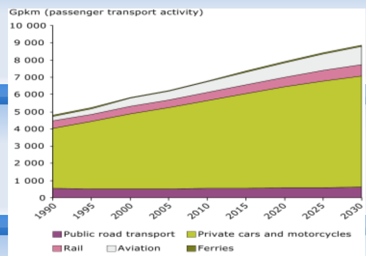
Slide 1


Slide 2

## Public transport not expected to increase in EU "business as usual" scenario




**Expected increase in transport volume for cars and aviation but not for public transport!**

Slide 3

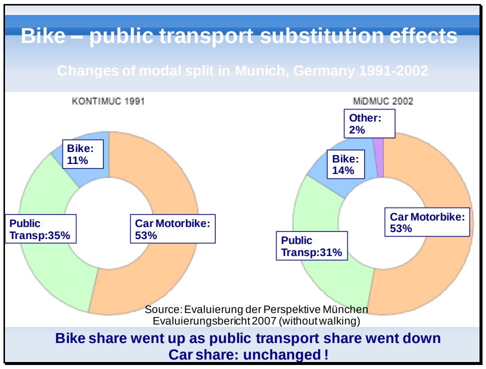
## Modal split in selected EU countries

| | Bike km/day | % trips Bike | % trips Walk | % trips PT | % trips Car |
|---|---|---|---|---|---|
| IT | 0.2 | 5 | 28 | 16 | 42 |
| CH | **0.5** | 10 | 29 | **20** | 38 |
| DE | 0.8 | 12 | 22 | 16 | 49 |
| DK | 1.7 | 20 | 21 | 14 | 42 |
| NL | **3.0** | 30 | 18 | **5** | 45 |

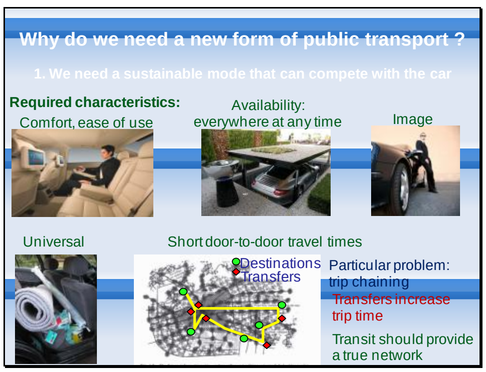
Source: http://www.ibike.org

**Bike and public transport seem to compete,**
**Bike use appears to be uncorrelated with car use!**

Slide 4




Slide 5




Private cars represent a constant threat on the road, they contribute to fumes and noise emissions and use-up space that could be used for more sustainable modes like walking or cycling. However, there are a number of strong reasons for the persistent popularity of the car. Any transport mode that seriously attempts to substitute the car should offer true alternatives.

Cars are rather easy to use (for those who are entitled or able to drive) and their usage and service quality is largely unified. The use of public transport instead is not unified. Travelling by public transport in an unknown city is always a new challenge, even though considerable effort are made at regional level to simplify the movement within and between public transport modes. But often the nature of different public transport modes or different ticketing methods does make a complete unification difficult or unpractical (example metro and bus).

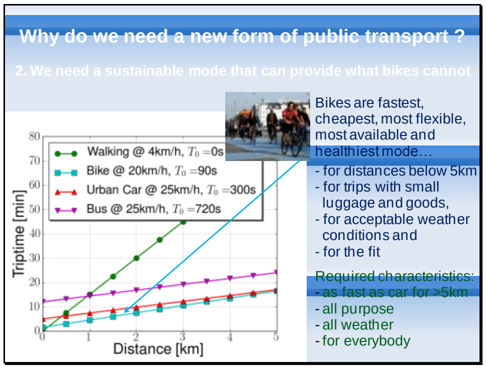
Cars are always waiting near their driver. This gives a great sense of independence. Cars do have a better image in society than other modes. This could be partially changed by appropriate campaigns in favour of public transport. But it has been shown that if the new and better image is repeatedly damaged by disappointments, then it will disappear over time.

