

TrolleyMotion

New Horizons for Urban Traffic
Innovative Electric Bus Transit Systems

Session 6a:
Energy and power supply
What do electric systems cost?

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Presentation

Zurich
19th November 2008

Business and socio economic approach! Only cost or overall economic result?

- Cost occur both on business and socio economic level
- Socio economics include. environment (external effects), e.g.
 - ecological balance for producing the operations include cost of producing traction energy
 - local and global emissions
 - value creation in global or local industry
 - transport of products for electric transport systems
 - increased value of real estate
- Business economic approach comprise capital expenses and operational expenditures, e.g.
 - investment
 - traction energy
 - maintenance
- Different revenue levels of transport systems have to be taken into account for overall economics

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Traffic**

**What do electric
systems cost?**

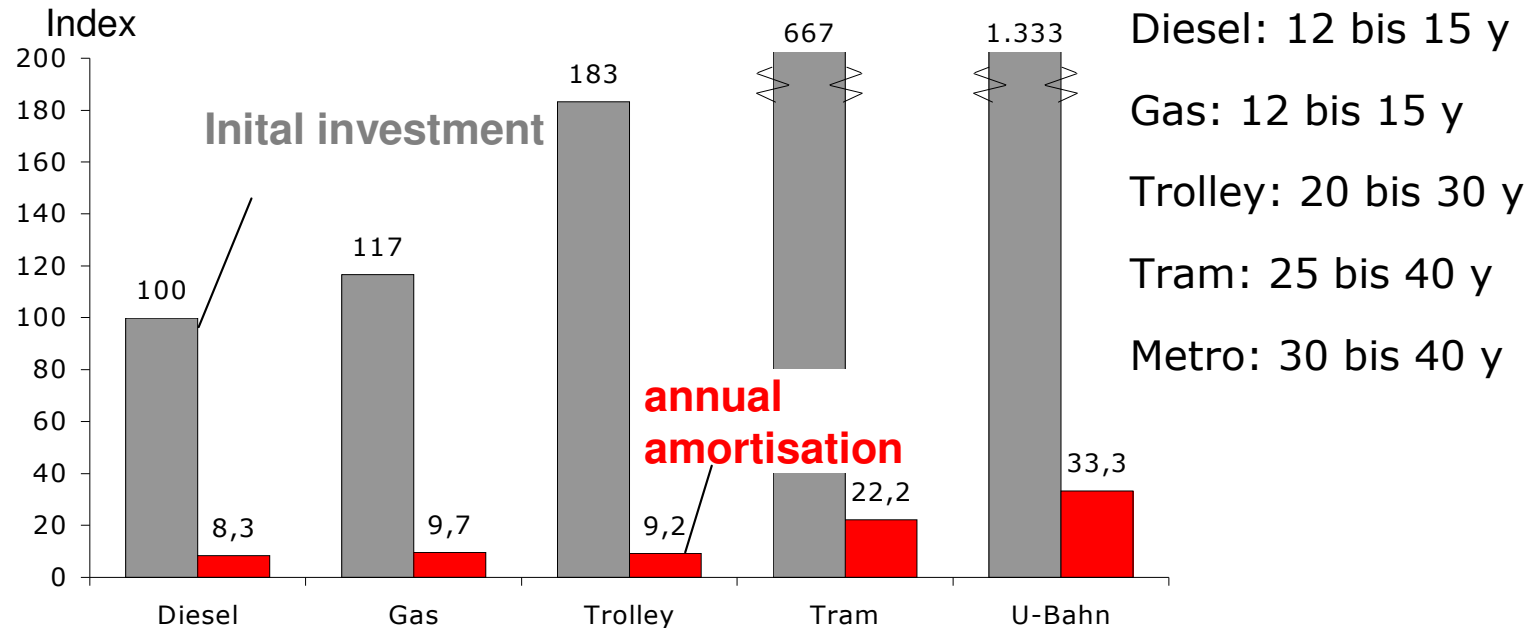
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Lifetime, investment and annual amortisation of PT systems

Investment and annual amortisation



Investment and amortisation

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- ➔ For trolley, tram and metro at least one modernisation of interior is carried out during lifetime, typically
- ➔ Diesel and gas show higher wear and tear due to vibrations and more parts with mechanical move
- ➔ Relation of investment and lifetime is much better for trolley than for tram

