Workshop on air quality and sustainable transportation challenge in South Asian cities
26 July 2012

FUEL QUALITY AND VEHICLE TECHNOLOGY ROADMAP FOR CLEAN AIR – ALTERNATIVE INITIATIVE (ELECTRIC VEHICLES, LPG VEHICLES etc.)

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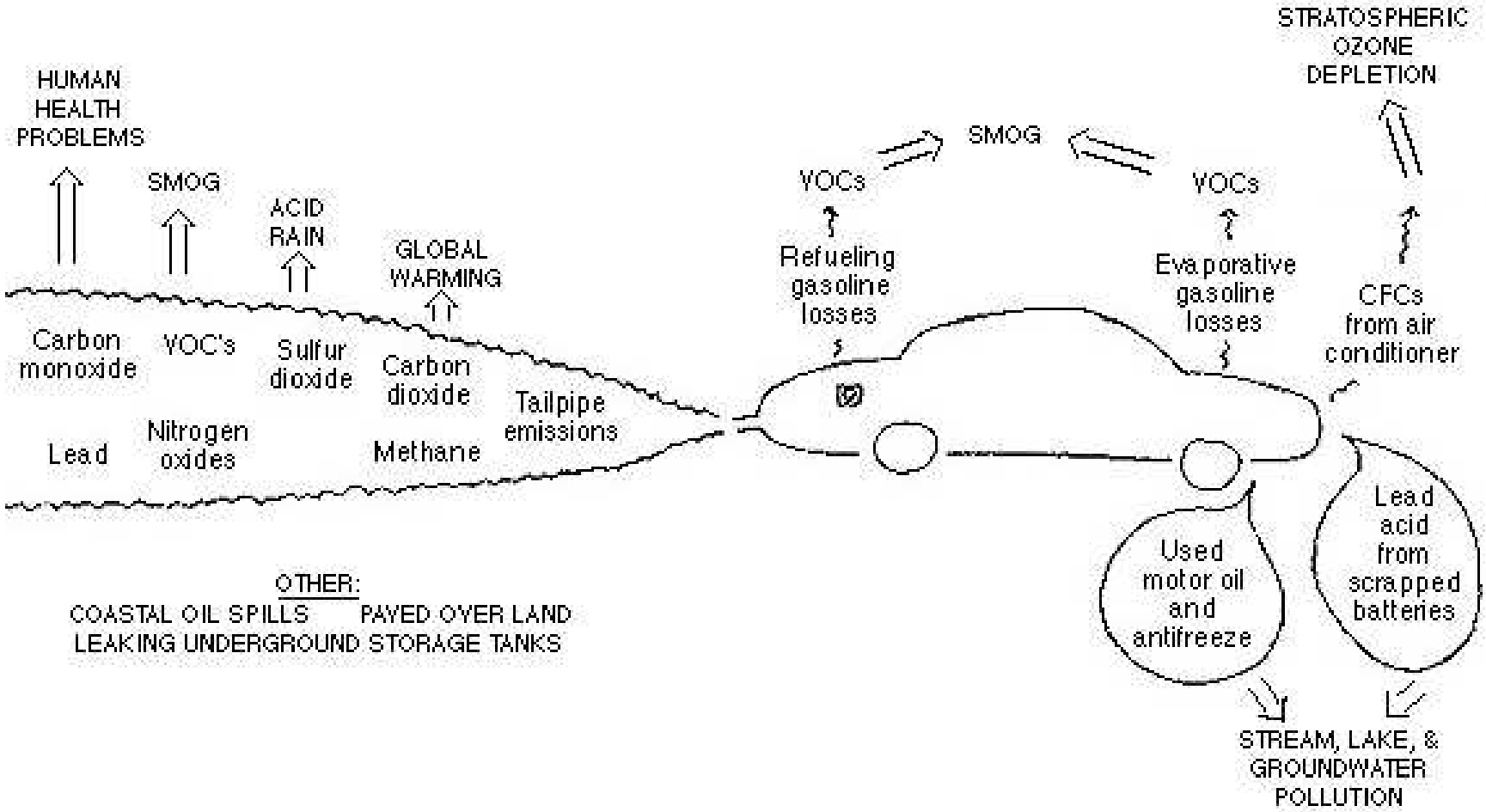
Fuel quality

