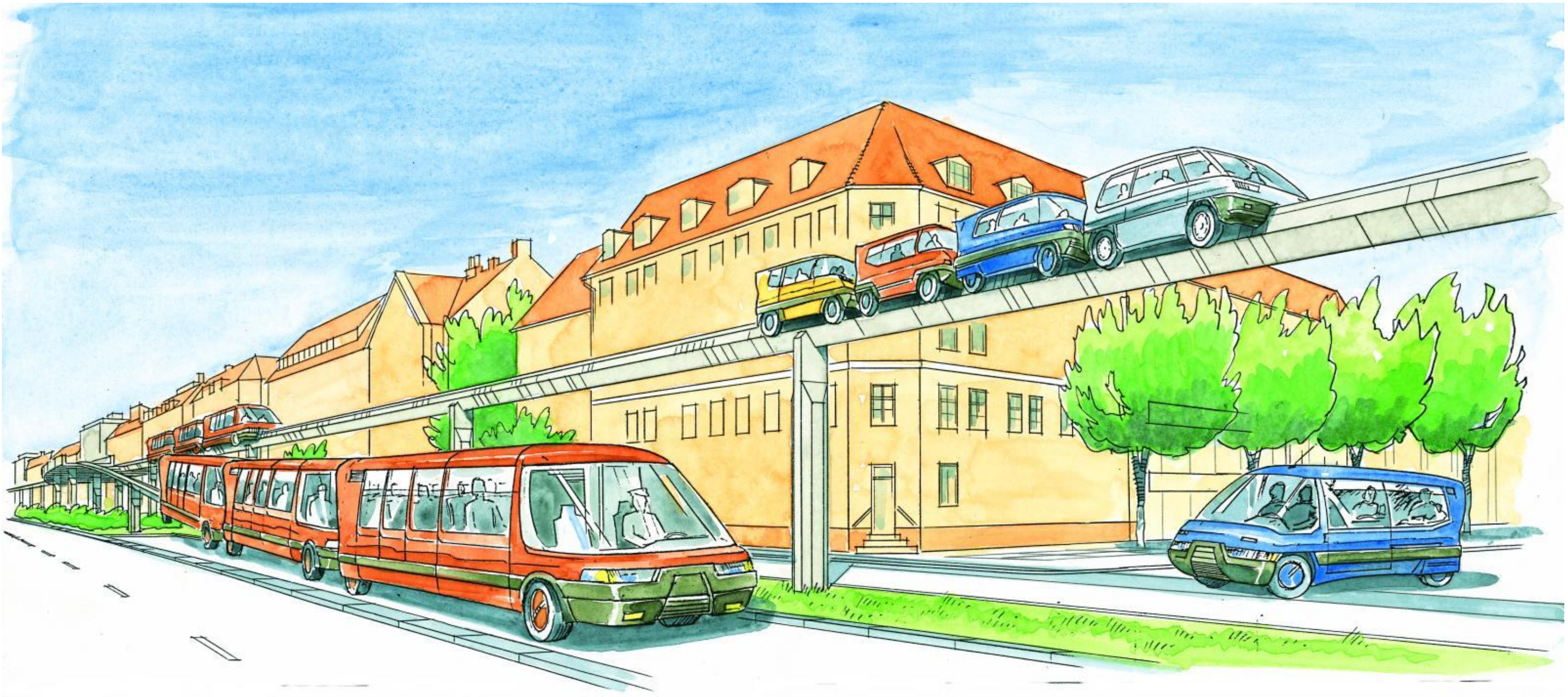
RUF status 2021



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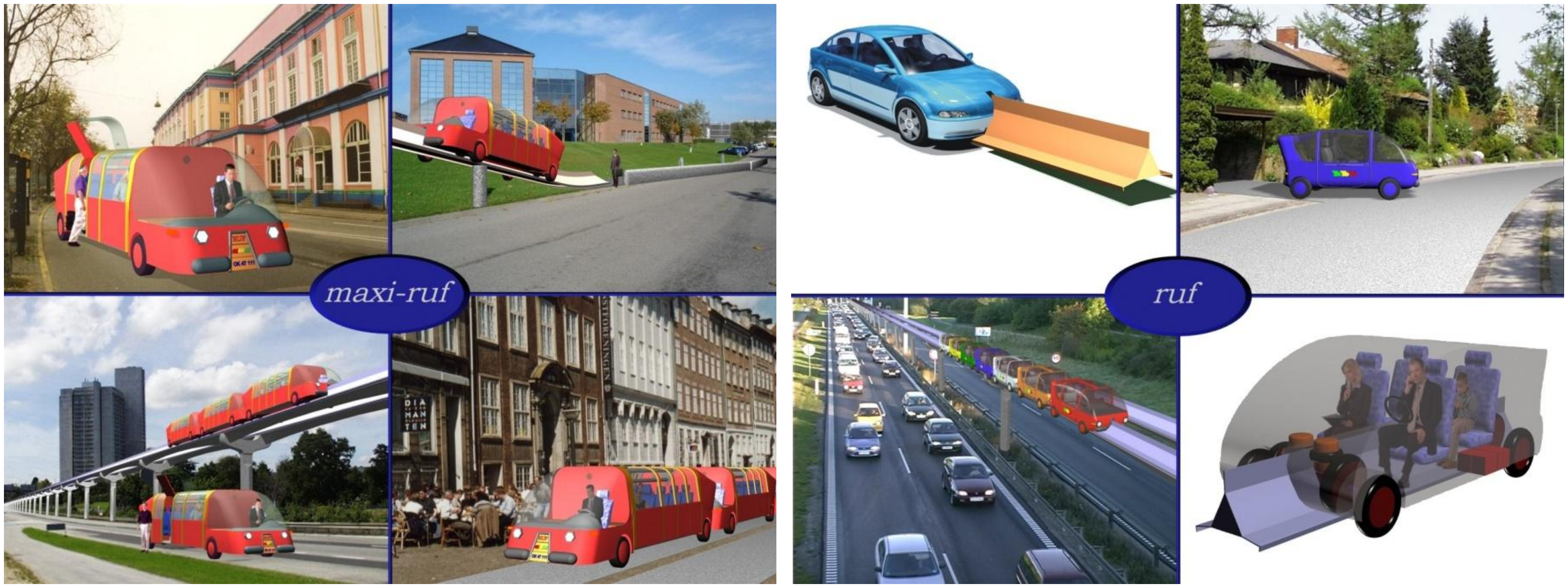
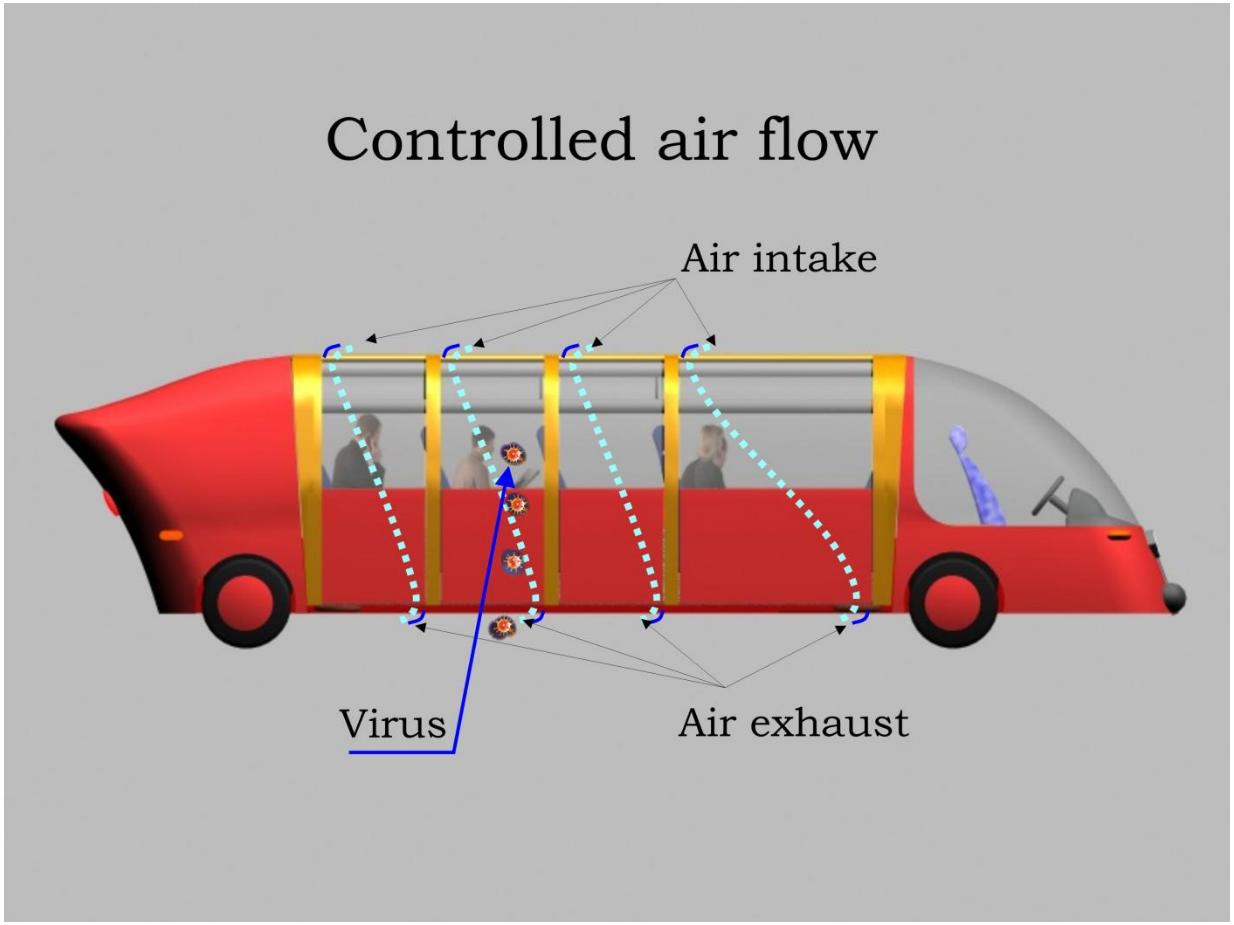
RUF DualMode



Phase 1: Public transport (maxi-ruf)
Faster than by car – only seated passengers – high comfort – door-to-door possibility – low construction cost – On Demand – flexible configuration
Phase 2: Electric vehicles (ruf)
Low energy consumption – small batteries – power from monorail – recharge of battery on-line – self driving in a safe way – hybrid extension unit possible.

RUF Antivirus



RUF as public transport is able to transport people in a safe way even if a virus is active in society.

Vehicle design 1

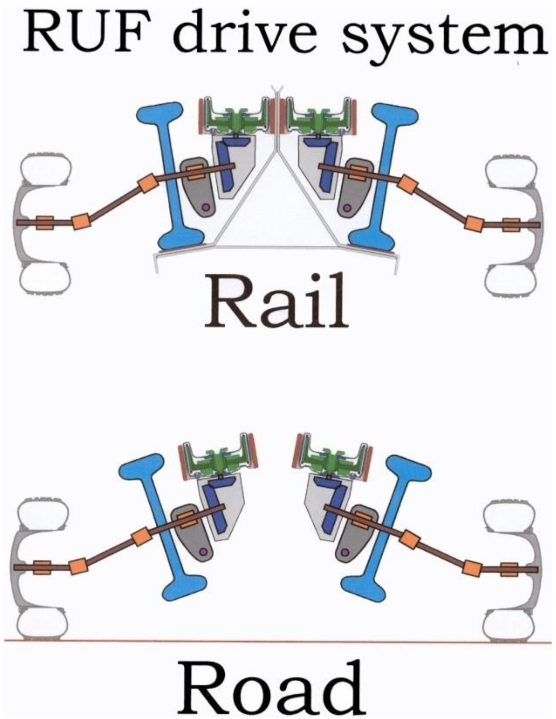
Concept and features

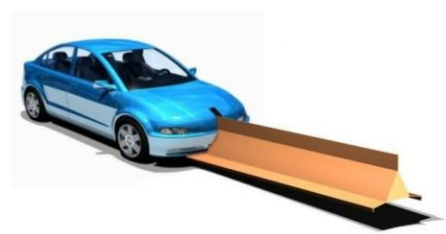
RUF vehicles are all designed using the same basic drive system. The vehicles differ in length and width as well as in equipment. The guideway is the same for all vehicles, but a super strong version can be made for heavy goods sections. A normal guideway is dimensioned to be able to carry 500 kg per m.

RUF cars (ruf) are normally 4 seaters but 2 seaters can be made also (mini-ruf)

RUF busses (maxi-ruf) are 10 seaters but 20 seaters mega-ruf and 6-8 seaters midi-ruf can also be built.

Cars (ruf) can be privately owned or public owned. Maxi-rufs can be used both as public transport vehicles and by companies as service vehicles.





Vehicle design 2

Vehicle speed / weight / size / capacity

RUF vehicles need to follow the RUF standard which demand that a ruf must be able to drive at least 80 km/h via the normal roads. On the monorail all vehicles follow automatically a fixed speed profile with a top speed of 150 km/h and a maximum acceleration of 0.2 G. On long sections (20 km) the speed can go as high as 200 km/h.

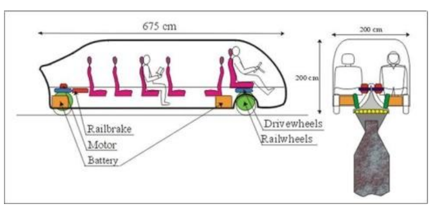
The vehicles can fully loaded weigh as much as 500 kg per m. The empty vehicle is light weight and could be made of aluminium (honeycomb structure) or carbon fibres.

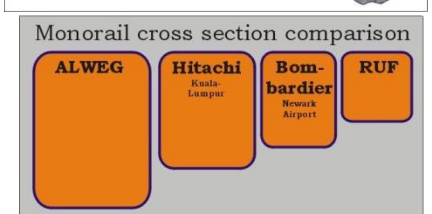
The ruf width is like a normal car (175 cm). Length can vary (typically 3.5 m). Height is slightly higher than most cars.

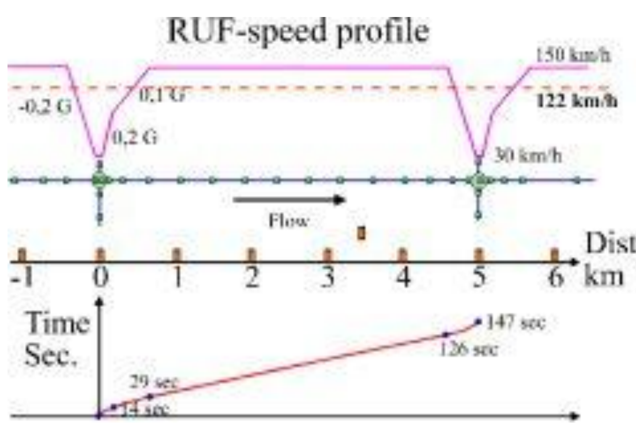
Maxi-ruf and mega-ruf is 2 m wide 2 m high and 7 m long.

