Technology Options for Urban Transport in China

A case of Beijing City

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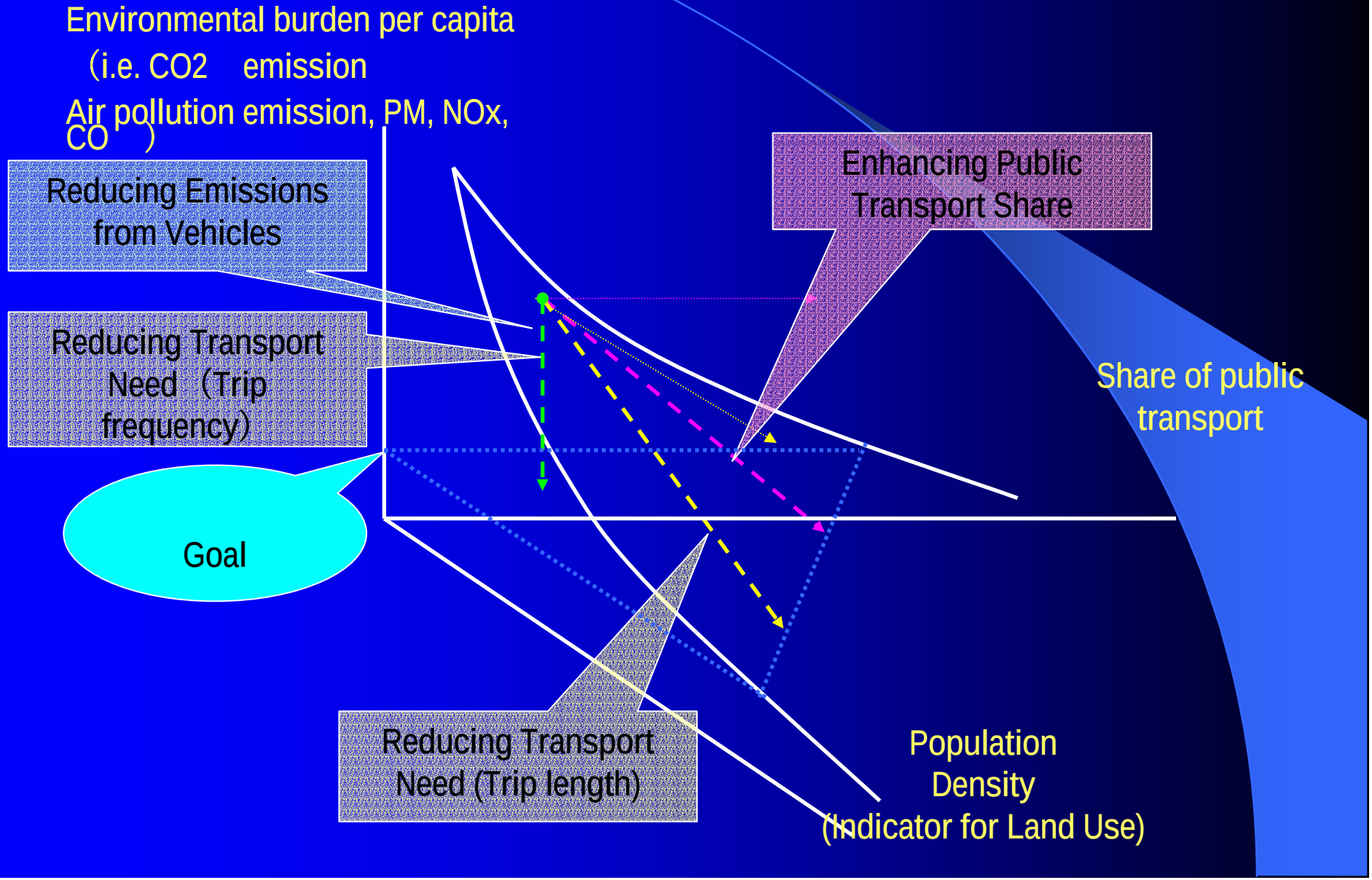
Objectives

