



Abstract

SNAP, the Student Night Assistance Program, is a program designed to transport WPI students safely between locations within one mile of the WPI campus. Currently, SNAP drives between 125 to 150 miles using almost a full tank each night. Our research focused on ways to make SNAP have a less significant effect on the environment. SNAP currently runs on fossil fuels which displace excess carbon dioxide emissions into the atmosphere. We have investigated three different scenarios which can reduce this excess of carbon dioxide emissions. The three different plans feature different eco friendly fuels such as biodiesel, hybrid electric vehicles, and liquid-nitrogen powered vehicles. These plans are arranged in order of both likelihood and expected time-scale for enactment, respectively.

How CO₂ is generated by car engine?

- Gasoline is a compound of hydrogen and carbon.
- In a car gasoline is burned causing a major heat release causing the major compounds of carbon and hydrogen to split
- One carbon molecule forms a bond with two oxygen molecules
- Leads to CO₂

Gasoline: Background Information

- Within the car there is internal combustion.
- The internal combustion works by bringing gasoline fumes into a cylinder.
- Fumes are compressed by a piston
- In piston, spark plug generates electricity and ignites the compressed gasoline to cause explosion
- Exhaust valve releases the CO₂ emission into air

Current Usage of Gasoline

- One Gallon: \$2.65
- 15 Gallons per car per night
- 14 SNAP shifts per week
- \$560 a week of gasoline
- \$17,000 a year

Plan 1: Biodiesel

- Biofuels get their energy from plants on the Earth's surface
- The carbon dioxide released from a combusted biofuel is recycled into the same system from which it was taken.
- Biofuels have a 78% net decrease in carbon



Converting to Biodiesel:

- Using a biofuel processor turns the vegetable and other oils to biodiesel.

- Option 1:
100 gallons in 48 hrs
- Option 2:
500 gallons in 48hrs

- Change the engine to a biodiesel engine using the same vans.

Analysis:

- Biodiesel Engine / capability:
\$3,500 - \$5,000 (per car)

- Vegetable oil / others: Free

- Filtration System:
\$13,500 or option 2: (variable price)

- Educational Opportunities: MQP/ IQP



Plan 2: Hybrid

- Hybrids are run on half battery and half gasoline
- Half CO₂ emissions released in comparison to petroleum fuel car
- Increases the miles per gallon

Converting to Hybrid:

- Brand new cars which would include 2 Toyota Prius and a Chevrolet Tahoe.

Analysis

Toyota Prius

- Costs \$22,400 with 48mpg
- 1300miles per week/ 48mpg = 27.08gallons
- 27.08gallons* \$2.65/gallon = \$71.77per week



Chevrolet Tahoe

- Costs \$50,000 with 20mpg
- 700miles per week/ 20mpg = 35gallons per week
- 35gallons * 2.65= \$92.50/ week