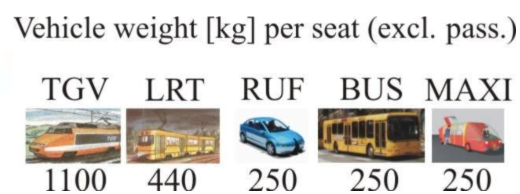
RUF vehicles enter the guideway with a speed of 30 km/h and with a separation of 5 m. This means 1 ruf per sec. and 0.5 maxi-ruf per second. If a ruf contain 1.3 passengers it means a capacity of 4680 pass/h. If 10-ruf trains are built before access to the rail system (length 10 x 3.5 m) it means a 40 m long train (plus separation) takes 5 seconds to enter. 13 passengers every 5 sec. = 9360 pass/h/dir.

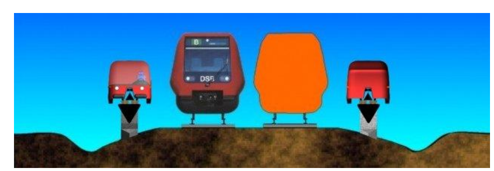
Maxi-ruf will typically form trains before access to the monorail. It runs On Demand so all 10 seats can be used. Capacity of a line based upon 5-maxi-ruf trains (40 m long incl. separation) is 50 pass. every 5 sec or 36,000 pass/h/dir. The same line based upon mega-ruf has a capacity of 72,000 pass/h/dir. No standing.











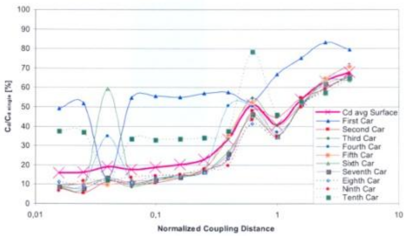
Vehicle design 3

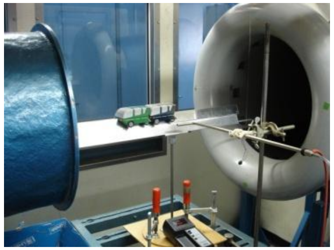
Vehicle aerodynamics

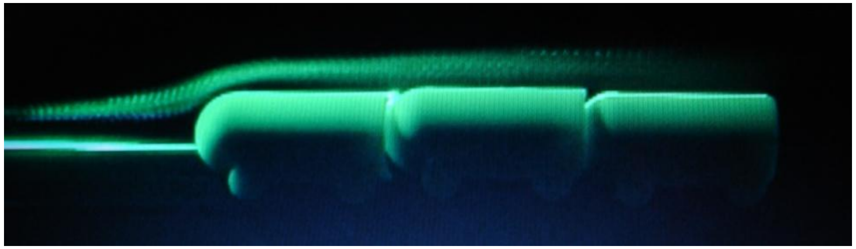
RUF vehicles need to follow the RUF standard which means that a ruf must fit reasonable well together. The front shape and the rear must have similar shape. According to a report from the Danish Energy Technology Lab at the Danish Technical University, the ideal shape will mean that every additional ruf in a train only add 10% to the air resistance of the train. This has been confirmed also by computersimulation and in wind tunnel tests.

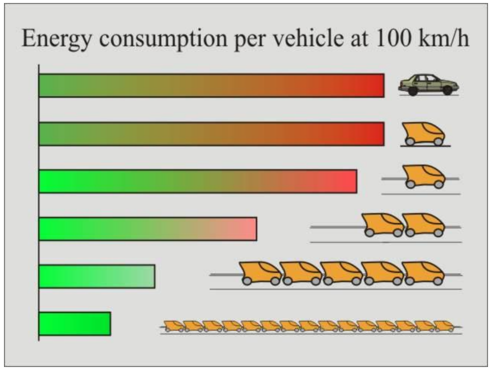
Compared to the Automated Highway System, RUF can offer far better aerodynamics in the platoon. Partly because the vehicles are shaped for this purpose, partly because the vehicles are driving with only 10 cm separation. AHS is using 1-2 m separation or more and the vehicles are of very different design.

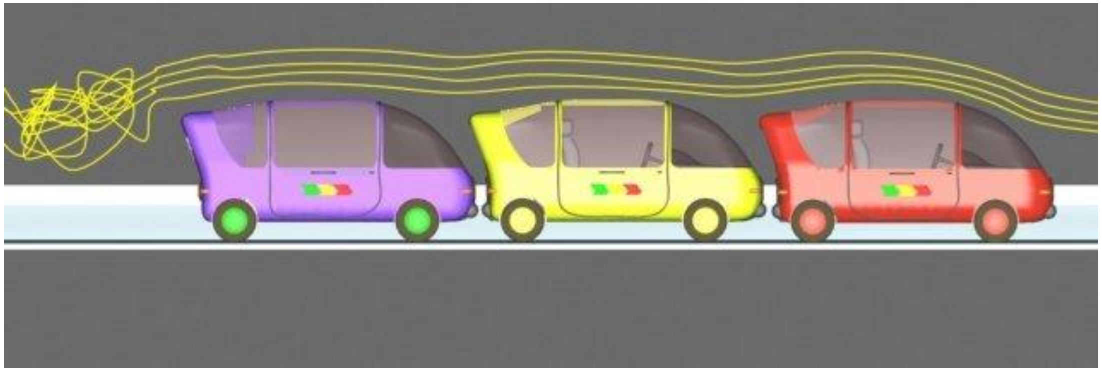
Normal cars have the problem that they tend to lift off the road at high speed. Special devices are used to prevent this from happening. RUF does not have this problem due to its special drive system. Lift on the RUF vehicles is an advantage and the vehicle are safely locked to the monorail.











Vehicle design 4

Safety features

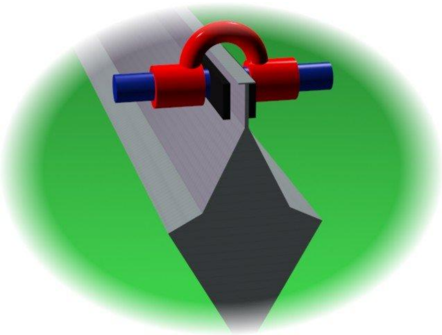
RUF is equipped with a powerful rail brake so that emergency brake of 1 G is possible under all circumstances.

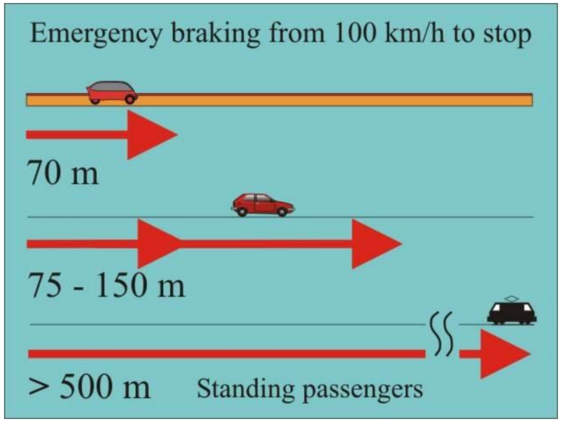
The vehicles are ”locked” to the monorail so that derailing is impossible.

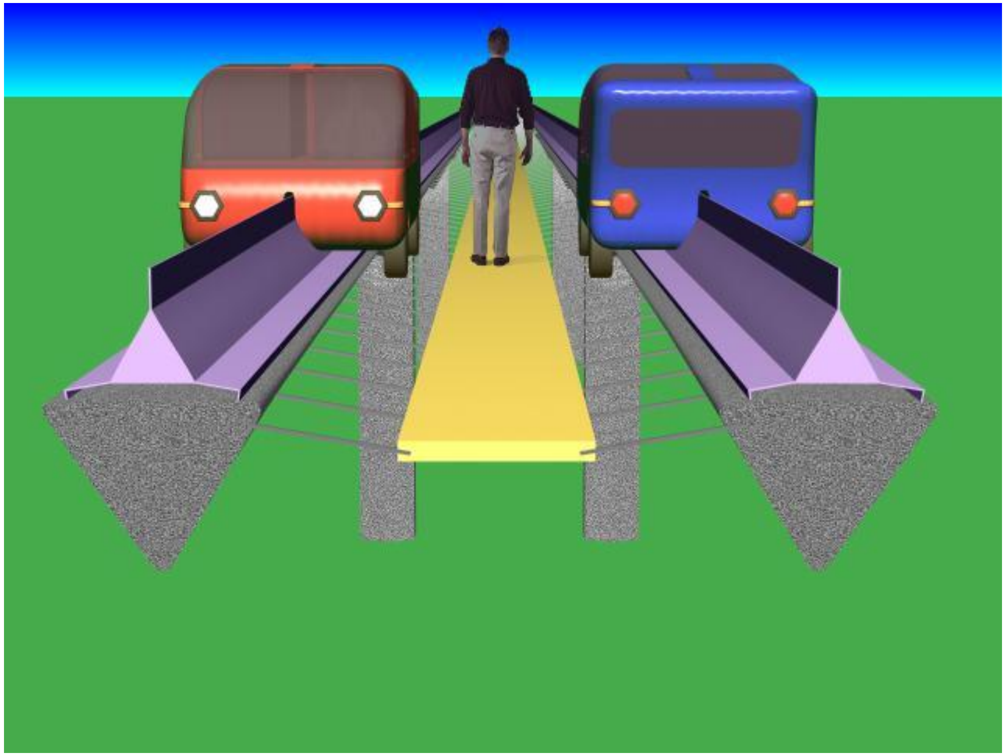
The channel through the vehicle makes it very stiff in a frontal collision.

An escape path can be placed in the space between the two monorails.

When RUF is running automated on the network of monorails, it is using a fail safe mode where the vehicles all the time must receive an OK signal. If not the whole section will be stopped or run at a reduced safe speed.







Vehicle design 5

Documents

Evaluations

RUF has been evaluated at numerous occations:

COWI (1991) has confirmed the energy savings of the concept. Financed by the Ministry for the Environment

RECONNECT (EU 1999) has appointed RUF as a ”most promising technology”

Bytrafik (City traffic) (2000) gave a very positive evaluation of RUF. Financed by the Ministry for the Environment

IPTS (Institute for Prospective Technological Studies), made in 2001 gave a positive evaluation of RUF

CyberMove under EU program for Energy, Environment and Sustainable Development evaluated a RUF network covering Greater Copenhagen and found it to have an impressive IRR(30) = 29% for the society.

Patents

The following RUF patentapplications have resulted in one or more patents:

WO 91/18777

WO 94/21479

WO 96/08401

WO 99/65749

Test documents

No documents are publicly available

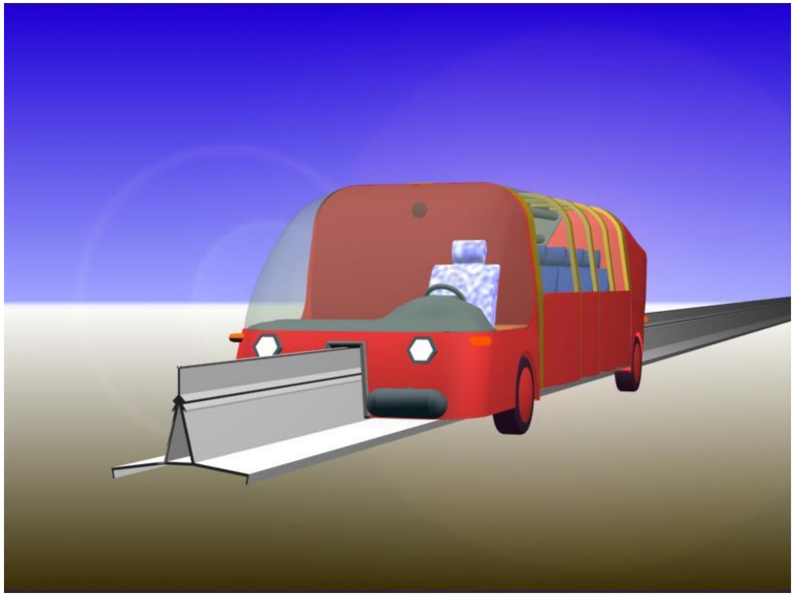
Infrastructure design 1

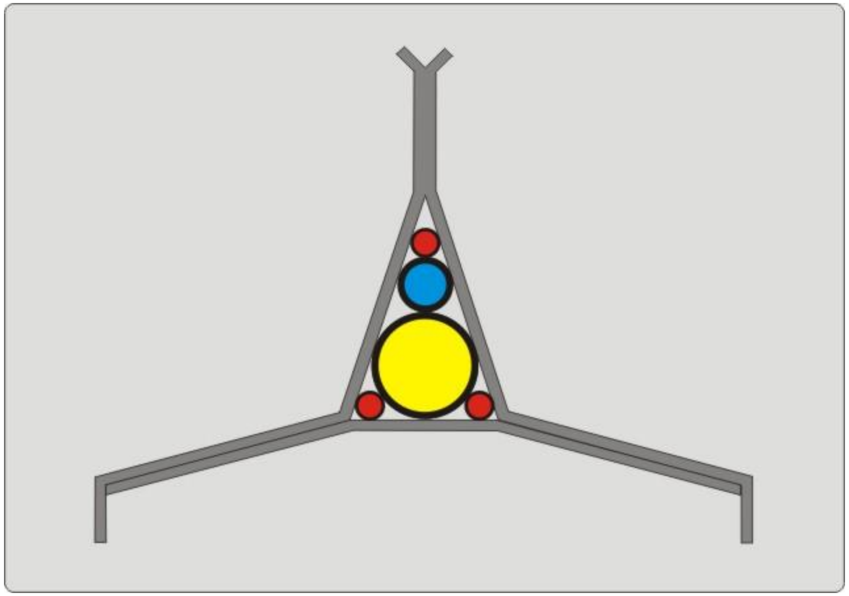
Concept

RUF guideway network is based upon 20 m long modules of triangular monorail.

The space inside the triangular rail can be used for all kind of critical infrastructure for the city.

The Y-shaped structure at the top of the monorail contains a ”leaky coaxial cable” which is used for the communication between the control system and every vehicle.