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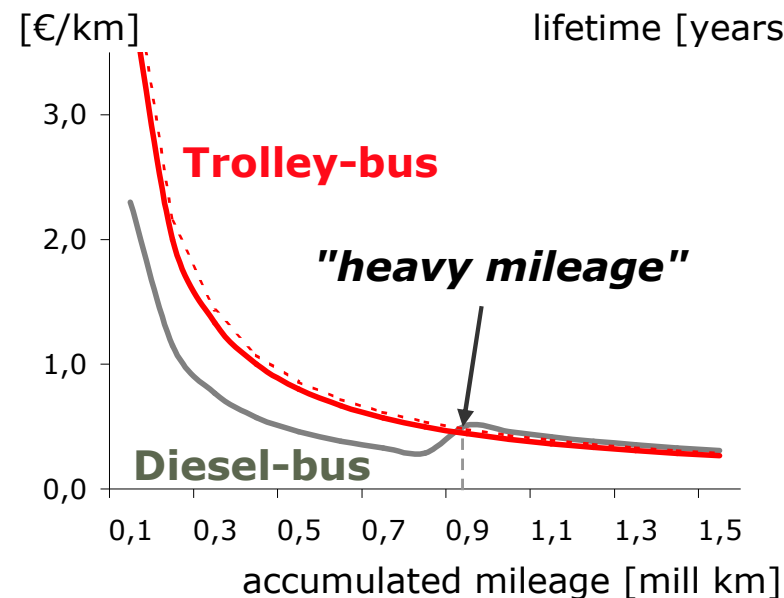
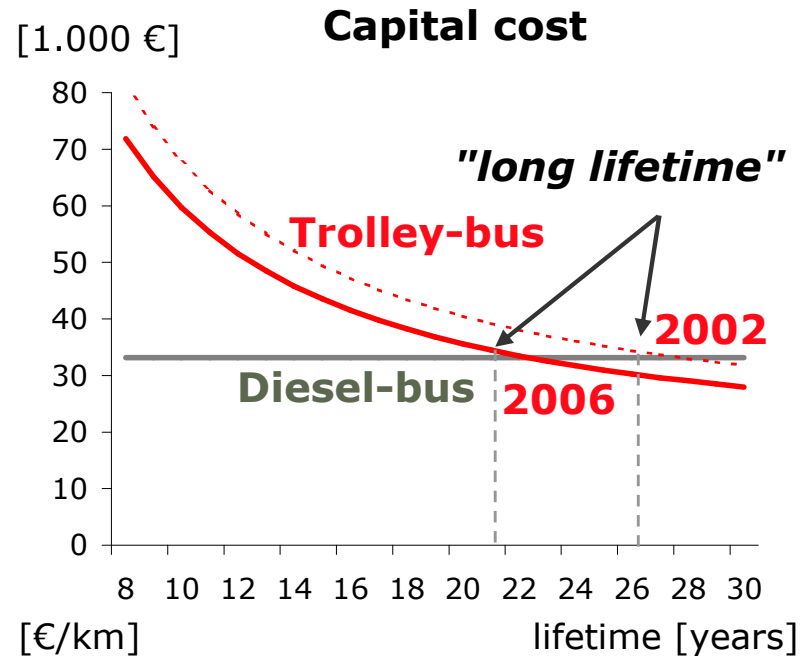
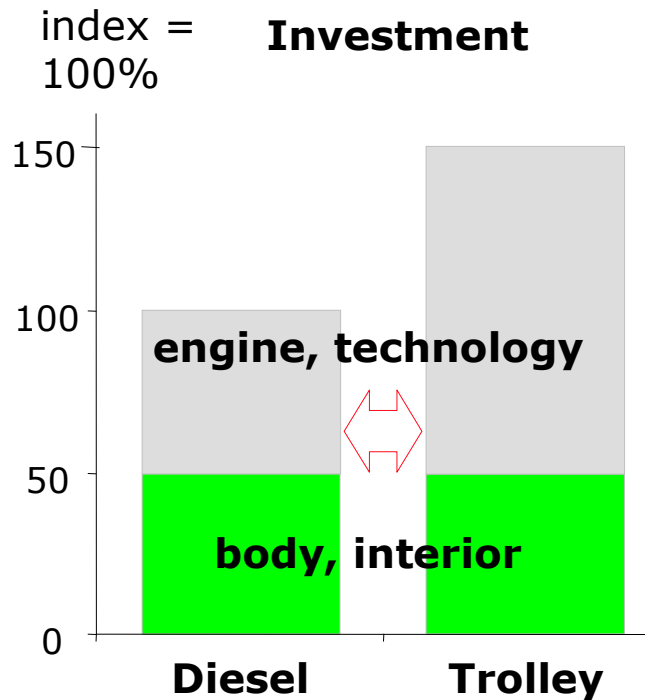
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Trolleybuses should be used intensively in order to gain economic advantages

