

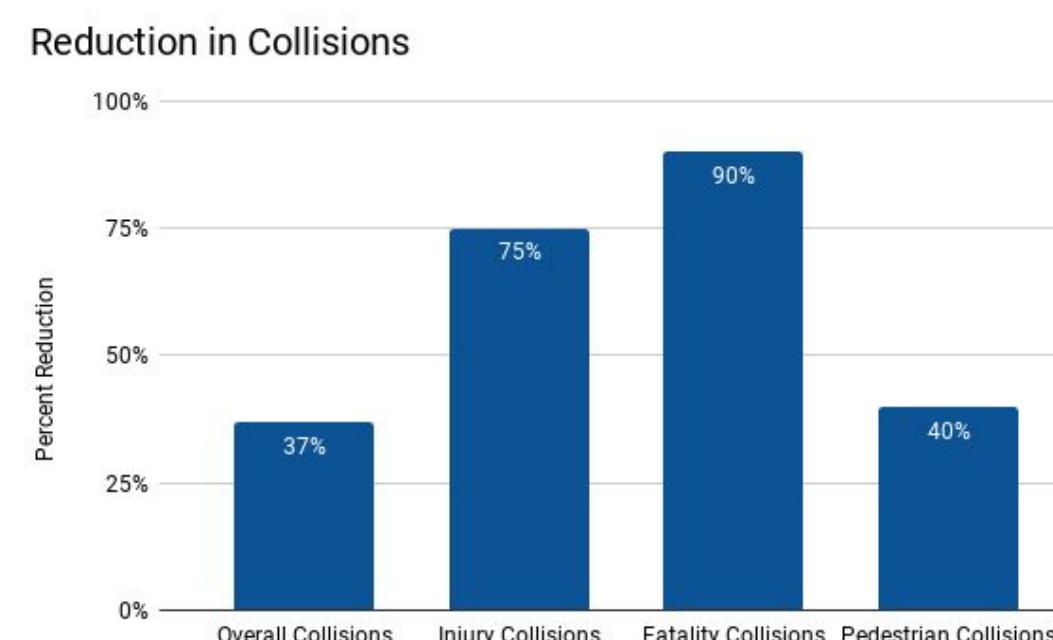
Paving the Road to Saving the Globe

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Background

While vehicles continue to improve on a day-to-day basis, a severe issue has arisen: traffic congestion. Information presented by Gellermann revealed that in 2014, commuters in the Boston Area, only the 7th most congested city in the U.S., experienced a total extra travel time of 154 million hours (Swasey, 2018). Recent migration patterns indicate rapidly expanding suburban populations guided by employment opportunity, even in comparison to metropolitan areas. From 2015-2016, urban areas experienced a population growth of 0.82% versus a 0.89% increase in suburban areas (Frey, 2017). Growing population will inevitably lead to exacerbated congestion in suburban towns, such as in our community of Lincolnshire, incentivizing the need for a cost-effective and sustainable solution.

Figure 2. Types of Collision Reductions in Roundabouts



Solution

Roundabouts

Flaws with Current Approaches

- The most conventional solution for reducing traffic congestion is often adding more lanes, which may be harmful.
 - Braess's Paradox: expansion of physical capacity worsens congestion because more people will opt to drive on these ostensibly faster routes, leading to greater traffic.

Safety

- While a traditional intersection may comprise of 32 conflict points, a roundabout only contains eight (FHWA, 2018).
- According to the WSDOT, studies observed a 90% reduction in fatal collisions and a 37% one in overall collisions (See Fig. 2).
- Since all cars move in a counterclockwise direction, it minimizes the threat of side collisions.

Traffic Reduction

- Since vehicles slow down while yielding instead of completely stopping, road backup decreases.
- According to IIHS, roundabouts have led to a 89% decrease in delays and a 56% decrease in vehicle stopping.