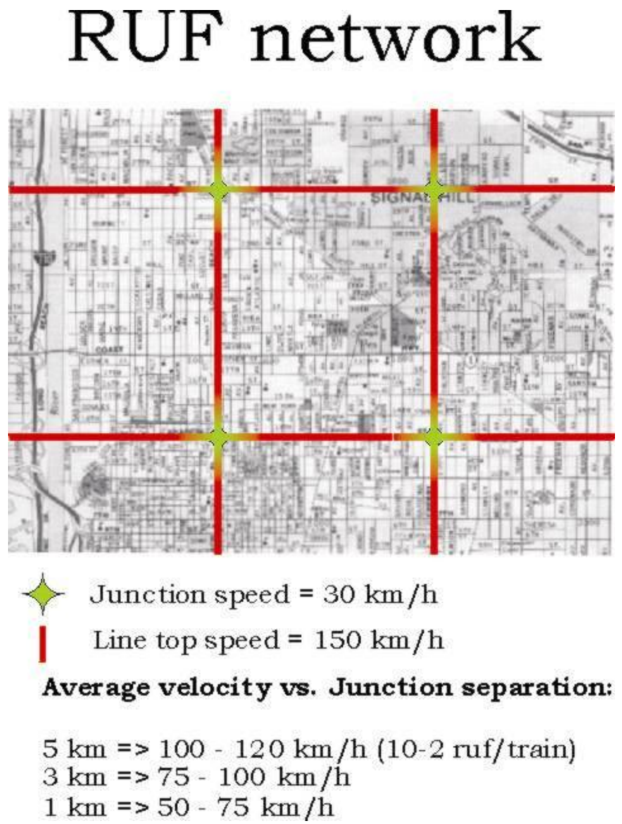


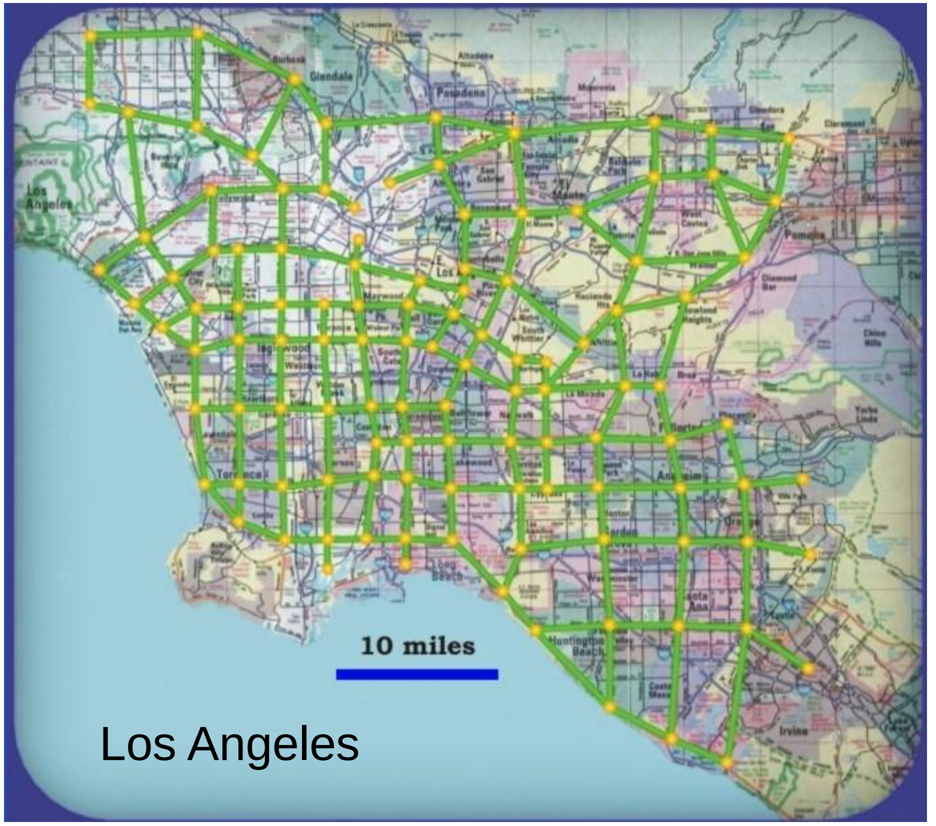
Infrastructure design 2

Structure

RUF networks are typically created with 5 km long segments. With a top speed of 150 km/h and a junction speed of 30 km/h, the average speed in a network with 5 km segments will be 120 km/h

The travel times in such a network can be seen in the simulator: www.ruf.dk/rufla.exe





Infrastructure design 3

Support

RUF monorail modules can be placed upon masts with 20 m separation but other support methods can also be implemented in special cases.

Infrastructure design 4

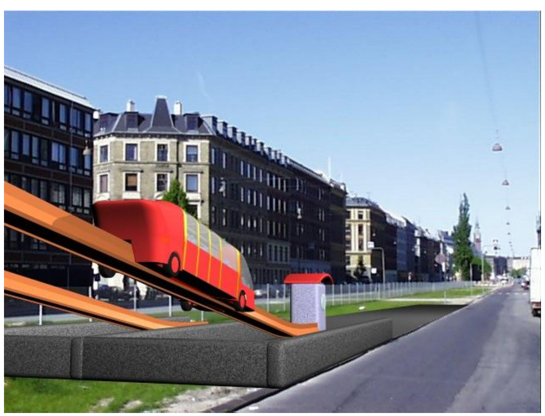
Interoperability

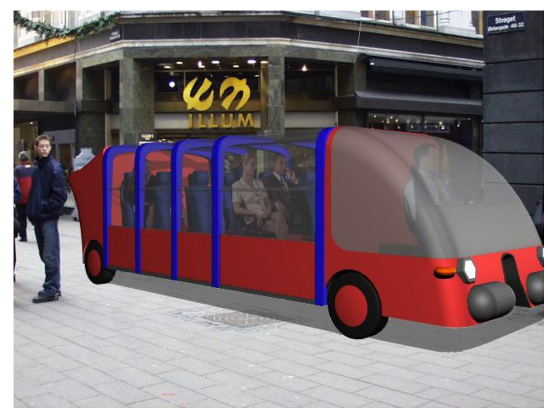
RUF is a very flexible system with small dimensions. This means that it can easily connect to other existing systems. A normal train platform can be used by RUF either from an elevated or an underground line.

Infrastructure design 5

Intercity connections

RUF can connect major city centers





Infrastructure design 6

Interchangable cabine

The cabine of the maxi-ruf can be exchanged by other structures such as freight containers, 20 passenger cabines, sleeping compartments etc.

Freight movements

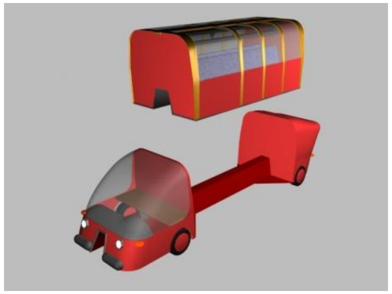
RUF can be used to distribute small goods in a maxi-ruf where the passenger cabin has been replaced by a freight cabin. 80% of the goods delivered by trucks today is small gods which can be handled by maxi-ruf vehicles. It is often high value goods.

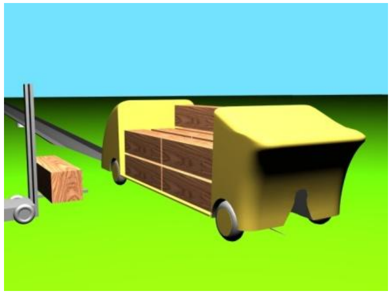
20 passenger cabine

If capacity is more important than comfort, a vehicle can be eqipped with benches along the sides. 20 seated pass.

Sleeping compartment

Short distance flight can be substituted by a trip using the cabine as a sleeping compartment for 4 passengers travelling during night between cities up to 1000 km apart. A business traveller can reduce hotel expenses using RUF.



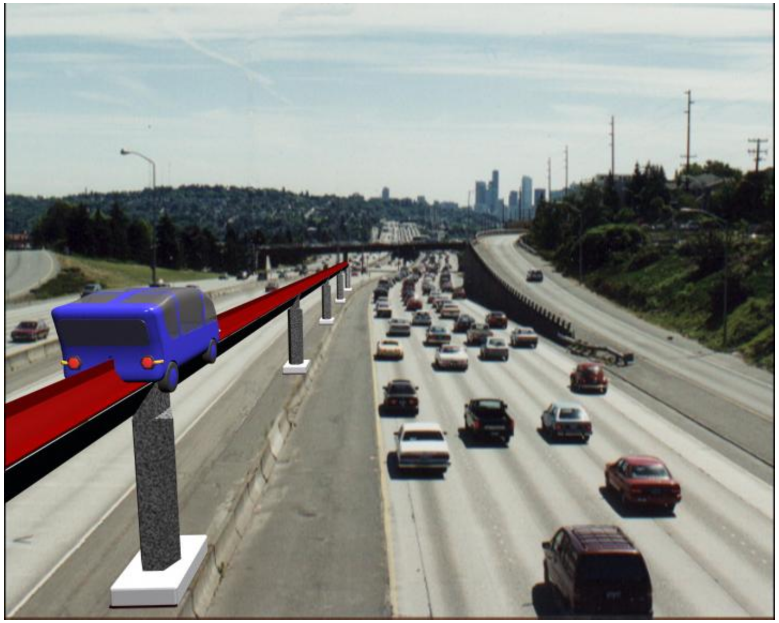


Infrastructure design 7

Footprint

RUF need no leveling but can be placed in the middle of an existing highway using masts with a diameter of approx. 50 cm.

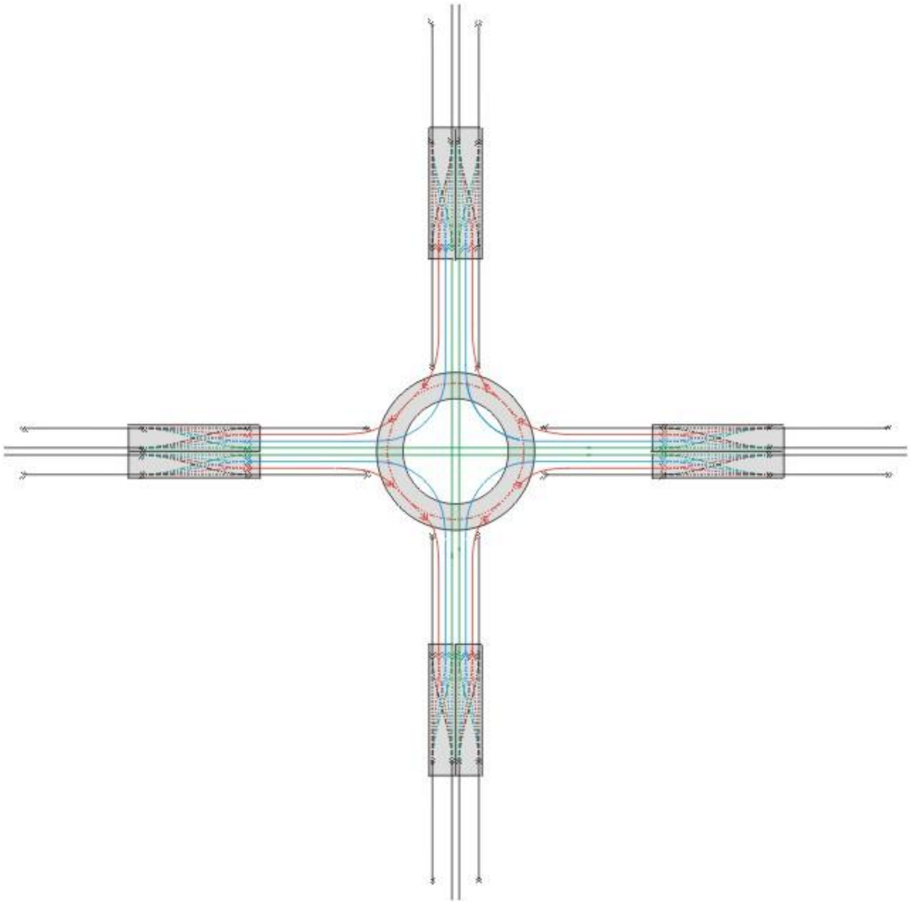
If it is impossible to make holes, the arch configuration can be used. An ordinary road dimensioned for trucks can carry the monorail system without reinforcement. At the same time this configuration will be more resistant to earthquake movements.

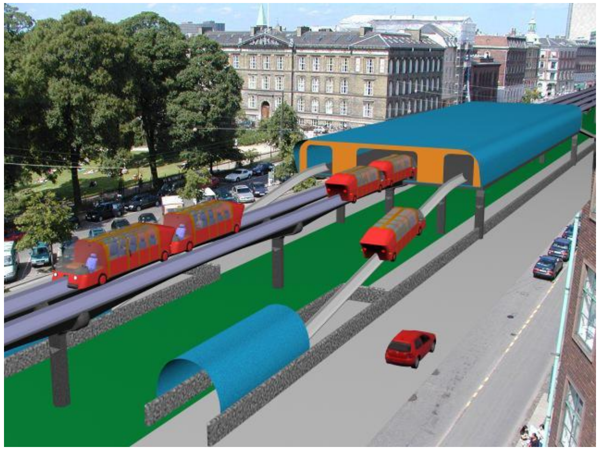


Infrastructure design 8

Ramps

Complex RUF junctions consist of 4 ”satellites” and a central roundabout. Access speed is 30 km/h and the minimum radius of curvature is 26 m. Access ramps are followed by egress ramps to be used in case the vehicle is tested and rejected on the access ramp. Magnetic guidance is used to guide the vehicles along road parts.





