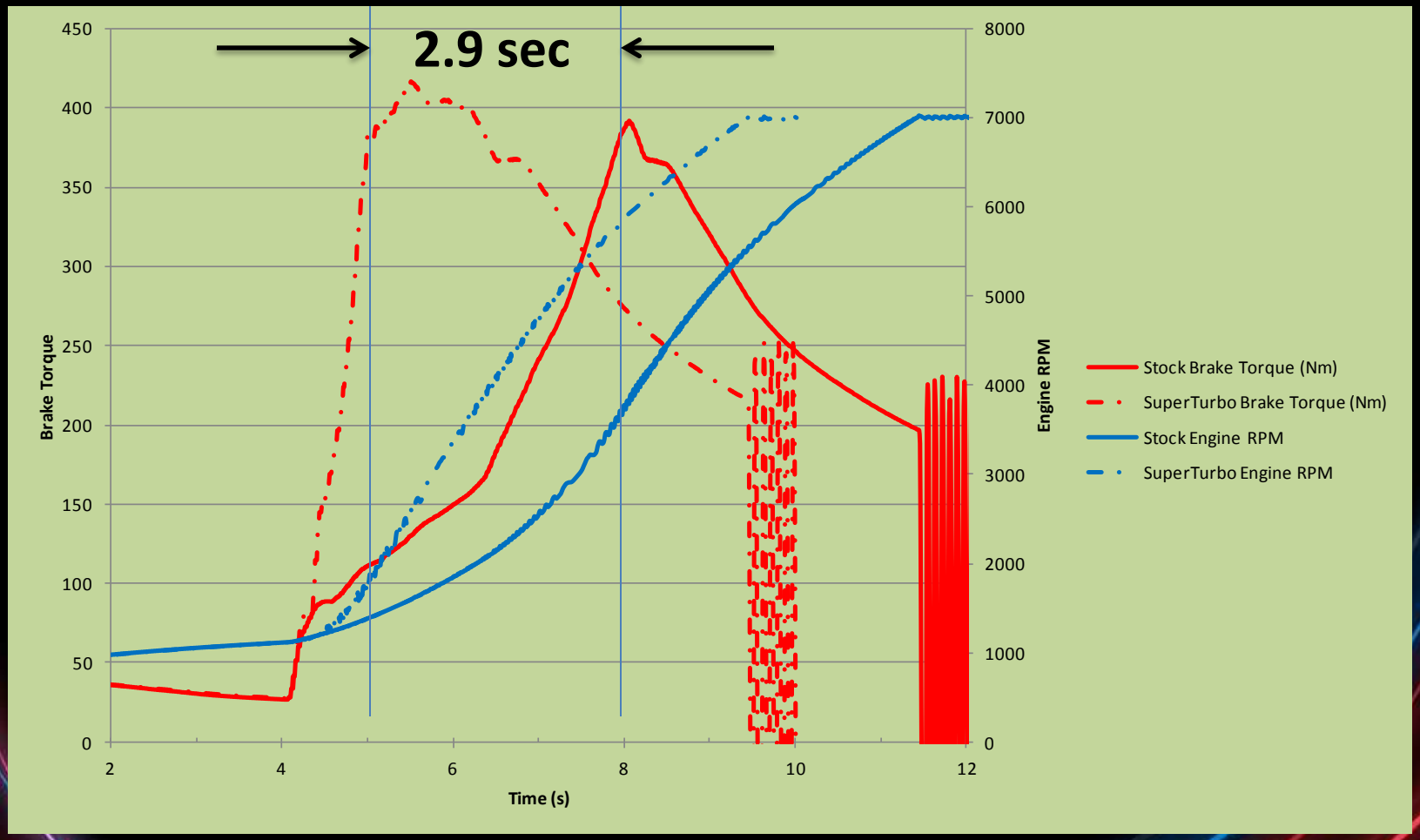
Torque Transient Response



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