



NASEC 2016

Energy and Alternative Fuels Transportation

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Problems Being Addressed



1. Although the use of more electric cars has the potential to be ecologically friendly, the increased demand on the power supply has the potential to increase fossil fuel usage in the electricity generation process.
2. With the ubiquity of motor vehicles, carbon emissions and energy consumption are rapidly growing. The country is in need of ecologically friendly options and programs.
3. A workforce of 143 million commutes to work each day, with a majority commuting alone. Carpooling is an underutilized solution that could be improved through policy, education, and app implementation.

Background - Energy Generation



- A large percentage of electricity is generated using fossil fuels (Figure 1). Though using electricity does not create as much emissions, the production of electricity does.
- Most vehicles run on oil based fuels, but a larger percentage of electric cars would decrease direct emissions.
- A rise in the percentage of electric cars would cause an increase in the demand for electricity, which is a production gap that would be filled mostly by fossil fuels such as coal and natural gas if alternative energy sources are not implemented into the energy markets more rapidly.

Problem - Energy Generation



The use of more electric cars has the potential to be ecologically friendly, but this increased demand on the power supply has the potential to increase fossil fuel usage in the electricity generation process.

Estimated U.S. Energy Use (2014)

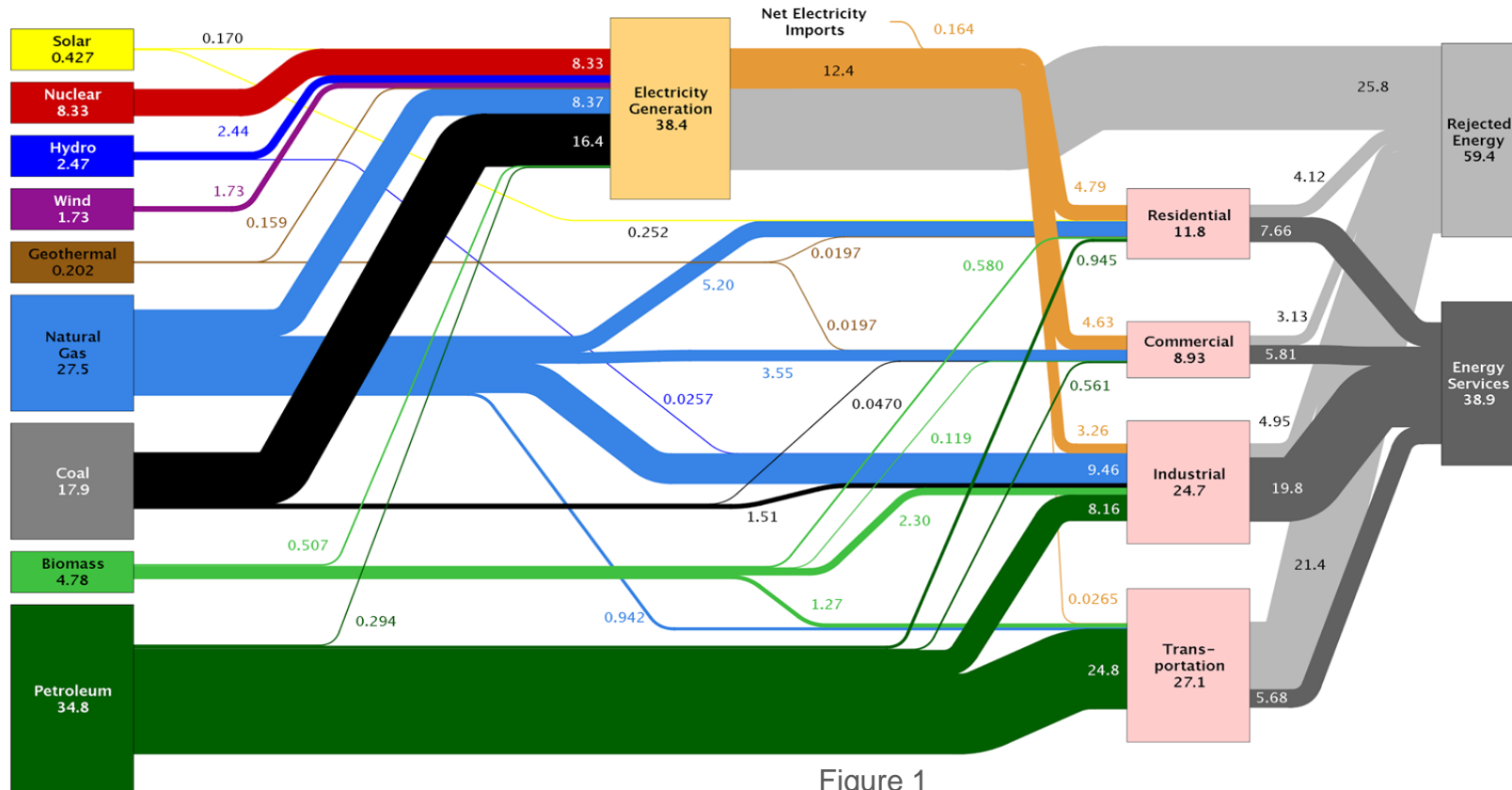


Figure 1

Past Solutions and Results - Energy Generation



- **Hydrogen fuel cells**
 - Expensive
 - Requires excessive amounts of electricity
 - Waste problem
- **Electric cars**
 - Slow implementation and cost prohibitive
 - The majority of electricity generated is fossil fuels



