China Operations

Alternative Fuel Vehicles for China

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Why Alternative Fuels

- **Energy security concerns, the original drive of alternative fuels in China**
  - Rapid increment of importation of crude oil predicted
  - Non-balance of regional energy supplies
- **Environment concerns**
  - Urban air quality deterioration
  - Global warming

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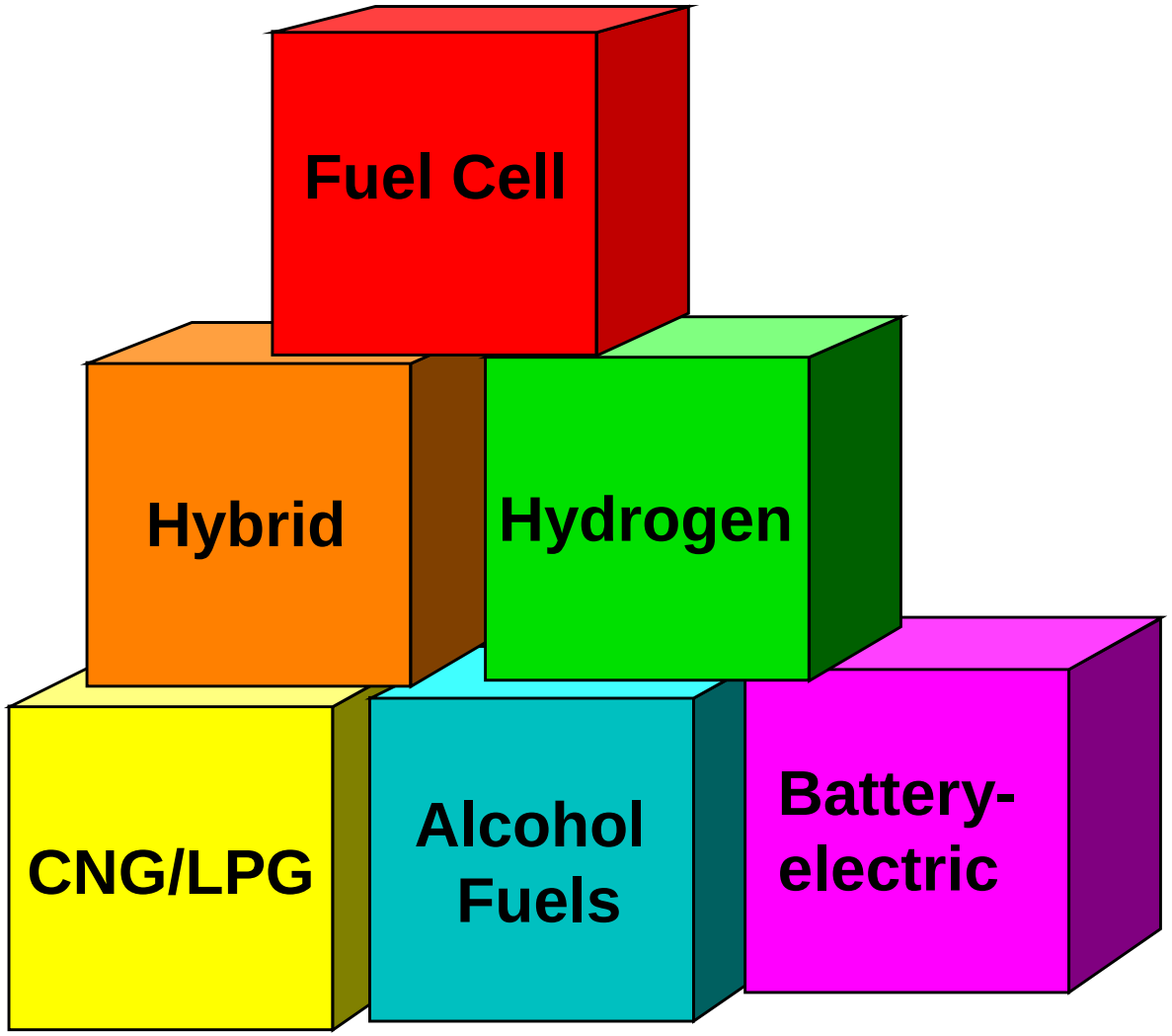
Options of AFV



