Analysis of Implementation Measures in the Transport Sector at the National Level

2nd Workshop of "Assisting Developing Country Climate Negotiators Through Analysis and Dialogue: Phase II"

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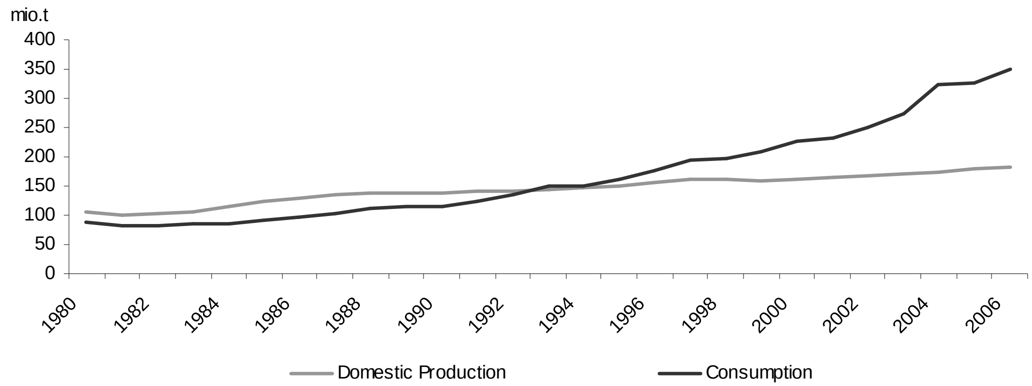
Review to Phase I results and motivation of a fuel economy standard

The energy supply situation requests the automobile control oil consumption



Source: LBL (2004), BP (2006,2007).

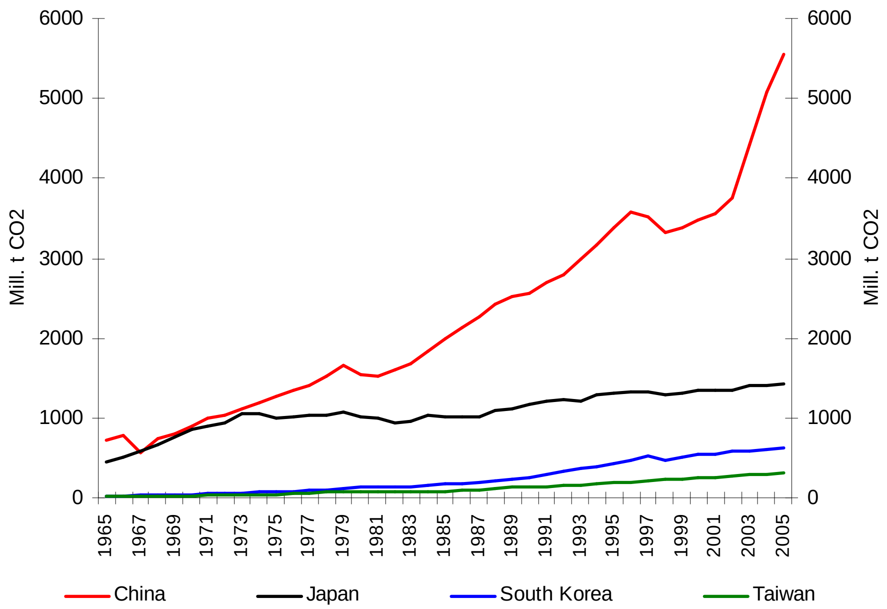
Production/Consumption 1992
142.1 mio. t/135.5 mio. t

Production/Consumption 2006
183.7 mio. t/349.8 mio. t

➢ Primary reason for a fuel economy standard

Review to Phase I results and motivation of a fuel economy standard

The Greenhouse effect requests the automobile to reduce the oil consumption



CO_2 emissions:
1980: 1538 mio. t
2005: 5300 mio. t

In 2000 the road transport sector was responsible for almost 8% of the total CO_2 emissions.