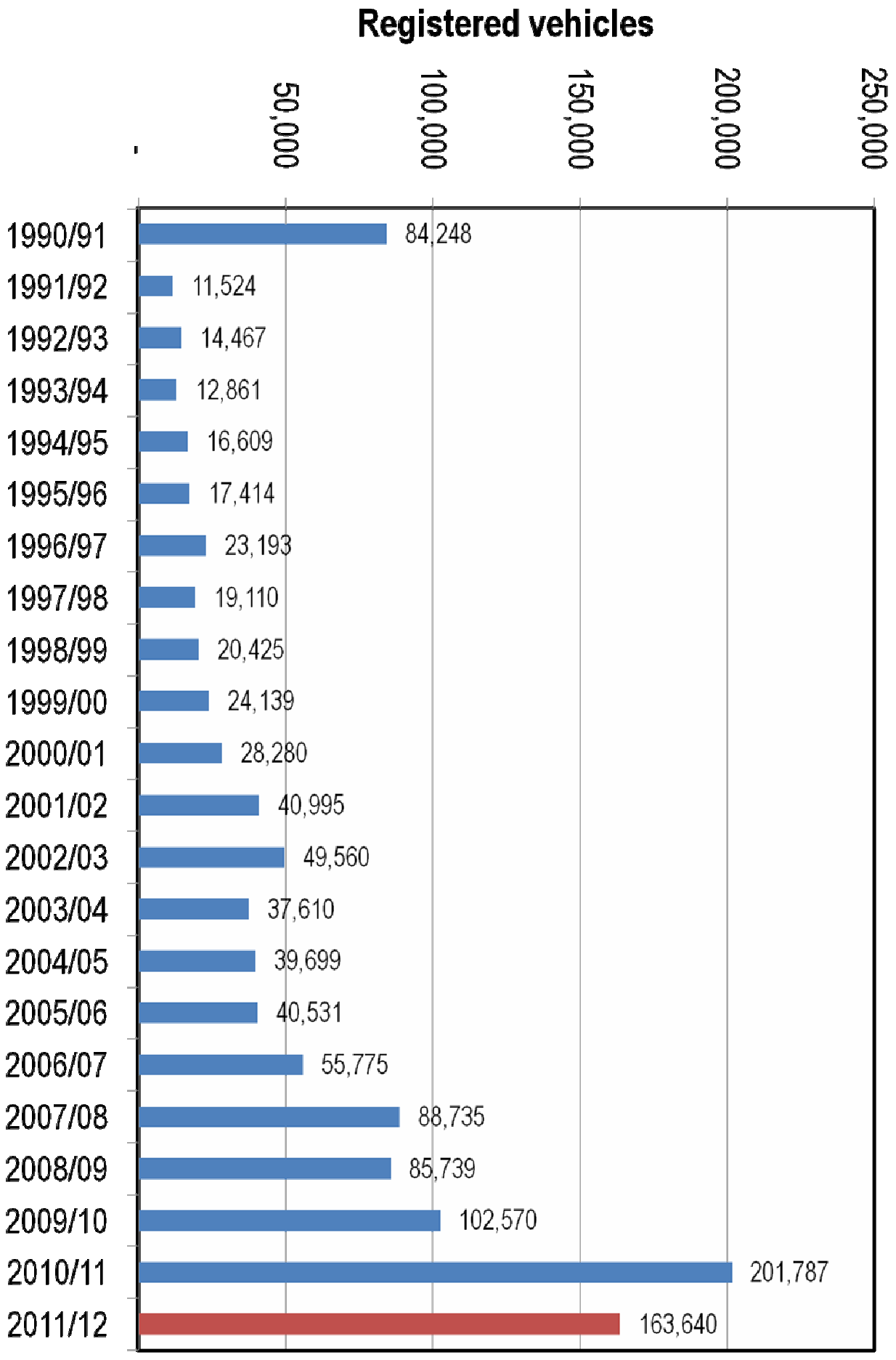
- Engine performance
  - Engine power, torque
  - Fuel adulteration
- Emission standard
  - Fuel specification: MS_BS III (IV); HSD_BS III (IV)
    - Octane no, density, RVP, Pb, S
    - Cetane no, density, kinematic viscosity, S
- Air pollution
  - CO, HC, NOx, SOx, PM, ozone, acid rain, smog
- Climate change
  - Global warming