Our Solution - Energy Generation

- Build more alternative power stations in order to supply the rise in the demand of electricity.
- Implement alternative power sources: solar, wind, hydroelectric, geothermal, and nuclear.
- As more electric cars are produced, more alternative power sources are needed to limit emissions.
- Integrate fast neutron reactors to increase the national electric output while also using nuclear resources.
- Distributed generation increases overall electricity output, decreases energy inefficiencies due to line resistance, and decreases dependence on the communal grid.



Engineering Aspect of Design - Energy Generation

- New technological advances in nuclear energy is a valuable way to increase the electricity output while limiting emissions.
- Fast neutron reactors (breeder reactors) maximize the full potential of nuclear fuel while continuing to produce electricity. There is also less radioactive waste because the spent fuel from the normal fuel cycle goes into the breeder reactors.
- Distributed generation can most easily be implemented through installing solar panels on rooftops and the use of new models of wind turbines.
- Most notably, the amount of electric cars would increase the electricity demand of large cities.

Potential Problems - Energy Generation

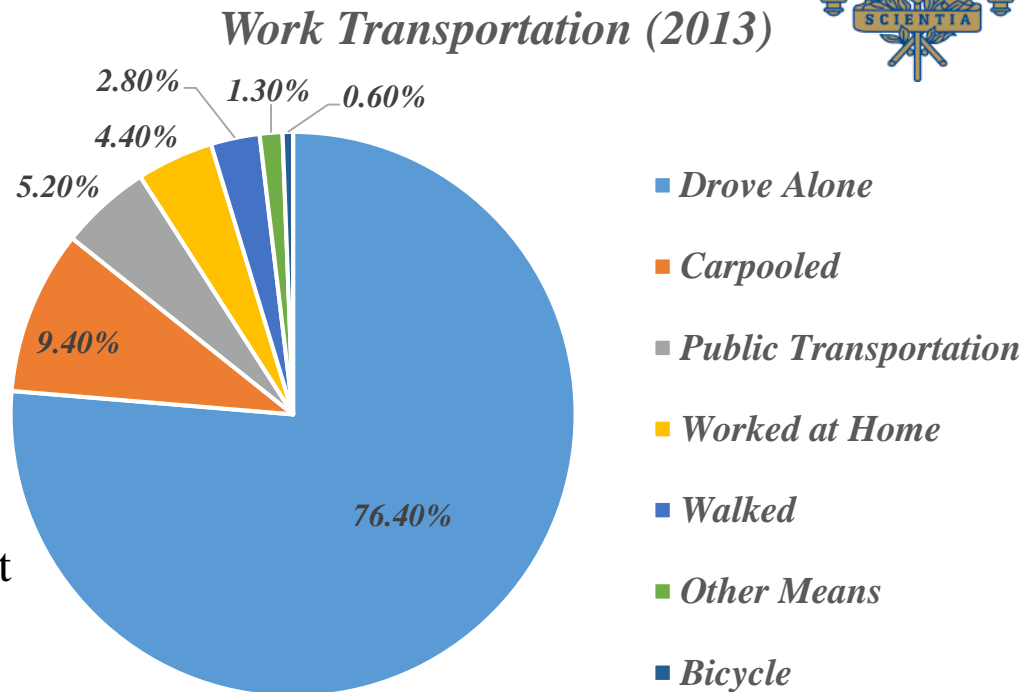


- The forms of waste associated with alternative power, most notably from nuclear sources are a concern. However, they are local forms of waste that can be properly stored and mitigated without creating emissions.
- Breeder reactors cause an increased potential for nuclear weapons. This can be mitigated by proper oversight by the NRC.
- An increase in the generation of electricity from alternative sources has been associated with a decreased trend in use of natural gas, but an increased trend in the use of coal, which creates more emissions than natural gas (The Economist, Nov 2015).