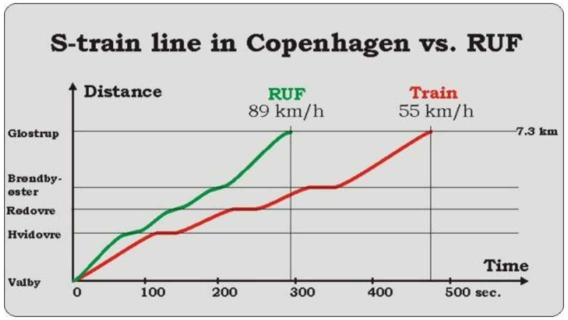
Infrastructure design 9

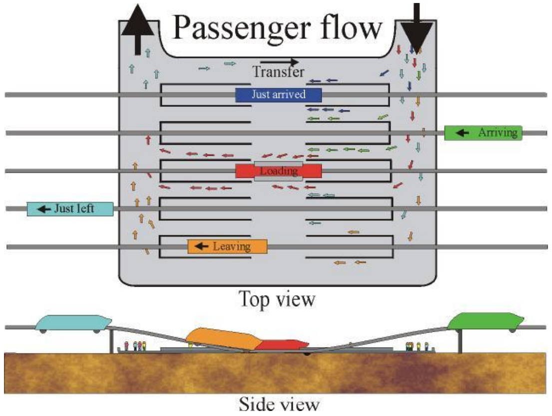
Stations

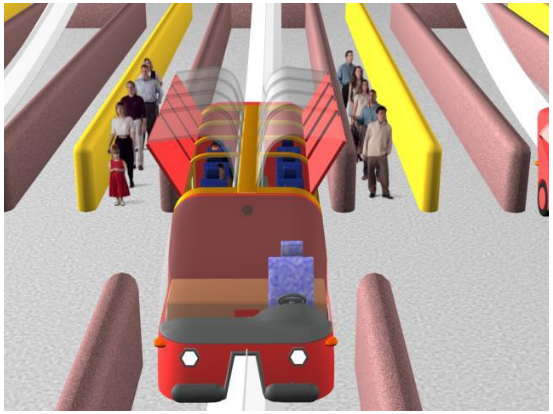
RUF can use off-line stations. It is possible because of the very flexible magnetic guidance switch. It is possible to create trains intelligently in order to minimize travel time.

Travel time compared to a normal train system can be reduced significantly, since the maxi-ruf only stops at the right station.

Multi platform stations can be created with a very logical passenger flow and fast access. No elevators are needed. RUF vehicles can climb very steep because of the patented drive system.





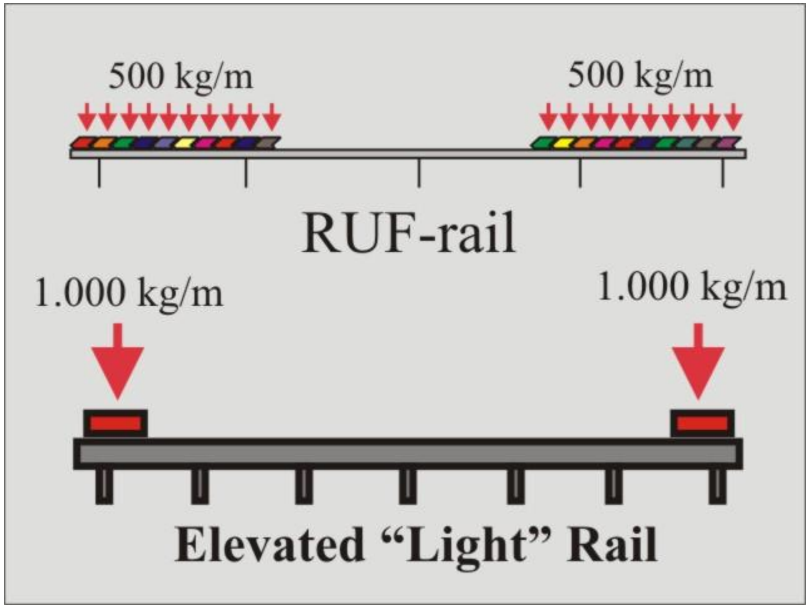


Infrastructure design 10

Load

RUF monorail is dimensioned to be able to carry 500 kg per meter of guideway. The RUF vehicles are very light weight, so they do not destroy the road surface like normal busses and trucks.

Also the cost of construction will be very low.



Control system

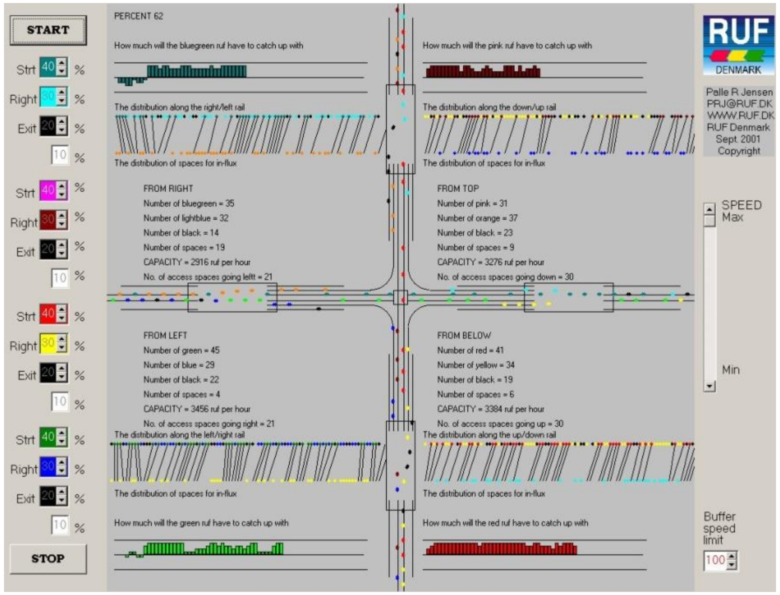
Strategy

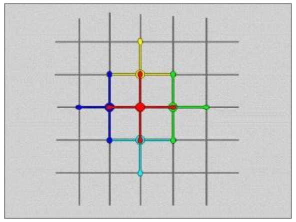
RUF control system strategy is described in the document: www.ruf.dk/rufsim.doc

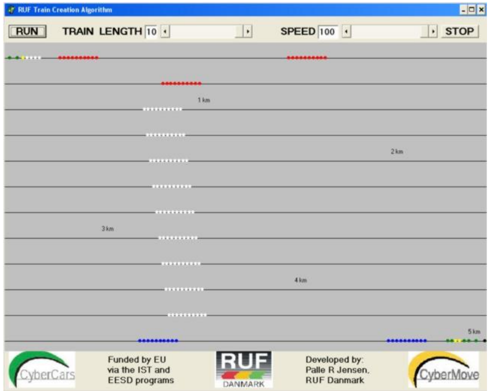
The function of a simple junction has been visualized in the program: www.ruf.dk/rufsim.exe

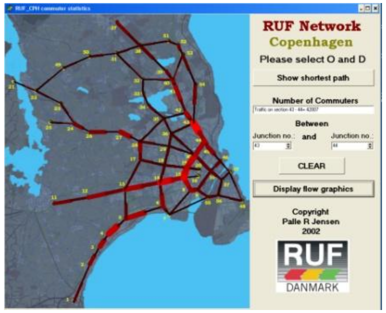
Every vehicle measure its position very frequently and send it to the approaching junction where it is compared to what it should be. If there are any problems, the system will slow down to a safe speed. In case of serious problems the whole section of monorail will stop until the problem has been solved.

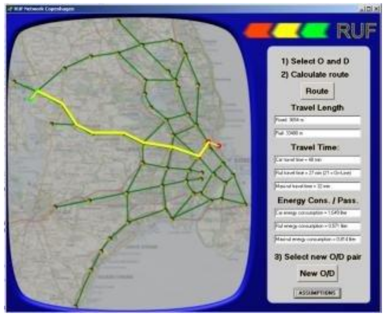
The sensors are based upon simple magnetic principles and has double redundancy. The communication uses a so called ”leaky coaxial cable” placed safely in the top of the triangular monorail. Every junction is manned and it communicates with all nabour junctions so that they can take over in case of control system breakdown. Most control is local in order to make the system scalable. Only a minor supervisory system will be needed in order to keep track of the traffic volumes all over the network in a city in order to avoid overload.











Power / Energy strategy 1

RUF

Power supply

RUF vehicles need to be able to drive at least 50 km on fully charged batteries. This is 1/3 of what is normally required from a normal electric car. When the RUF vehicle has reached a safe distance from ground (or shielded from the surroundings) power is collected from two power rails, one on each side of the triangular monorail. The power level is 600 V and the power rails are floating so that you have to touch both rails to get an electric shock.

The power pickup can be placed so that water cannot be collected and so that a finger cannot touch the power rail.

The type of battery is not defined, only the voltage and the capacity.

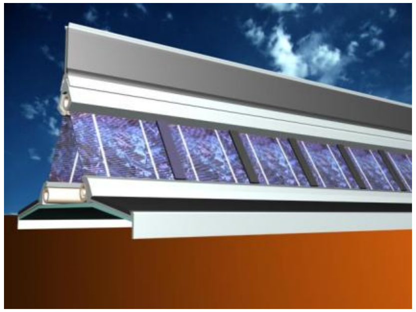
The vehicles can be charged during night where the power plants can deliver cheap power.

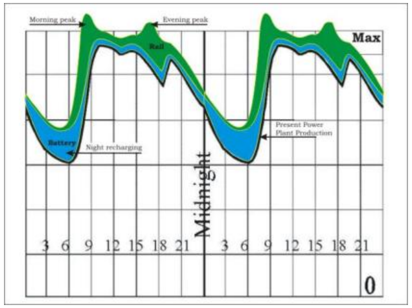
On the monorail a modern battery can be charged from 10% to 70% in 15 minutes (a typical commuter travel time). In this way many commuters may never need to recharge at home.

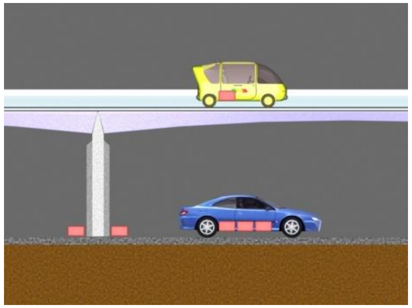
Windmills and solarcells may help supply power to the system directly without transmission losses.

A normal electric car may need 300 kg of battery.

In the RUF system, 100 kg of battery is placed in the car while 200 kg can be placed along the monorail masts, so that they always are ready to be recharged by windmill power when the wind is blowing.







Power / Energy strategy 2

Hybrid unit

RUF vehicles can drive at least 50 km away from the monorail, but that may not be enough.

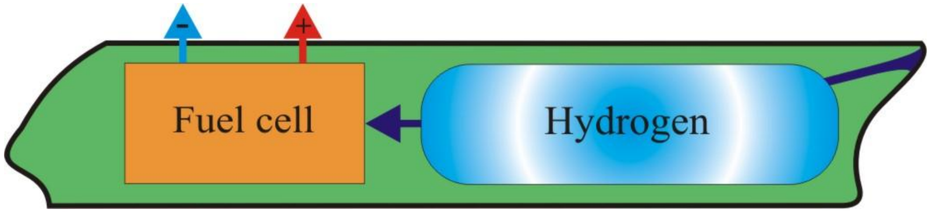
In this situation a special hybrid unit can be used in order to extend the range of the vehicle.

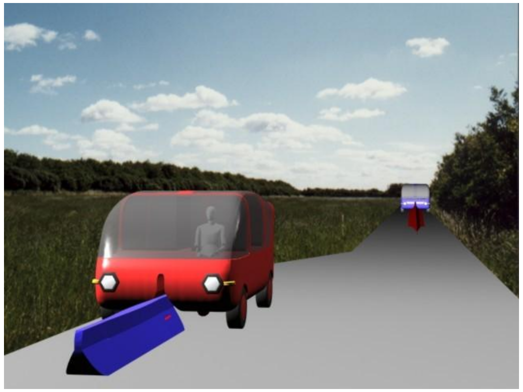
It contains a small engine running at constant speed fully optimized for high efficiency and low noise

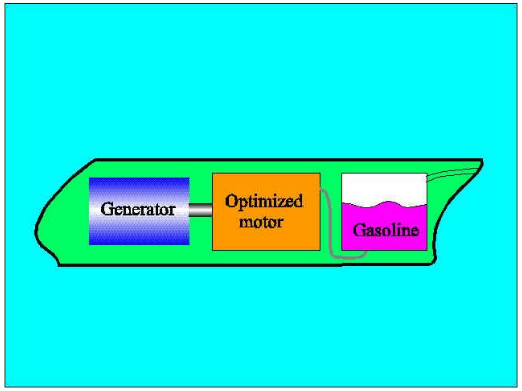
It can be mounted in the empty slot underneath the vehicle and act as a substitute for the rail. The unit can be refilled at any gaz station just like a normal car.

It could also be a hydrogen unit which could be mounted at the exit from the rail system.

A RUF vehicle (car or bus) could also from the start be a hybrid vehicle.







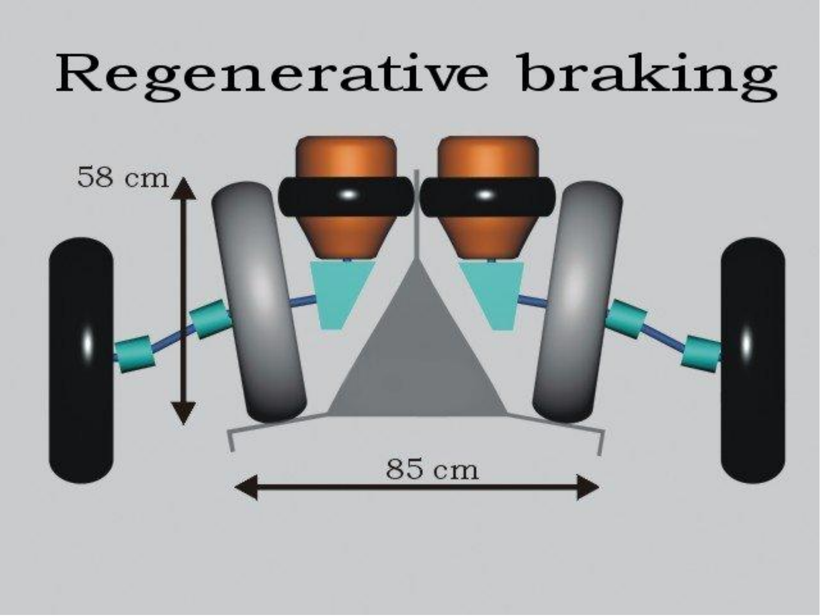
Power / Energy strategy 3

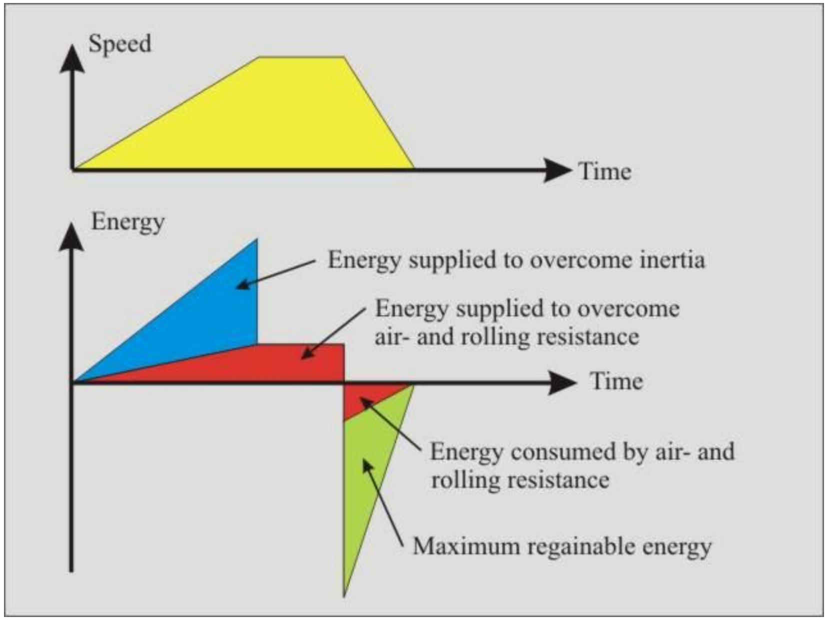
Regeneration of braking energy

The electric motors are able to regain a large part of the power normally lost during braking. Normally this is not possible because batteries cannot tolerate large charging currents. This is not a problem in the RUF system since the power is sent back into the power rails.