SOURCES OF VEHICLE EMISSION

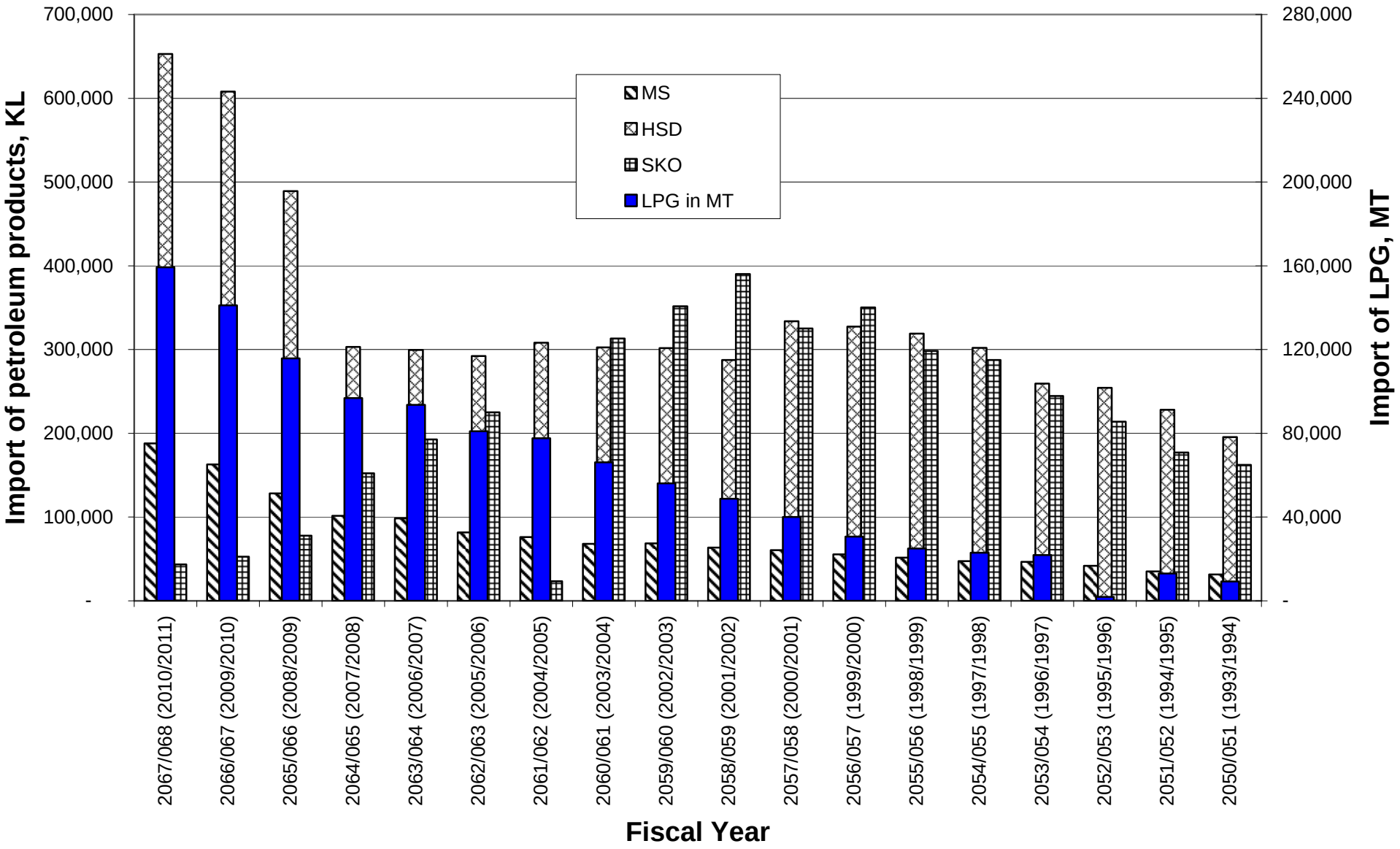


CAUSES OF MOTOR VEHICLE POLLUTION

- Poor fuel quality
- Improper Maintenance
  - Low quality parts
  - No culture of preventive maintenance
  - Lack of formal knowledge, equipment, skills
  - No auditing of I&M facilities
- Poor transport infrastructure & road conditions
- Fraud and Corruption
- Driving habits