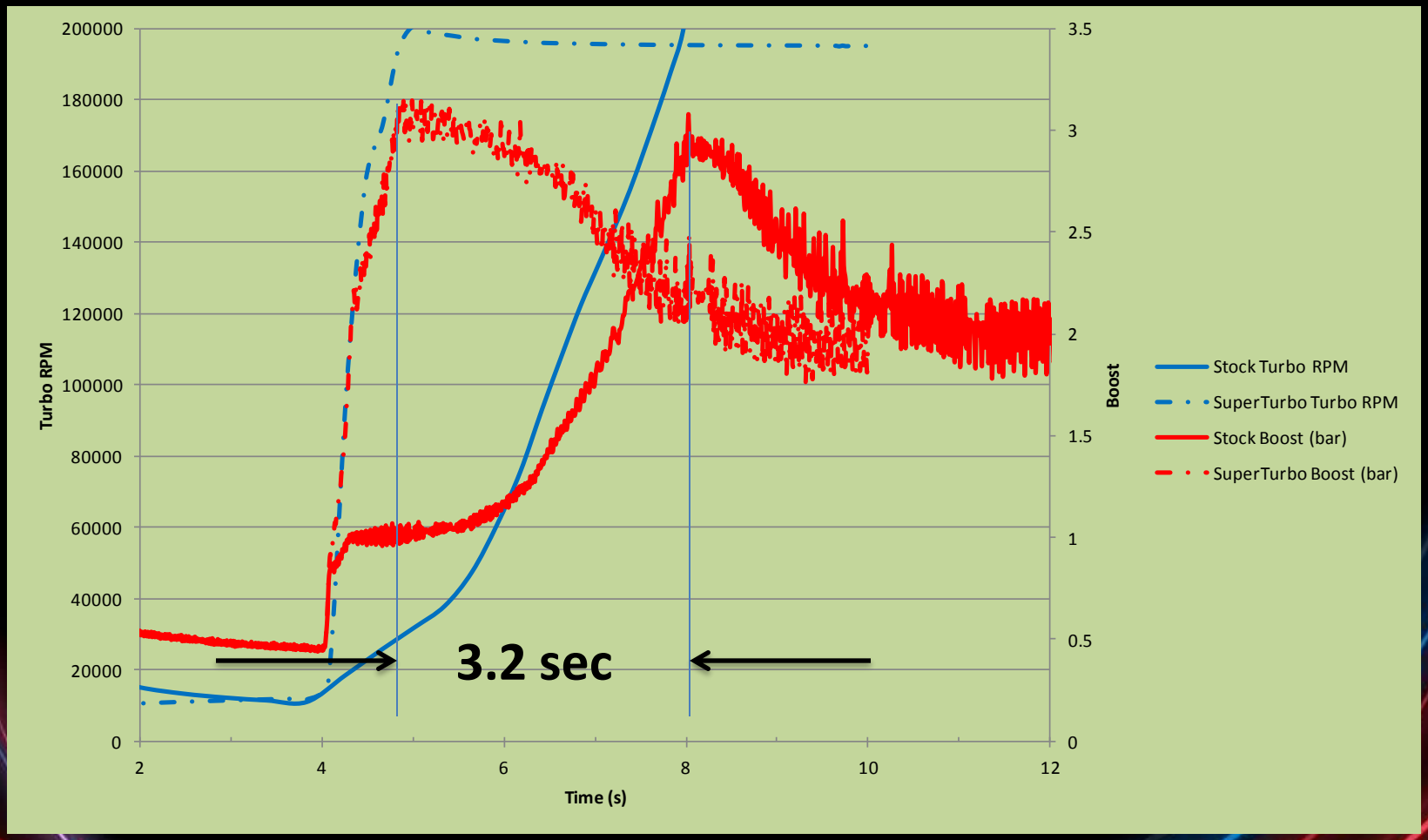
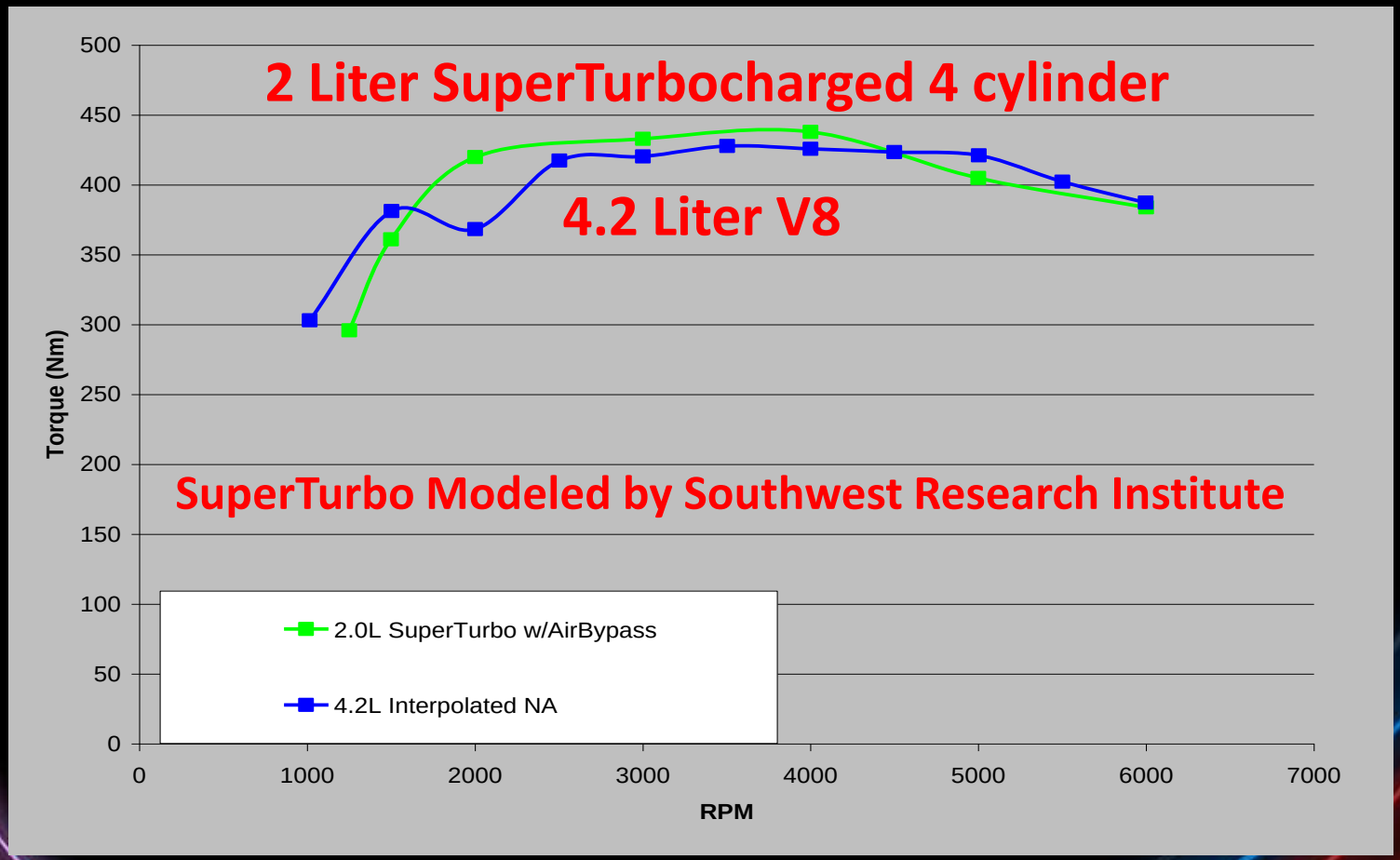
Boost Pressure Response