Another important factor is, that when the vehicles are system controlled, it only brakes when it has to. No unexpected braking will normally occur.

The transmission losses are at a minimum when the motors are placed directly in contact with the top of the monorail.





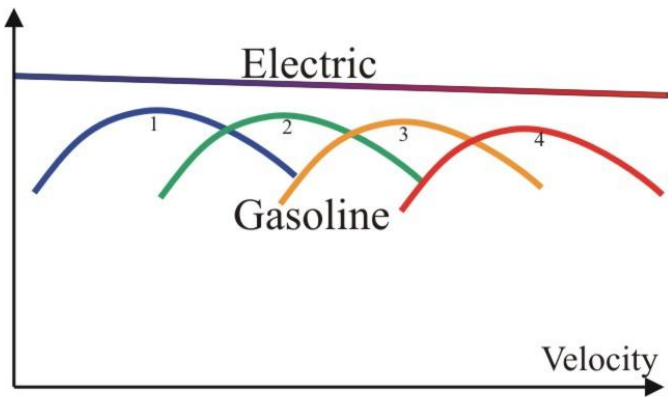
Power / Energy strategy 4

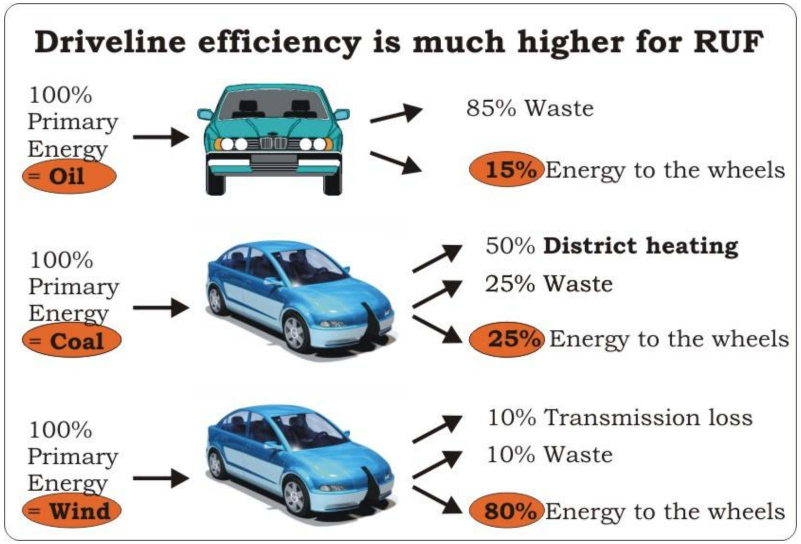
Efficiency of electric vehicles compared to normal cars

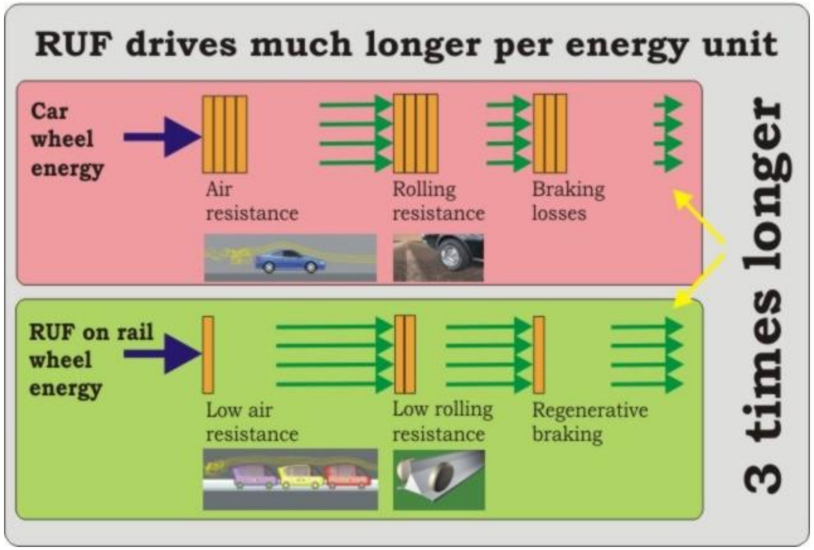
Electric motors are very efficient compared to a normal car engines.

From well to wheel efficiency is much better and the heat produced at power plants can be used for district heating.

In an automated system it is also very important that the characteristic of the motor is smooth and easy to control. It is extremely difficult to create platoons with normal cars of varying size and power.







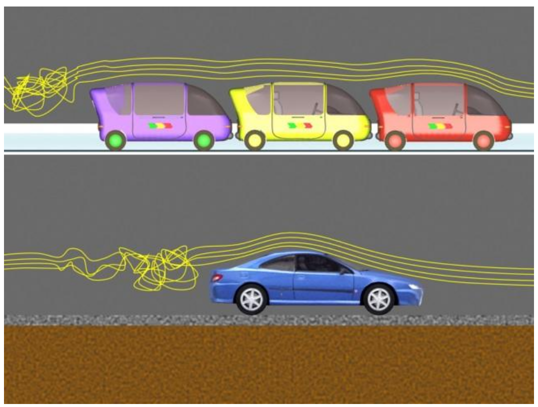
Power / Energy strategy 5

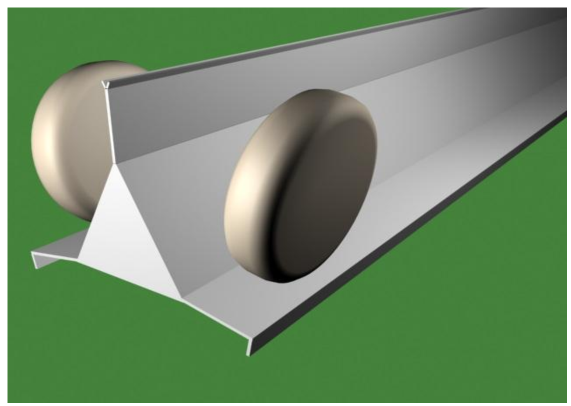
Air resistance

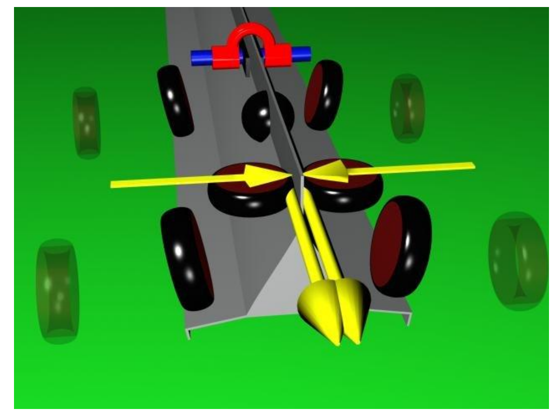
RUF vehicles are driving individually along the roads but in trains on the monorail. This will allow for a much more smooth flow of air and the air resistance per vehicle will be greatly reduced.

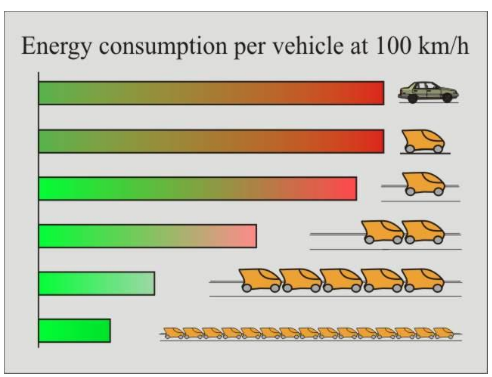
Rolling resistance

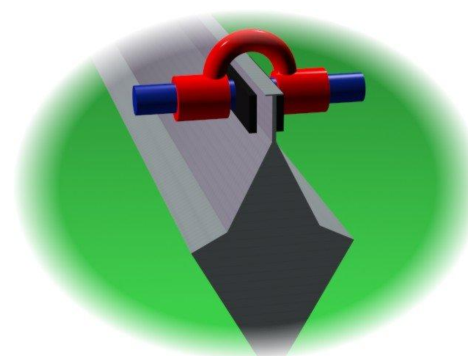
Cars need to have friction all the time in order to be able to steer and brake. RUF vehicles have a special rail brake, so they can be carried by smooth low noise, low resistance wheels on the monorail.











Power / Energy strategy 6

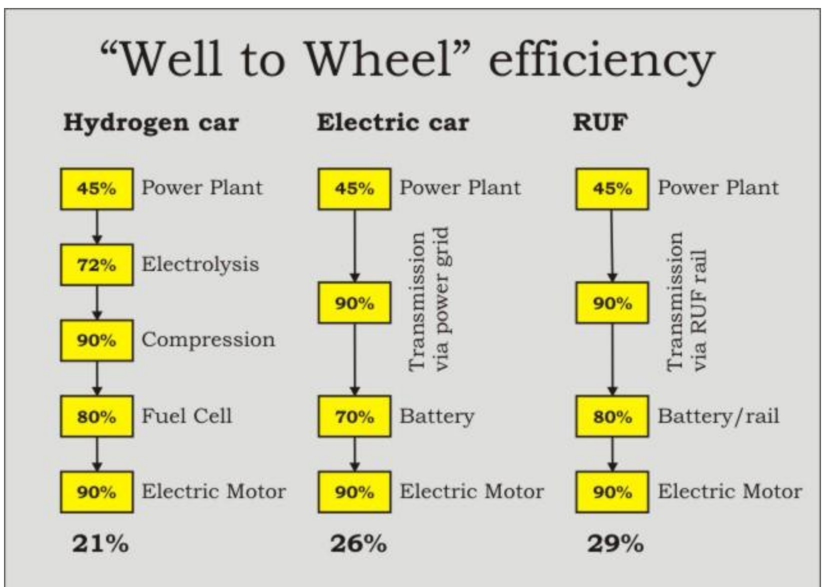
Well – to – Wheel – to – Way efficiency

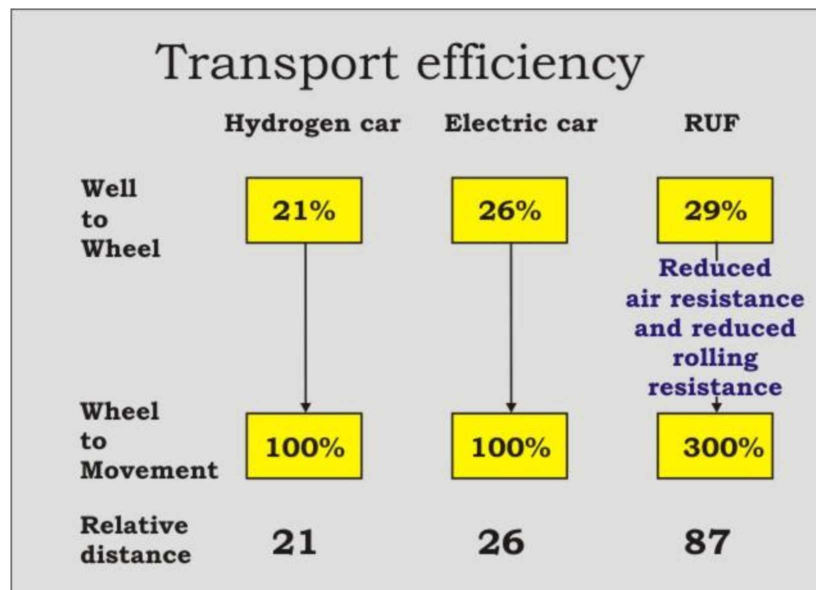
RUF can drive 300% longer than a car on the same amount of energy delivered to the wheel due to the reduction of air resistance and rolling resistance while driving in a train on the monorail.

Since most of a typical trip is using the monorail, this effect is very important.

The well – to – wheel efficiency is high due to electric motors and direct supply from the power rails.

On top of that the waste heat from the power plant can often be used for district heating (at least in Denmark ☺)





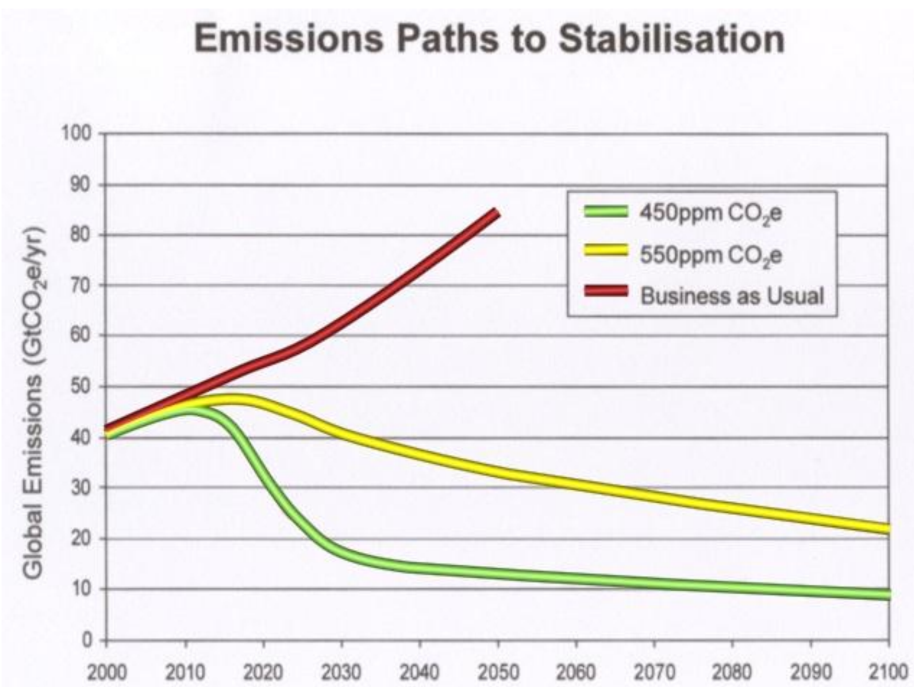
Power / Energy strategy 7

Climate effects

RUF is able to deliver the needed reduction in CO2 emmission from transport without limiting the mobility in the society.