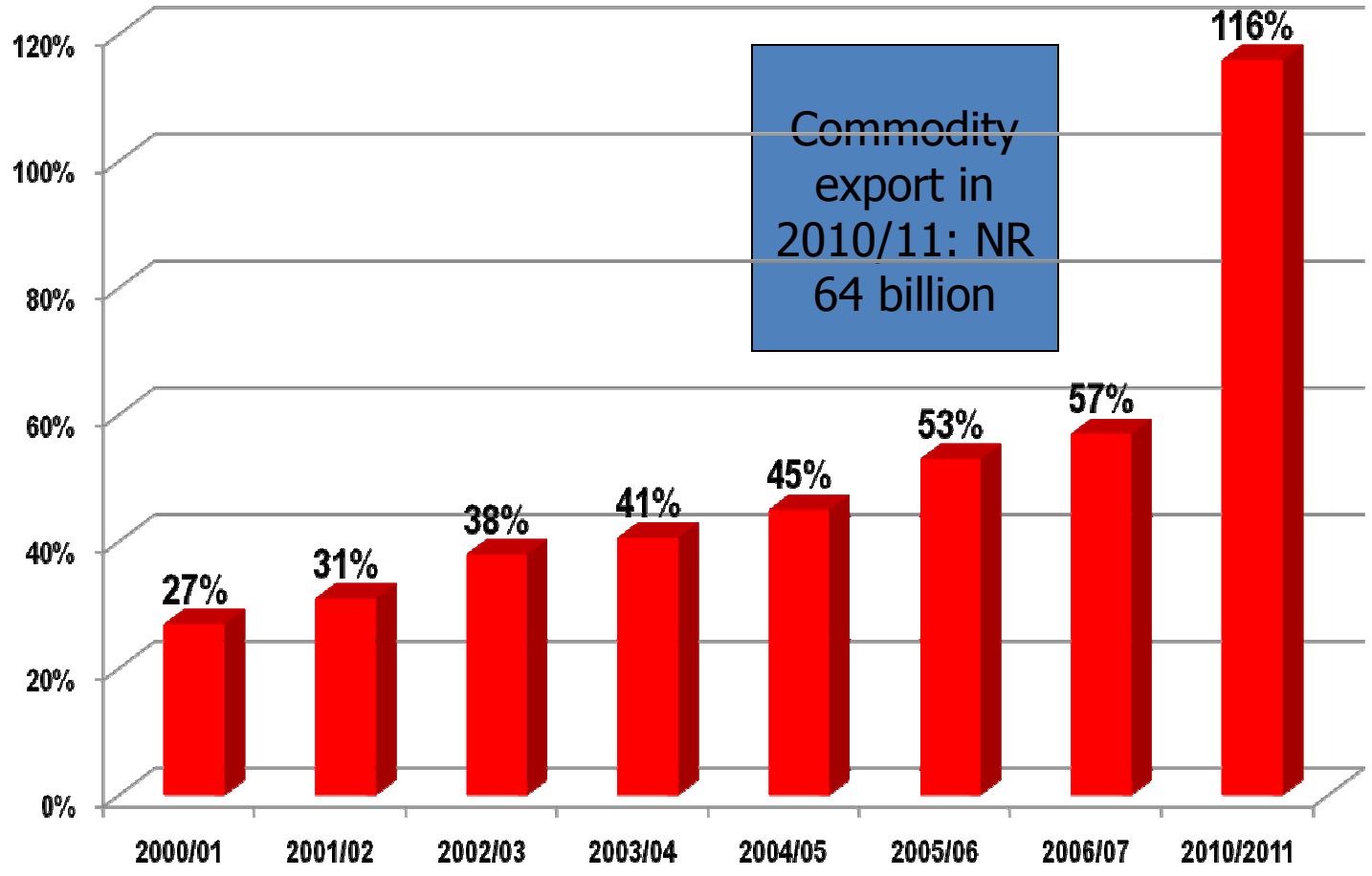

Registered vehicles
-
50,000
100,000
150,000
200,000
250,000
1990/91
84,248
1991/92
11,524
1992/93
14,467
1993/94
12,861
1994/95
16,609
1995/96
17,414
1996/97
23,193
1997/98
19,110
1998/99
20,425
1999/00
24,139
2000/01
28,280
2001/02
40,995
2002/03
49,560
2003/04
37,610
2004/05
39,699
2005/06
40,531
2006/07
55,775
2007/08
88,735
2008/09
85,739
2009/10
102,570
2010/11
201,787
2011/12
163,640

Source: DoTM


Import of petroleum products, KL
Import of LPG, MT
MS
HSD
SKO
LPG in MT
700,000
600,000
500,000
400,000
300,000
200,000
100,000
-
280,000
240,000
200,000
160,000
120,000
80,000
40,000
-
2067/068 (2010/2011)
2066/067 (2009/2010)
2065/066 (2008/2009)
2064/065 (2007/2008)
2063/064 (2006/2007)
2062/063 (2005/2006)
2061/062 (2004/2005)
2060/061 (2003/2004)
2059/060 (2002/2003)
2058/059 (2001/2002)
2057/058 (2000/2001)
2056/057 (1999/2000)
2055/056 (1998/1999)
2054/055 (1997/1998)
2053/054 (1996/1997)
2052/053 (1995/1996)
2051/052 (1994/1995)
2050/051 (1993/1994)
Fiscal Year