Trying to figure out technical options for mitigating emissions from urban transport system by Scenario analysis

Background of urban transport system in Beijing

- Rapid growth in vehicle stock, in particular family car;
- One of main sources of air pollution and GHG emission;
- Diversity in technical options: conventional vehicle, AFVs (dedicated vehicle, bi-fuel vehicle), trolley-bus, MRTs;
- Single technical option in family car: car-gasoline

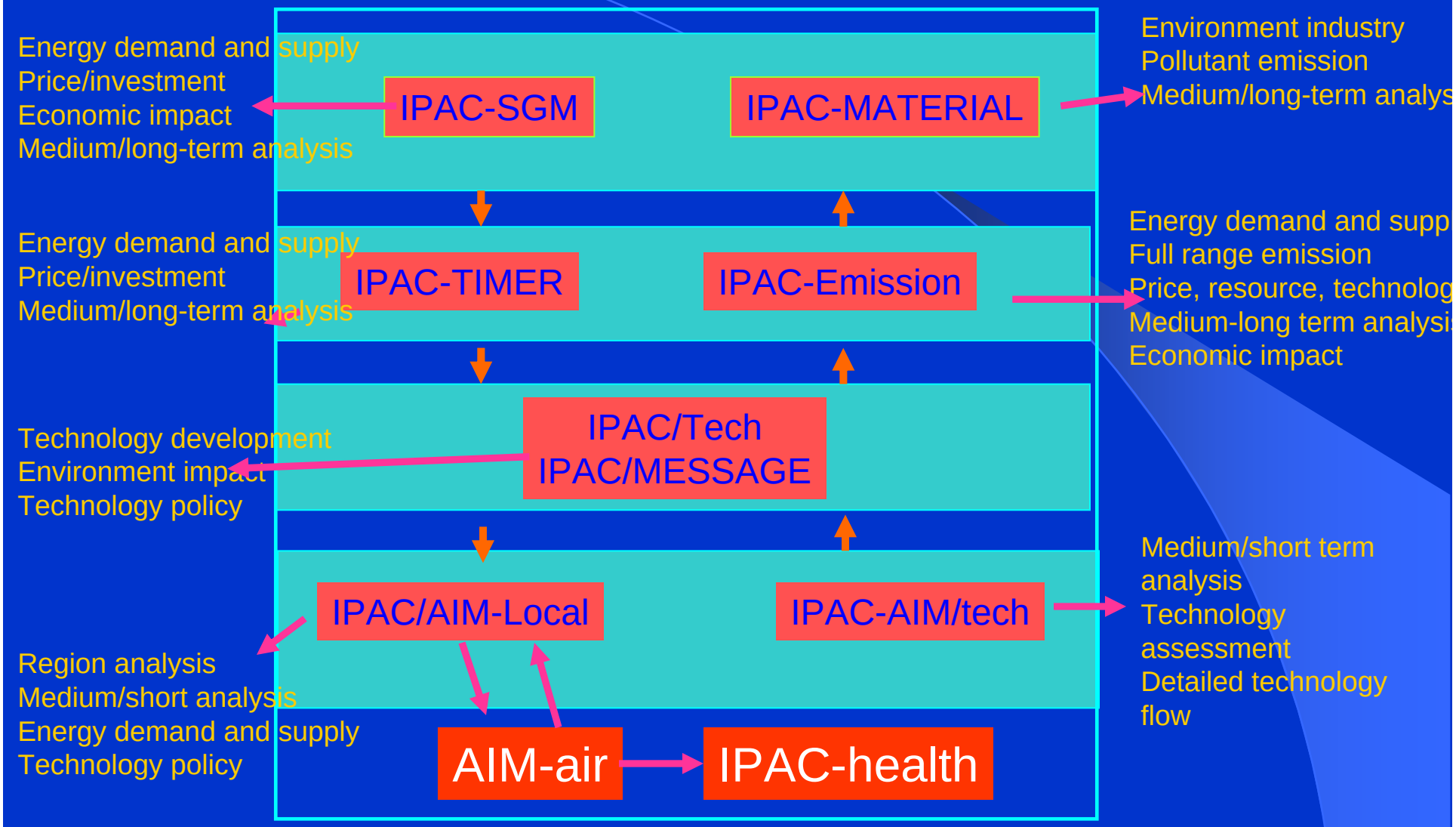
Strategies and Environmental Impact



Methodology: IPAC-AIM/tech model

- Least-cost linear programming model
- To determine the vehicle stocks and level of their operation to meet the total pass-km during planning horizon 2000~2020 at minimum discounted total cost.
- Total cost includes cost of new vehicles that should be added during the planning horizon as well as O&M costs of the existing and new vehicle.

Framework of IPAC



Data and assumption

- Cost: capital cost and fuel cost of vehicles;
- Annual utilization, load factor and fuel efficiency of vehicles
- Life-span of vehicles;
- Discount rate;
- Existing number of vehicles with age;
- Forecast travel demand for each mode and the total;
- Minimal travel demand met by different transport mode
- Emission factor of vehicles
- Passenger transport concerned; excluding motorcycle, bicycle and social vehicles

Technical options to assess

- Transit bus (Gasoline, Diesel, CNG, LPG/Gasoline, Trolley);
- Taxi (Gasoline, LPG/Gasoline);
- Car (Gasoline, Diesel, Hybrid, Electricity, Fuel Cell);
- MRTs

Environment Sound Transport Scenario for Beijing

- ***Government promotion (BaU)***