Capital cost of vehicles



Cost structures and mechanisms

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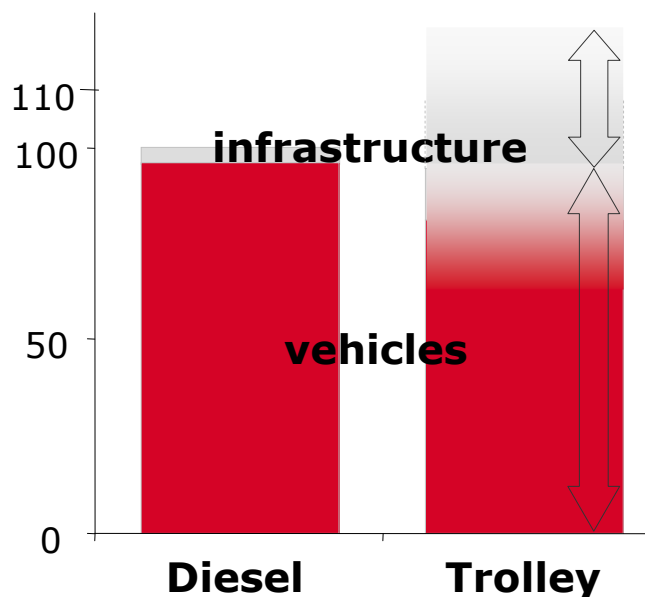
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Infrastructure investment also has to be justified by intensive use

Trolley-bus infrastructure	Initial investment	Total annual cost [€/km or unit]	Share of capital
overhead contact wire system	~ 350 K€ p. km	20 - 25	~80%
substation	~ 500 K€ p.unit	25 - 30	~80%

Cost structures and mechanisms

index =
100%



Infrastructure costs are predominantly fixed costs



Vehicle and infrastructure costs are strongly correlated with the utilisation of the system