Source: NOC

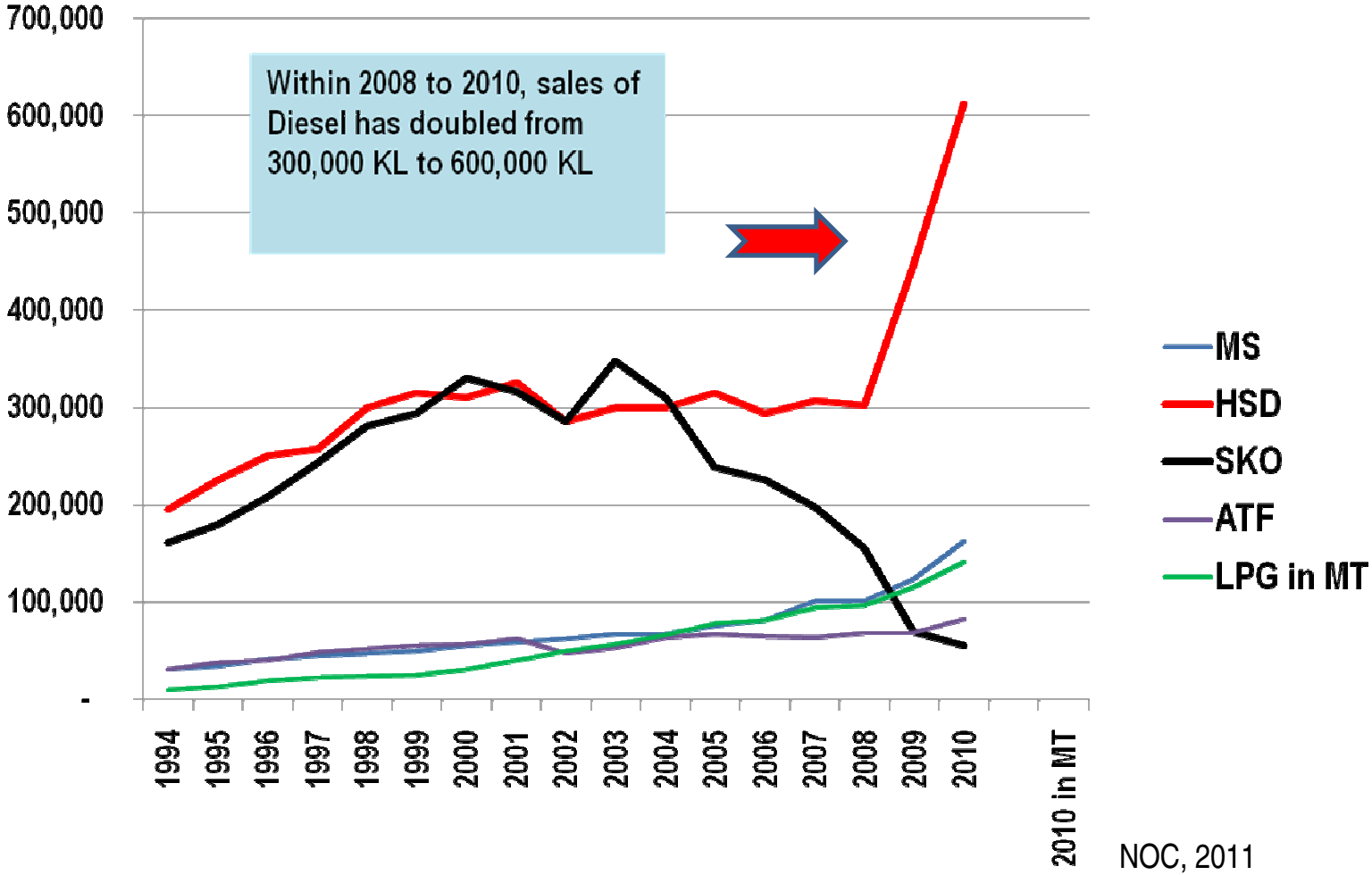
IMPORT OF PETROLEUM PRODUCTS AGAINST COMMODITY EXPORTS



*POL imports in 2011: NR 75 billion

Economic survey, GON, 2011; NOC, 2011

SALES OF PETROLEUM PRODUCTS FROM 1994 TO 2010



NOC, 2011

COST OF DIESEL CONSUMPTION FOR ELECTRICITY GENERATION

- Diesel consumption 40% 260,000 KL
- Cost of diesel NR 20 billion
- Captive genset installed 520 MW
- Capital cost (in one year) 12 billion
- Amount for Diesel import NR 17 billion
- Loss to NOC in diesel sales NR 5 billion
- Opportunity loss to NEA NR 7.4 billion
- **Total avoidable/opp costs NR 41 billion**
- (150 MW power plant can be established by the diesel fuels costs in a year only)

Based on NOC, 2011 and author's calculation

WHY ALTERNATIVE FUEL VEHICLE?

- Global oil is finite and its demand is growing with the increase of number of automobiles.
- Fossil fuels causes air pollution and global warming.
- Fossil fuel price is increasing as the resource is depleting.