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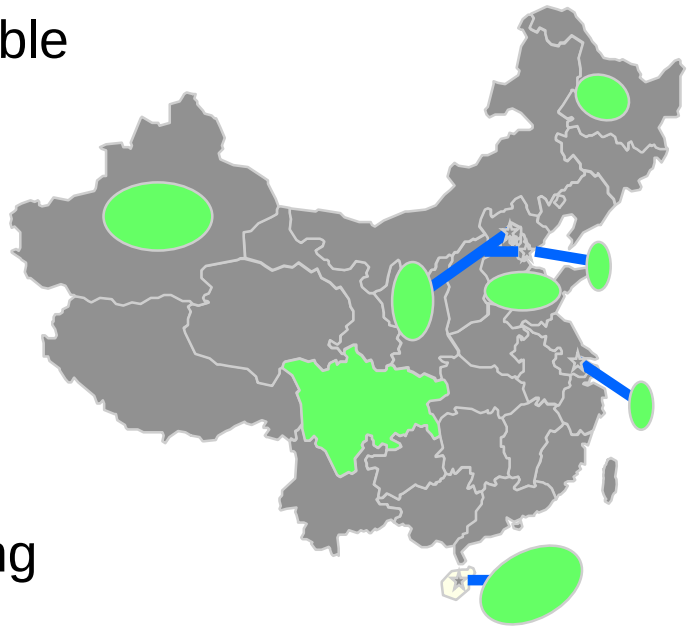
GM's AFVs

GM ALTERNATIVE FUELS

- **Alternative fuels for conventional IC engines**
  - CNG
- **Advanced vehicle propulsion technologies**
  - Battery-electric vehicles commercially available
  - Hybrid (EV/Gasoline) propulsion vehicles
    - Serial propulsion system
    - Parallel propulsion system
  - Fuel cell vehicles

CNG Vehicles

- **Advantages**
  - Potential to reduce tailpipe emissions to 1/10 of California ULEV standard
  - Technology commercially available
  - Beneficial to energy structure
  - Better fuel economy
  - Affluent reserve in China



- **Disadvantages**
  - Extra cost for CNG system
  - Lack of Infrastructure for refueling

Electric Vehicles

- **Advantages**
  - Zero emission vehicles
  - Compact propulsion system
  - Beneficial to peak-valley conflict of power capacity
- **Disadvantages**
  - Short range
  - Battery: short lifetime and durability, high cost
  - Lack of quick charge station.
  - Emission from power station

Hybrid Electric Vehicles

- **Advantages**
  - High energy efficiency
  - Lower emission
  - Longer range
  - Low dependency on charge station

- **Disadvantages**
  - Complex with two propulsion systems
  - Higher cost

Fuel Cell Vehicles

- **Advantage**
  - Meet ULEV, almost zero emission
  - High energy efficiency
  - Better fuel economy
  - Competitive range

- **Disadvantage**
  - Technology not meet commercial stage

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Best Choice Now

	Emission	Fuel Economy	Range	Performance	Cost	Commercial Availability
CNG	***	***	****	*****	****	*****
EV	*****	**	*	**	*	***
HEV	****	****	*****	****	**	***
Fule Cell	*****	*****	*****	*****	****	*

Worst * / Best *****

- Fuel cell is the most promising technology, but not ready for commercial production
- So far, CNG and HEV are the best choice with mature technology

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Gov't Effort on AFV

- China top leaders alert the attention of environmental/sustainable development
- Government strongly encourage CNG application with MST takes lead
- Approved 12 demo cities for CNG/LPG
- arrange dozens of seminars/meetings for AFV
- aggressive upgrade big city public transportation/taxi into CNG/LPG
  - Shanghai will convert all taxi to bi-fuel vehicle
  - Beijing will convert more than 10,000 taxi to bi-fuel vehicle