Background - Car

- Most cars still operate on fossil fuels
- Exacerbates global warming
 - Air and sound pollution
 - Electric vehicles still rely on standard methods of electricity generation
- Alternative fuels are possible
 - 1859: Gaston Plante invented rechargeable lead-acid batteries
 - Modern batteries improved concept
 - Hydrogen fuel-cell cars near production on commercial scale



Problem



With the ubiquity of motor vehicles, carbon emissions and energy consumption are rapidly growing. The country is in need of ecologically friendly options and programs. These solutions must involve improving emissions, manufacturing processes, power, range, and lifespan of motor vehicles.



Past Solution Attempts and Results - Car

Electric cars:

- Tesla, Toyota, Nissan, etc.
- Successful in reducing emissions
 - Gas-powered cars became cheaper when the Ford Model-T was conceived.
 - Technology for electric cars is limited
 - Power for battery-electric cars comes from power plants
 - Manufacturing cars create the same amount of emissions as driving



Our Solution - Car

Longer-lasting/more stable aluminum-air batteries

- Replace more inefficient lithium-ion batteries
- 8 times the range of current batteries
- Lowers the overall weight of the vehicle

Solar paneled modular roadways

- Reduces emissions (up to 75%) by introducing clean energy into the grid instead of burning fossil fuels
- Improves infrastructure
 - Easier maintenance of roads
 - “Smart” lane lines direct traffic around accidents, damaged roads, etc.

Research into hydrogen cells to increase fuel efficiency

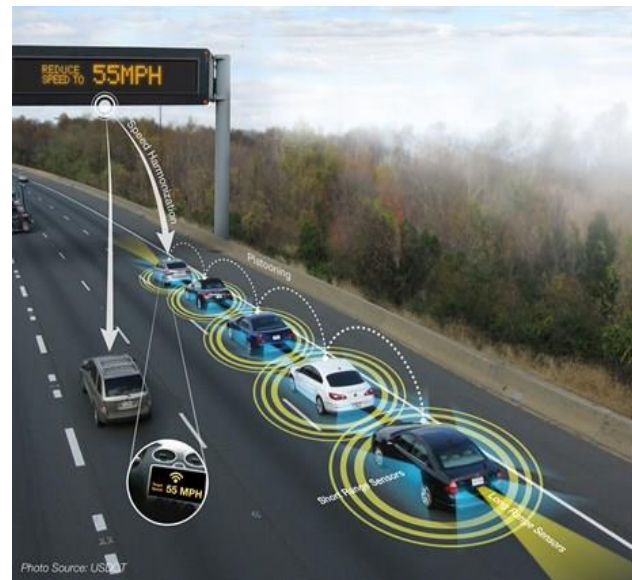
Human-less manufacturing to increases efficiency (no human error/breaks)



Our Solution - Car (ctd.)

Induction charging and high efficiency lanes

- Autonomous electric cars communicate to improve efficiency
 - Create a “train” of vehicles to reduce air resistance, traffic, and energy consumption
- Reduces carbon emissions by charging electric vehicles as they drive, via induction
 - Alternative to charging from the grid, which uses traditional organic fuels
 - Increases driving range of electric cars
 - Potential “fast” charging application similar to smartphone induction chargers

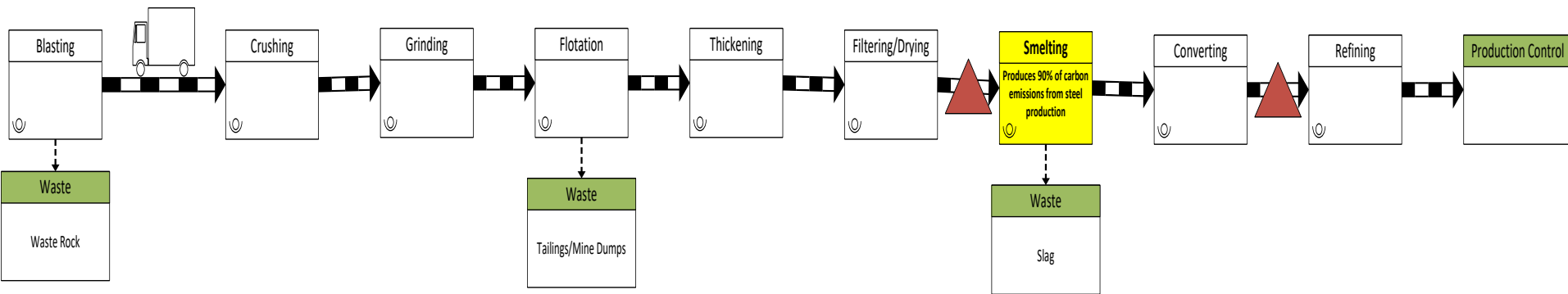




Our Solution - Car (ctd.)