- Emission reduction is not the primary reason for a fuel economy standard

Review to Phase I results and motivation of a fuel economy standard

- How to define "Standard" and how to deal with it

Define it as:	**Policy**	**Technology**
Research area/ focus:	- Implication to CO_2 reduction - Implication to co-benefits - Barriers of implementation - What does the implementation of this policy cost - Which potentials bring the implementation? For Phase II As well as ↓ for an extension of the areas of application (fuel economy standards for HDV, LDB, LDT)	- Which policy is best to promote this technology ↓ Need to identify different types of policies

Course of Action

Objects of Phase II have been:

- An analysis of the effects on energy security,
- The implication on CO_2 reduction,
- Further Co-Benefits,
- An analysis of the costs of implementation, and
- Finding barriers of implementation

Primary Effects on Energy Security

- **3 Scenarios:**

  - BAU scenario: - no standard is considered

  - Scenario 1: - fuel economy standard for LDV & passenger cars Phase I + II
    - Phase 1: 7/2005 Phase 2: 1/2008 (for passenger cars)
    - Phase 1: 2/2008 Phase 2: 1/2011 (for LDV)

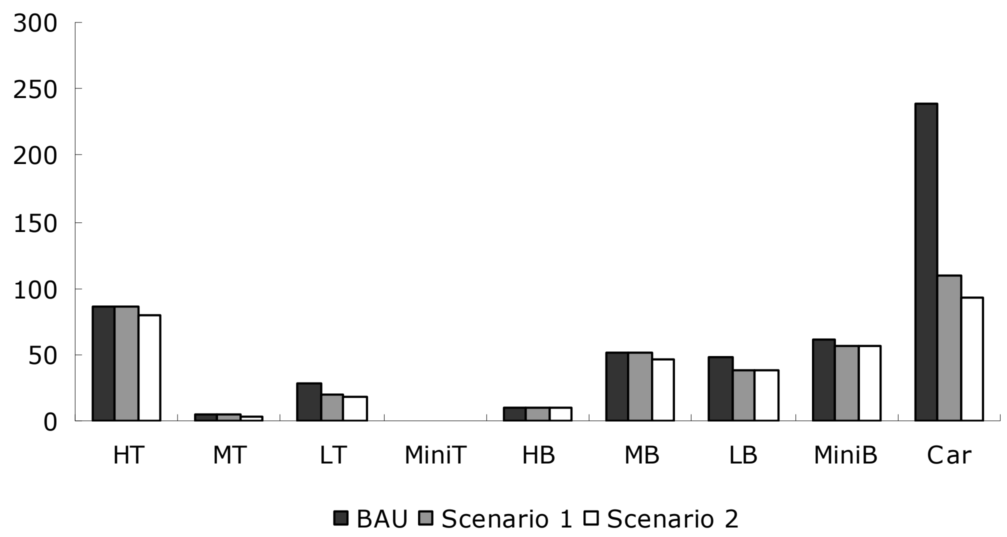
  - Scenario 2: - fuel economy standard for HDV as well as Phase III for LDV and passenger cars
    - Phase 3: 1/2012 (for passenger cars)
    - Phase 3: 1/2015 (for LDV)
    - Phase 1: 1/2015 (for HDV) (conservative assumption of 10%)

Primary Effects on Energy Security

- Energy Security (till 2030)
  - Oil Consumption in BAU-Scen. = 529.761 mio. tones
  - Oil Consumption in Scenario 1 = 375.678 mio. tones
  - Oil Consumption in Scenario 2 = 343.085 mio. tones

-29,1%

-35.2%



$$OC = \frac{1}{FE_{c,f}^{t}} * TM_{c,f}^{t} * VP_{c,f}^{t} * D_{f}^{t}$$

FE = fuel economy
TM = annual average traveled mileage
VP = vehicle population
D = fuel density in kg/l
c = vehicle category (HT, MT, HB, etc.)
f = fuel type (gasoline, diesel)
t = time period/year