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CNG Development in China

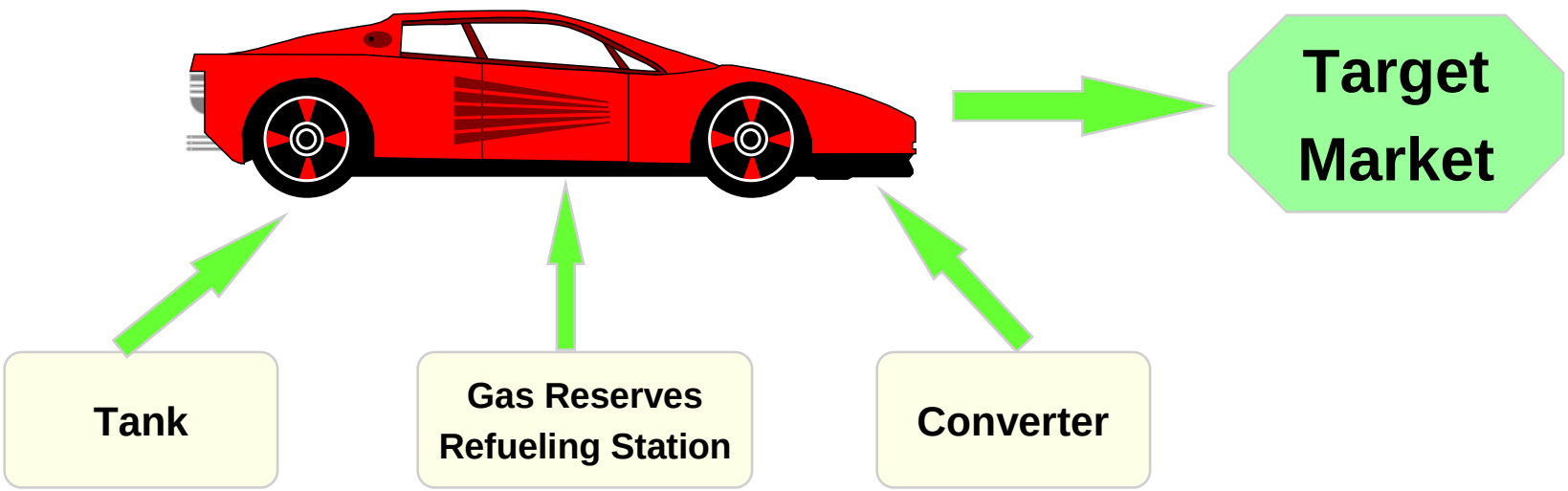
Anticipated CNG Development in 12 Demo Cities

	Volume of CNGV (OEM&Aftermarket)		CNG Refueling Station	
City	By 2000	By 2010	By 2000	By 2010
Beijing	3,000	100,000	40	500
Chongqing	10,000	90,000	66	450
Sichuan Prov.	10,000	50,000	70	300
Shanghai	50	50,000	1	300
Xi'an	1,000	20,000	15	100
Urumqi	1,000	5,000	5	20
Harbin				
Changchun	1,000	10,000	11	40
Tianjin	2,000	40,000	15	300
Guangzhou				
Shenzhen				
Hainan Prov.	5,000	35,000	25	100
Total	**33,050**	**400000**	**248**	**2110**

- CNG vehicle and refuel station will increase sharply in the next 5 years.
- A lot of taxi drivers are pleased to switch from gasoline to LPG/CNG bi-fuel because of the better fuel economy.

GM CNGV Activity in China

- **SGM, GM China and IMPCO jointly developed a CNG/gasoline bi-fuel vehicle.**
  - California LEV compliance
  - Almost equivalent performance to gasoline drive
  - Easy CNG/gasoline switch
  - Will be shown on Beijing IAEP Tech PSE in Dec.



Importance of OEMs

- **Voice of Customers**
  - Safety
  - Range
  - Performance
  - Quality/Durability
  - Refueling
- **To meet the customers' requirement such as the safety, reliability and after-sale service, OEM must involve in the AFV development.**
  - Canada, after 28 years experience, realizes that to retrofit cars by AF system suppliers is not a smart way. No warranty of safety, no warranty of reliability. OEMs should lead the developing and retrofitting.

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GM EV Activities in China

- **1995**
  - GM signed cooperation agreement with SSTC
- **1996**
  - Vehicle usage and infrastructure surveys
  - Partnership development with Guangdong STC, Tsinghua Uni., etc.
- **1997 to 1998**
  - Contract Tsinghua University for EV battery gauge development program
  - Participate Guangdong EV Demonstration Program
    - 3 Electric S-10 Pick-up trucks and 2 EV1's
    - Training offered to local engineers
- **1999**
  - Donate one S10E pickup to CAS for jointly study/test

GM EV Activities in China (Con'd)

- **What we are learning ...**
  - Gov't support is the key factor to ensure the success of the project.
  - Running EVs in China requires ample technical support
  - Service and Parts are also critical
  - Lead-acid batteries do not like very warm weather
  - Range problem will limit big cities and inter-city transportation use.

Recommendations

- **More support from government, such as**
  - Preferential tax on alternative fuel, such as CNG
  - Tax incentives for AFV manufacturing and purchasing
  - Ease on AFV registering
  - Privileged policies to encourage related enterprises to establish CNG and LPG refueling stations
  - Free custom duties for equipment and conversion kits for refueling stations and CNGV&LPGV
  - Strengthen the cooperation with foreign company to share advanced technology and experience