  Present transportation policies will continue; present vehicles with lower energy use will spread gradually

- ***Technology Progress (TG)***

  Extra environment-friendly policies will be introduced and present vehicles with lower energy use will spread rapidly.

- ***Clean future (CF)***

  More policies and countermeasures will be introduced to increase the environment performance of transportation, such as introduction of advanced cars (e.g. hybrid cars, fuel-cell cars), encouraging policies for mini cars, integrated design for transportation system and city function area, big priority for public transit, use of bio-gasoline, public involvement, etc.

Scenario for Beijing

	BaU	TG	CF
GDP.	2000-2010:9.3% 2010-2020:8.5%	Same	Same
Pop.	2000:13.6 2020:15.7	Same	Same
GDP per Capita	2000: 10515 2020: 49994	Same	Same
Vehicle Stock	2000: 1.37million 2020: 4.8million	2000: 1.37million 2020: 4.2million	2000: 1.37million 2020: 4.6million
Total passenger traffic volume	2000: 23.4 2020: 36.7	Same	Same
Total freight Traffic volume	2000: 8.73 2020: 13.36	2000: 8.73 2020: 13.36	2000: 8.73 2020: 13.36
Share of public transport in total passenger	2000: 31.7% 2020: 24.9%	2000: 31.7% 2020: 36%	2000: 31.7% 2020: 36%

Scenario for Beijing

	BaU	TG	CF
MRT	2000: 56 2008: 300 2020: 1000	Same	Same
Number of Buses	2000: 13000 2020: 18000	2000: 13000 2020:18000	2000: 13000 2020:18000
Clean fuel bus	2000: 3680 2020: 10000	2000: 3680 2020: 12000	2000: 3680 2020: 12000
Emission Standard	2007: EURO III	2006: EURO III 2010: EURO IV	2006: EURO III 2010: EURO IV
Parking fee		Increase	Increase
Public Transport Oriented Policy		Bus lane Better interchange	Bus lane Better interchange
ITS		Finish by 2006	Finish by 2006