DOUBLE the TORQUE or HALF the ENGINE



Based on 26 Bar BMEP in the 2 L Engine

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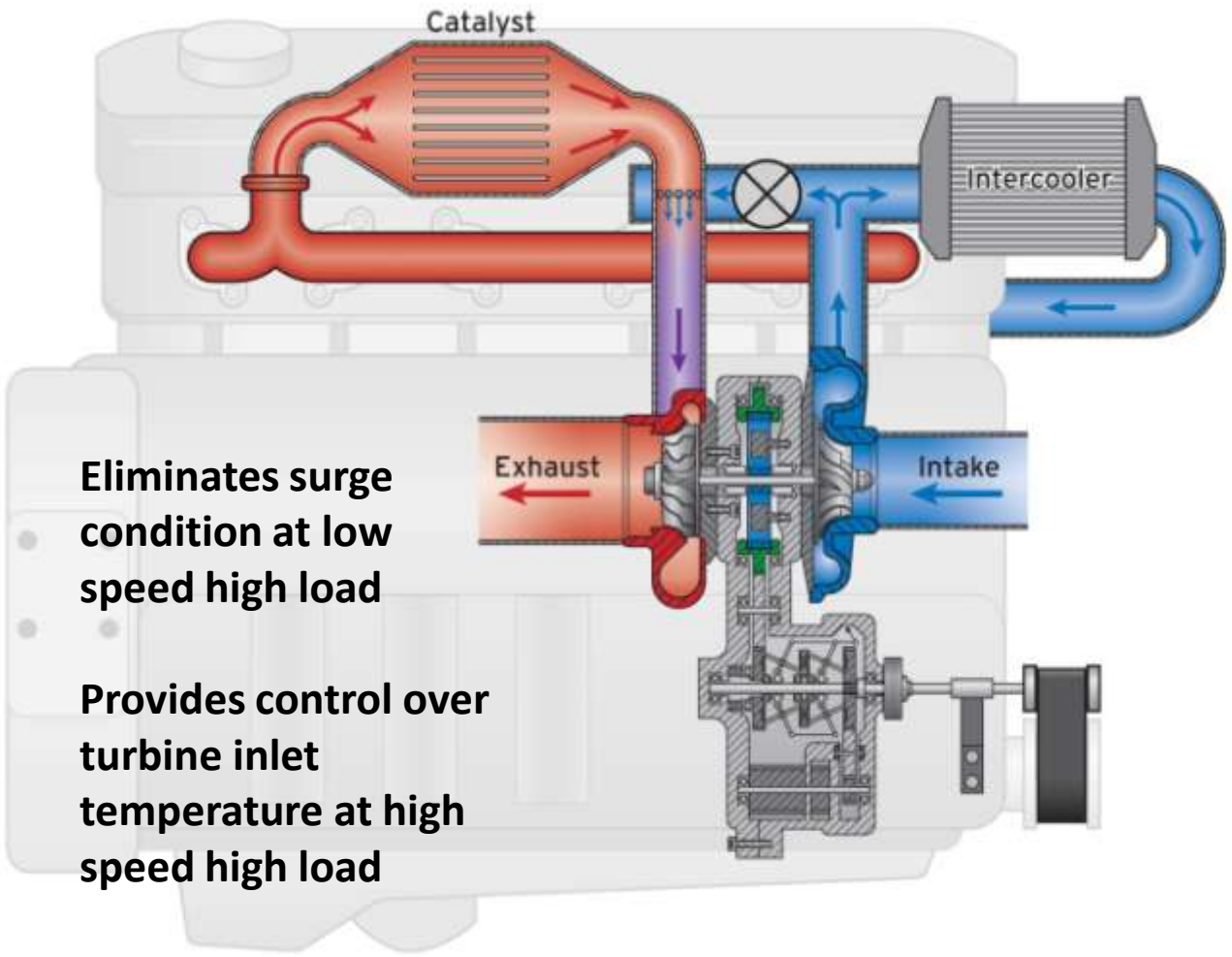
What can be Done Differently