Manufacturing

- Manufacturing a new car creates 6-35 tonnes of carbon
- Almost 33% of carbon comes from extracting metals and more specifically steel
 - 90% of these emissions are produced in the smelting process
- Use lighter & stronger materials such as carbon fiber to reduce weight of car



Steel Manufacturing Value Stream Map

Engineering Aspect of Design - Car

- Many futuristic car models (ie - Toyota Nori)
- Battery technology and materials science
 - Lighter, stronger materials (carbon fiber)
 - Longer-lasting batteries (aluminum-air cell)
- Powering the car without producing emissions
 - Integrate solar panels into the carbody
 - Utilize an air nozzle to focus airflow through wind turbines
- Aerodynamics
 - Streamlining - use wind simulation programs)





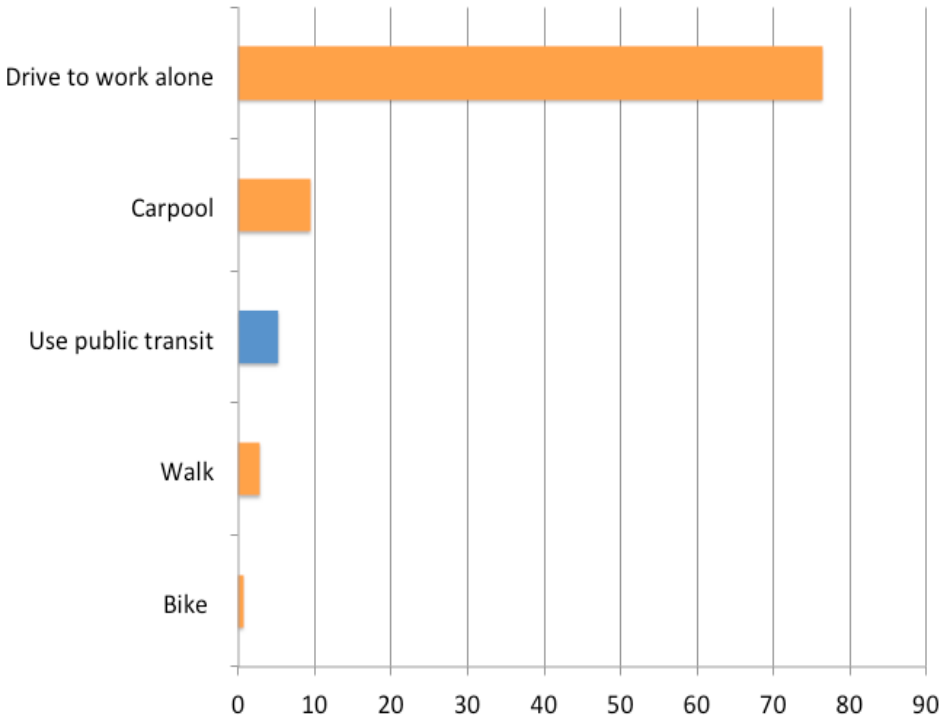
Potential Problems - Car

- **Costs**
 - People prefer fossil fuel-powered vehicles due to their cheapness
 - Potential political measures to make efficient technology cheaper (subsidies, etc.)
- **Technological curve with newer ideas**
 - Many ideas are in the prototype stage
- **Unemployment**
 - If machines replace human labor, fewer people will be able to earn income without increasing their knowledge and education

Background - Mass Transit



How Americans Get To Work, %



- Workforce strength: 143 million
 - 109 million travel alone
- Transportation accounts for 27% of CO2 emissions
- The use of public transportation is largely regional; 57% of N.Y.C. and less than 2% of Oklahoma City employees take public transportation to work
- \$330 billion annual expenditure on fuel
- The average American spends 40 hours a year stuck in traffic

Problem



A workforce of 143 million commutes to work each day, with a majority commuting alone. Carpooling is an underutilized solution that could be improved through policy, education, and app implementation.