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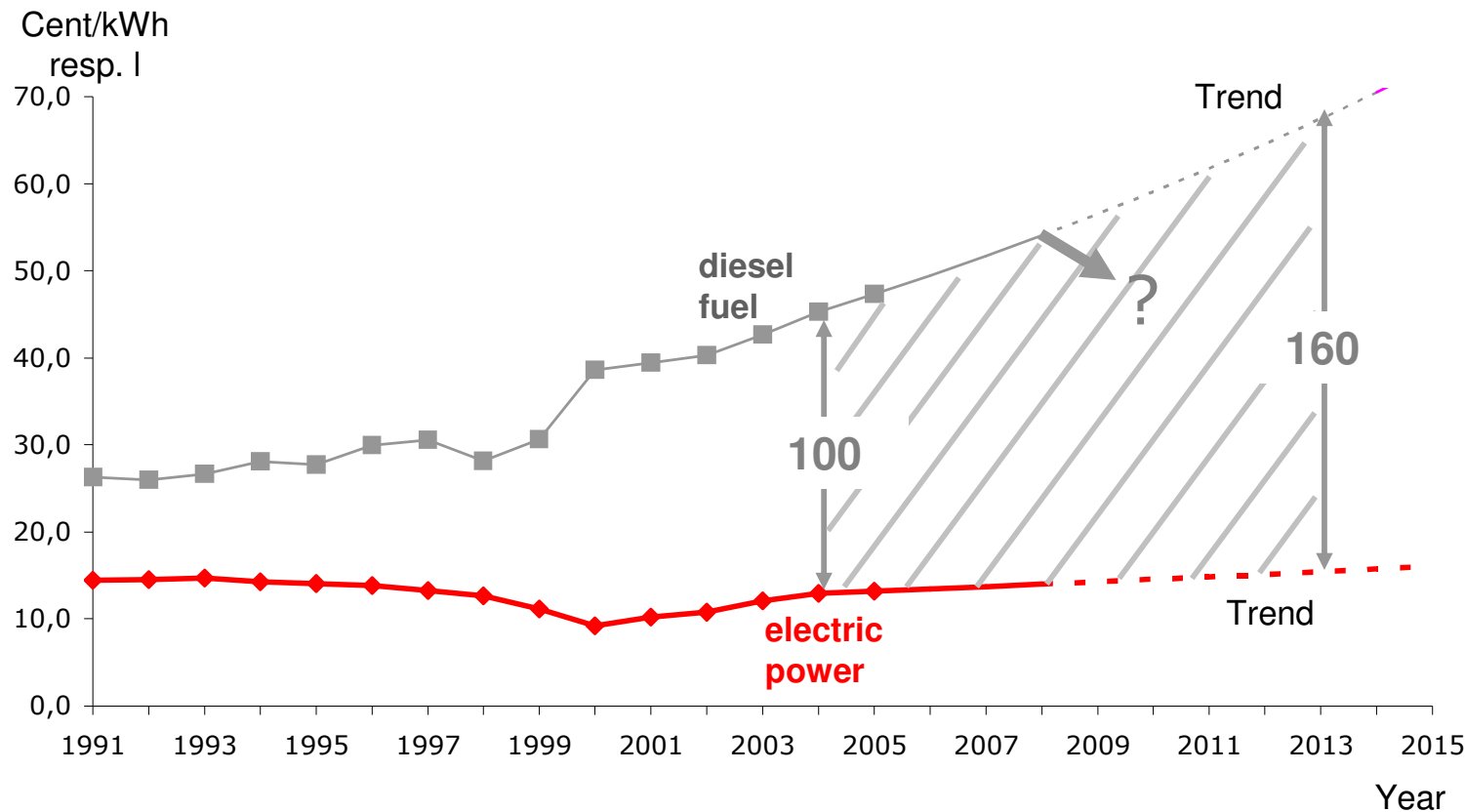
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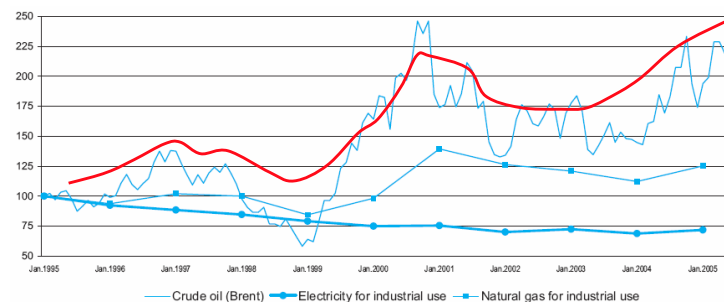
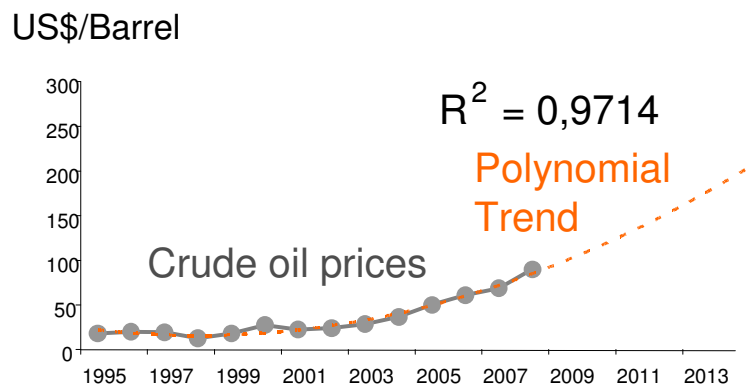
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Extrapolation of energy prices shows the potential of the electrical systems



➔ The development of energy prices is crucial for the right decision on PT systems

