

## Handling and Chassis Optimization of the CNG Snowmobile

### Overview

The purpose of the SAE Clean Snowmobile is to produce a clean, quiet, and efficient snowmobile to use in environmentally sensitive areas such as national parks. For this project, a stock snowmobile has been converted so that its fuel source is compressed natural gas (CNG). In order to make the conversion possible, the stock gasoline tank was removed and a CNG tank was fitted to the snowmobile.

### Problem

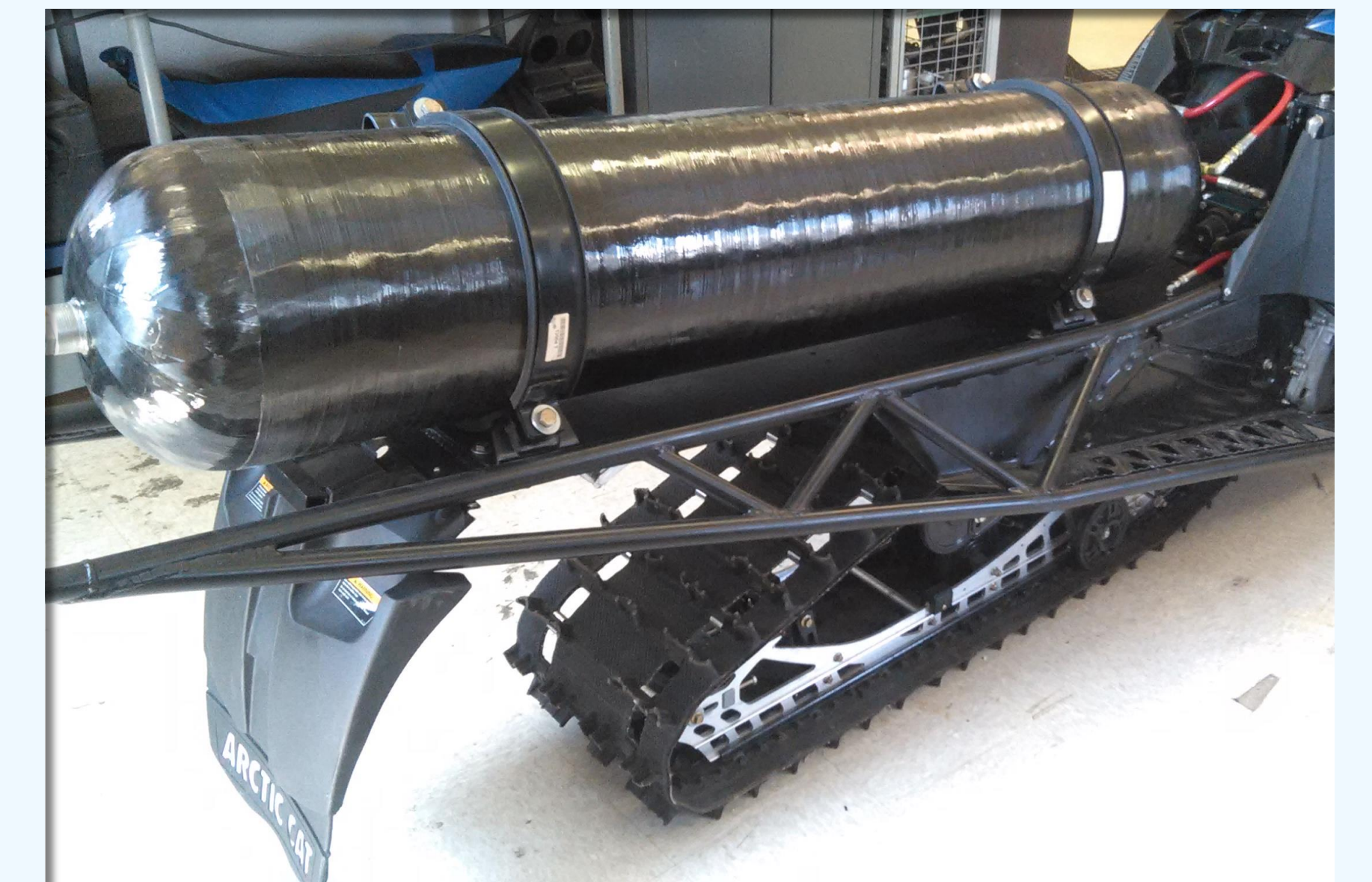
As one might imagine, the CNG tank is larger and heavier than the previously used gasoline tank. This in turn, caused the snowmobile's weight distribution to be negatively affected. Because of the change in weight distribution, the snowmobile became very hard to drive. With the CNG tank installed, the snowmobile would not turn easily and eventually the stock structure holding the tank collapsed. Our team's focus has been to address these issues.