Public transport with maxi-ruf is far more attractive than traditional public transport. It is faster than the car and it offers the same high comfort as the car

This means that many car drivers will be using maxi-ruf as their daily commute vehicle.

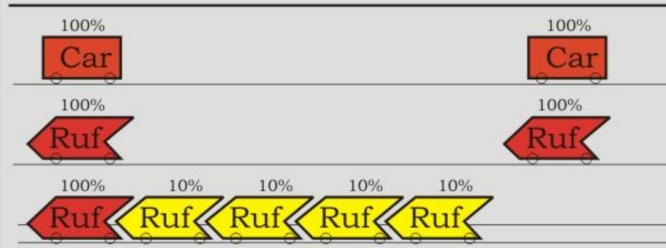


CO_2

Emissions per pass. km

Lupo 3 L	33 km/l	**67** g/km
EV with power from coal		**67** g/km
EV with power from windmills		**0** g/km
Ruf with power from coal		**23** g/km
Ruf with power from windmills		**0** g/km
Maxi-ruf with power from coal		**8** g/km
Maxi-ruf with power from wind		**0** g/km

Cars ~ 1.2 pass. Maxi-ruf ~ 6 pass. of 10 possible

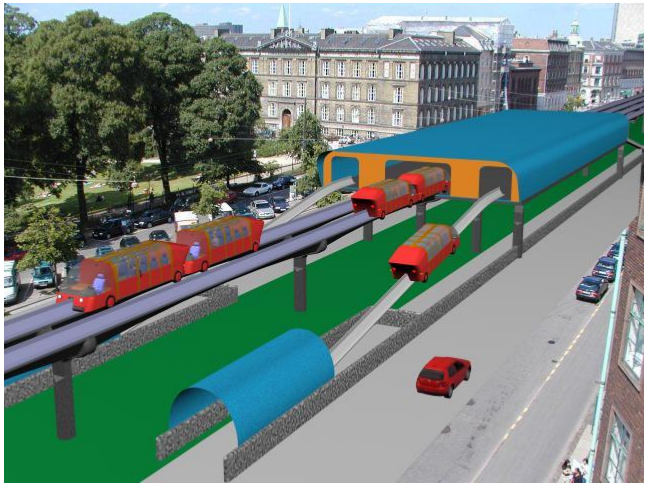


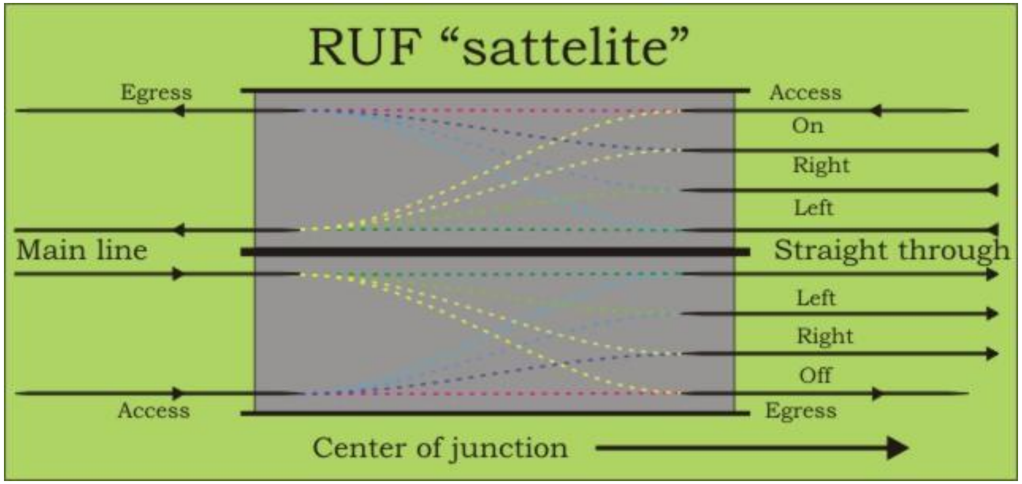
1 + 0,1 + 0,1 + 0,1 + 0,1 = 1,4
Average = **0.28** (air resistance)
Plus reduced rolling resistance + regen.

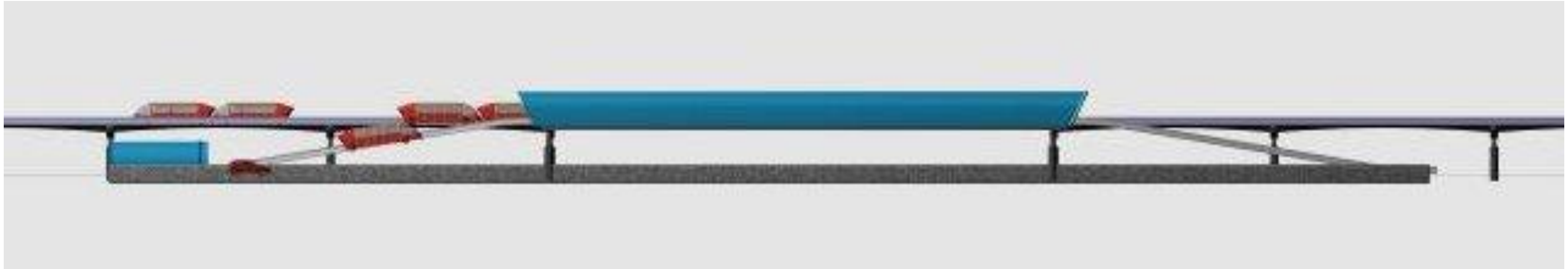
Check-in / Check-out 1

Strategy

RUF will test the vehicles while they use the access ramp at a junction. While using the access ramp, both road wheels and rail wheels are active (not shown). If a problem appears, the vehicle will not be allowed access to the main line and it will be guided via the egress ramp to go back to road driving. If a driver has fallen asleep and he doesn't respond to a signal from the system telling him that he has to be ready to get off, he will be parked nearby the egress ramp and help will be called. Unless he has a very good explanation he will get a fine.







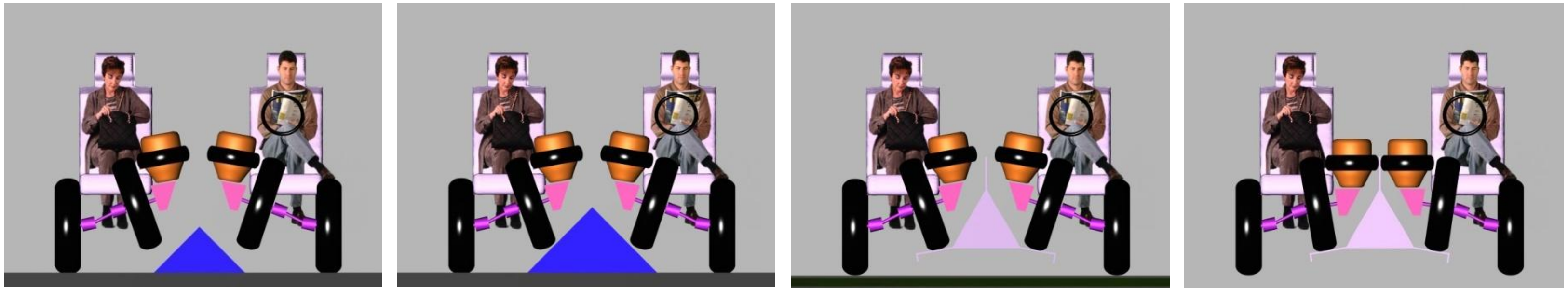
Check-in / Check-out 2

Control

The RUF control system takes over control at a point before entering the access ramp. This point is so far from the monorail that it is possible to brake the vehicle from high speed to the required 30 km/h in case the driver has not found the correct speed. During this distance, the vehicle is guided by means of magnetic fields from wires in the road surface.

When the vehicle get close to the access rail, a passive structure will make sure that the vehicle will hit the rail even if the guidance doesn't work. This mechanism makes use of the fact that the support wheels are tilted more than 10 degrees when the drive system is in its open position. This makes it possible for the passive structure (blue) to align the vehicle if needed.

Other guidance strauctures can be made in order to make this transition multi-redundant for maximum safety.



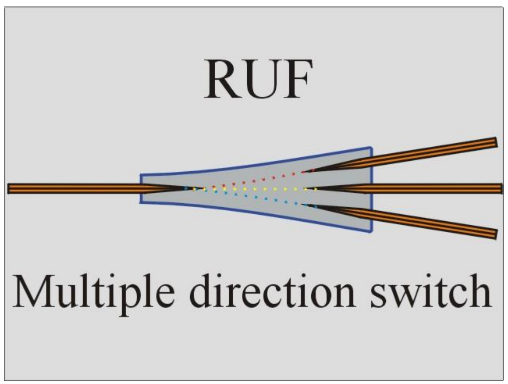
Check-in / Check-out 3

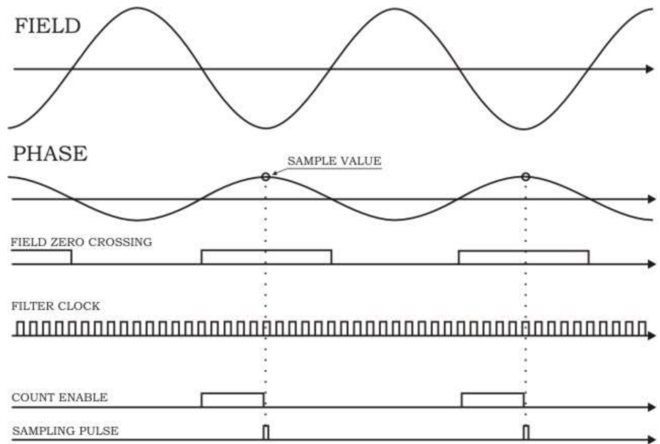
Guidance

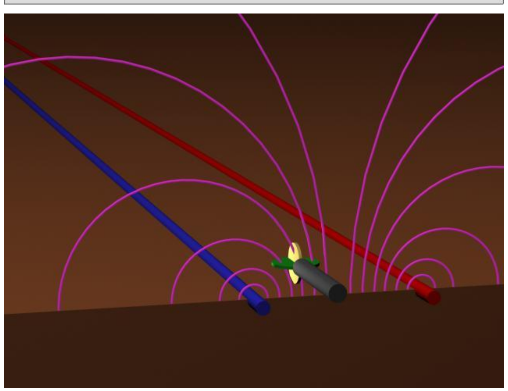
The RUF guidance, when driving automatically along a road, is made with magnetic fields of different frequencies.

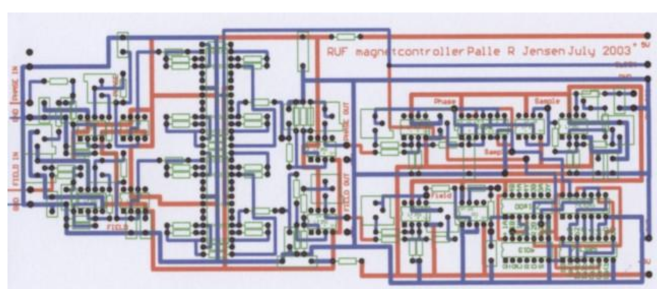
The field is created by two wires just below the road surface. The frequencies are in the 8-15 kHz range. Magnetic fields are very robust and are not disturbed by snow/ice/water etc.

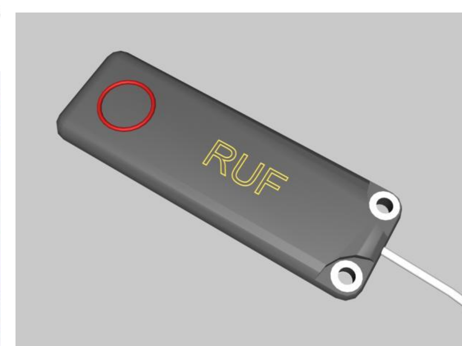
A very important advantage is that this principle makes it possible to select between several directions in one switch. Normally this is not possible with other switch principles. Very compact multi directional switches can be implemented. The principle of magnetic guidance is used many places (the English Chunnel) without problems.











Check-in / Check-out 4

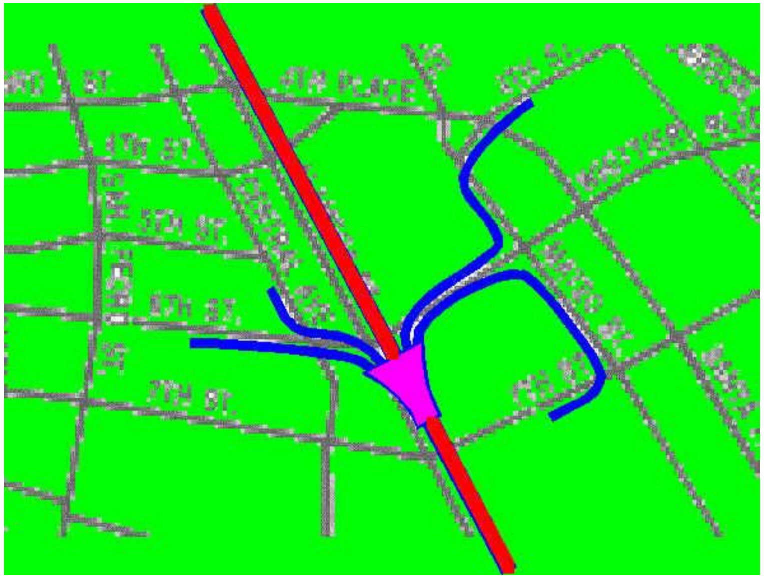
Congestion avoidence

The RUF system has a control system which can avoid congestion on the network of guideways. It has no control over the street congestion, so special care must be shown when planning the network egress points. If the vehicles cannot leave the network, the system could ultimately be blocked.

The best solution is to plan the position of egress ramps so that there is plenty of room for vehicles leaving the monorail. A good philosophy will be to place the RUF network as a complement to the freeway system. This means that freeway exits and RUF exits are as far apart as possible.

Multiple exits is also a good strategy. Direct exit to parking facilities will eliminate some problems and the parking facility can act as buffer for the flow of RUF vehicles.

It is planned to monitor the traffic at exits closely (every junction is manned). In case of severe congestion at all exits from a junction, the vehicles may have to continue without exiting at this junction. This will mean a detour for some vehicles, but only in the order of magnitude of 5 km.