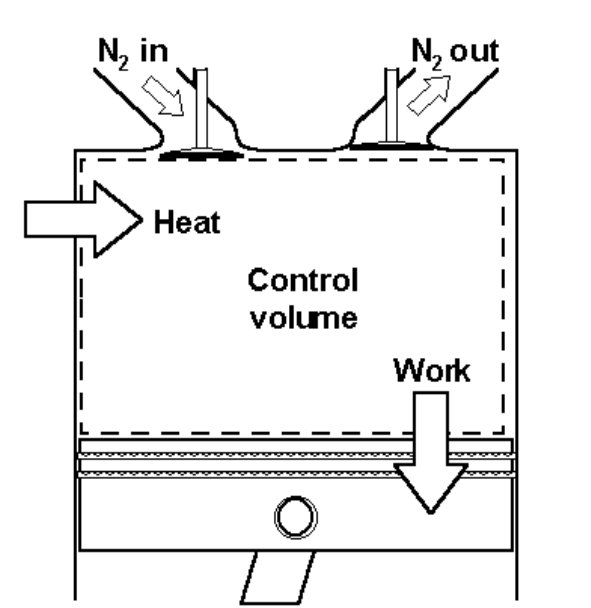
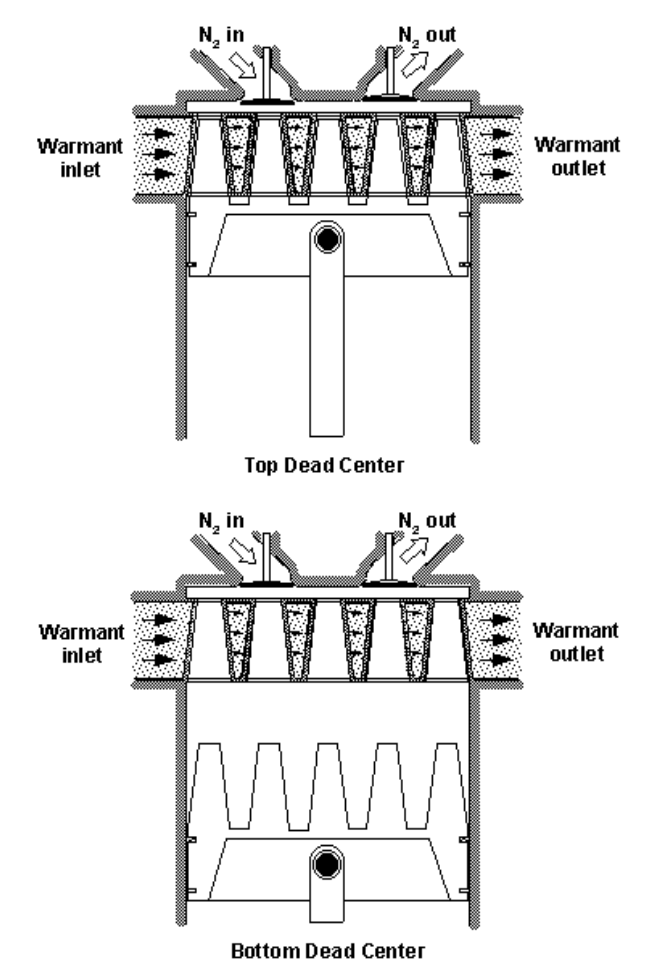
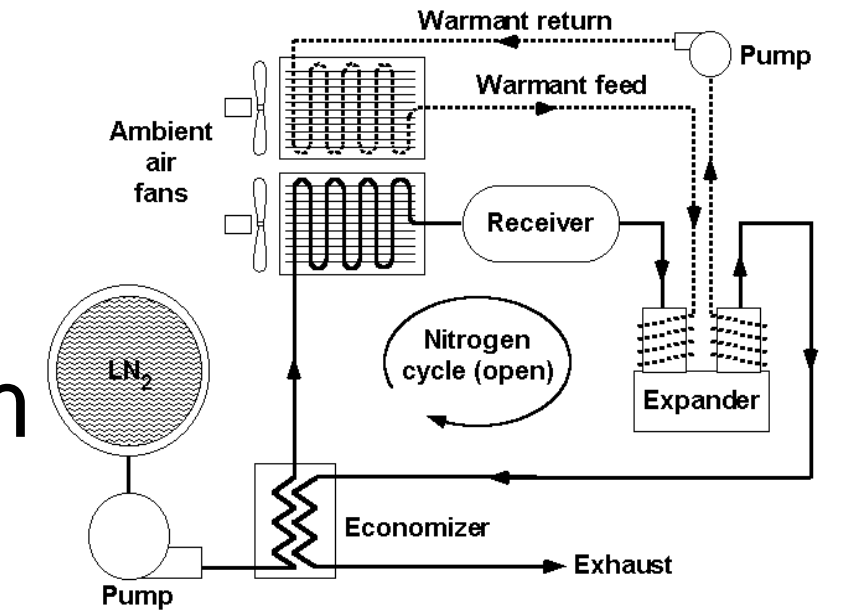


Both

- \$71.77 + \$92.50= \$164.52/week opposed to 556.5/week **saving \$391.98 a week and \$11,759.40 per year.**
- \$22,400+ \$22,400 + \$50,000= \$94,800 upfront.

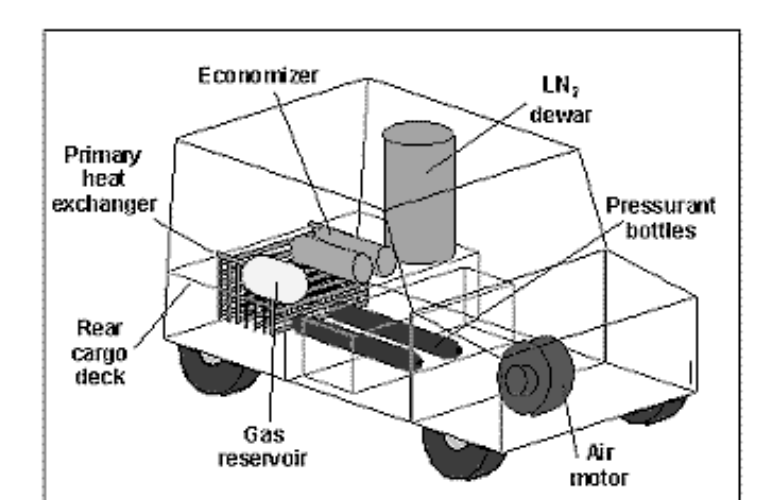
Plan 3: Liquid Nitrogen

- Liquid nitrogen engines run on the expansive force of nitrogen converting from a liquid to a gas.
- Liquid nitrogen use the same basic concepts of internal combustion
- The nitrogen is not combusted to move the engine pistons, it's expanded.
- Liquid nitrogen is clean source of energy.
- Liquid nitrogen is cheap



Converting to Nitrogen:

Change the gas tank to a pressurized tank.