Past Solution Attempts and Results - Mass Transit



- Carpool apps
- Carpooling parking lots
- D.C. Metro: fail, inefficient, unreliable, dirty and expensive (\$3 billion budget)
- Express lanes / EZ-Pass

Our Solution - MT



Policy



Education



Application





Engineering Aspect of Design - Policy

- **Government subsidize carpooling**
 - Washington, D.C. carpoolers get \$2 subsidy per day
 - Florida carpoolers earn up to \$150 per month
 - Birmingham, Alabama carpoolers earn \$70 for carpooling for over 90 days
 - San Jose, California drivers earn up to \$60 in free gas for carpooling
- **Infrastructure construction**
 - Improve HOV lanes coverage
- **Tax reduction**
- **Company involvement**
 - Companies provide carpooling service for their workers

Engineering Aspect of Design – App Creation



- A 2015 Pew Research Center study found 68% of adults to own smartphones- that's around 220 million people.
- In the first year of operation alone, Uber drivers in Austin,TX provided 2.5 million rides.
- The U.S. spent \$819 billion on application development, hardware and software improvement, and I.T. assistance; the average app costs a mere \$6,543 to develop.
- Failed attempts, such as SideCar, Ridejoy, and iCarpool attempted to create a carpool app and failed due to a lack of private funding and public outreach.
- By providing funding, local supportive policy, public outreach and advertisement, and a feedback system, a carpooling app can be successful.

Engineering Aspect of Design - Education



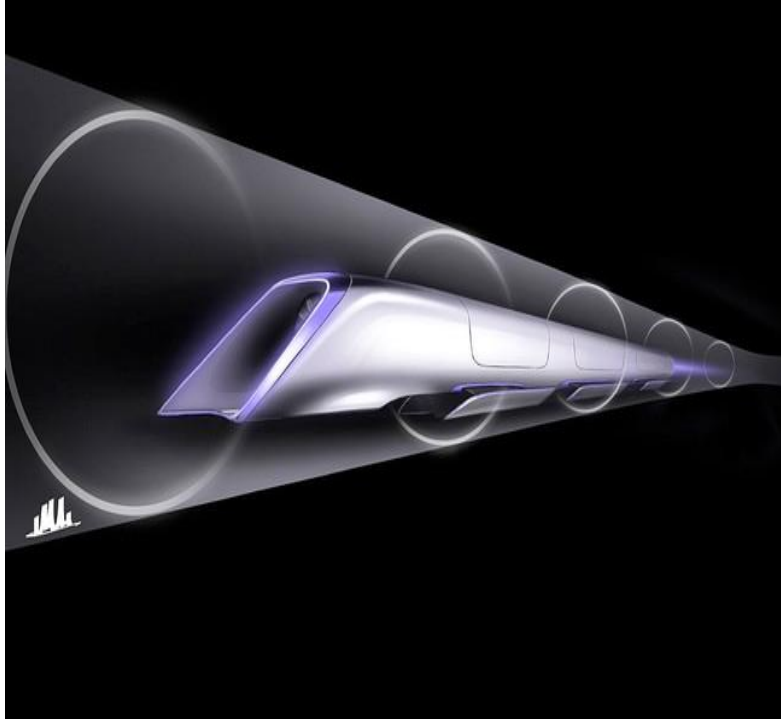
- Regain trust of public opinion on ride sharing programs by increasing publicity, reliability and cost. Since ridesharing and commuting will have to compete with the comfort and ease of driving your own personal vehicle, people will have to be convinced that ridesharing and commuting will save them money, be reliable and safer than driving their personal vehicles.
- It is imperative to educate the community to understand the environmental impact of emissions and pollution related to commuting to work and from work, saving them time, stress and money.



Potential Problems - Mass Transit

- Convenience/Comfort
- Conflicting political agenda for re-election
- Single driver habits may be hard to break
 - Flexibility
 - Emergency situations
- Cost of supporting infrastructure
- Allocation of additional land for parking lots and metro lines
- Trust / Reliability of Public Transport

Engineering Aspect of Design - Hyperloop One



- "A cross between a Concorde, a railgun and an air hockey table".
- Train set inside of a semi-vacuumized tube, therefore reducing air friction and allowing for accelerated speed with less energy expenditure.
- Still sustainable- using Tesla batteries and other energy sources, not fossil fuels.
- Takes people from San Francisco to L.A. in 30 minutes, otherwise a 3 ½ hour drive.

Conclusion



Energy Generation

Transition to renewables

Power stations

Fast neutron reactors

Cars

Aluminum-air batteries

Solar paneled modular roadways

Hydrogen cells

High efficiency lanes

Improve manufacturing

Mass Transit

Policy

Education

Application