Cost / Benefits 1

Costs

The following numbers refer to a CBA made for a RUF network covering greater Copenhagen. The study was financed by EU under the CyberMove project. See: www.ruf.dk/rufcba.doc and www.ruf.dk/rufcba.xls.

The RUF guideway has been analyzed by several groups of students and professionals. Based upon these studies, an official cost estimate for 1 mile of bidirectional guideway is $7 million. That includes the guideway + masts + mounting + all necessary installations.

A RUF car is thought to have the same cost as a normal car when mass produced. It contains fewer parts. No engine, no complex gearbox, no differential, no exhaust pipe and catalytic converter. On the other hand it contains two electric motors and a small battery. The size of the battery is approx 1/3 of what is normally required for an EV. RUF uses more wheels than a normal car, but the extra wheels are simple wheels. The RUF chassis need not be as strong as for a car driving at high speed on the highways. RUF is not using the highways.

The cost of purchasing 1 ruf is estimated to be = $25,000.-

The maxi-ruf is estimated to cost $75,000.-

The junctions are complex structures, so they are estimated to cost $15 million each

For more details see: www.ruf.dk/rufcba.xls

The total cost for a 320 km network covering Greater Copenhagen is: $3 billion including rolling stock.

Cost / Benefits 2

Benefits

The benefits come from several factors:

•Travel time is reduced (see: www.ruf.dk/rufcph.exe)

•Travel time is converted from stress time to constructive time

•Safety is increased

•Energy consumption is minimized (see: www.ruf.dk/rufcph.exe)

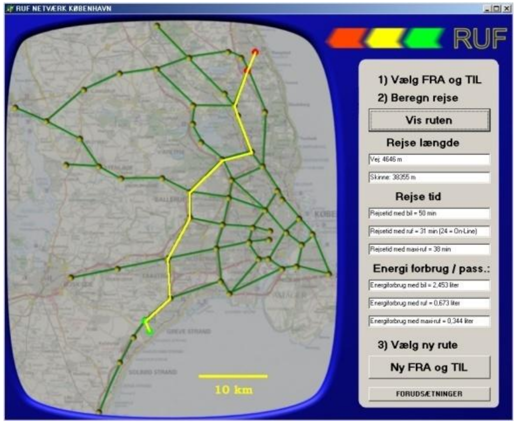
•Operating costs for light weight electric vehicles are low

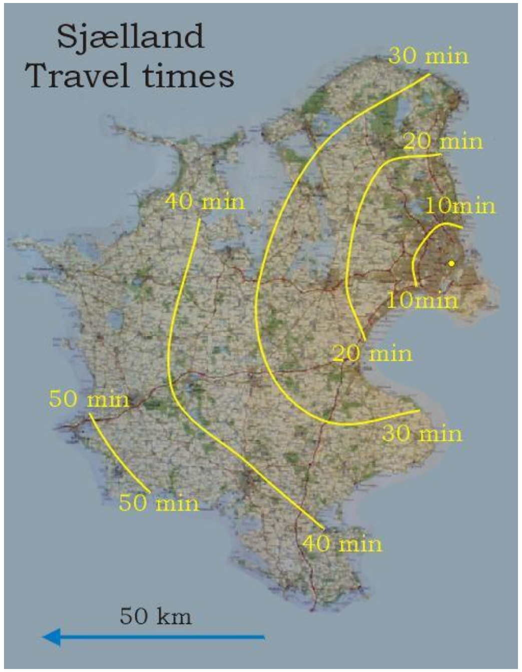
•High speed internet access is offered on the monorail

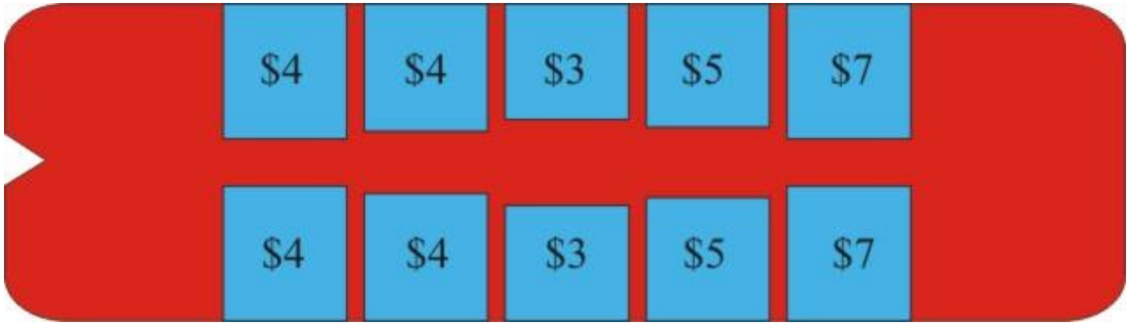
•Public ruf vehicles are used as a substitute for TAXI

•Public transport in maxi-ruf attract high level passengers. The fare is depending on the level of service and a door-to-door option cost more than a simple bus service. Comfort is high and everybody have a single seat.

This system gradually implemented over 8 years can give an internal rate of return of **IRR(30) = 29%**







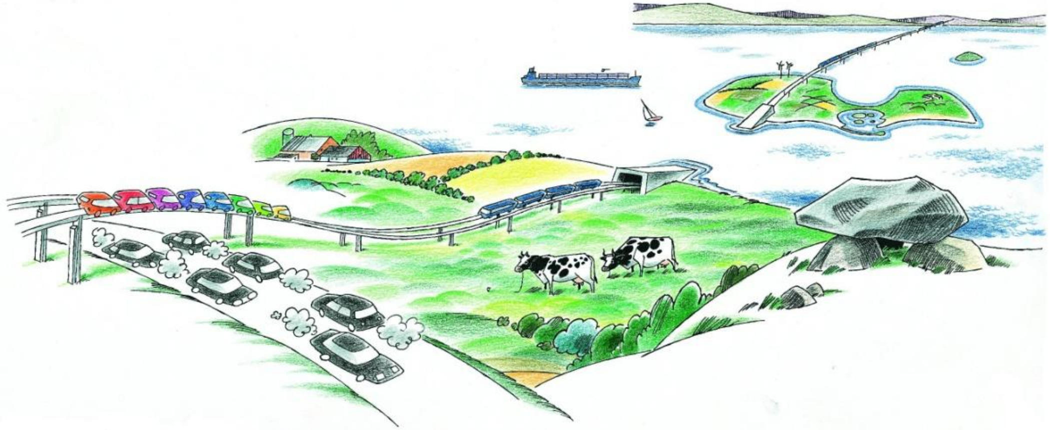
Cost / Benefits 3

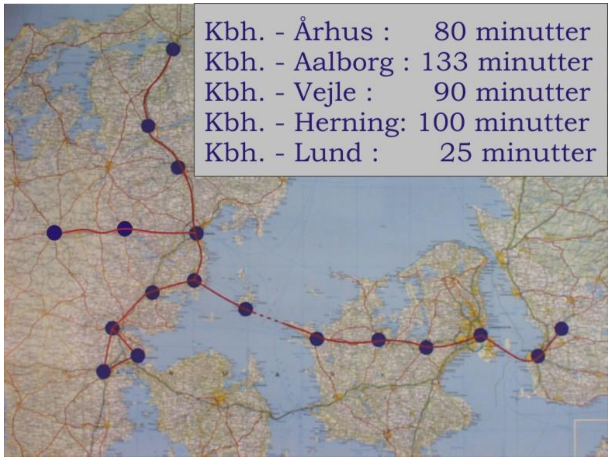
Other aspects

The RUF system will probably start as a system in a large city and with a maximum speed of 150 km/h. The typical distance between junctions will be 5 km.

As an intercity system, the top speed could be increased to 200 km/h.

The typical distance between junctions will be 20 km.

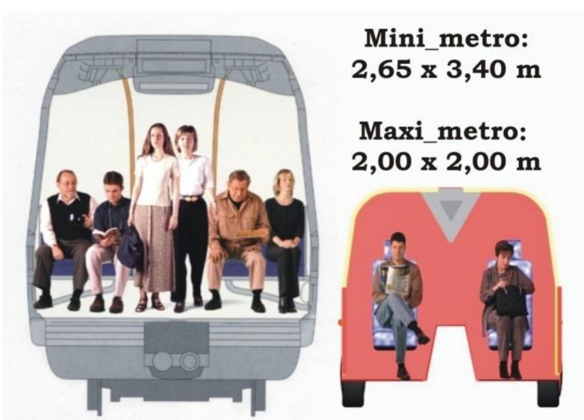


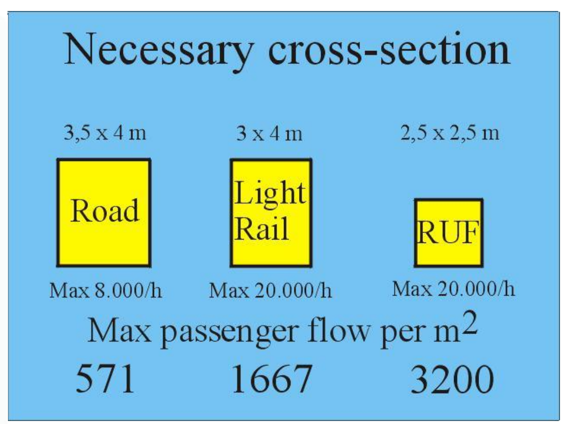


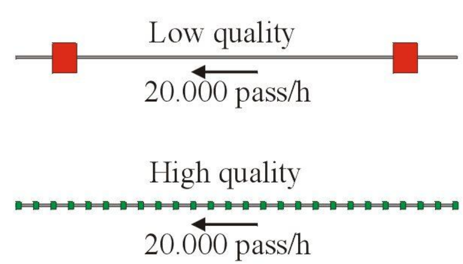
Cost / Benefits 4

Efficient use of space and time

The RUF system can use the limited space in modern cities very efficiently, so very few modifications need to be made. Because the system does not allow standing passengers, the cross section of a RUF line is much smaller than that of traditional systems. It can have the same capacity as traditional system due to its rail brake and very efficient drive system. RUF can offer the same capacity at a much higher frequency than normal train systems.







Cost / Benefits 5

High comfort public transport

The maxi-ruf can offer a very high level of comfort.

•The access to the seats is extremely easy and ideal for elderly people. A wheelchair lift can make acces for disabled people very convenient.

•Every passenger has his own seat which is as comfortable as a car seat.

•If you pay for it you can watch video while you travel.

•Door – to – door is an option in RUF public transport

•The view from an elevated sytem is spectacular and the ride on a RUF monorail is very smooth and silent.

Cost / Benefits 6

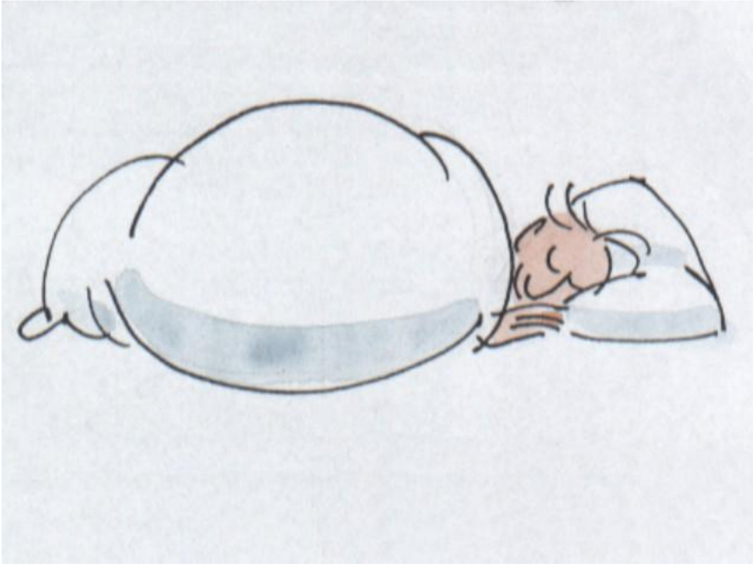
Additional revenue sources

The maxi-ruf can be used for both commuters and as a school bus.

It can also be used outside rush hours for all kind of service tasks. Delivery of food, mail, small goods etc.

During night it can be used at longer distances if the RUF network has spread to connect cities. The cabin can be equipped with two beds so you and your partner can be moved 1500 km while you sleep.

The fact that a normal maxi-ruf has separate access to the individual seats makes it possible to introduce a lottery financing supplement. Some people may want to pay extra given the chance that their seat number will be chosen and a sum of money will be payed.

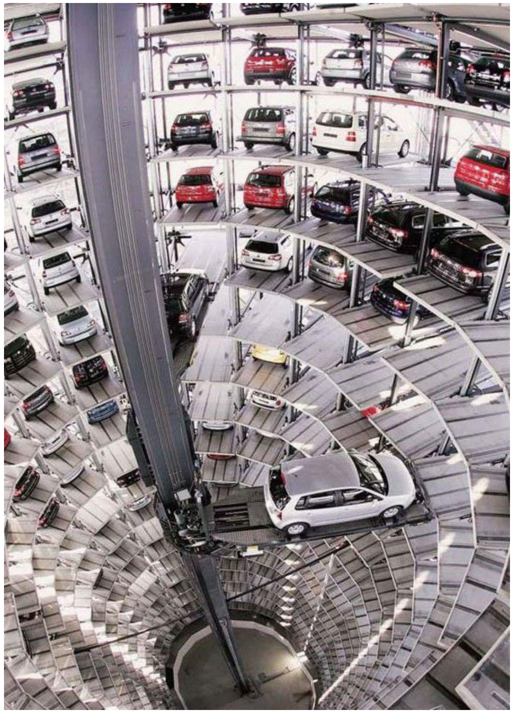


Cost / Benefits 6

Public RUF vehicles

Parking in modern cities is a nightmare

A ”parking rail” for public ruf vehicles can be a very efficient way of solving this problem. While they wait for a customer, they are recharged and the temperature is kept at a pleasant level. When used together with an electronic personalized device, vandalism can be prevented.



Development status 1

Estimated total dollars to mature technology

In order to demonstrate the basic maxi-ruf vehicle on 2 km test track in Denmark, **$3 million** is needed.

A good site for this test track has been identified in Køge south of Copenhagen, Denmark.

In order to create the first line in Copenhagen (Ring 3) 16 km long, **$35 million** is needed to fully mature technology for a line system. After that, **$215 million** is needed to built the line and run it with 300 maxi-ruf vehicles.

At this stage, the basic RUF technologies for the vehicle has been developed and what is left is the control system and the junctions.

The junctions are built from modules and placed above major road crossings. To develop the modules will require less than **$10 million**.

The control system will require creation of test loop in order to test the function in a junction with real physical vehicles. This is a development task in the order of **$25 million**.