➔ In ten years the already existing difference might increase by additional 60%



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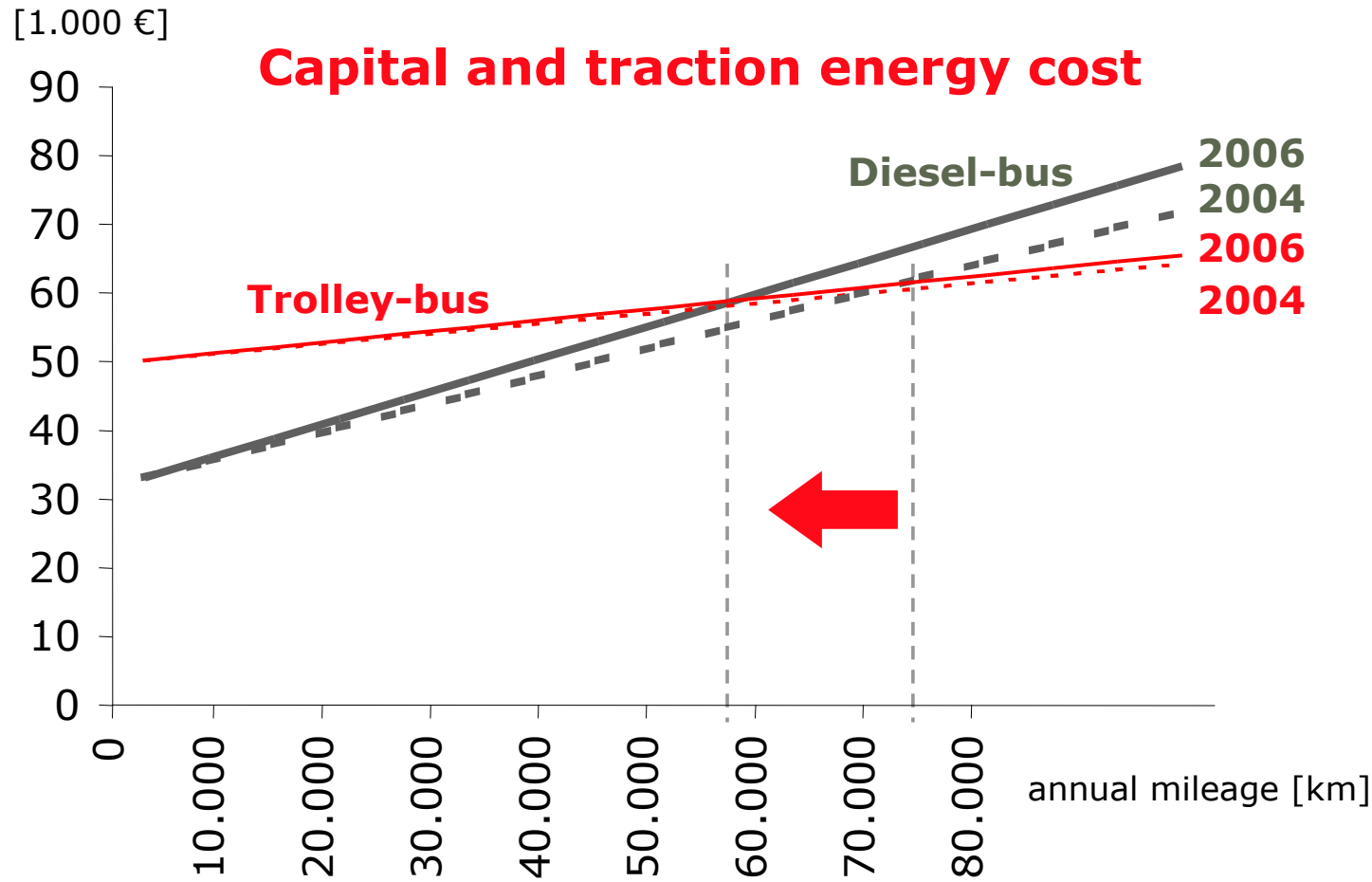
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Increasing diesel-price makes trolley-buses more competitive



Cost structures and mechanisms

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➔ The more intensive the use of trolley-buses the cheaper they become

➔ The actual advantage in traction energy sets in at approx. 58.000 km p.a.

Experiences with supercaps gain a certain cost advantage for trolleys

Annual cost [€/km]

	Trolley-bus	Trolley-bus with supercaps	Diesel-bus
Energy / fuel	0,28	0,18	0,54
maintenance	0,32	0,32	0,40
capital	0,62	0,62	0,50
infrastructure	0,27	0,27	0,02
other operations	-----	identical	-----
total	1,49	1,39	1,46

depending on difference in energy cost (VAT, special taxes), trolley-bus is cheaper in total