Eliminates surge condition at low speed high load

Provides control over turbine inlet temperature at high speed high load

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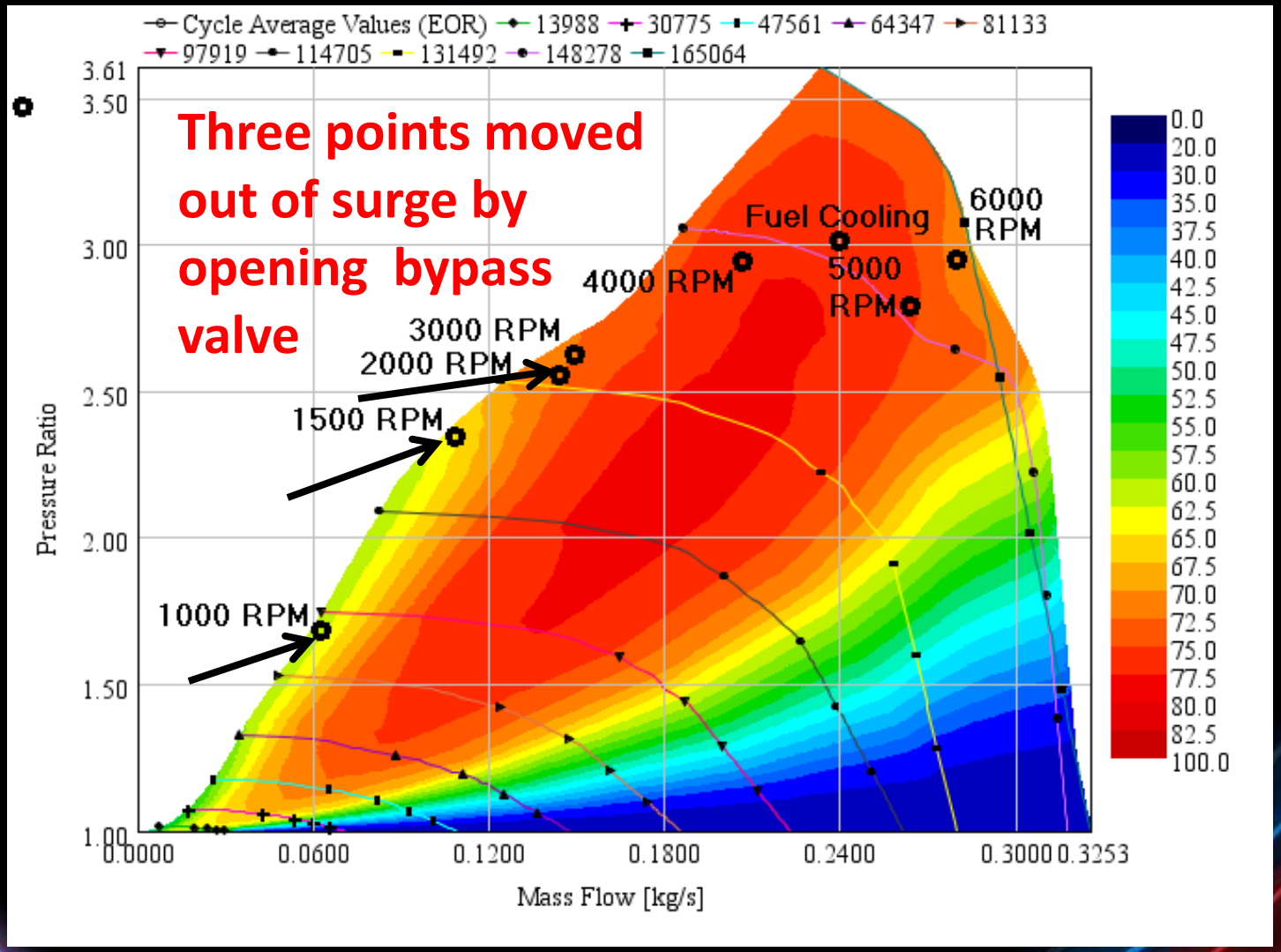
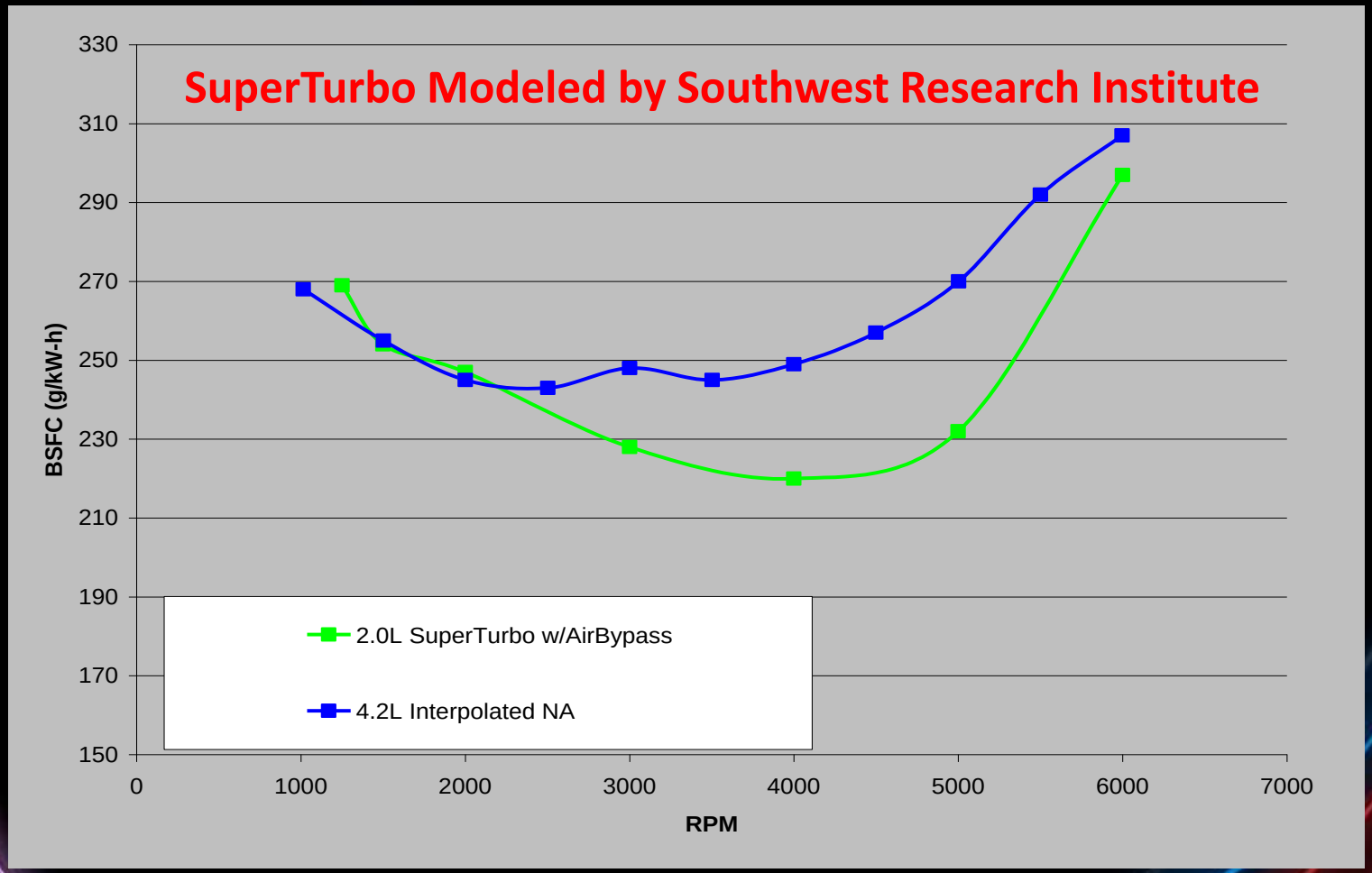
Compressor Map