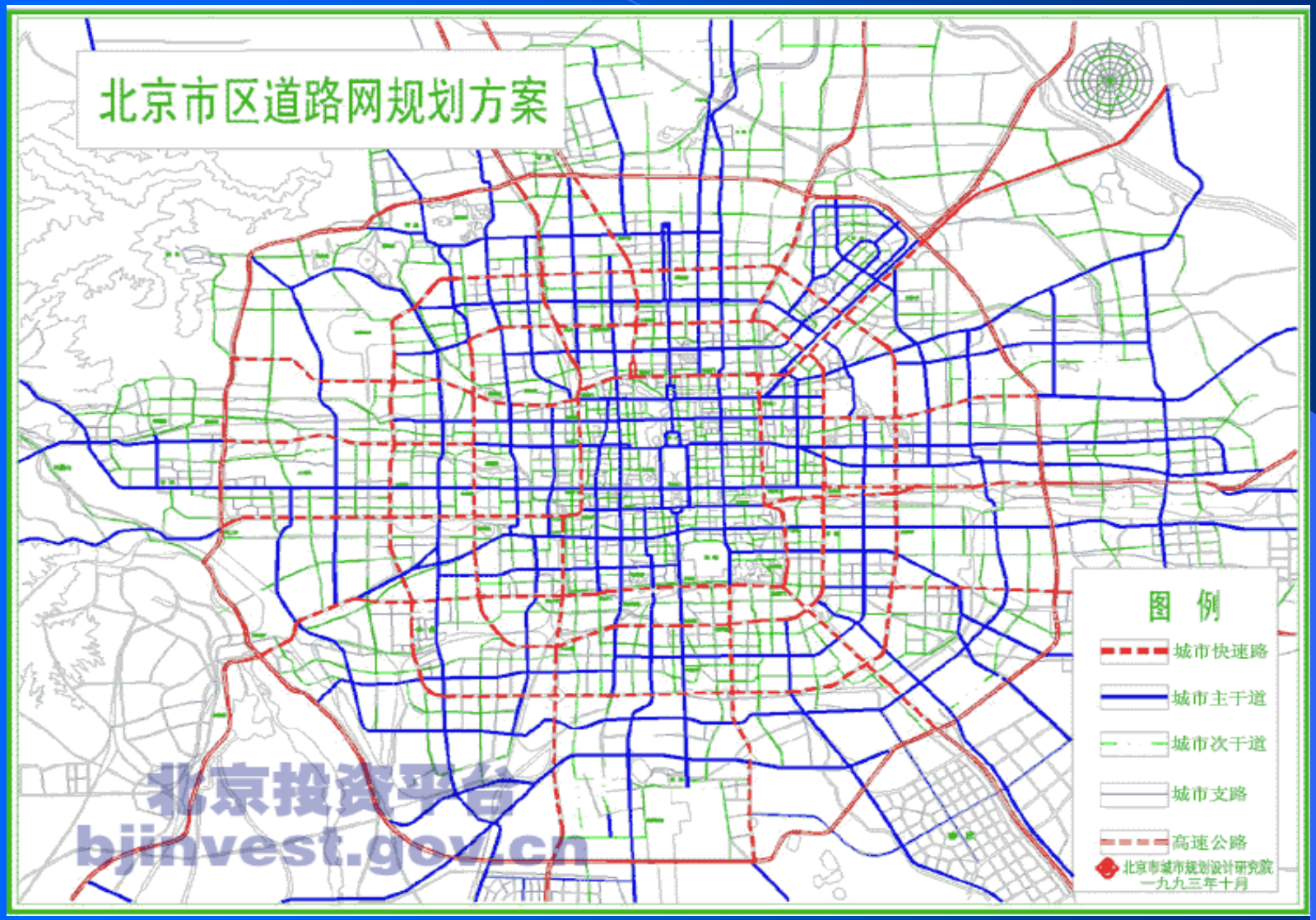
Scenario for Beijing

	BaU	TG	CF
Clean fuel			2007: M85%
High efficiency car			2004:Hybrid car 2005: New diesel car 2010: Fuel cell car
Mini Car			Incentive policies
Integrated transport		Public interchange	Public interchange Bicycle
Public involvement			Public transport Energy saving driving