Cars are universal, they can be used at any time, they go anywhere and can be used for (almost) any purpose. These features became very important values to western societies. A significant modal shift is possible if the alternative offers similar features.

Trip chaining means a trip with multiple purposes and therefore multiple designations that need to be connected. As for example bringing children to school on the way to work.
Trip chaining does minimize time spend for transport. However, line-oriented public transport makes trip-chaining unpractical if destinations are note lined up.
It may be argued that people would choose all their destinations along a line in a corridor oriented urban development.
Fact is that most of current cities have a 2D extension and citizens are likely to oppose solutions that constrain their choices of destinations to a line.

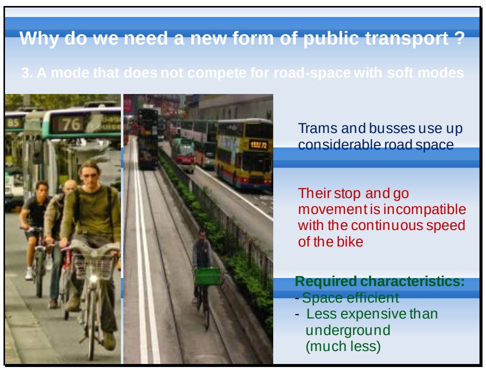
A true alternative to the car would have to offer a convenient everywhere-to-everywhere service, covering the entire city.

Slide 6



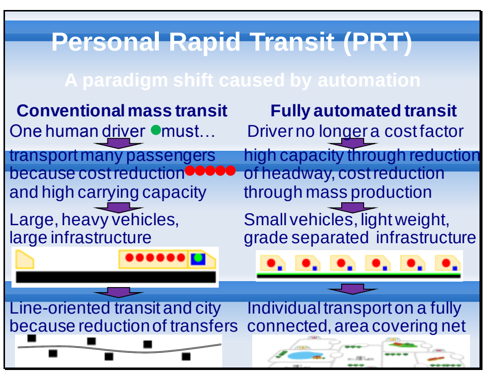

Cycling does provide many features that a car does, it is even faster in average than a car in urban zone below 3-5km. Thus, the ideal public transport should favour and enhance cycling (as well as walking) by providing functionality that cannot be accomplished by the bike.

Slide 7




In many historically grown cities road space allocation is a crucial issue. The ideal transit should not compete with cycling and walking, especially not in central activity centres.

Slide 8




The consequent application of automation to transport systems will lead to a paradigm shift towards smaller units. Large units are justifiable by high labour costs of the driver. When the driver is no longer required, the “technological and economical equilibrium” does prefer mass produced, smaller units that circulate on light weight infrastructure. Individually controlled vehicles can give a better service to the user and the stations can be placed closer to the origins. The distribution of the traffic over the area does also lower the high capacity requirements with respect to conventional transit.

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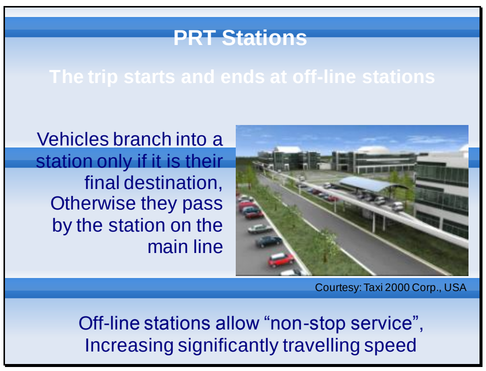


Off line stations are a fundamental concept of PRT. They do not only allow non-stop service but avoid intermediate stops. This means that maximum speed equal average travelling speed.