Development status 2

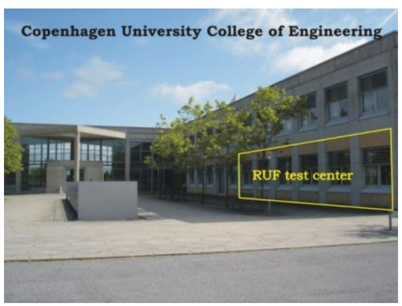
Current status of development, hardware

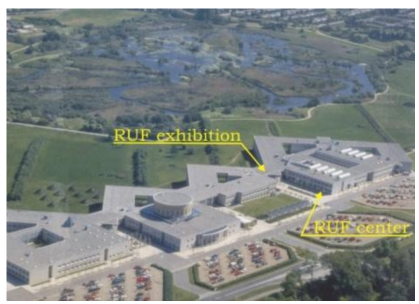
RUF has been under development since 1990. The development has been supported by funding from the Danish Government as well as from EU. Mogens Balslev, Consultant Engineers A/S have invested heavily in RUF International in the period 1993 to 2004. Private companies like Siemens Danmark A/S have donated components or money to the project.

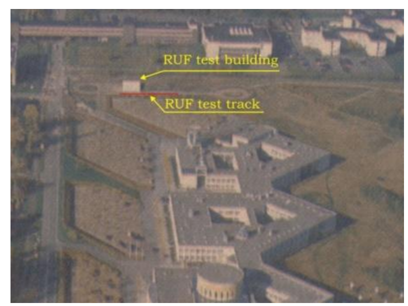
The result is that in 2000 the RUF test track was opened and a test vehicle made ”proof of concept” tests. The tests were reported by CNN (see: www.ruf.dk/cnn.doc)

A mock-up of the maxi-ruf was built by students and sponsored by the company Alu+. Several versions of a door opening mechanism have been built and tested.

The American Lounsbery Foundation has donated money to buy components for the next step which is to create test vehicle no. 2.







Development status 3

Current status of development, software

Financed by EU research funds, RUF software has been developed in order to visualize the potential of a RUF system in major cities.

www.ruf.dk/rufcph.exe is for a network covering Copenhagen

www.ruf.dk/rufla.exe is for a network covering Los Angeles

www.ruf.dk/rufcity.exe is almost ready. It is meant for city planners who can build a RUF network for their own city and see the consequences and edit the network to suit their needs.

www.ruf.dk/ruftrain.exe illustrates the ruf flow between junctions

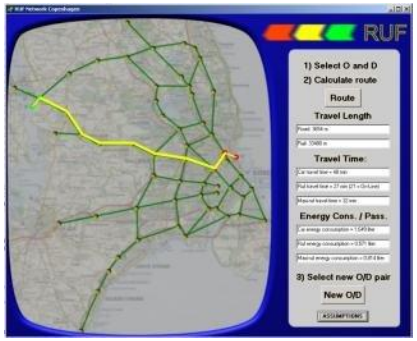
www.ruf.dk/rufcom.exe shows the traffic volume in Copenhagen if every commuter uses the network

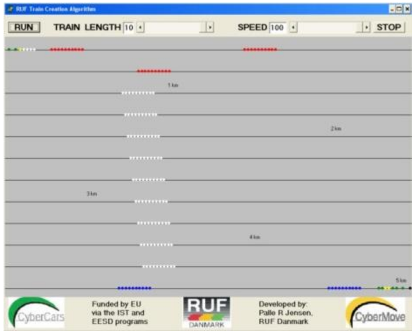
www.ruf.dk/rufsim.exe and www.ruf.dk/rufsim.doc illustrate what happens in a simple junction of a RUF network.

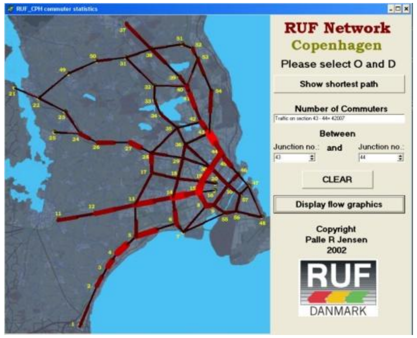
www.ruf.dk/rufcba.xls and www.ruf.dk/rufcba.doc is a Cost Benefit Analysis of a RUF network in Copenhagen

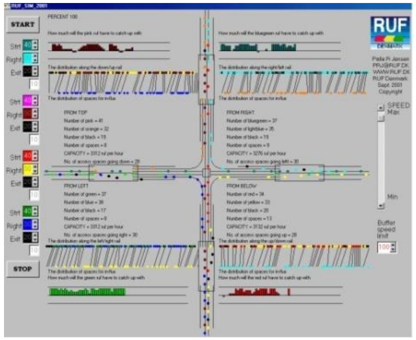
Many more files are ready for download from www.ruf.dk/files

The newest file is the paper given at the recent traffic conference in Aalborg, Denmark, August 2006. A special RUF session was organized and the paper can be downloaded from: www.ruf.dk/ruf2006.pdf









Development status 4

Current status of development
Media coverage

RUF has been featured on media all around the world. Most important was the CNN program in 2001. See: www.ruf.dk/cnn.doc

This very positive program (overstating the actual development status) had a tremendous impact on the RUF website.

Countless newspaper articles have been printed in Denmark as well as other countries.

A technical magazine: ”Teknisk Nyt” in Denmark allocated 14 articles in a series covering all possible aspects of RUF.

Thousands of downloads of RUF animations from the RUF web has spread the knowledge about RUF to all corners of the world.

A CD ROM multimedia presentation was produced in 1998 and used for exhibitions and conferences all around the world. It was funded by the Balslev Foundation.

Development status 5

Current status of development

Political support

RUF has had the pleasure to get in contact with many politicians from Denmark, Holland, India and USA.

The general experience is that as soon as I get their attention for more than 1 hour, they get totally convinced about the qualities of RUF.

In 1996, the politicians from a Danish city (I have promised not to mension the name) contacted me and said that they wanted to be the first in the world to have a RUF system. An application for funding was negotiated and everybody were positive until a person from the Ministry of traffic said NO.

In 1997 (?) I was invited to Holland by a group of politicians who have decided that they wanted to do something else than the usual expansion of roads and railroads. They became very interested after my RUF presentation and asked where they could see it in reality. Since we had no test track, the interest died out.

In 2004 I was invited to India and met with the transport Minister in Calcutta. He is very interested in constructing a 100 km RUF line in Calcutta and a contract was signed between RUF International and the largest financing company for infrastructure in India: SREI. The project is still pending as they are waiting to see RUF demonstrated on a test track.

Development status 6

Scientific references 1 of 3

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Development status 7

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Development status 9

Support letters

The most recent support letter for RUF is from the Chairman of the Traffic Committee of the Danish Parliament, Mr. Flemming Damgaard Larsen. It says:

” To whom it may concern
I have had the pleasure of being fully informed about the new RUF transportation system and the promising new possibilities at a meeting in Copenhagen on January 30th 2006.
RUF (Rapid Urban Flexible) combines the advantages of cars with the advantages of the train.
RUF has the potential to become a solution to many of the traffic problems: Capacity problems, Oil dependence, Climate problems, Safety problems plus the problem of creating attractive Public Transport.
If RUF can be realized, many of these problems can be solved in a way which doesn’t require a long development process since RUF technology is a new combination of known technologies.
I therefore fully support the efforts to perform a comprehensive testing of RUF in order to verify the promising perspectives. I also support the efforts to make public funding available for this activity.”
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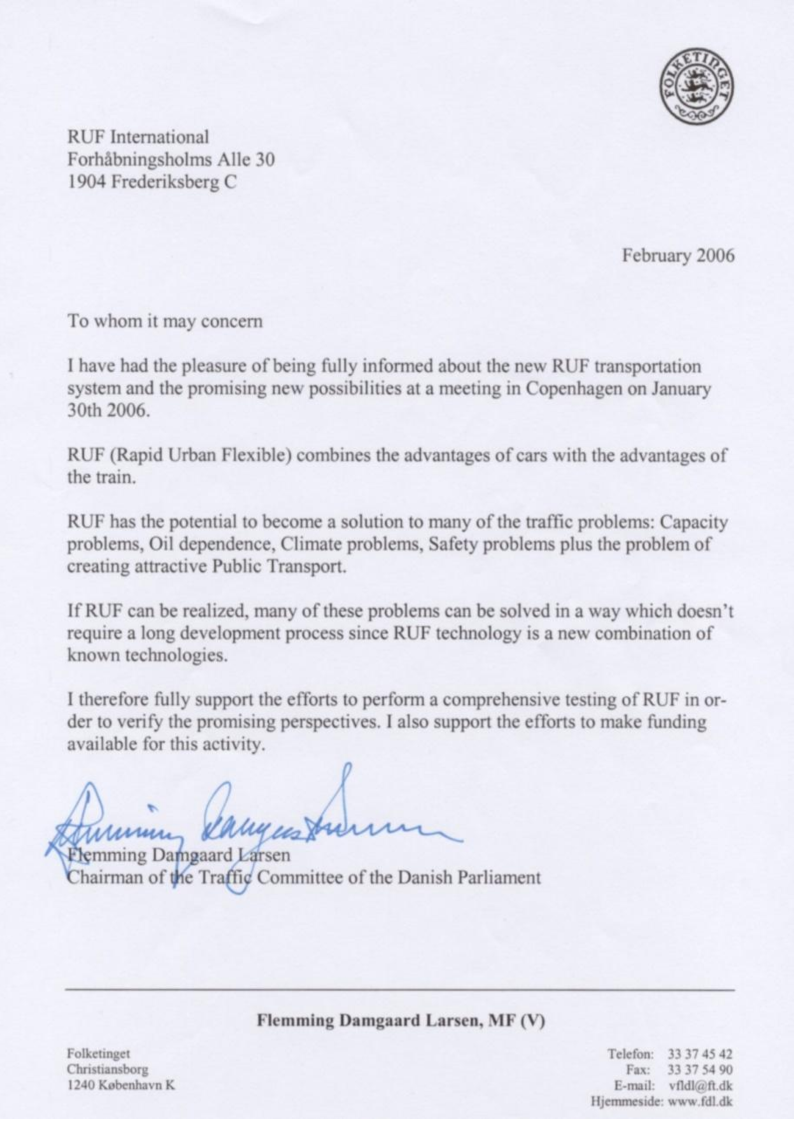
More letters on the address: www.ruf.dk/letters



RUF International
Forhåbningsholms Alle 30
1904 Frederiksberg C

February 2006

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Flemming Damgaard Larsen
Chairman of the Traffic Committee of the Danish Parliament

Flemming Damgaard Larsen, MF (V)

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1240 København K

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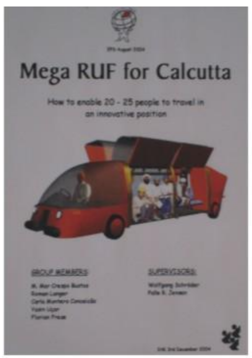
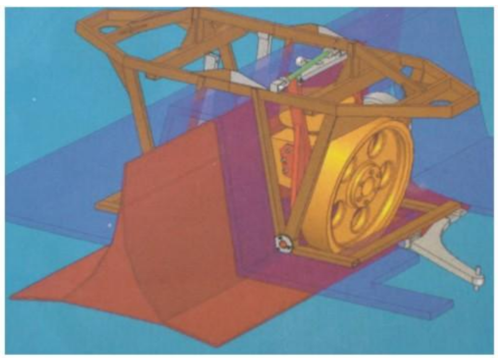
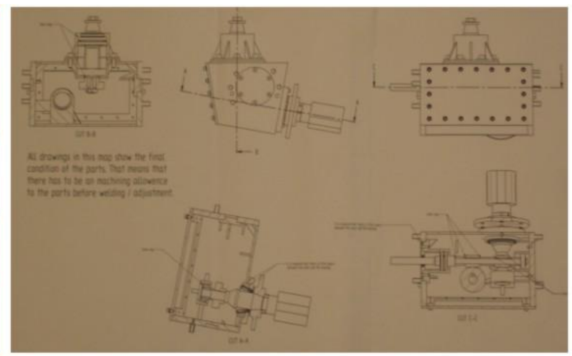
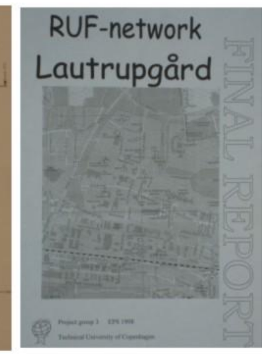
Hjemmeside: www.fdl.dk

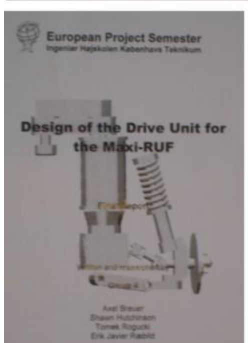
Expertise

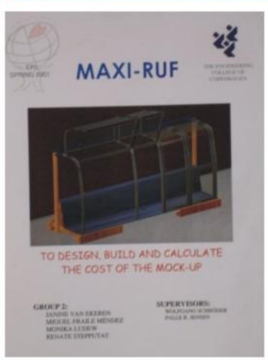
Expertise involved in design

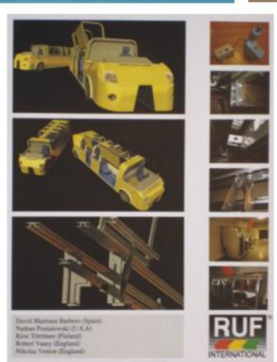
All know-how regarding RUF is collected in RUF International (Palle R Jensen)
Many different companies, institutions and students have participated in the creation of this expertise.
The internet discussions regarding Transit Alternatives have been very helpful i the period from 1993.
More than 200 students from numerous countries have been involved in the process.
The companies Balslev, NIRAS, Siemens Danmark, NCC, Bravida, Alu+ and many more have made important contributions to the development process.









Conclusion

RUF has proven to be a technology which is able to handle the huge challenges facing the transport sector in the future.

Not only is RUF a very attractive transport mode, it is also able to reduce the energy consumption so much that renewable sources can handle all transport from cars, busses and trains, now and in the future.

In this way it is possible to convince the majority of people that it is OK to move to a new system to avoid the climate problems facing us.

RUF International owns the concept 100%

A RUF standard will be defined, so that a RUF monorail anywhere in the world, can be used by certified RUF vehicles no matter who have produced the vehicle.

RUF production licenses can be obtained by complying to the RUF standard.

Potential investors are recommended to download the report: www.ruf.dk/rufinvest.pdf