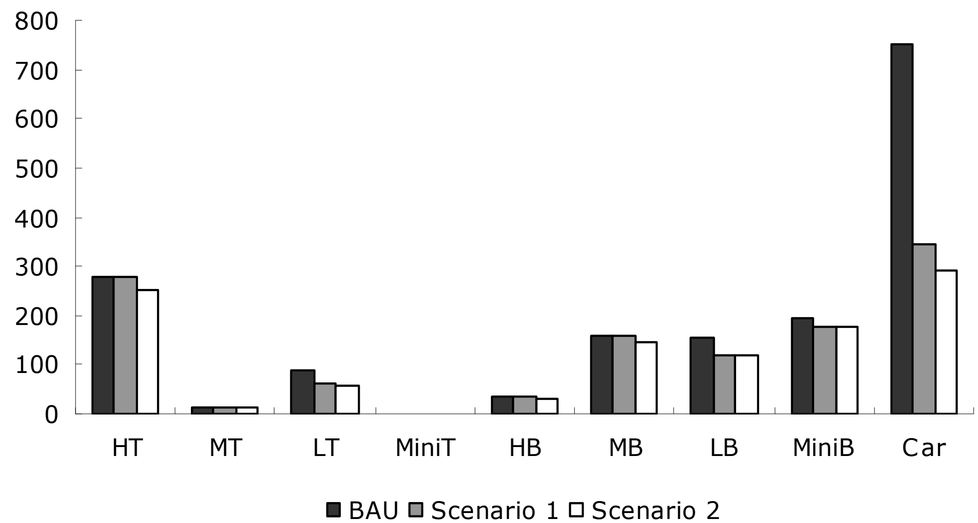
Oil Consumption in mio. tons

Implication on CO_2 Reduction

- Implications on CO_2 reduction
  - CO_2 emission in BAU-Scen. = 1672.546 mio. tons
  - CO_2 emission in Scenario 1 = 1188.002 mio. tons
  - CO_2 emission in Scenario 2 = 1084.937 mio. tons

-29.0%

-35.1%



$$CO_2 = OC^t_{c,f} * \frac{44}{12} * CC^t_f$$

OC = oil consumption
CC = carbon content of fuel in %
T = time period/year
C = vehicle category (HT, MT,HB, etc.)
F = fuel type (gasoline, diesel)

Health Benefits

Epidemiological research into air pollution has shown that air pollution is damaging to human health:

Carbon Monoxide:	reduces the flow of oxygen in the bloodstream
Hydrocarbons:	react in the presence of nitrogen oxides and sunlight to form ground-level ozone (irritates the eyes, damages the lungs, aggravates respiratory problems)
exhaust hydrocarbons:	some are toxic and can cause cancer

- improvement in air quality will save lives
- WHO estimate (0.5 % - 1 % additional daily deaths for every 10μg/m3 increase in daily ambient concentration of particles smaller than 10μm
- *Vennemo et al.* found out that the median of all studies is 70 and the percentiles 34 and 161

Health Benefits

- ***between 34 and 161 lives can be saved for each million ton of CO_2 reduced in China***

Saved lives till 2020:

Scenario 1: 7,900 – 37,300

Scenario 2: 9,300 – 44,000

Saved lives till 2030:

Scenario 1: 16,500 – 78,000

Scenario 2: 20,000 – 94,600

Monetary Benefits

Monetary effects can be divided in ***direct*** and ***indirect*** effects

Direct effects:

can be measured by means of the market prices of the reduced amount of consumption

Indirect effects:

impacts can be translated into estimates of monetary benefits by using impact assessment models to value the effects and benefits on

- *higher agricultural yields* (valued at market prices)
- *less corrosion* (valued by costs of maintenance and avoided repairs)
- *less wear and tear of buildings* (valued by costs of maintenance and avoided repairs)
- *hospital admissions, outpatient visits and lighter cases of disease* (valued by an estimate of real resources spent, on medicines, doctor's time and, an appropriate share of hospital's capital costs

Monetary Benefits

i) Health Benefits

How much is saving a life worth?