Business case experiences

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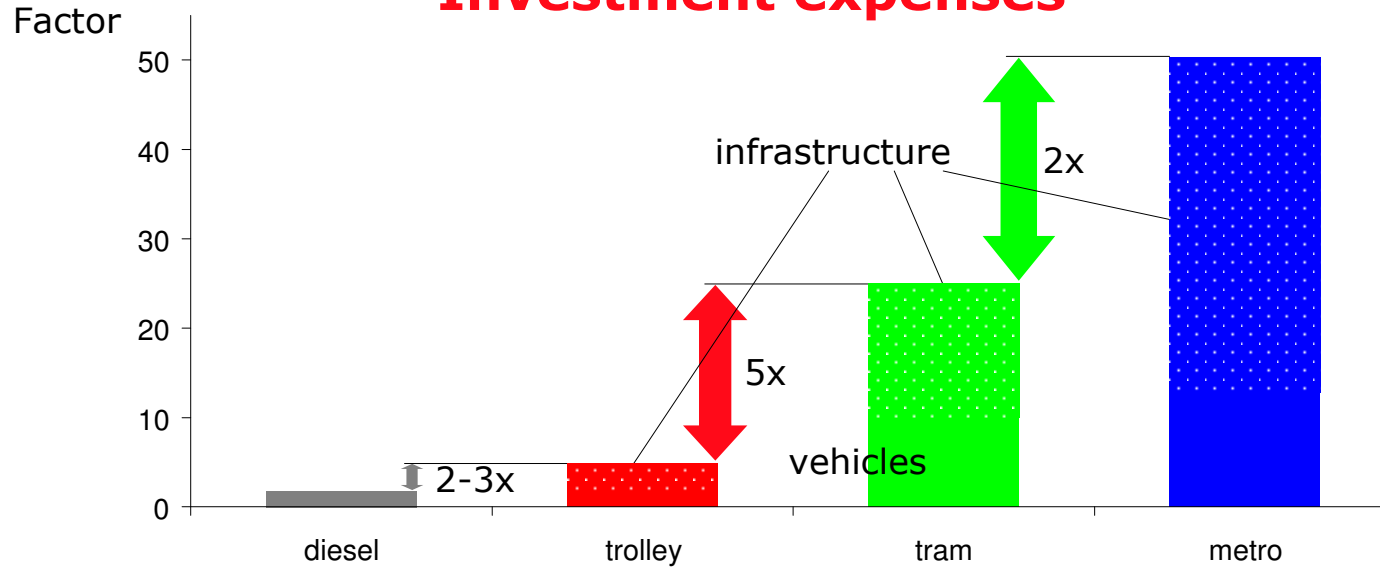
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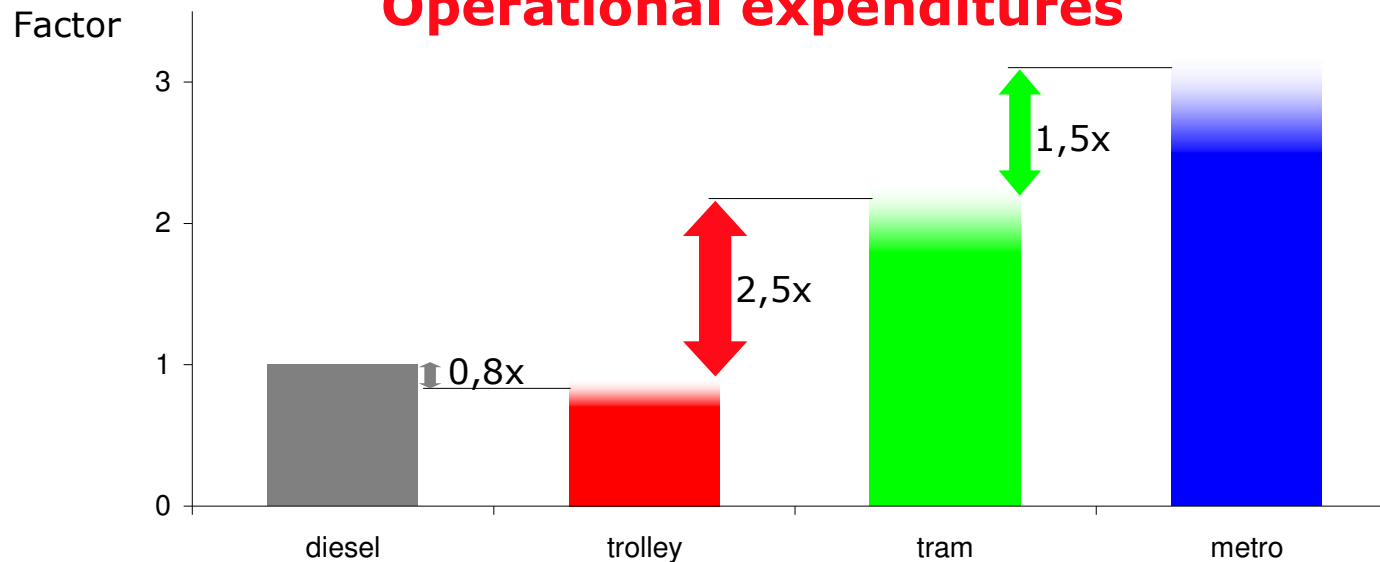
- First time in Solingen, trolley-bus can produce services on cost level of diesel-bus
- The developments in recent years support the effect from the supercaps

