



World Changing Impact

by rethinking transportation

By 2040 we estimate *annual benefits* to include:

2.4 Billion tons of carbon reduction

10 million traffic injuries avoided

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Executive Summary

By 2040 there will be an estimated 2 billion cars and 9 billion people worldwide with over 60% of the population living in urban areas. As the global population and number of automobiles increases and shifts to urban areas, the problems of traffic congestion, air pollution, road deaths and injuries and traffic related productivity losses will worsen.

Building more roads will not solve this problem. Swift Rails will.

Swift Rails is a highly impactful and disruptive transportation solution that addresses the growing worldwide challenges of traffic congestion, traffic casualties, deteriorating air quality and loss in productivity by elevating people above the traffic using ultra-light rail.

Swift Rails provides people with an on-demand, private, convenient and comfortable transportation solution that is 5 times faster and about 40 times cheaper than conventional mass transit, 100 times safer than cars and pollution free.

Swift Rails' light footprint, rapid construction, low cost and ergonomic design presents an economically superior solution to connect urban areas with an ultra-light rail capillary network that feeds transit arterials and frees up green space to create more livable, pedestrian friendly urban areas.

Swift Rails has extraordinarily compelling advantages that we believe will enable it to mode shift 25%¹ of people from their cars to Swift Rails within 2 decades.

By achieving large scale usage, Swift Rails will have a hugely beneficial impact on worker productivity, the economy, health and the environment by changing the way we get to and from work and other destinations, the quality of the air that we breathe and the livability of our cities.

*By 2040 we estimate Swift Rails **annual benefits** will include:*

- 2.4 Billion tons (gigatons) of carbon reduction²*
 - 10 million⁴ traffic related injuries including 380,000 deaths³ avoided*
-

Swift Rails' benefits are estimated to be:

- Reducing 2.4 gigatons of annual carbon emissions by 2040²
- Avoiding 10 million⁴ traffic related injuries including 380,000 deaths³ annually by 2040
- Saving hundreds of billions of dollars in car crash medical expenses and work loss costs annually
- Preventing hundreds of millions of animal deaths yearly
- Conserving billions of gallons of gasoline yearly
- Enabling people to spend their time more productively instead of driving and in traffic jams
- Providing personal convenience and time savings - the key driver for quick, large scale adoption

The Swift Rails Story

The Projected Impact of Swift Rails in 2040

Swift Rails came out of a radically different way to do transportation. If we redesigned transportation to be better on all counts, what would it look like? Swift Rails CEO, Kevin Neumaier, gave a talk on the future of transportation at the UN meeting on Climate Change in Copenhagen⁵ that began to describe a new way to get to sustainable transportation. Jim Enright said we could build it – so we did. We have begun to create a novel system in Swift Rails, which can have a very positive impact on how we travel around locally.

This is our best case/excellent case projection. It represents our aspirational goals as a business. We are a mission driven organization. We want to bring sustainable transportation to the world. We also want to make local travel much safer, more convenient, and just plain out more fun. We seek to grow in a way that will benefit our investors, employees, customers and communities. We believe we can accomplish these goals by combining great innovation with excellent management, quality and impassioned execution.

We chose two decades from now as the timeframe to project our impact. This represents the reality that significant changes take time, and exponential growth of beneficial solutions have their greatest impact when they reach full scale. For the early leaders of Swift Rails, this likely is our biggest lifetime career impact we can make on the world. We project out our impact by estimating the greenhouse gas (GHG) impact, safety, reclaiming time, neighborhood and ecosystem impacts.

Greenhouse Gas Impact

Focusing on the impact and simplifying for the reader, we calculate our impact based only on GHG from emissions. This is not to say that life cycle is not important, but rather that we believe Swift Rails' long lived steel rails that will eventually be recycled into new rails is less damaging than concrete and asphalt roads, and that our lighter weight electric vehicles with fewer parts will have a lower lifecycle impact, but we are excluding these impacts for now.

Our target markets are primarily ones where no transit exists. In this case, 98% of the trips that we are comparing against are cars and light trucks. On an energy intensity basis, we provide a substantial benefit per passenger mile: **Energy intensity = Swift Rails (500 mpge)/Average for cars and light trucks (25 mpg) = 20 times (2,000%) improvement.**

This substantial reduction is accomplished through reductions in rolling resistance and weight, improvements in aerodynamic shape and eliminating the start/stop nature of traffic – which gets the rider to their destination quicker.