### Tunnel

The new aluminum tunnel was specially designed for improved weight distribution and strength. With the new design, the placement of the tank was moved forward 12", which helped in returning the center of gravity to the stock position. The tunnel is made of 1.25" round aluminum tubing which creates the exterior tubular structure, and a 3/8" aluminum plate which is welded to the tubular structure and creates the mounting surface for the tank and heat exchanger. The dimensions for the tubing were calculated to easily support the 130 lb. CNG tank without bending or fracture.



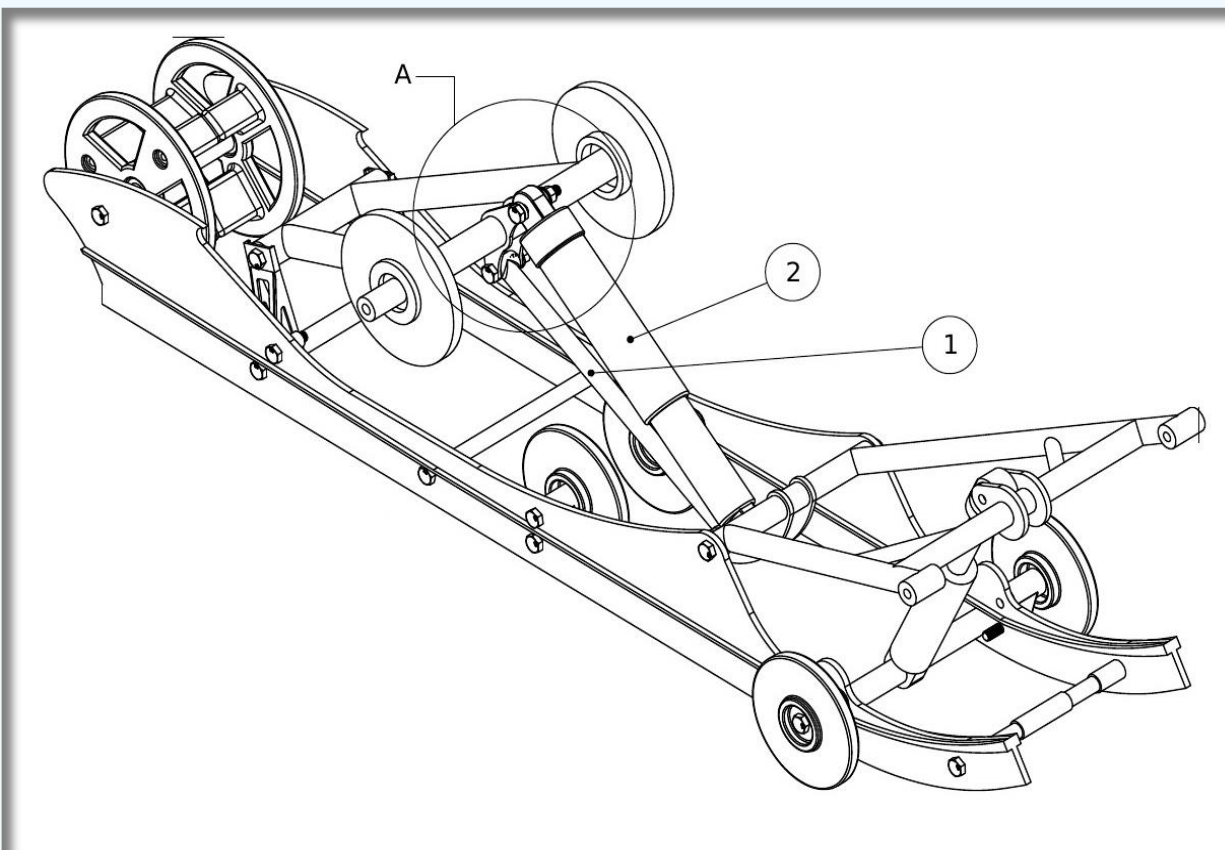