Prediction of traffic volume

	2000	2010	2020
Vehicle stock, 10^4	136.5	370	480
MRTs, km	56.0	350	1000
Bus stock, 10^4	1.3	1.5	1.8
Family car stock, 10^4	32.1	202.2	318.9
Truck stock, 10^4	21.4	30	35
Motorcycle stock, 10^4	33.2	40	43
Bicycle stock,10^4	988.7	1100	1100
Railway freight , 10^8t-km	200.2	255.0	310.0
Railway passenger , 10^8p-km	62.7	95.0	140.0
Air transport freight , 10^8t-km	16.8	36.2	71.2
Air transport passenger , 10^8p-km	198.5	514.9	1012.8

Planning scheme of road system in Beijing's urban area



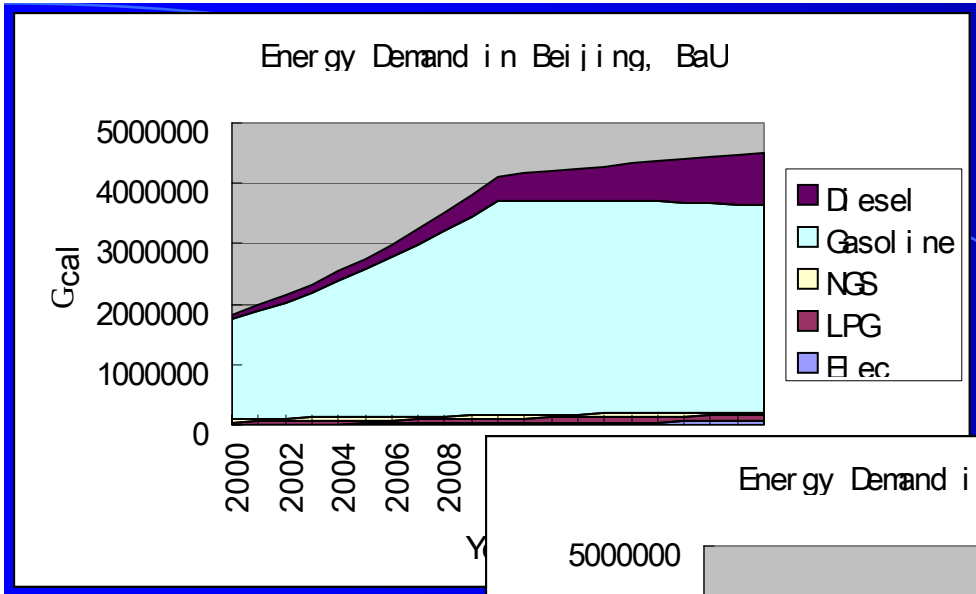
Planning scheme of Rail-based transit system in Beijing's urban area

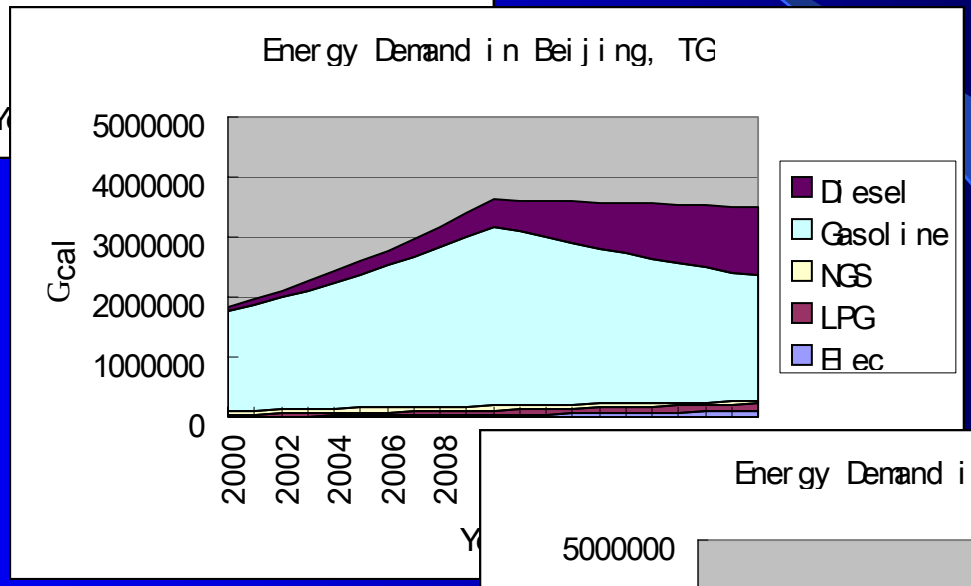
Fuel-cell cars: whose price will reduce to present car's level by 2015