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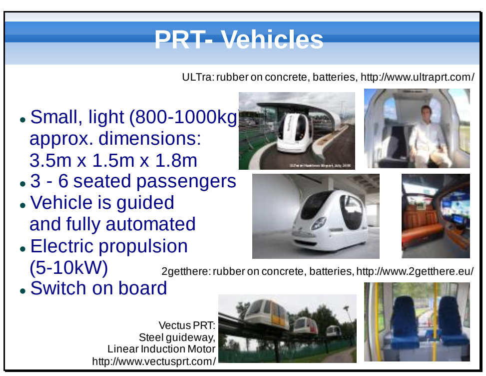


PRT vehicles from different suppliers have nearly the same dimensions. What differes strongly is the propulsion, guidance and control technology. The technological choice determines the performance parameters in terms of speed, line capacity, range etc.

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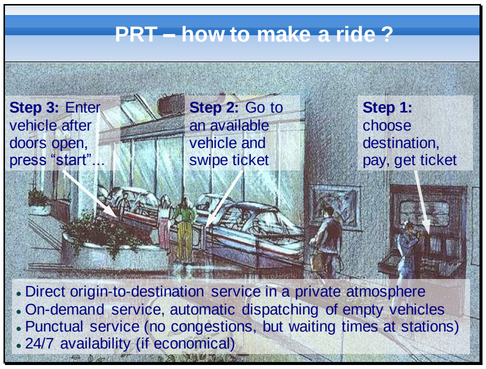
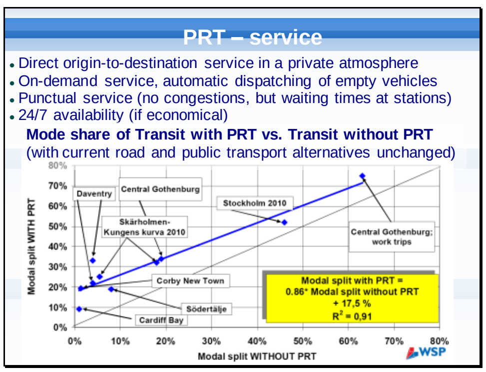


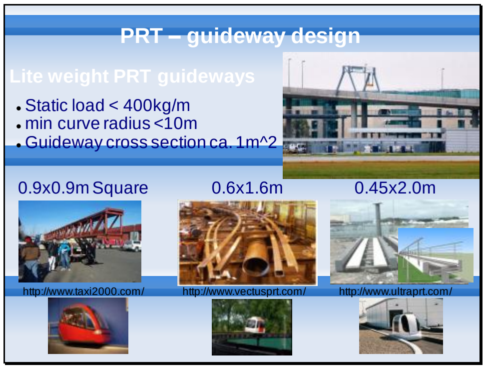

Note that it is important to tell the system the exact destination before the travel can begin. There have been different approaches discussed on how this can be performed. As for example sending the destination via cell phone or using a smart card as ticket etc.

Slide 12




The transport service above have been shown to attract a higher ride share than conventional public transport. Averaged over all studies, the total transit ride share (PRT+existing transit) rises by approximately 15% with respect to current transit share [Tegner (2009): "PRT Plans in Swedish Cities" PRT@LRT conference].
However, mode choice models are difficult to calibrate due to the lack of experience with PRT. The studies in the diagram assume that people have the same roads and public transport alternatives in addition to the PRT network. This is quite unrealistic, as a city would at reduce existing public transport services at least in the zones where PRT is offered. In addition parking- and road policies could discourage car use where the PRT network is operating.

Slide 13




Due to the lite vehicles, the guideways can be designed extremely slim. This feature reduces guideway costs and makes it fit more easily into urban fabric. A further important property is the tight curve radius of less than 10m (ULTra at 5m minimum radius). This means a guideway can follow virtually any street in a city, either elevated or under-ground.