Efficiency at Full Power



Estimated efficiency gain of 36% in EPA test

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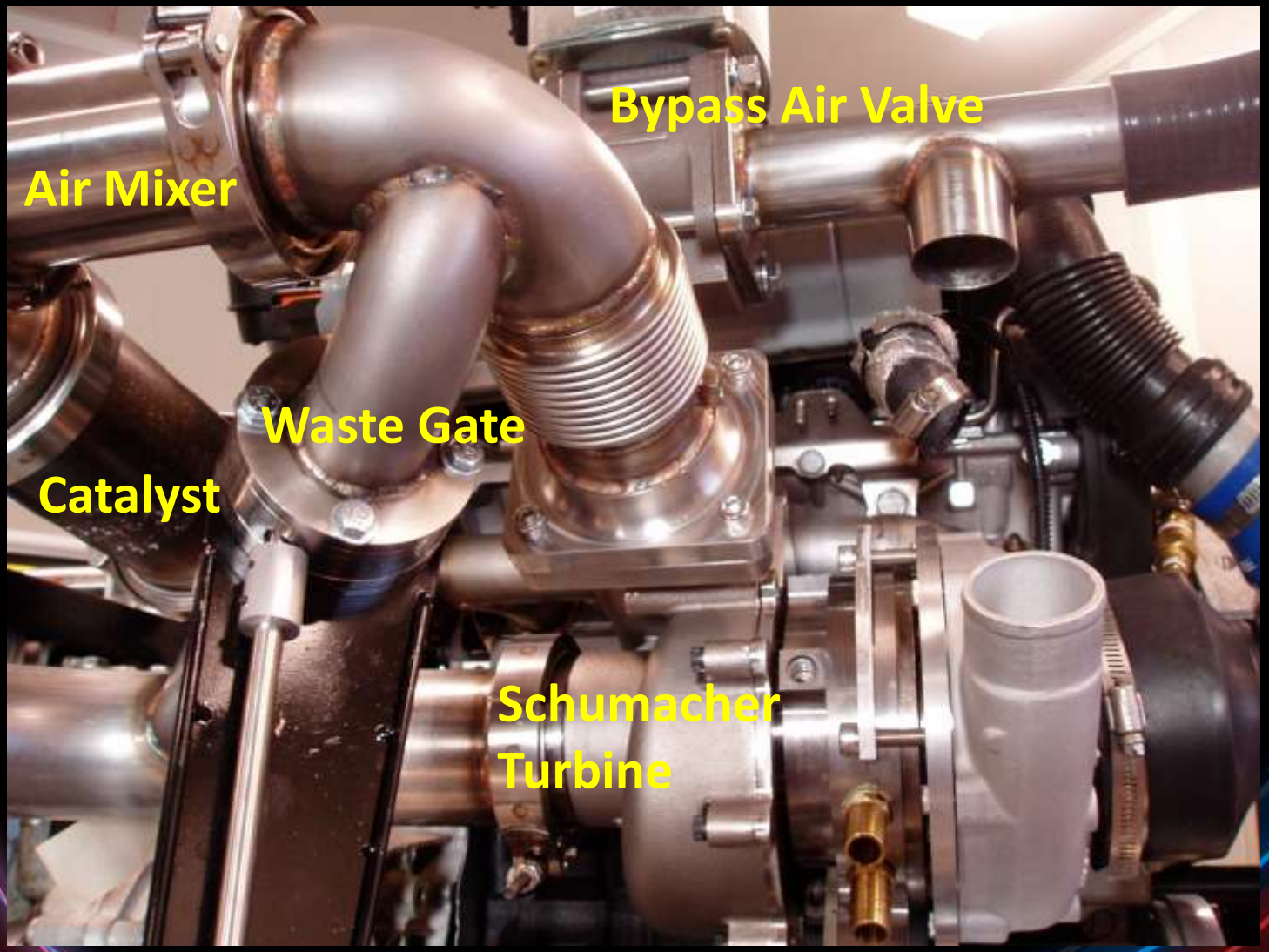
NSF Project Set-up



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Equations

$$P_{ad} - P_{Fr} = P_C + P_T = P_C\left[1 + \frac{P_T}{P_C}\right]$$

$$P_C = \frac{\dot{m}_C}{\eta_{Cis}}\left(\frac{\overline{c_p}}{R}\right)_{air} R_{air} T_{Ci}\left(\frac{T_{Cois}}{T_{Ci}} - 1\right) = \frac{\dot{m}_C}{\eta_{Cis}}\left(\frac{\overline{c_p}}{R}\right)_{air} R_{air} T_{Ci}\left(\pi_C^{\left(\frac{R}{\hat{c}_p}\right)} - 1\right)$$

$$\dot{m}_T = \dot{m}_C + \dot{m}_F - \dot{m}_{Wg} = \dot{m}_C\left(1 + \frac{\dot{m}_F}{\dot{m}_C} - \frac{\dot{m}_{Wg}}{\dot{m}_C}\right) = \dot{m}_C(1 + \beta - \gamma)$$

$$P_T = \eta_{Tis}\dot{m}_T\left(\frac{\overline{c_p}}{R}\right)_{gas} R_{gas} T_{Ti}\left(\frac{T_{Tois}}{T_{Ti}} - 1\right) = \eta_{Tis}\dot{m}_T\left(\frac{\overline{c_p}}{R}\right)_{gas} R_{gas} T_{Ti}\left(\pi_T^{\left(\frac{R}{\hat{c}_p}\right)} - 1\right)$$

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Road Car SuperTurbo Benefits

- Low turbo lag (less than 1/2 second)
- Highest efficiency supercharging
- Turbo machinery has higher efficiency
- Smaller lower cost catalyst because of higher density before turbine
- Lower engine backpressure
- Better mileage from a ½ size engine
- Lambda 1 to full power
- Lower cold start emissions