Hybrid cars' price

In 1996, 600,000 Yen
In 2003, 200,000 Yen

Fuel economy：35km/l


Energy Demand in Beijing, BaU
5000000
4000000
3000000
2000000
1000000
0
Gcal
2000
2002
2004
2006
2008
Diesel
Gasoline
NGS
LPG
Elec


Energy Demand in Beijing, TG
5000000
4000000
3000000
2000000
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0
Gcal
2000
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Diesel
Gasoline
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LPG
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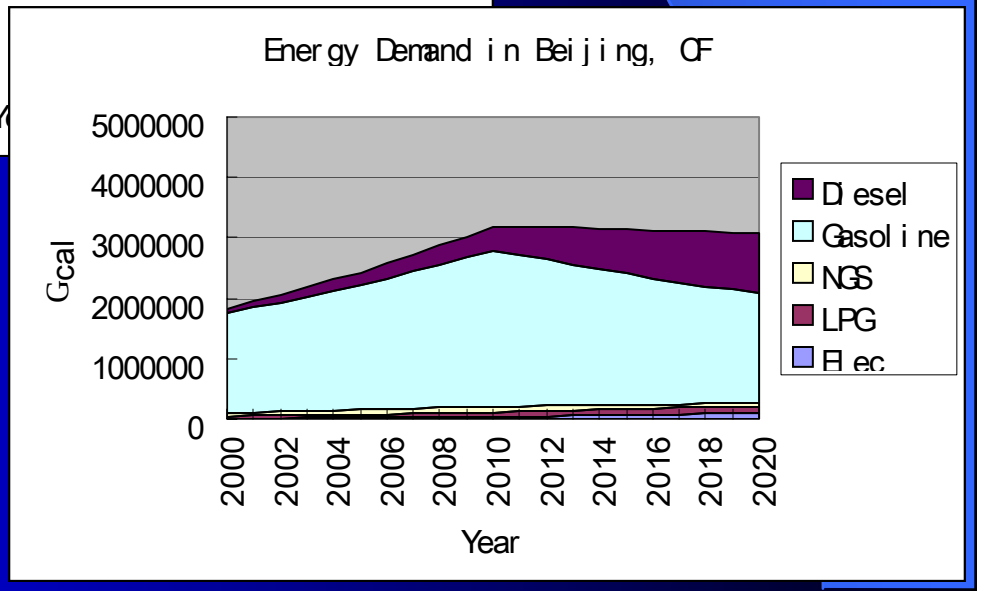
Energy Demand in Beijing, CF