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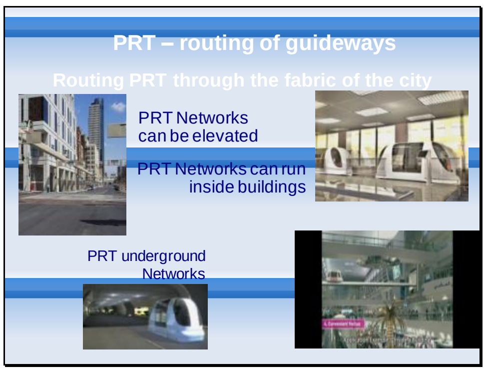
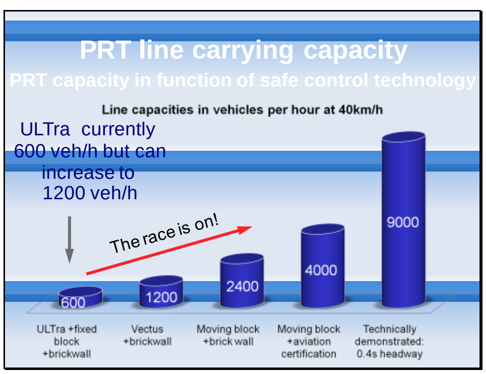


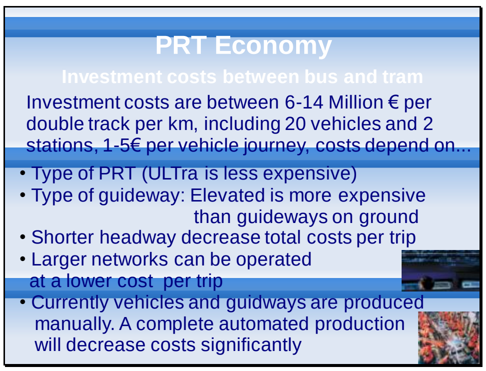

Due to the small cross-section (<1m^2), the tight curve radius (<10m) and the steep grades (10°), a PRT guideways can be routed
Flexibly through a city. The small, silent and emission-less vehicles can enter existing buildings. For underground applications, canals can be build with the cut and cover technology, following existing street layout.

Slide 15



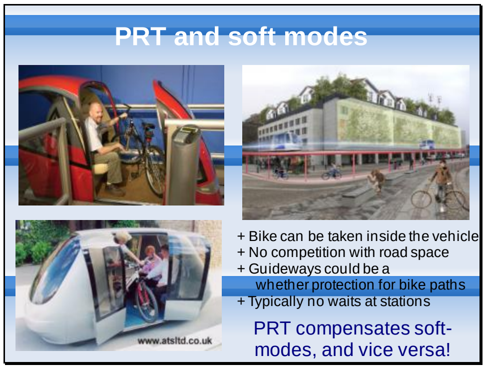

Capacities depend on control technology, more specifically on how the automated vehicle protection system (AVP) is designed. There are no physical limits to higher capacities and shorter headways. The problem is that technologies have to be developed alongside safety certification procedures that assure safe and reliable operation. Often too rigid rail technology specific requirements rule outinnovative solutions. The aviation industry may be a good example on how to develop certification procedures based on the implicit probabilistic failure approach rather than on an explicit application of safety rules that impose specific technologies.

Slide 16




System costs are difficult to estimate as no PRT network is in operation. Nevertheless, as test track became operational, cost estimates became more realistic. Tegner summarized cost information from current PRT vendors in his report: “Severe shortfalls in current public transport – and why podcars may make the difference”, presented at the Podcar conference 2007 in Upsala, Sweden.
System costs depend on the type of PRT. ULTra is less expensive than Vectus. But attention, the headway does significantly influence the costs per vehicle journey. Costs per passenger trip decrease significantly as networks expand and headways decrease. A huge potential of PRT is that the production of small size vehicles as well as the basic assembly of the guideway can be automated as large scale production sets in. This is in stark contrast with conventional mass transit where large-size vehicles are manually assembled.