3D Render



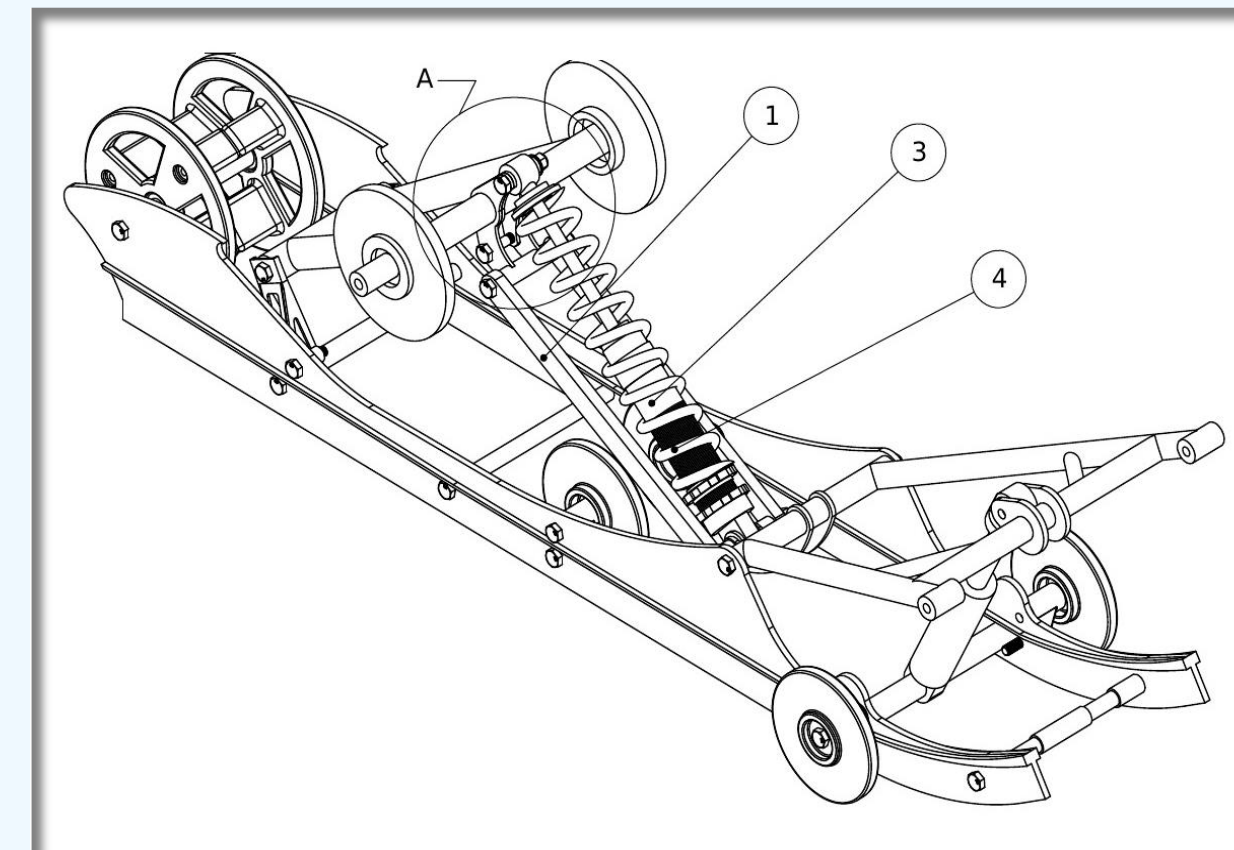
Installed Tunnel

### Suspension

The stock suspension was not designed for the extra weight of the CNG tank. Without tuning, the suspension was fully compressed which removed important weight from the front skis. We have tuned the suspension by increasing the preload of the spring and installing an aftermarket linkage system. The addition of the linkage system helps the suspension resist full compression during operation. The combination of the linkage system and spring preload has decreased the amount of suspension compression and returned weight to the front skis.