5000000
4000000
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2000000
1000000
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Gcal
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Year
Diesel
Gasoline
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LPG
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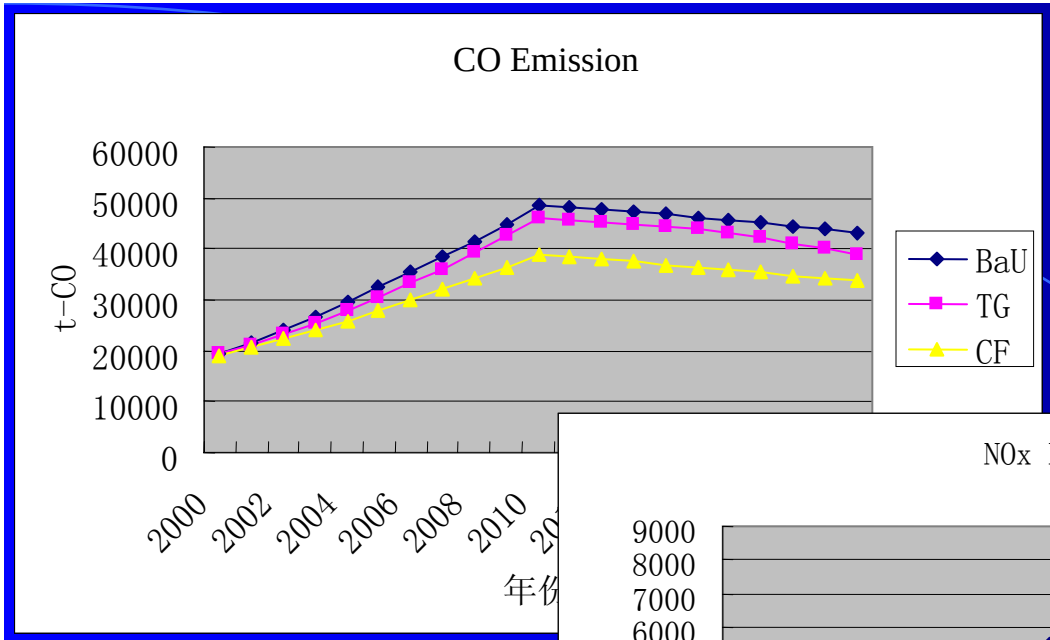
CO Emission
60000
50000
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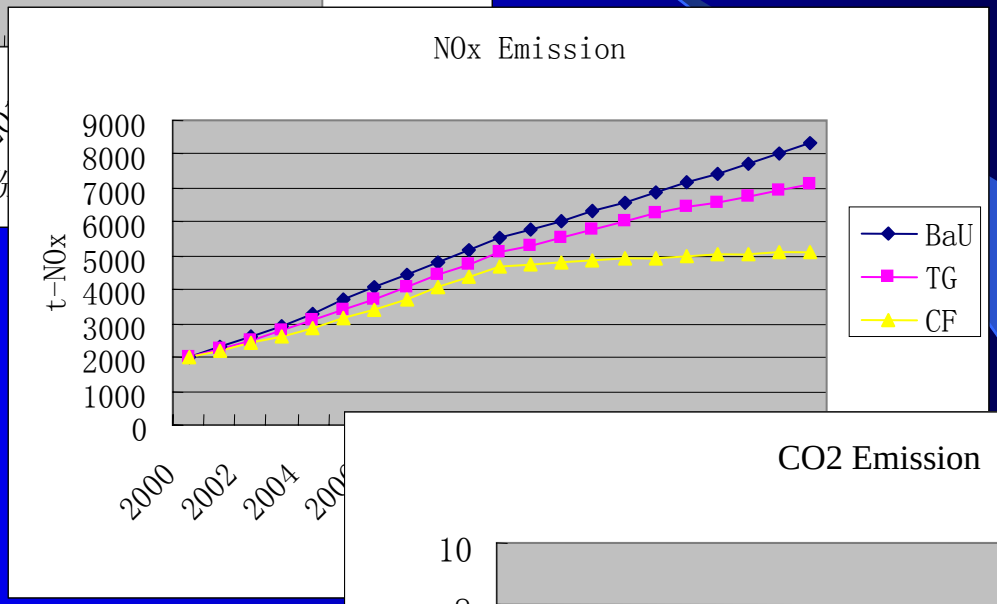
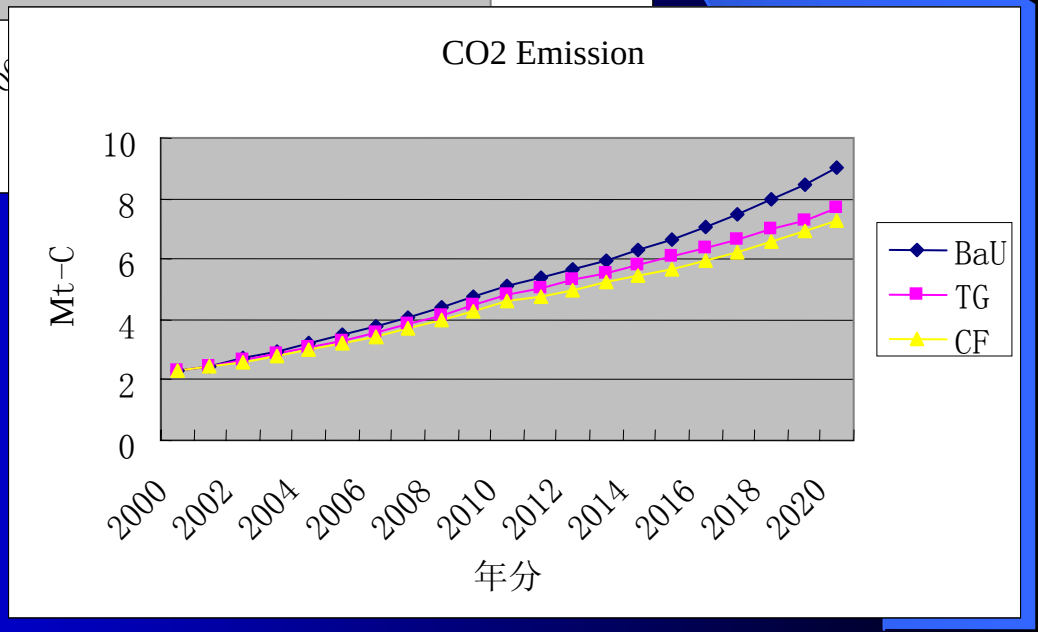
30000
20000
10000
0
t-CO
2000
2002
2004
2006
2008
2010
BaU
TG
CF