Slide 17




Cycling and walking would profit from PRT in many ways. First of all, PRT would allow to completely remove motorized traffic from roads, without restricting accessibility or convenience of the citizens. A second main advantage is that the bike can be transported within all PRT vehicles. This means PRT trips can be seamlessly integrated within bicycle trips without the hassle of parking and securing a bike when accessing public transport. In most cases, there won’t even be any waiting time at PRT stations. In contrast with most conventional public transport, PRT is actually faster than the bike in urban areas over longer distances.
On the other side, PRT does need soft modes for local, short distance trips for 2 reasons:

1.) If the freed road capacities are not dedicated to bikes and pedestrians, and even short trips are moved to PRT than there is the risk that waiting times at PRT stations will increase (in other words, the PRT will saturate, just like the road network). If, instead, the freed capacities are used for soft-modes, then a significant share of the previous car traffic would shift to walking and cycling.

2.) If road space remains dedicated to cars despite the installation of a PRT network, then there is the risk that both networks congest, PRT and roads. The reason is that people are likely to use the additional capacity provided by the PRT network to travel more or to seek more distant destinations. An improvement of local community-life resulting in the availability and accessibility of local services may counterbalance the trend of exploring ever remoter destinations.

Still, the PRT network would offer convenient accessibility to remoter places for those who have no local alternatives.

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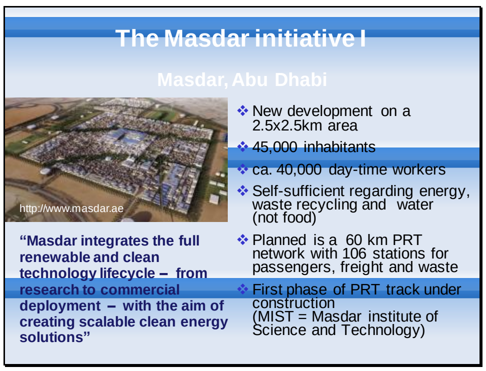
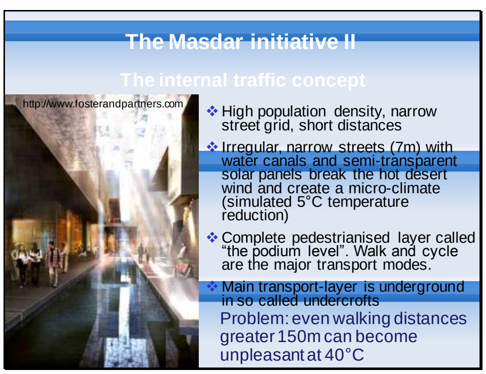


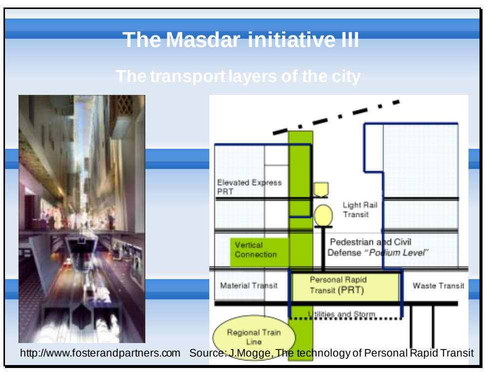

A fundamental drive behind this 15 billion $ project is to achieve a lead position in clean energy technologies and to diversify the Emirates economy away from the oil business.

Slide 19




The major transport modes in Masdar is walking/cycling and PRT. Mainly for external traffic there will be a light rail and in the future an Underground Metro.
It is planned that there are (almost) no cars in Masdar. Exceptions are electric limousines for special events and small-size electric devices like Segways or Pedelecs. During rush hours it may also be necessary to circulate electric busses. From the transport engineering point of view it has been a major challenge to estimate the modal split between PRT, cycling, walking and light rail. These modes are separated in different layers, as shown in the following slide.

Slide 20




The city is organized in layers. The layer-concept is consequently applied throughout the entire city:

Underground layer:
In the future, the Abu Dhabi underground Metro network is planned to extend into Masdar.