On top of the 20 times improvement in energy intensity, Swift Rails will use renewable energy to power all our vehicles. This means in addition to zero emissions from the vehicles locally, there will not be emissions somewhere else in the supply chain.

Safety Impact

Unfortunately, many of us know family or friends that have been killed or severely injured in transportation accidents. The global numbers are staggering – according to the World Health Organization (December 2018)⁴, **1.35 Million people die annually as a result of traffic related deaths.** This number unfortunately continues to rise. The WHO report goes on to say:

“Road traffic injuries are now the leading killer of people aged 5-29 years. The burden is disproportionately borne by pedestrians, cyclists and motorcyclists, in particular those living in developing countries”

It would be great to prevent just one of these deaths. Wouldn't it be great if we could go back in time and just change one incident? It would be wonderful if we could change one event and our kids didn't have to attend the funeral of one of their grade school friends killed by a drunk driver or someone that didn't see a stop sign. It would be so wonderful for their parents, their family, their friends, and their community. Unfortunately, there is no way to go back and change events that have already taken place.

We can, however, change the conditions that cause them. Swift Rails is an engineered solution to safety. The 12 wheels on Swift Rails vehicles lock it into the track so it can never “drive off the road”. The elevated track means there will be zero collisions with bicycle riders, pedestrians, cars, or deer and other large animals. One-way-only track prevents a deadly head on collision from ever happening. We control all the Swift Rails vehicles. Every vehicle drives at a safe speed. There is no need to be concerned if a person in another vehicle is texting and not paying attention or had a couple drinks. The system, as well as in-person command center operators, know where every Swift Rails vehicle is at every moment. We are continually monitoring each vehicle and professionally maintaining them, but in the event there is a mechanical problem, it is known almost instantly, and corrective measures are taken for all vehicles potentially impacted.

“When all the human errors can be removed, something approaching perfect safety can be engineered. Unlike any other form of transportation, Swift Rails has the potential for zero accidents.”

- Mark Cotter, Chief Safety Officer, Swift Rails

Reclaiming Time

There are few things more precious than time. We help our riders reclaim time in the following ways:

- Express point to point travel – get there 5 times faster!
- Better use of time while riding – it's comfortable and fun!

Today, the average transit commute of approximately 6 miles takes 45 minutes each way⁶. Our ultra-lightweight Swift Rails vehicles accelerate faster than conventional transit and the reason **we can get our riders to their destination 5 times faster** is mostly about our personalized non-stop express service. For Swift Rails there is no waiting and no sharing (unless you want to) which makes a huge difference! When we take out all the waits and the acceleration and decelerations, the trip that used to take 45 minutes now takes about 8 minutes.

The following table shows the substantially simpler and faster trip when using Swift Rails versus conventional transit.

| Typical 6 Mile Daily Commute | |
|--|--|
| Conventional Transit – 45 minutes | Swift Rails – 8 minutes |
| 1. get to the station | 1. Hail your personal vehicle like an Uber, so it is ready when you are (<i>i.e. No waiting</i>). |
| 2. wait for your train | 2. Your vehicle accelerates to speed (<i>with No in-between stops before your destination</i>). |
| 3. the train accelerates | 3. At your stop the vehicle decelerates and switches off the track to your station (<i>Swift Rails' trip complete!</i>). |
| 4. decelerates for the next stop | <p>Saving 37 minutes, each way, every day adds up. This saves the average commuter 284 hours per year or seven 40-hour work weeks!</p> <p>What would you do with an extra 7 weeks each year?</p> |
| 5. wait for people to get on and off (about 30 seconds) | |
| 6. Repeat | |
| 7. Repeat | |
| 8. Repeat | |
| 9. Repeat | |
| 10. Repeat | |
| 11. Get off at your station | |
| 12. Walk to connecting train | |
| 13. Wait for your train | |
| 14. the train accelerates | |
| 15. decelerates for the next stop | |
| 16. wait for people to get on and off (about 30 seconds) | |
| 17. Repeat | |
| 18. Repeat | |
| 19. Repeat | |
| 20. Repeat | |
| 21. Get off at your station | |

This reclaims a lot of time.