Delta in investment and operation cost focus on optimal system circumstances

Investment expenses



Operational expenditures



- ➔ Investment must be justified by intensive use and long life of assets
- ➔ Only trolley can compete with diesel bus from economic point of view
- ➔ Tram and metro need high patronage

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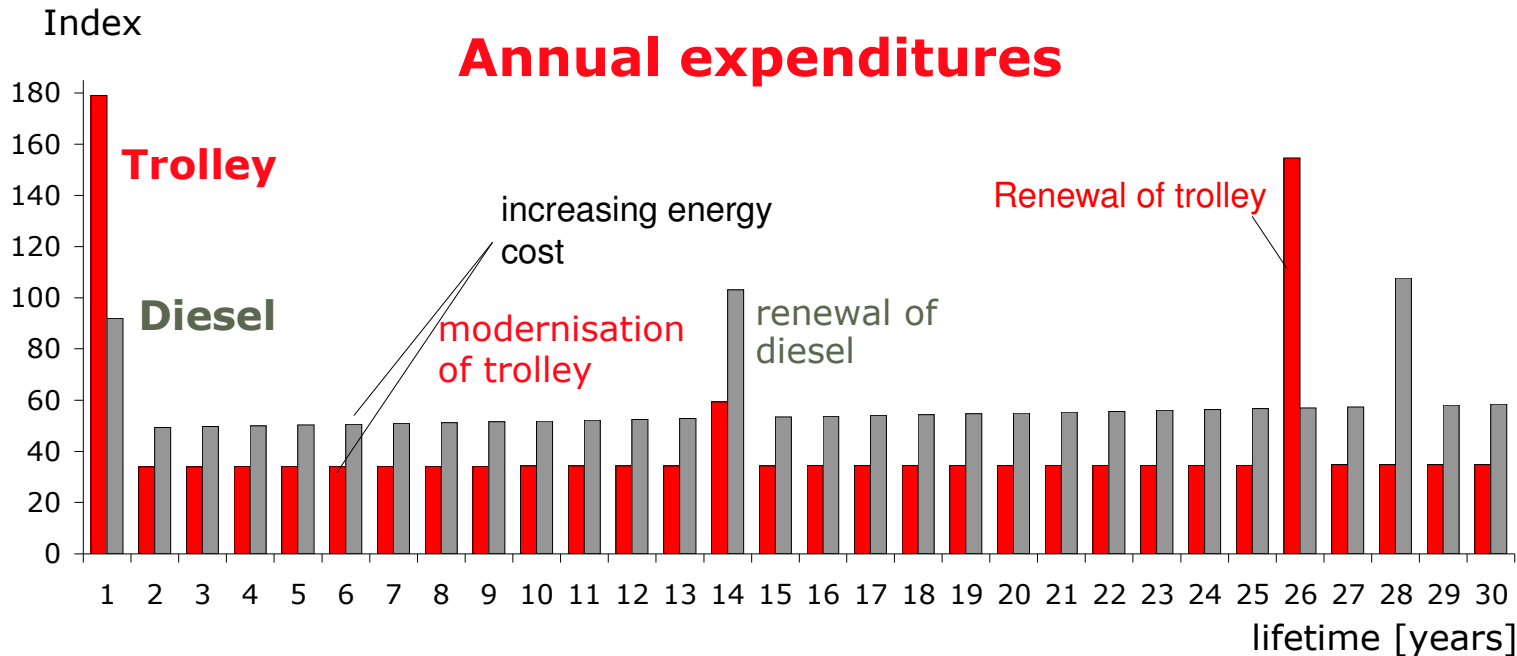
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For decision making life-cycle-cost should be taken into account carefully



- ➔ Assuming the trend of energy trolley can be cheaper than diesel in terms of LCC
- ➔ Cash flow analysis results in advantage of 20%

- Even though initial investment in trolley-buses is high, LCC can be lower than for diesel-buses
- Strong impact have the lifetime of fixed assets, the utilisation and energy cost in the respective country
- New developments and innovations support the economic situation of trolley-bus (energy price, super-caps, use of trailers, double-articulated trolleys, etc.)