Undercroft:
The PRT network is planned as the main distributer of pleople, goods and waste within Masdar city.
The PRT network is dense with a grid of stations at approximately 300m spacing.

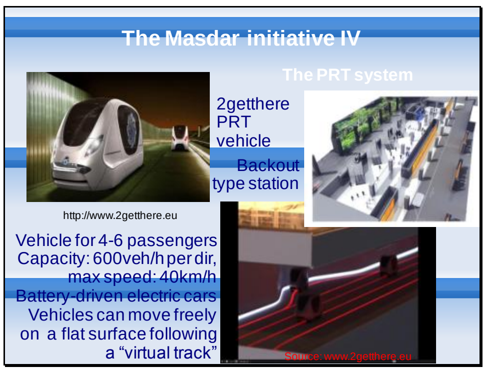
Podium level:
Podium level is reserved for pedestrians, cyclists and civil defence vehicles. Presumably there will also be electric busses circulating during rush hours.

Elevated light rail:
There will be an elevated light rail, connecting Masdar with Abu Dhabi, the capital. This single light rail line has 4 stations within Masdar along the diagonal of the "squared city". The diagonal, also called "the spine" is the major road of Masdar city. The light rail is also connected to external car-

park.

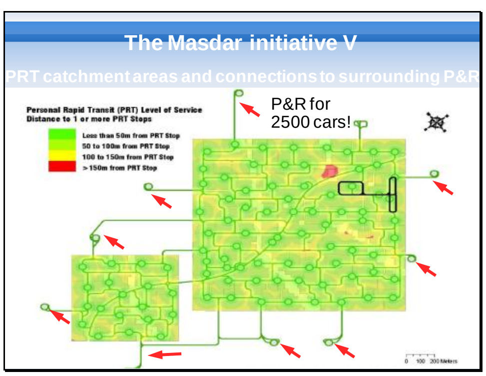
An elevated “express PRT” has been foreseen to connect Masdar with the Airport.

Slide 21




2getthere has won the tender for the first PRT circuit at Masdar: the MIST phase, connecting an external car-park with MIST (Masdar, institute of Science and Technology). This is accomplished with 8 to 12 running vehicles.
The advantage of 2getthere’s technology is that lanes can be implemented in a flexible way on a simple flat road surface. This allows to create several parallel tracks on major traffic corridors in order to increase carrying capacity.

Slide 22

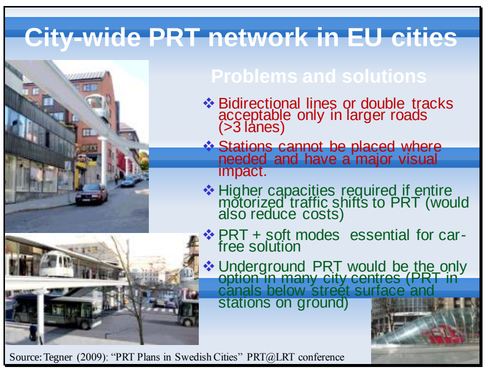



The dense PRT network performs not only the internal traffic, but is also connected to 9 major external car-parks with 2500 cars each. More than half of the 40000 day-workers are expected to arrive by car and the PRT network is thought to bring these workers to their final destination inside the city .

This however, turned out to be a major challenge: the almost 100% increase of population during the day is difficult to handle for the PRT with its currently modest capacity and despite the use of parallel tracks.

Previous PRT simulation studies with European cities (Bologna, Rimini) showed also capacity bottlenecks (using current 3s headway, 1200 vehicles/hour PRT technology), if a large percentage of the present motorized traffic would convert to PRT.

Slide 23




Even with 3s headway (1200veh/h) and a PRT guideway in all major roads of a larger city, it will be difficult to cope with the peak demand. Doubling of guideways is in general not an option, in particular not in city centres, where the main traffic hotspots are. Car free would be possible if current motorized traffic shifted to PRT and to soft modes for short. If no space available, underground PRT solutions may be feasible, even though more expensive.

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