NOx Emission
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
t-NOx
2000
2002
2004
BaU
TG
CF


CO2 Emission
10
8
6
4
2
0
Mt-C
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
年分
BaU
TG
CF

Conclusion

Technology selection

- Compared with private transport system (cars) and MRTs, transit bus has an advantage on cost competitiveness.
- Diesel bus has advantage both on cost and CO2 emission.
- Diesel car has large reduction potential, though total cost is higher than gasoline car.
- Because coal's dominance in power generation, electricity car does not have advantages on CO2 emission.

Conclusion (cont.)

Policy Recommendation

- Maintaining present transportation control policy
- Encouraging policy for low-energy-use vehicles：
  1. encouraging development of mini cars： abolishing the limit on running of mini cars
  2. encouraging low-energy-use vehicles： reducing tax, and putting out energy use standard as soon as possible;
  3. introducing advanced vehicles： such as PRIUS， LUPO
  4. establish long-term development plan for fuel-cell vehicles
- Use of ethanol gasoline
- Integrated design of transportation system
- Integrated design for city function areas（it should be divided according to district, but not street）

Conclusion (cont.)

Policy Recommendation

- Traffic controlling policy
  1. on the condition of improvement of public transit, promoting the running cost for cars (increase the parking fee to 10-20 Yuan/h, integrated with public transit)
  2. encouraging telephone meeting
  3. developing electronic payment
  4. nearby purchase
  5. school-bus plan
- Public involvement（flameout when waiting for more than 6 minutes, less use of vehicles, more use of walking and bicycles）
- Develop a clean transportation system through international cooperation mechanism

Thank you!