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Big Diesel SuperTurbo

Making 1.7kW at 1200 rpm 75kW load

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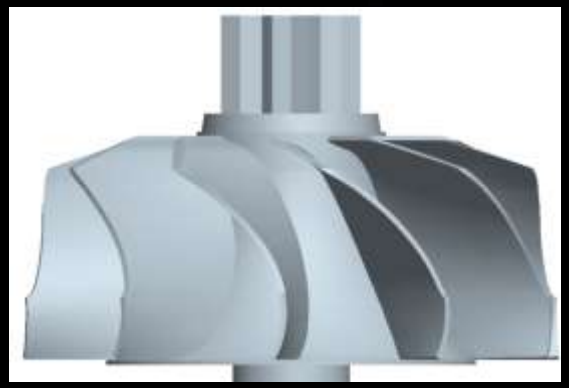
Turbine Comparison



Stock Turbine

Schumacher

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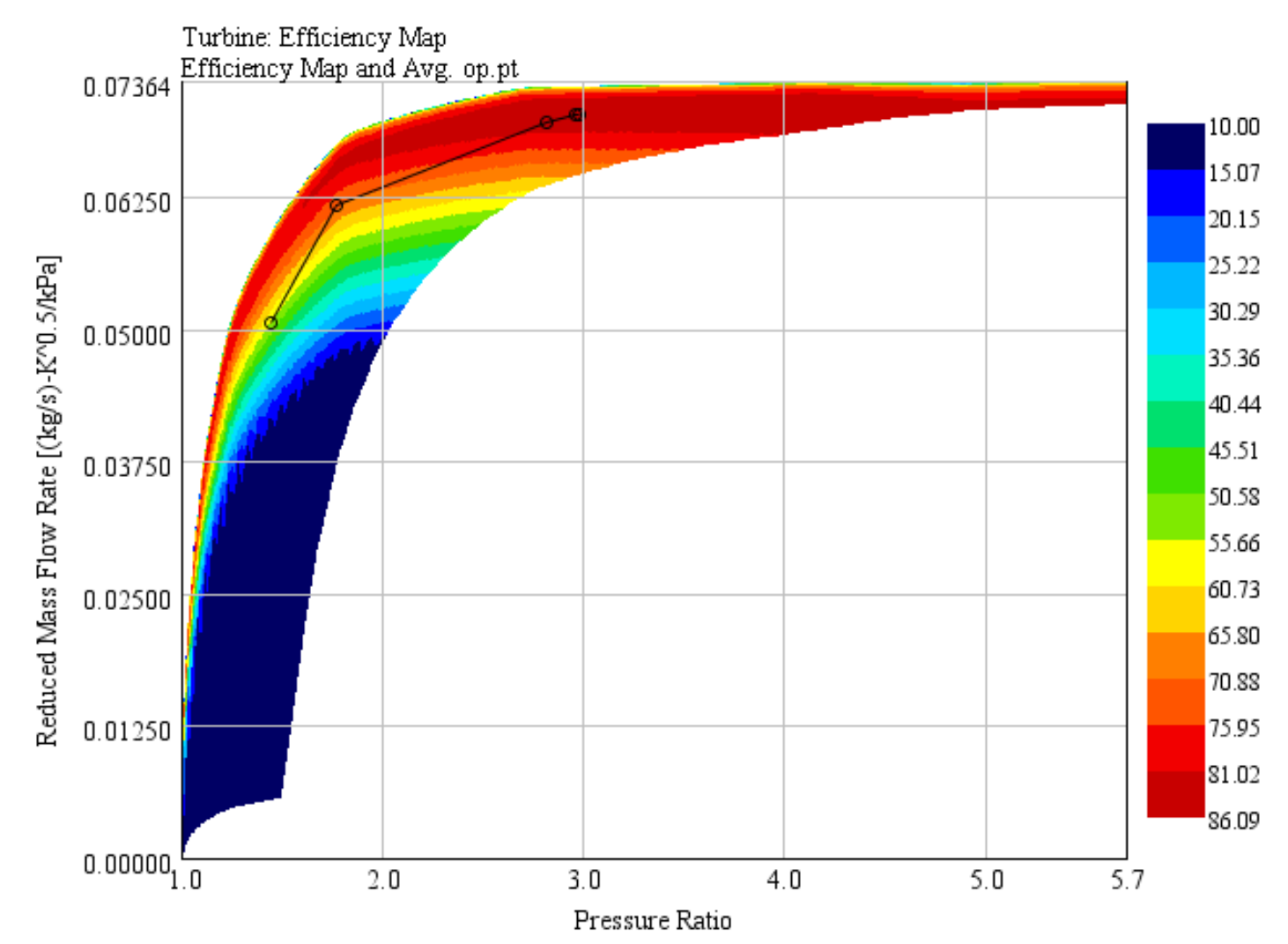
Schumacher Turbine Map