ALTERNATIVE FUELS VEHICLES

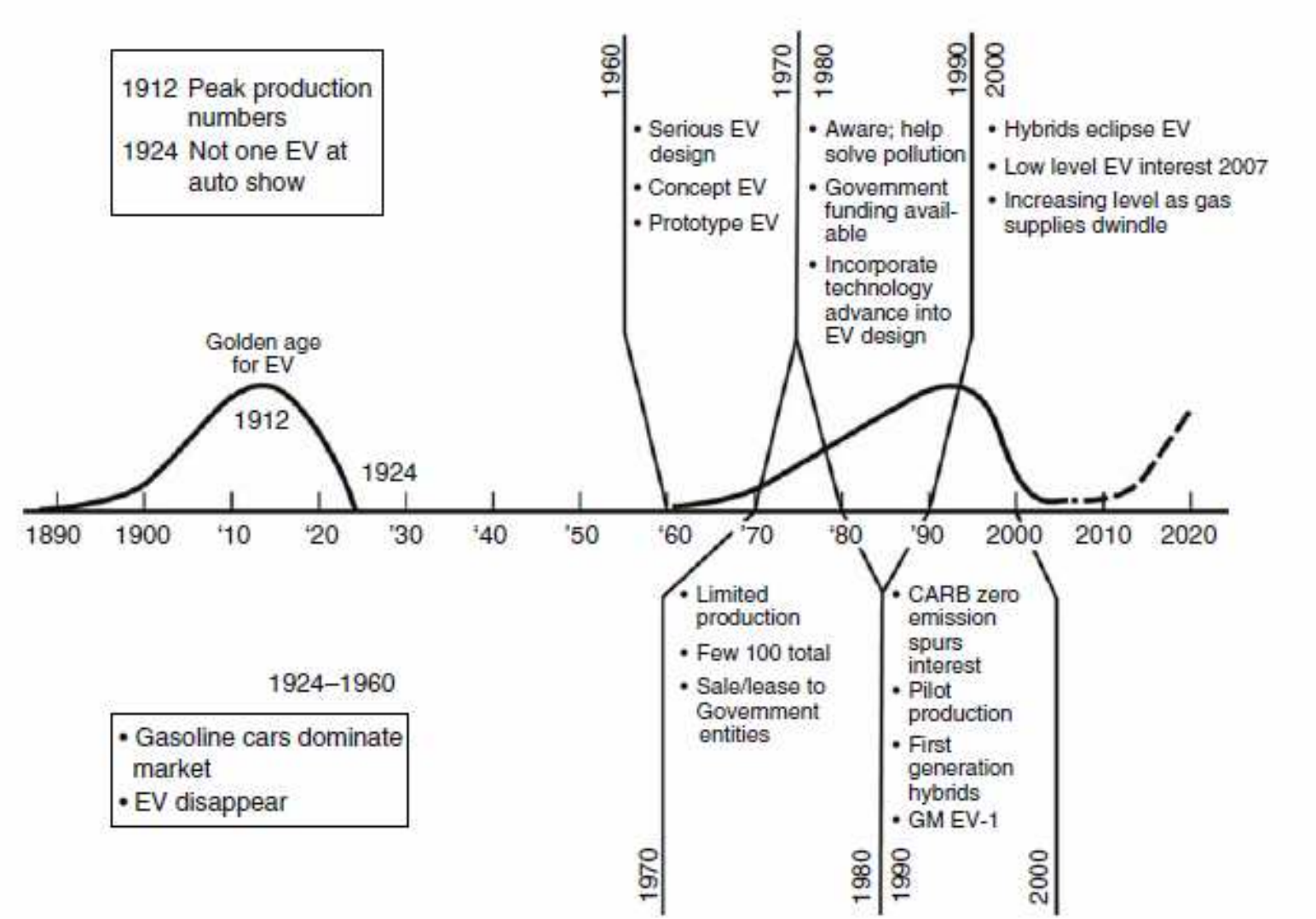
- Ethanol: Ethanol is produced domestically from corn and other crops and produces less greenhouse gas emissions than conventional fuels. For example; E10 (gasohol), E85
- Biodiesel: Biodiesel is derived from vegetable oils and animal fats. It usually produces less air pollutants than petroleum-based diesel. For example; Common blends include B2 (2% biodiesel), B5, and B20.
- CNG: Natural gas is a fossil fuel that generates less air pollutants and greenhouse gases. It can be used in the form of compressed natural gas (CNG) or liquefied natural gas (LNG) to fuel cars and trucks.

ALTERNATIVE FUELS VEHICLES

- LPG/ Propane, also called liquefied petroleum gas (LPG), is a domestically abundant fossil fuel that generates less harmful air pollutants and greenhouse gases. LPG-fueled vehicles can produce significantly lower amounts of some harmful emissions and the greenhouse gas carbon dioxide (CO_2). LPG is usually less expensive than gasoline, it can be used without degrading vehicle performance.
- Hydrogen: Hydrogen can be produced domestically from fossil fuels (such as coal), nuclear power, or renewable resources, such as hydropower. Fuel cell vehicles powered by pure hydrogen emit no harmful air pollutants. It can be used in fuel cells to power electric motors or burned in internal combustion engines (ICEs).

