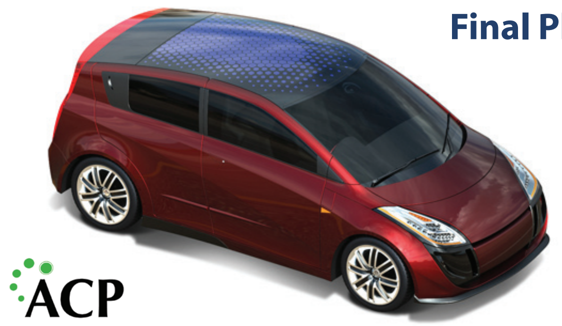
FutureSteelVehicle

Final Phase



WorldAutoSteel

Key Achievements

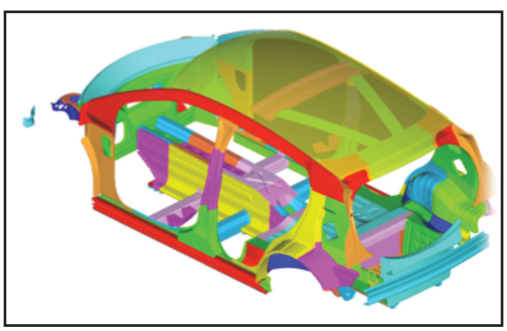
1. Reduced PD Cost in Concept & Development Phase
2. Reduce Mass By Over 35%
3. Reduced Total Life Cycle Emissions by nearly 70%
4. Reduced mass and emissions at no cost penalty

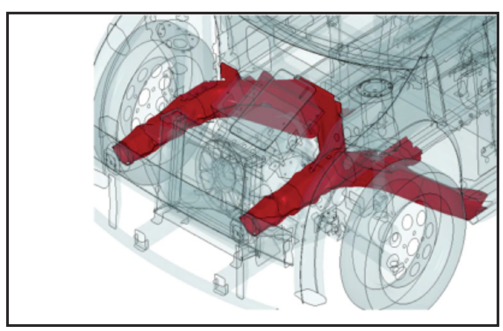
Full Vehicle System MD 2G Optimization with Detailed Manufacturing Using the ACP Process™

The **Accelerated Concept to Product (ACP) Process**™ was applied in In the final stage of the FutureSteelVehicle Program. The **ACP** Process™ is a proprietary, performance-driven, holistic product design development method, which is based on design optimization. ACP incorporates the use of multiple CAE tools, including ***Red Cedar Technology's HEEDS Optimization Code,*** in a systematic process to generate the optimal design solution.

During the final phase, ETA used the ACP Process™ to design all the major sub-systems, while the components were modified by manual design manipulation based on selected manufacturing processes. The new vehicle architecture was then integrated into the full-vehicle system based on the ACP selections of materials and manufacturing processes. A full vehicle BIW and closures structure was designed in detail (joining, interactions, sub-assemblies) using design specifications and manufacturing evaluations to meet vehicle performance targets. This resulting design represents the most robust load path, geometry, gauge and grade of the materials on the vehicle.

Since this model could contain inefficiencies due to modifications based on new material choices and manufacturing processes, multi-disciplinary 2G optimization was used in this phase to make sure that the new design (based on sub-systems) still met all vehicle performance targets in terms of crash, stiffness and low frequency NVH, while considering the manufacturing process. Manufacturability using one step and incremental formability for all the components was also completed and design changes to remove any manufacturing issues (strain, wrinkling, cracking and thinning) were implemented.





Above is a summary of the grade and gauge changes showing the parts that were updated by changing grades and/or gauges due to reflect design optimization and formable front rail results.

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With design optimization updates incorporated, the new (T6) Baseline body structure was reduced to 179 kg mass. The T6 Baseline exhibited significantly better crash performance than the T5 Final version in several of the load cases, indicating potential additional mass saving. The following is a summary of the results.

Design	Mass kg	NCAP	Front ODB	IIHS Side	Side Pole	IIHS Rear	IIHS Roof	Bend.	Torsion (kN-m/deg)
Targets	<188	38 g	Good	125mm	125mm	Pass	37.5kN	12	20
T5-Final	188.4	39.7	Good	142	150	Good	55	15.5	19.6
T6-Final	176.8	37.8	Good	152	138	Good	44.5	14.2	19

The next step was to improve NCAP and Torsion results by balancing the gauges, particularly for the new TRIP 800 front rail sub-system, for better performance and potential additional mass reduction.

At this stage in the ACP Process™, the designed vehicle system met all vehicle performance and a 25 - 30% mass reduction, based on vehicle class and mass targets. The following is a diagram showing the mass reduction evolution.

FSV Mass Evolution