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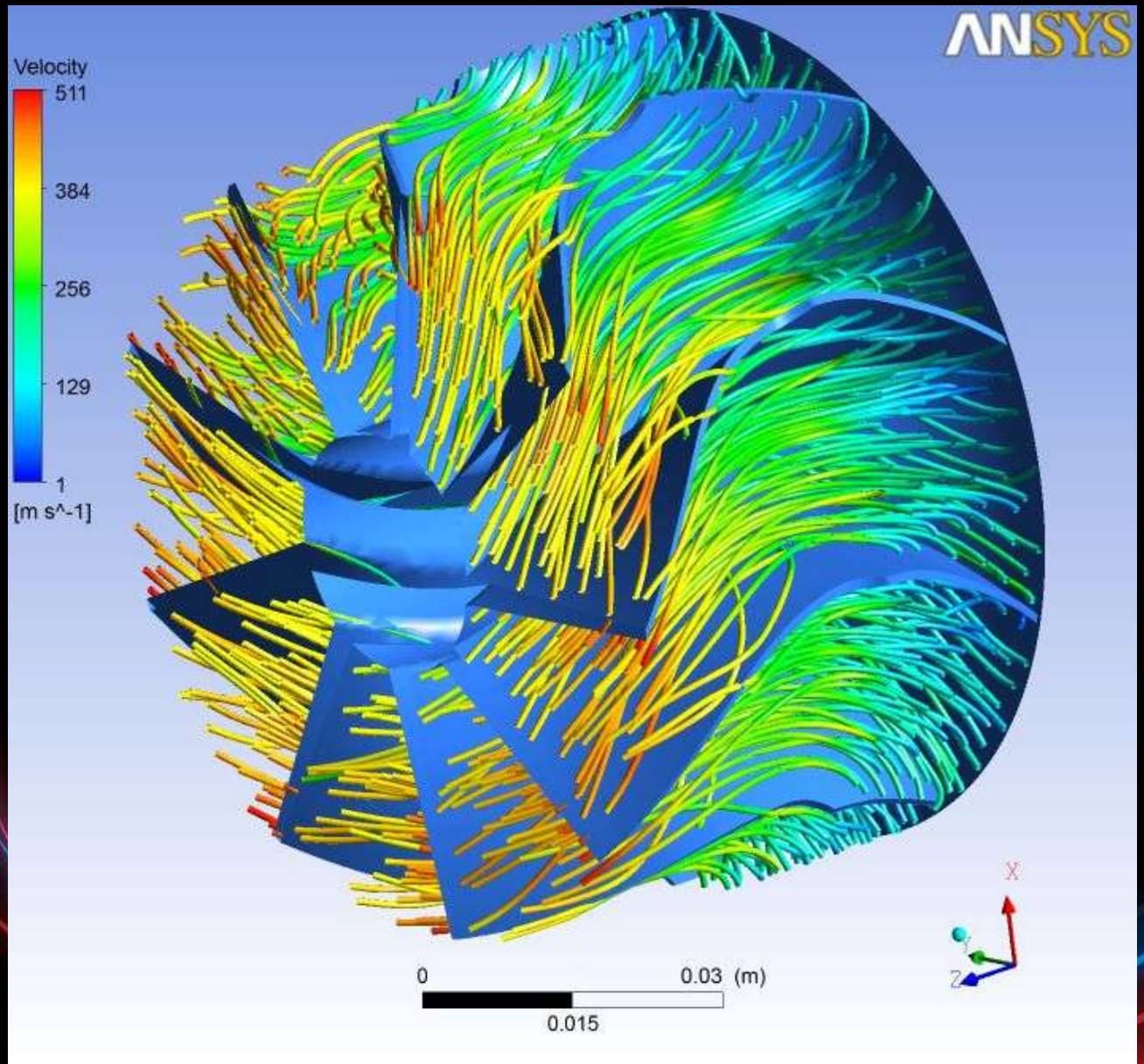
Velocity in Meters per Second



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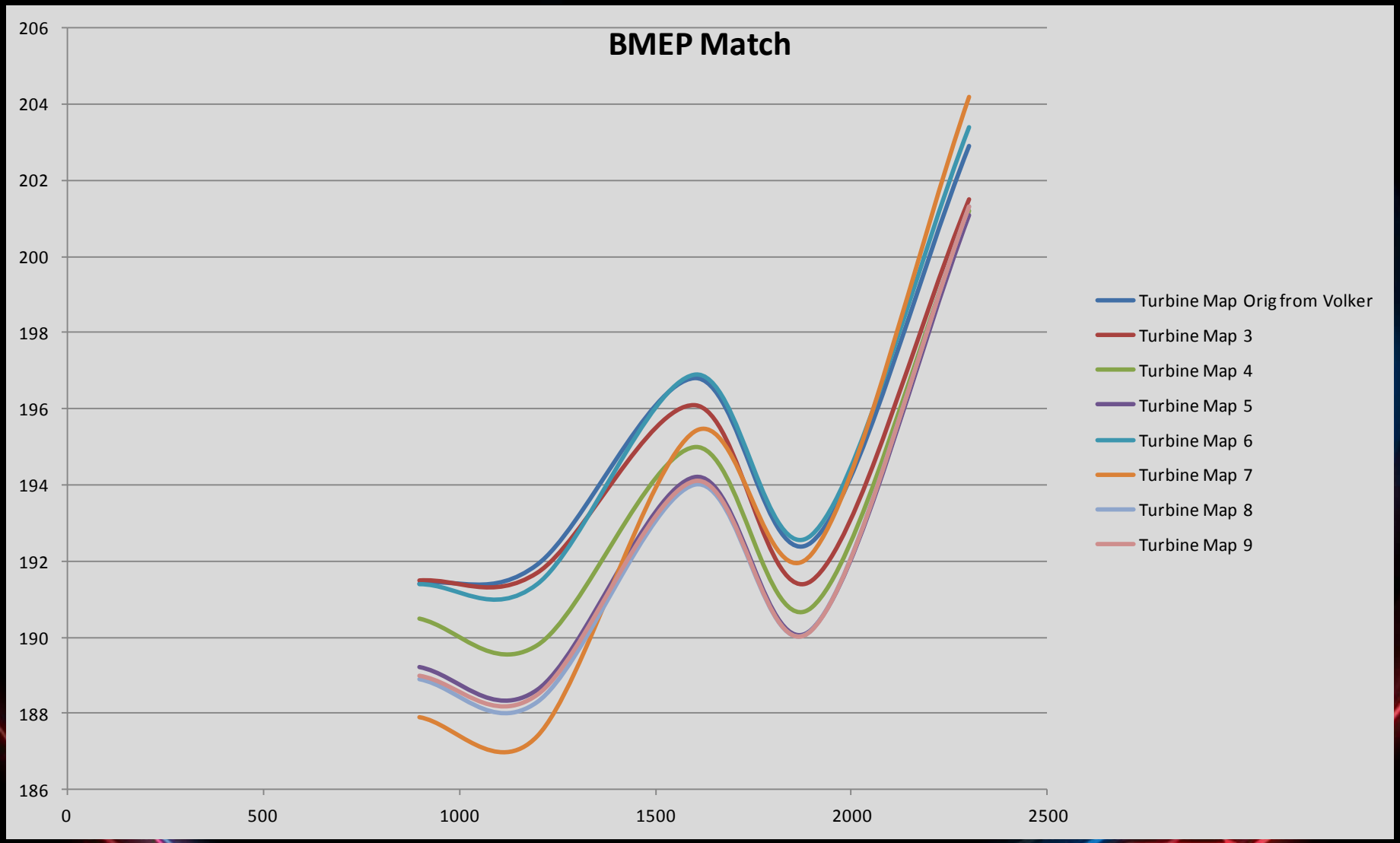
Turbine Optimization