It is our belief that getting there faster is a big part of the value. The other is that having a comfortable guaranteed private seat during the ride is much more peaceful, productive and enjoyable.

According to the Texas A&M Transportation Institute (TTI)⁷:

*“Congestion is a persistently growing problem. The problem is larger than ever. In 2017, congestion caused urban Americans to travel an extra 8.8 billion hours and purchase an extra 3.3 billion gallons of fuel for a **congestion cost of \$166 billion**”*

Neighborhood and Ecosystem Impacts

Swift Rails is an elevated system with a small footprint of ground space taken for support poles. **Where a typical two-lane road in the US takes 3.7 acres/mile, Swift Rails takes approximately 402 times less space at 400 square feet/mile.** As there are millions of miles of roads, and not the space to build more of them in many cities – the total space in land area is a concern. Large multi-lane roads can cause a number of problems. Constructing them can change the hydrology of a location as well as creating a physical barrier. According to a conservative estimate by the Humane Society of the US and the Urban Wildlife Research Centre – over 1 million animals are killed each day on US roads. In the animal world, surface transportation cuts off ecosystems. In an urban planning sense, highways cut off neighborhoods and people from livable communities.

At a typical height of 12-15 feet, every land animal, including humans, can pass freely under Swift Rails (and in areas where giraffes roam, we will happily go to 19 feet). Rain and snow pass right through the tracks, keeping the natural hydrology in place.

Economic Equality

Surface transportation not only physically divides neighborhoods, it can be a substantial barrier to economic equality. It is after all, impossible to work at a job that you can't get to. The cost of **transportation represents 1/7th of the typical US budget**⁸. This has a much greater negative impact on low- and middle-income persons. The current system where a car is required to get to work in order to get a job, to pay for your car is especially difficult – putting those at a disadvantage, at a greater disadvantage. Public transportation options and times are largely a limiting factor in being able to achieve upward economic mobility.

In the developing world, this level of inequity is even worse. In addition to the economic disadvantage, the deterioration of personal safety is also especially troubling with an alarming increase in number of traffic accidents and deaths among bicyclists and pedestrians.

Extent of Impact

The impact is huge for each passenger mile traveled on Swift Rails – zero emissions, 20 times improvement in energy efficiency, greatly improved safety, and reclaimed time. The total impact of course is dependent on the extent of the adoption. In 1885 the world's first practical internal-combustion engine automobile was built. It would have been the rare individual that would have predicted that there would be more than a billion cars on the road just over a century later. The car in the early 1900s was the fastest, most convenient, and most comfortable way to get from place to place. At that time, the biggest thing lacking was a network of good roads.

We think we are in a similar situation today. Swift Rails is a much faster, safer, more convenient and environmentally sustainable way to get around than cars, and also much cheaper and more comfortable

than transit— all we need is the network of ultra-light rails. Since this is our most optimistic scenario, we are going to make several assumptions that, while challenging, are reasonably probable:

- The future demand for mobility cannot and will not be met only with more cars. The projected demand to double the number of cars is difficult to accomplish. The current road infrastructure will not support it, the environmental impact that it would cause is a great concern, and in many areas the physical space to build more roads and parking on this scale simply does not exist.
- We will be able to execute upon our plans in system performance, marketing, and cost.
- We will co-exist and be a complementary system to existing mobility solutions. The predominant means of travel globally is on roads. Traffic congestion has numerous causes all related to the number of vehicles trying to occupy the same roadway. The elevated nature of Swift Rails allows it to use space that could not, except at great expense, be used for cars. Getting people to their destination faster, safer and more efficiently while not using a car, will reduce congestion and be good for mobility in general.

The progression of our optimistic plan goes something like this:

- Our early systems prove out our technology. Those things that we have engineered and proven with smaller scale testing and prototyping work similar to designed.
- The economic model is that systems can fund themselves and not require ongoing subsidies that are required by conventional transit. This will allow them to be “free” for municipalities – they are paid for by ridership. This will allow systems to be financed and rapid deployment to occur.

In addition:

- When we get to scale, there will be additional benefits derived from manufacturing efficiencies, lower costs, greater flexibility in vehicles that can be ordered, and improved vehicle utilization. At scale, our system cost will be at parity with roads. We anticipate that there will also be corridors and routes specifically designed for Swift Rails. This will work together with planned building entrances to further accelerate the adoption and benefits of Swift Rails.