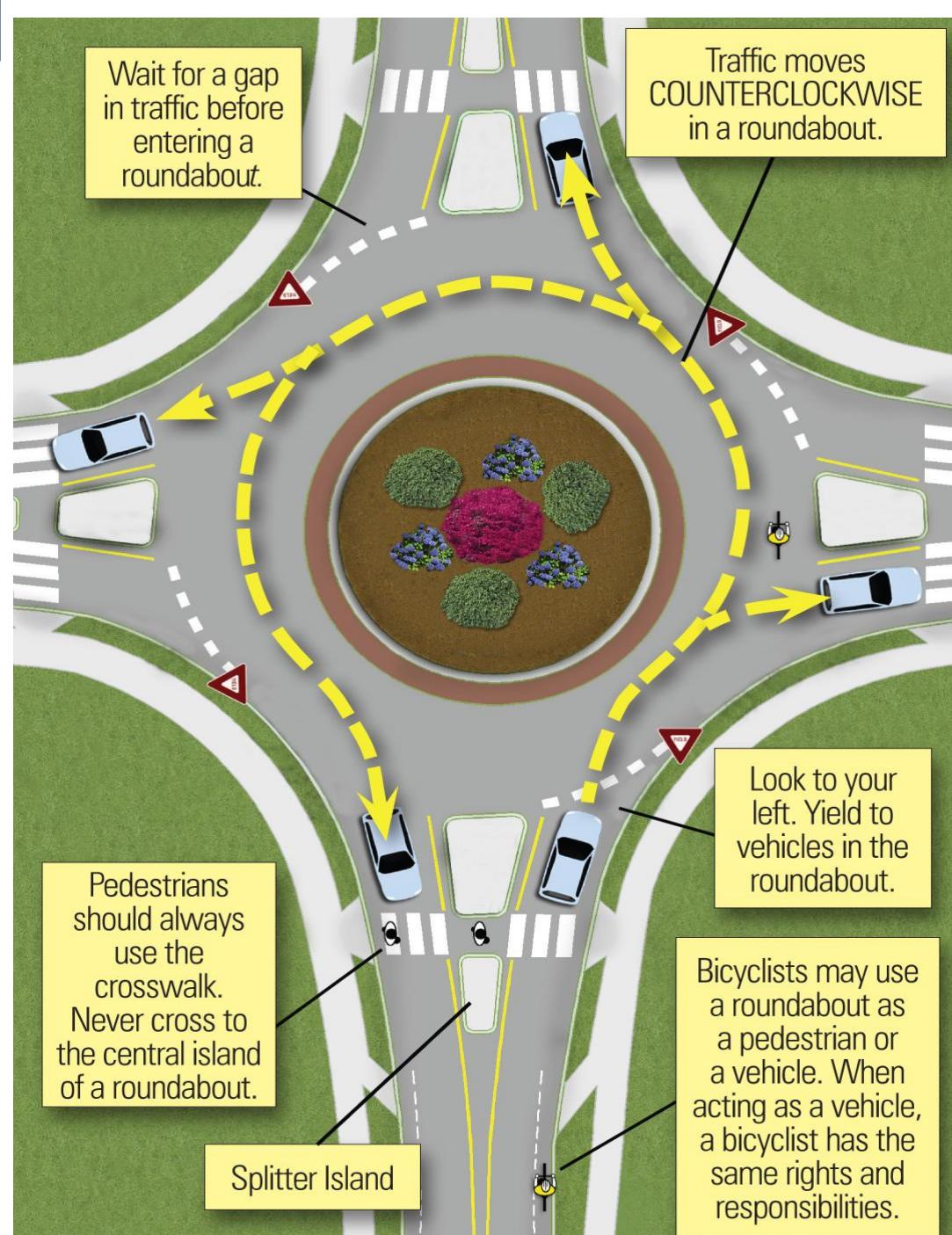


Figure 1. Roundabout Guidelines and Bird's-Eye View

Solar Panels and Hydronics

Incentives

- The curved design of roundabouts creates difficulty for vehicles to turn in snowy weather.
 - Hazardous weather impacts pavement friction and lane obstruction, leading to traffic delay (FHWA).

Hydronic Heating

- Hydronic heating circulates warm fluid through pipes beneath the pavement to melt snow/ice buildup.
- In comparison to traditional heating systems that incorporate air, water has better retention of heat, translating to more efficient heating due to reduced temperature fluctuations.

Solar Panels

- As a way to optimize energy use, solar panels are used to power the hydronic system.
 - Energy stored (using a battery) during the day will be used to heat roads when the weather conditions aren't optimal, especially during the winter.

Implementation

Estimated Costs

Two-lane roundabout: **\$194,000**

- 50 ft radius for inscribed circle
- 32 ft radius for central island

Hydronic system: **\$27,800**

14 kWh Tesla battery: **\$5,500**

7 kW Solar panel: **\$15,700**

Total Cost: \$243,000

The hydronic system requires 6.4 kWh of energy to maintain a full day of heating. As our solar panels are able to recharge a full 7kWh, the hydronic system would work with intermittent snow and shine, even if it snows for an entire day. In case they are unable to recharge, a 14 kWh battery will be installed.

Implications

Environmental:

- Our solution which utilizes solar-powered hydronic heating focuses on sustainability.
- Vehicle idling from traffic congestion leads to increased carbon dioxide emissions.
 - Traffic congestion increased fuel consumption by 72 million gallons in 2014 (WBUR).
 - Hydronic heating as a means to melt snow also serves to preserve the environment.
 - Other methods such as manual shoveling are damaging to vegetation and road surfaces.
 - Solar energy is inexhaustible and free of pollution

Economic:

- Economic productivity will compensate for setbacks presented by the expenses of the initial construction.
- According to WBUR, in 2017, 5.5 billion dollars went towards congestion in the Chicago, including individual costs.
 - Because money is wasted idling in traffic, our solution will benefit the economy through reducing traffic congestion.

Societal:

- Each year, a driver in the Chicago area wastes up to 10% of driving time and \$1,994 due to traffic (Swasey, 2018).
- Traffic congestion interrupts tight schedules, while also causing needless spending on money and resources such as gas.
 - Public health will be improved through reduced air pollution.

Timeline (2019): Intersection of Half Day and Riverwoods Road



January 1st

February 1st

February 20th

April 20th

June 20th

September 20th

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