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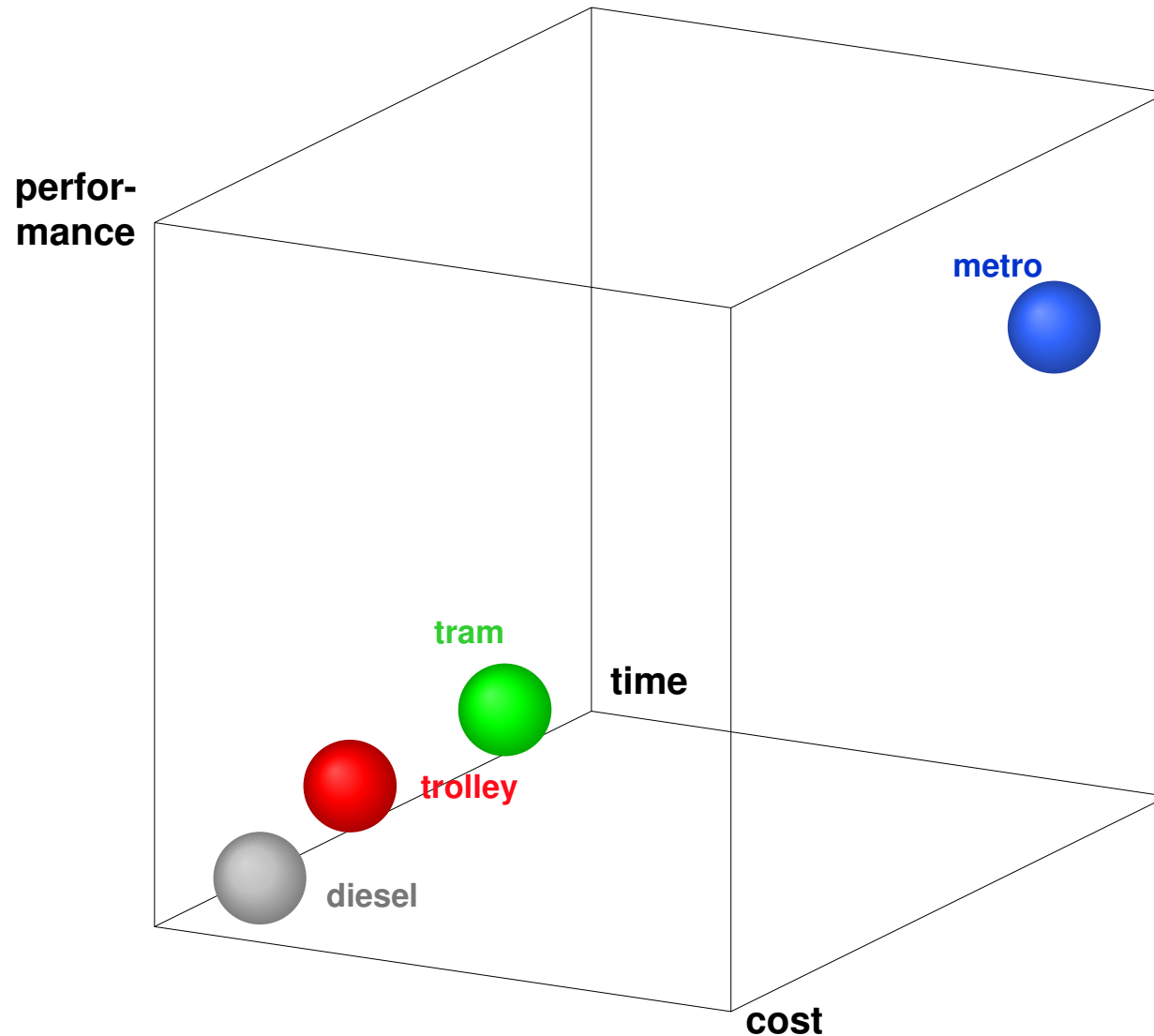
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Not only cost, but performance and time to market are typical systems' criteria



➔ While performance can be nearly the same, realisation time and cost are one tenth for trolley compared with tram

➔ Metro systems is highest in all criteria

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- **Metro systems are without discussion for big cities and high passenger volume**
- **Between tram and trolley the gap has been narrowed due to high performance of trolley systems**
- **If circumstances allow for high capacity by separate lanes, green waves and appropriate stations, trolley is better choice than tram due to**
 - **lower investment**
 - **faster implementation**
- **Business economic advantages are possible for trolley against diesel (gas), if specific requirements are fulfilled**
 - **high usage of infrastructure and vehicles (fixed cost), which needs good planning (infra and operations)**
 - **energy cost are developing like the last years**
 - **opportunities of recuperation are used optimally**
 - **maintenance is optimised**
 - **rail bonus for revenues can be achieved**

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Summary

- **Socio economic advantages are clear for electrical systems**
- **Keeping them in mind trolley is more than competitive for small and medium sized cities**

Summary

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**If you have any questions or if you
would like to receive further
information, please do not hesitate
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