Given the estimate obtained above of 34–161 lives saved per million ton CO_2, and using 1 million RMB to illustrate the value of a statistical life saved (Vennemo et al. 2006: 222,223):

34 and 161 million RMB are saved per million ton CO_2

	Scenario 1	Scenario 2
2020	7.9 – 37.3 billion RMB	9.3 – 44.0 billion RMB
2030	16.5 – 78.0 billion RMB	20.0 – 94.6 billion RMB

Monetary Benefits

ii) Saved oil imports

Assumed barrel price for crude oil: 100 US$ (in our calculation in December 2007)
130 US$ (in June 2008)

100US$-Scenario

	Scenario 1	Scenario 2
2020	US$ 54 billion	US$ 63.7 billion
2030	US$ 112.95 billion	US$ 136.85 billion

130US$-Scenario

	Scenario 1	Scenario 2
2020	US$ 70.23 billion	US$ 82.8 billion
2030	US$ 146.84 billion	US$ 177.9 billion

Costs of Implementation

2 different approaches to calculate the implementation of a fuel economy standard

Technological Approach

- Costs of development of technologies
- Production Costs

Political Approach

- Costs of the policies which are necessary to support a fuel economy standard
  - i) Fuel taxes and fees
  - ii) Vehicle taxes and fees
  - iii) New vehicle incentive programs

Costs of Implementation

Technological Approach

In Phase I report we refered to *Huo 2002* and her recommendations about costs and benefits of efficient technologies.

6 years after her publication and after the implementation of Phase I of the fuel economy standard the share of models using upgraded technology changed

	2002 models	2006 models
Multi-Valve	37 %	85 %
Variable valve system	1.5 %	20 %
Electronic throttles	0 %	56 %
Roller rocker/arm oil tappet	0 %	9 %
Aluminum material	10 %	40 %
4MT	24 %	2 %
5MT	55 %	65 %
6MT	0 %	4.5 %
4AT	11.5 %	25 %
5AT	3 %	9 %
6AMT	0 %	5 %

Source: Tian, Guo, Zhang 2007 p. 102.

Costs of Implementation

In the next 5 – 20 years the focus will lie on a wider use of the recommended engine- and transmission technologies as well as on a further development of:

- GDI engines
- Homogeneous Charge Compression Ignition (HCCI)
- Hybrid technologies, and
- Fuel Cells

Costs of Implementation

	Potentials/Costs			
	Tian, Guo, Zhang		EPA	
Engine Technologies				
GDI	10-15 %	3500 RMB	-	-
- Stoichiometric	-	-	-	122-525 US$
- Lean Burn	-	-	-	750 US$
HCCI	10-20 %[1]	3000 US$[1]	-	-
Hybrid Technology	20-40 %[1]	$^{1}/_{3}$ of total costs of a car[1]	-	-
- Integrated Starter Generator w/idle-off	-	-	7.5 %	563-600 US$
- Integrated Motor Assist (IMA)/Integrated Starter-Alternator-Dampenser (ISAD) hybrid	-	-	-	2477-3153 US$
- Two-Mode Hybrid	-	-	40 %	4655 US$
- Power-Split Hybrids	-	-	35 %	3754 US$
- Plug-in Hybrids	-	-	-	4500-6750 US$
Fuel Cell	Depends on the fuel	2000 US$/kW[2]		

Costs of Implementation

Political Approach

i) Fuel taxes and fees

- Gasoline and diesel tax
- Carbon taxes

➢ Imposing fuel tax will excite the demand for energy-saving engines and thus promote the development and application of upgraded engines

ii) Vehicle taxes and fees

- Annual Vehicle Attribute-Based Taxes and Fees
- Tax/Fee Reduction or Exemptions for New Clean Efficient Cars

iii) New vehicle Incentive programs

- Rebates
- Fees
- Feebates

→ With more than 2.5 million new registered cars per year since 2004 these incentive programs seems to be the most effective one for China if it comes to the impacts to fuel economy standard.