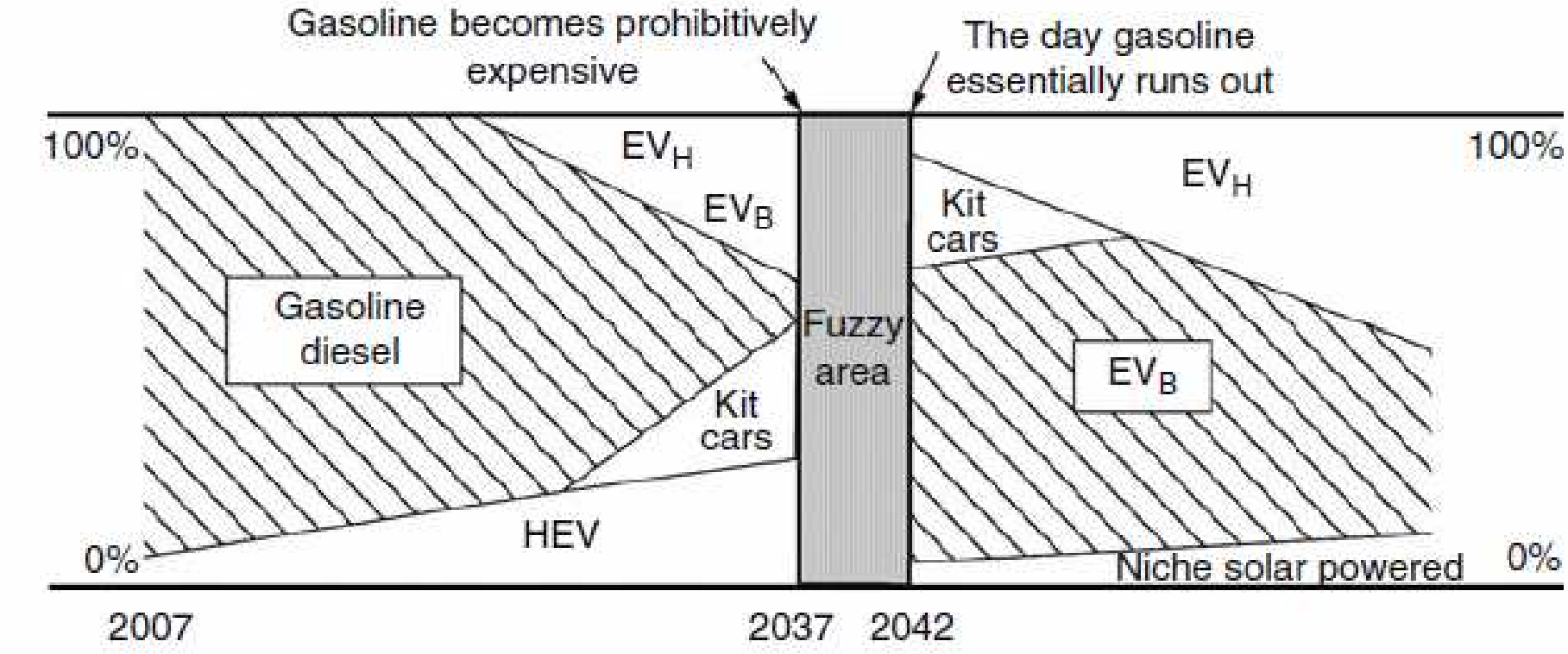
ALTERNATIVE FUELS VEHICLES

- Electrical vehicles: Electric vehicles (EVs) are propelled by an electric motor (or motors) powered by rechargeable battery packs. EVs have several advantages over vehicles with internal combustion engines (ICEs).
- Hybrid vehicles: Plug-in Hybrid Electric Vehicles (PHEVs) are hybrids with high capacity batteries that can be charged by plugging them into an electrical outlet or charging station. PHEVs can store enough electricity from the power grid to significantly reduce their petroleum consumption under typical driving conditions.



Curves are qualitative and provide a feel for the level of interest and activity in the EV from 1890 to present day. EV merged into HEV (hybrid electric vehicle). In the future, the HEV may become EV.

VEHICLE DEVELOPMENT TREND



Shift in types of vehicles in the future as petroleum supplies diminish

Source: Allen Fuhs, 2009,Hybrid vehicles and the future of personal transportation, CRS Press, Tayler &Francis Group

CONCLUSIONS

- Fossil fuel resource is finite and it will run out. That is; rate of oil production can never increase and production will decrease over time.
- In future, there will be either hydrogen vehicle or electric vehicle.
- Hybrid vehicles are the intermittent solution to meet the stringent vehicle emission standard, reduce fuel consumption and reduce GHG emissions.
- Introduction of hybrid vehicles and efficient electric vehicles is to be initiated in Nepal with the generation of more electricity from hydropower.