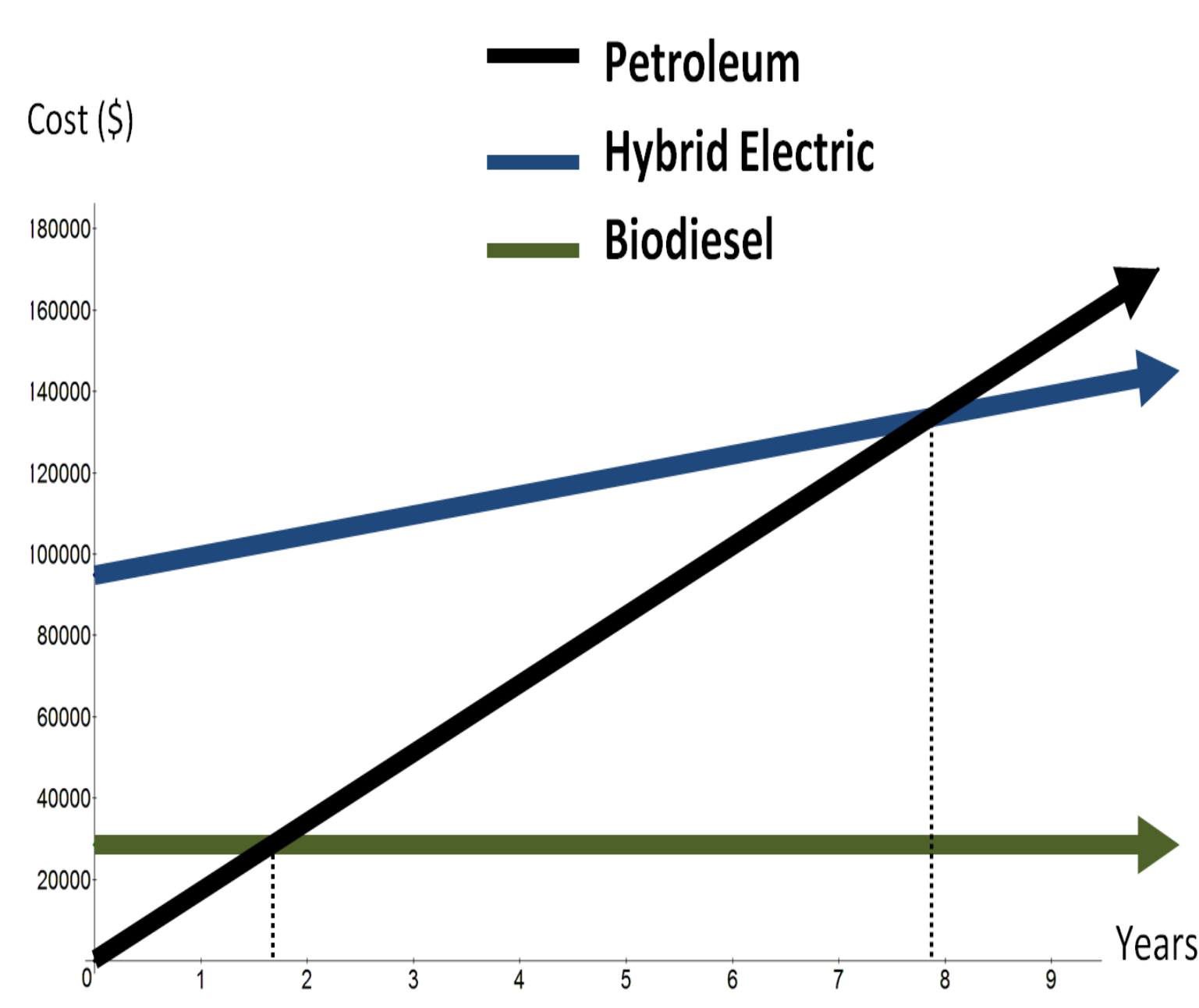


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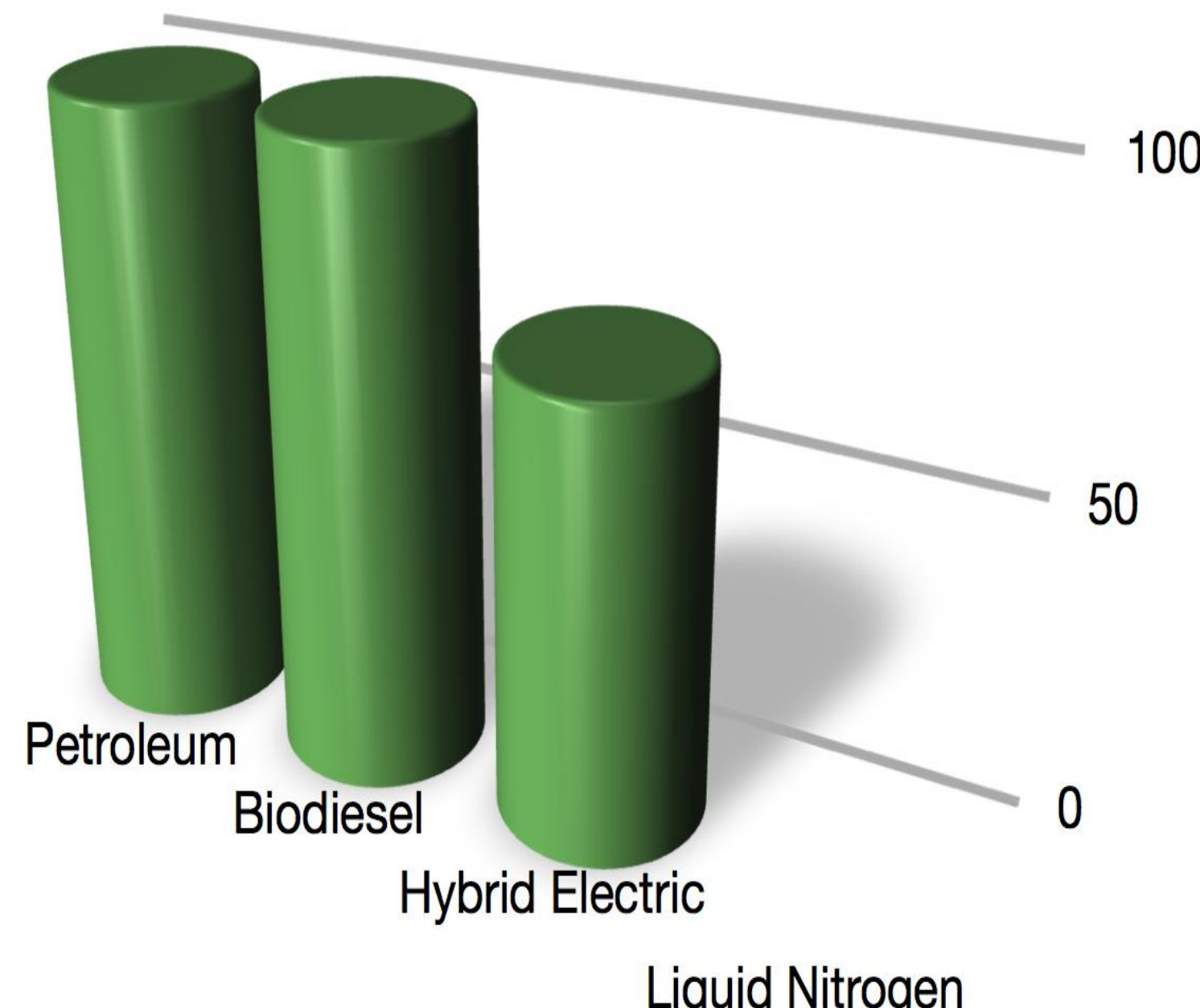
- Liquid Nitrogen: 10 cents per gallon.
- By storing the nitrogen in a pressurized tank, 482kj/kg of energy is generated -4 times greater than EV1.
- Educational Opportunities: MQP/ IQP

Charts

Plans: Cost vs. Time



Carbon Emissions Compared to Petroleum



Conclusion & Recommendation

- The best option is Plan 1: Biodiesel because of the following reasons:
 - Environmentally Friendly
 - Most realistic
 - Shortest payback time (2yrs)
 - Safer than Liquid Nitrogen
 - Free fuel
- Plan 2: Hybrid payback time is too long in comparison to life span of cars. (8 year pay back)
- Plan 3: Nitrogen could work but more research would need to take place.
 - Great for an IQP or MQP project.

References

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