Costs of Implementation

- Focus of the report are the New Vehicle Incentive Programs and their effects and costs

- Rebate
- offer cash back or a credit to those who buy better-performing vehicles M26
- exemptions from motor vehicle fees
- tax reduction

- Fee
- targeted fees impose costs only on poorly-performing vehicles
- result in the net collection of new funds, as do taxes
- the level of fees determines their effectiveness

- Feebate
- combining fees and rebates M27
- policy design adheres to the "polluter pays" principle
- work best when there is a large selection of vehicles to choose from M28
- aim of feebates is to shift consumer purchase decisions on the margin throughout the market

Slide 20

M26 can apply to consumer, manufactures, bussinesses
Matthias, 7/11/2008

M27 “fees” (costs imposed discouraging use of inferior goods) and “rebates” (rewards subsidizing purchase of better products)
Matthias, 7/11/2008

M28 If a greater number of “best-in-class” vehicles were purchased, overall fuel economy would increase dramatically
Matthias, 7/11/2008

Costs of Implementation

	No Policy	Gas-Guzzler Fee ($1000 per 0.01 GPM)	Gas-Guzzler Fee ($2000 per 0.01 GPM)	Feebate ($500 per 0.01 GPM)	Feebate ($1000 per 0.01 GPM)	Rebate ($500 per 0.01GPM)
Cars (mpg)	**28.3**	**31.6**	**31.8**	**31.8**	**35.2**	**28.7**
Light trucks (mpg)	**21.8**	**25.1**	**25.1**	**26**	**29.2**	**22.4**
Total (mpg)	**25**	**28.3**	**28.4**	**28.9**	**32.3**	**25.5**
Consumers' surplus						
Governm. Expenditures	**$0**	**$0.2**	**$0.2**	**-$0.1**	**$0.1**	**-$0.8**
Changes in Sale (%)	**0**	**-0.6**	**-0.6**	**-0.5**	**-1.6**	**0.2**
Fuel Saved/vehicle (gallons)	**126**	**684**	**694**	**773**	**1195**	**223**
Total fuel savings	**$3.10**	**$16.9 (445.16%)**	**$17.1 (451.61%)**	**$19.1 (516.13%)**	**$29.2 (841.94%)**	**$5.5 (77.42%)**
Societal Value	**$2.30**	**$12.4 (439.13%)**	**$12.6 (447.83%)**	**$14.0 (508.70%)**	**$21.4 (830.43%)**	**$4.1 (78.26%)**
Manufactures' revenue	**$1.40**	**$1.1 (-21.43%)**	**$0.7 (-50.0%)**	**$1.5 (7.14%)**	**$0.4 (-71.43%)**	**$1.7 (21.43%)**

Billion dollars

Costs of Implementation

- key advantage of feebates is that they provide an on-going incentive to increase fuel economy as new technologies are developed
- Other vehicle fuel economy policies, including gas taxes, gas-guzzler taxes, may not be as effective as feebates at increasing vehicle energy efficiency because they are less dynamic tools

Why?

- Consumers tend to under-value fuel savings, but accurately reckon vehicle prices in their purchase decisions.
- Manufacturers tend to accurately weigh the costs and benefits of increasing miles per gallon so as to avoid fees and capture rebates.

Barriers of implementation

- For passenger cars *(past and current)*
  - no control on imported cars > super vision problem
  - production level of local producers is not high enough
  - problem of consistency > cars for testing vs. produced cars

- For LDV
  - standard is more complex for LDV than for passenger cars
  - mostly trucks (light and mini trucks) which are in general local produced
    - > no import of production line possible > technical barrier
    - > no clear structure of stakeholders > bureaucratically barrier

  Stakeholders: State Council, NDRC, Ministry of Transportation, Ministry of Transport, Ministry of Public Security

- For HDV
  - time consuming
    - > testing method takes 2 years
    - > establishment takes around 5 years

- in General
  - no institution controls the "on road" fuel economy
  - NDRC is the only institution that is involved in the implementation of the standard

Thank You

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