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Power, A/F Ratio, Efficiency

		1000 RPM	1200 RPM	1500 RPM	2000 RPM
Stock A/F Ratio		19	22	30	29
SuperTurbo A/F Ratio		28	29	30	30
Engine Power (kW)		200	300	450	420
SuperTurbo Power (kW)		-10	2	+25	+28
Efficiency Gain		+2%	+3%	+5%	+6%
SuperTurbo Engine Power Potential (kW)		300	450	500	500

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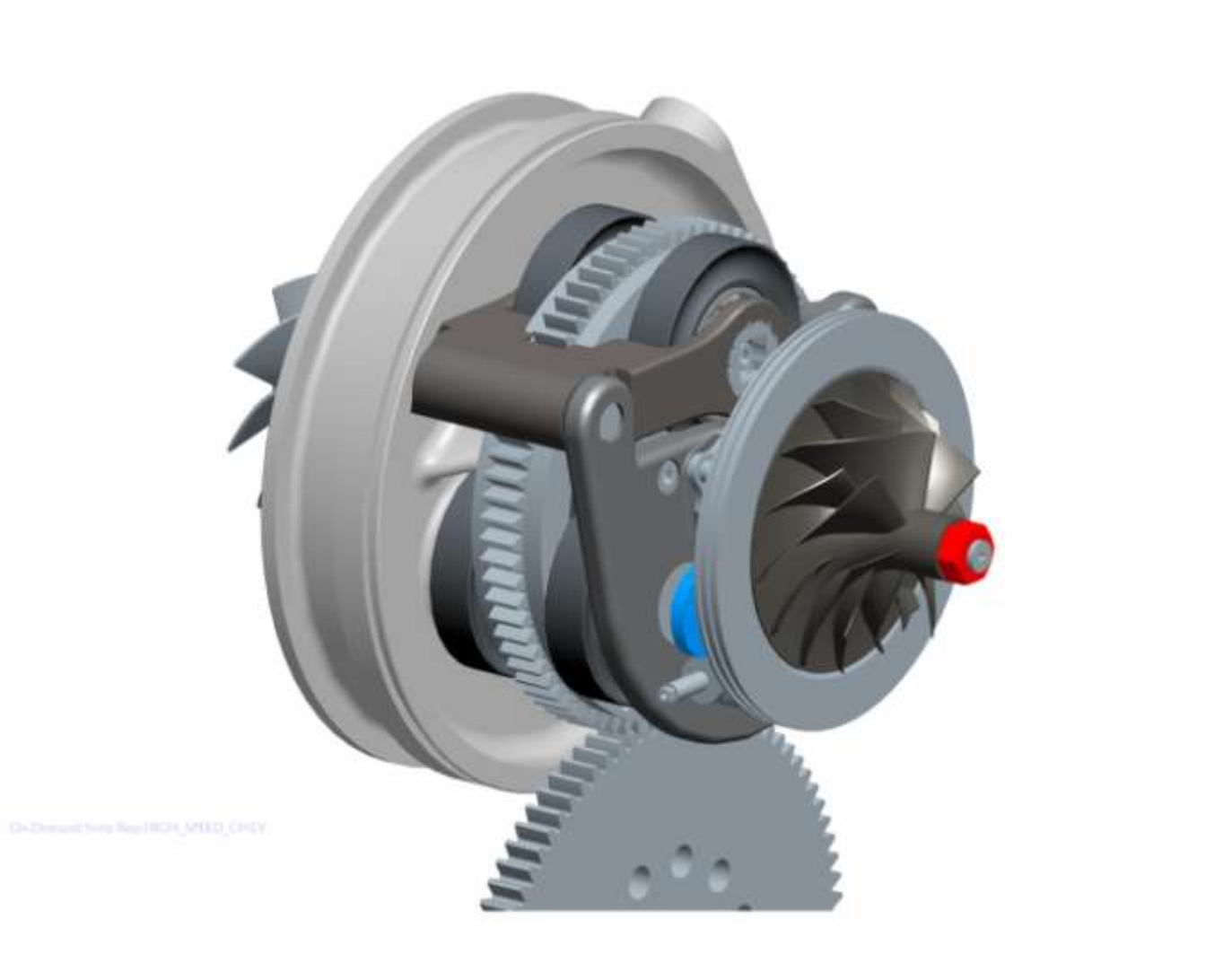
High Speed Drive



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Benefits of a Diesel SuperTurbo

- Lower engine out soot emissions
- Lower fuel consumption and CO_2 emissions
- Higher boost pressure possible in one stage
- Highest efficiency supercharger for improved low rpm torque and leaner A/F Ratios
- Low turbo lag from turbo machinery
- SuperTurbo is based on existing technologies
- Better torque response from a smaller engine
- Can eliminate the cost of the variable vanes
- The highest amount of waste heat recovery
- Replaces existing turbocharger

VanDyne SuperTurbo, Inc.

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Powering the way to greater fuel efficiency!

THANK YOU

Ed VanDyne

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