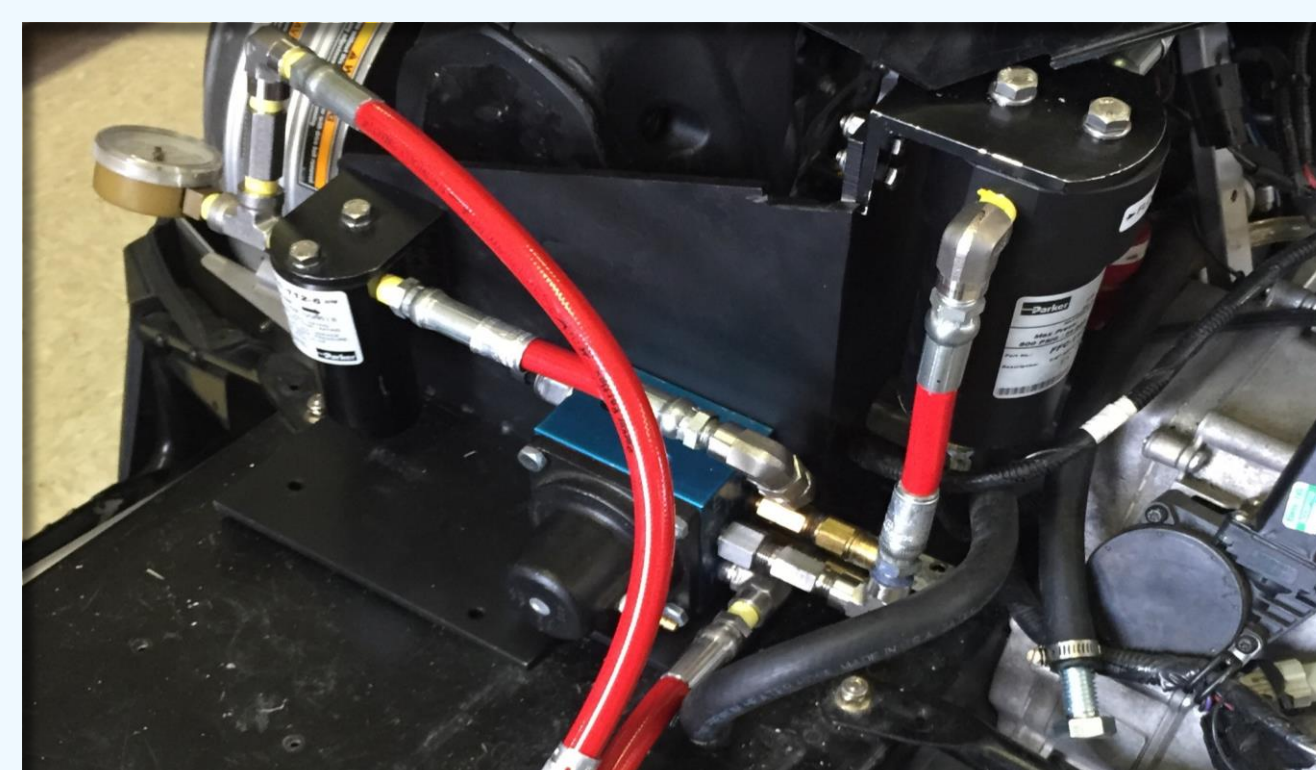
Without Linkage Kit



With Linkage Kit

### Air Silencer and CNG Filter Configuration

The stock air silencer and CNG filter configuration had to be modified to allow the placement of the tank to be moved forward from that of last year's team. The stock air silencer was cut and resealed so that it could be shortened by 12". The mounting plate that last year's team made for the CNG filter system also had to be modified for the new tank placement. The mounting plate was cut and turned 90 degrees, allowing clearance for the tank to be mounted.



CNG Fittings



Air Silencer

### Results

The combination of suspension tuning and tunnel redesign was successful in improving the weight distribution of the snowmobile. The new tunnel removed a total of 30 lbs. from the snowmobile and moved the center of gravity forward 5". A 13% weight increase was added to the front skis as a result of the center of gravity shift. This will dramatically improve the steering responsiveness of the sled.



● Previous Center of Gravity

● Current Center of Gravity