If we can accomplish these things, we think that we become an equal part of the surface transportation for 85% of the cities. This would yield 85% city adoption rate * 60% of population of the world in the cities * 50% of city surface transportation. At the current passenger miles traveled of 24 Trillion, this would save 6 Trillion passenger miles traveled, or 25% of the total passenger miles traveled.

Worldwide the total annual impact by 2040 equates to:

- **2.4 Gigatons of Carbon reduced**
- **380,000 deaths avoided**
- **10 million traffic related injuries prevented**

How We Scale Our Impact

Swift Rails has the potential to drastically cut carbon emissions, save lives, and make traveling more fun. The extent of our success in accomplishing these things depends on how quickly we scale and grow. This becomes our impact. With respect to impact, capitalism is relatively neutral in that it is neither good or bad in itself, but rather depends on the type of development itself. When the new and disruptive invention has dramatic advantages in cost and performance it is possible to achieve sustained high double-digit growth for decades. It is this virtuous part of capitalism that we seek to harness so that Swift Rails

becomes globally known as one of our key modes of transportation. This benefits all - riders gain time and comfort at a reasonable price; municipalities have highly effective transportation infrastructure that they don't need to maintain; Swift Rails investors, employees and communities gain as we create substantial financial returns and good paying jobs around the world. Even other modes of transportation gain, which we describe in the next paragraph. These things collectively create a positive impact on civilization.

Innovative and Complementary Technology

There is sometimes a misconception that all things that accomplish the same thing (like transporting people to their destination) are always in a state of competing with one another. At least in the case of Swift Rails, this is not the case. There are many parts of the world where there are not practical ways to increase lanes of roads or parking spots to park the vehicles. More cars simply increase gridlock – a frustrating negative process that wastes gas and time (3.3 Billion gallons and 8.8 Billion hours in the US alone according to Texas Transportation Institute). Swift Rails complements existing infrastructure. **At 12-15 feet above the ground we are using space that cannot otherwise be used to move people.** People traveling on Swift Rails reduce the travel demand on the roads and reduce gridlock.

Challenges and Opportunities

In order to go places with Swift Rail, you need ultra-light rail. If we had all the rails in place, it would be simple – just get in, select your destination, and go. There will inevitably be challenges until we get there. These will range from permitting, to copycat competitors, to our own ability to execute. We have significant cost advantages and other benefits. Those other benefits will become even greater as we scale. It is those that we have summarized in this document. We are assuming we can meet the demand to provide Swift Rails to cities around the world. In this scenario we anticipate providing growth of 65% year over year for the first 8 years after putting in the first system. In the following 8 years, we expect that year over year growth to slow to 40%.

While this is clearly an enormous challenge, it is also an even bigger opportunity. We see this as an opportunity to greatly improve our world.

Appendices

Appendix 1: Assumptions and Data Sources

1. Ridership attraction: If PRT designs deliver the claimed benefit of being substantially faster than cars in areas with heavy traffic, simulations suggest that PRT could attract many more car drivers than other public transit systems. Standard mass transit simulations accurately predict that 2% of trips (including cars) will switch to trains. Similar methods predict that 11% to 57% of trips would switch to PRT, depending on its costs and delayshttps://en.wikipedia.org/wiki/Personal_rapid_transit
2. Transportation is responsible for 24% of worldwide direct CO2 emissions from fuel combustion. Road vehicles – cars, trucks, buses and two- and three-wheelers – account for nearly three-quarters of transport CO2 emissions. <https://www.iea.org/tcep/transport>. Transportation emissions are expected to increase 60% (from current levels of 6 billion tons) by 2040 https://read.oecd-ilibrary.org/transport/itf-transport-outlook-2019_transp_outlook-en-2019-en#page20
3. The World Health Organization forecasts that there will be 1.5 million road deaths worldwide in 2040 https://www.who.int/healthinfo/global_burden_disease/projections/en/.
4. The number of annual traffic injuries cited by the World Health Organization’s 2018 report was between 20 and 50 million <https://www.who.int/en/news-room/fact-sheets/detail/road-traffic-injuries> and number of deaths was 1.35 million. Swift Rails’ injury reduction estimate scales a 2018 mid-range value of 35 million by the percentage increase in road deaths from 2016 to 2040
5. See Appendix 2 for United Nations Convention on Climate Change Transportation Panel Speech
6. <https://www.governing.com/gov-data/transportation-infrastructure/commute-time-averages-drive-public-transportation-bus-rail-by-metro-area.html>
7. <https://static.tti.tamu.edu/tti.tamu.edu/documents/mobility-report-2019.pdf>
8. <https://budgeting.thenest.com/typical-percentages-household-budgets-3299.html>

Appendix 2: United Nations Convention on Climate Change Conference, Copenhagen Transportation Panel Question: What is the one thing you would do as President, Prime Minister or King?

Kevin Neumaier's opening remarks:

What one thing would I do if I were king?

First, I think that the effort is larger than just that of a king and will require the collective efforts of all the brilliant and well connected here in this room and at Copenhagen. That said, my answer is:

Vision. Transportation is unsustainable now and getting worse. We need Vision. Look at where we want to be in 40 years and lay out a vision of how to get there. An 80% reduction is a huge change. We need vision that will spur investment and action that will put people to work on the right things and move us toward a better world.

We need the entire vision before we break it into all its little parts. This is especially true for transportation. The entire vision can save us trillions of dollars over the next 40 years.

The economic arguments on carbon reductions are not based on enough good real-world data. Let's take buildings. I run Ecology and Environment, Inc. Over the past 9 years we reduced the carbon footprint of our global headquarters by 80% and our net savings was several hundred thousand dollars. 80% savings; 9 years; net savings! We can do this with most of the world's existing buildings and all of the new buildings - and we should. But let's not improve buildings all by themselves, like they are an independent sector.

To get to our 2050 target of an 80% carbon reduction requires all sectors. So we also need solutions that develop local agriculture and closed loop processes for most of what we use.

Transportation is what ties all of these things together. We can build sustainable, low carbon agriculture, industries and buildings. But once we build them, we can't relocate them except at tremendous cost - so we better develop them in a cohesive way.

Let's develop a low carbon transportation system and design everything around it.

Let's use our best and brightest to develop the vision of what our future transportation system should be. Does anyone think that the internal combustion engine and rubber on asphalt is our best technology?

Over the past 40 years our company has looked at the environmental impact of most every type of development and energy production and use. We've done this in 84 countries in every type of ecosystem on the planet. The automobile and its current transportation network is not something we would recommend as the best alternative.

Let's use physics and engineering to guide us to our best alternative - to the vision of the future. To remove rolling resistance we should use rail or magnets; to reduce weight and make better use of low carbon energy we should power the guideway instead of the vehicle; to allow the young and old to better use our transportation system and to improve our lives by better use of our time and safer travel we should use our computer technology for guidance.

This vision is not of a minimalistic system that is based on minor improvements - this is the grand vision of a better life. One that saves millions of lives from traffic fatalities; one that spurs investment and puts people to work; one that is kind to our climate; one that reclaims the millions of hours of time wasted in traffic jams; ultimately one that makes our lives much better.

Once we put out the vision, there are many ways to achieve lower energy transportation. Government incentives, entrepreneurs, great engineers and scientists, and economics will get the job done, once we decide on the vision.

Along the path we should make our cities more walkable, bikable, and livable. Design around our lives by designing it all together - our sustainable homes, manufacturing, agriculture, and transportation should all work together to enhance our lives.

Take short term steps as we pursue this longer term vision. For example, we wrote the software for the little city of Redmond, Washington - daytime population 100,000. Making great use of carpooling, vanpooling, and incentivizing human behavior, they were able to reduce 1 million roundtrips in 15 months. The same system implemented for the US would reduce 2.6 billion trips a year - that's over 3 million trips around the globe annually.

So the one thing I would do as king is put out the vision. In 2050, we need an 80% reduction in carbon emissions. I'll be 85 years old. I want to get into a vehicle and say, "Take me to my grandkids' house." It should automatically take me there using 5 times less energy and 10 times less carbon emissions than the same trip does today. There should be no delays or waiting in traffic. The chance of an accident or fatality should be close to zero.

And one last thing - the person that makes this happen will be the next king.

2019 Update: Swift Rails vehicles will use 20 times less energy (400% improvement) and zero carbon emissions