

China's Medium to Long-term Renewable Energy Development Plan -- Promotion of Bio-ethanol Introduction and Future Strategic Developments¹ --

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Introduction

China launched the test introduction of ethanol-mixed gasoline called E10 for automobiles in five cities in Henan and Heilongjiang Provinces in April 2002. At present, E10 diffusion is taking place in five provinces and 27 designated cities in four other provinces. The Department of Industry at the National Development and Reform Commission (NDRC) presented to the State Council's National Energy Leading Group a report² on the evaluation of auto ethanol test projects and industrial development of bio-ethanol fuel and the group gave a high rating to the report. Relevant parties interpreted the rating as the central government's green light and have started a plan to positively introduce bio-ethanol fuel.

In a bid to make its bio-fuel introduction promotion policy clearer, the Chinese government specified the bio-fuel industry as a priority development area in its medium to long-term renewable energy development plan and the 11th five-year (2006-2010) development plan³. NDRC Energy Bureau Director General Xu Dingming⁴ came up with a plan to boost renewable energies' share of primary energy demand to 16%⁵ by 2020. The annual demand target toward 2020 is set at 100 million tons for bio-ethanol and at 2 million tons for bio-diesel. The plan calls for three phases to promote bio-fuel.

Many studies have identified reasons for the Chinese government to strategically promote its bio-fuel policy. This report's objective is to clarify the position of bio-fuel in

¹ This report analyzes the recent developments and future government policy regarding ethanol-mixed gasoline in China, based on the author's "Current Status and New and Renewable Energies in China – Introduction of Fuel Ethanol" as put on the IEEJ website in January 2006.

² The report was titled in Chinese: "The evaluation of auto ethanol test project and further step on bio-ethanol industries development".

³ The policy was specified in a notification of opinions on the implementation of energy-saving measures in 10 priority areas under the 11th five-year development plan. The notification, which was released by the NDRC and seven other government agencies on July 25, 2006, specified energy-saving measures in 10 policy areas including the alternative fuel policy that cited bio-ethanol and bio-diesel for priority development.

⁴ In July 2006, Mr. Zhao Xiaoping took up the NDRC Energy Bureau director general post. Mr. Xu still serves as deputy director general of the National Energy Leading Group Office.

⁵ "Raising renewable energies' share to 16% by 2020," *People's Daily Online*, 6-17-2006. Then NDRC Energy Bureau Director General Xu Dingming unveiled the plan at a forum in Beijing on China's commercialization of renewable and new energies. See http://j.peopledaily.com.cn/2006/06/18/jp20060618_60678.html

the renewable energy policy, barriers against the bio-fuel promotion and future developments of the bio-fuel policy.

1. Evaluation of ethanol introduction projects in past 5 years

How has the Chinese government evaluated the introduction of ethanol fuel in the past five years? On May 10, 2006, the NDRC Department of Industry compiled details about the ethanol fuel introduction in the past five years into a report⁶ on the evaluation of auto ethanol test projects and industrial development of bio-ethanol fuel and submitted the ethanol introduction report to the State Council's National Energy Leading Group. The group gave a high rating to the past achievements. Based on the ethanol introduction report, the NDRC Department of Industry called on more than 50 representatives from governments, economic and trade commissions of nine provinces implementing the E10 project, China National Petroleum Corporation (CNPC), China Petroleum & Chemical Corporation (Sinopec) and four companies⁷ designated for bio-ethanol production. Based on their discussions and opinions, the division compiled proposals on the development of bio-ethanol fuel. Among the proposals are:

The government should lead the development of bio-ethanol production as a new strategic industry and commercialize bio-ethanol gradually.

The government should **expand the E10 introduction to cover Beijing, Shanghai and Tianjin** and should increase bio-ethanol **production capacity to 6 million tons a year** during the 11th five-year development plan between 2006 and 2010.

Bio-ethanol should have **spillover effects on agriculture-related industries** and contribute to industrializing agriculture and boosting farmers' income.

The government should promote the **development of new technologies** and secure **environmental conservation**.

CNPC and Sinopec should take the leadership in expanding the bio-ethanol industry. Government subsidies should be reduced to liberalize the industry.

NDRC Department of Industry Deputy Director General Xiong Bilin sought stakeholders' cooperation in four proposals: enhancing the future balance between bio-ethanol production and demand, in four provinces including the 27 cities designated for the introduction of ethanol fuel, local governments should implement

⁶ Refer to footnote 2.

⁷ China Resources Alcohol Co., Ltd. of Heilongjiang Province, Jilin Fuel Ethanol Co., Ltd. of Jilin Province, Henan Tianguan Fuelethanol Co., Ltd. of Henan Province, and Anhui BBKA Biochemical Co., Ltd. of Anhui Province have been designated to produce auto ethanol fuel by the end of 2005.

province-wide ethanol fuel diffusion efforts, CNPC and Sinopec should maintain E10 production, supply and sales market order, and the designated bio-ethanol fuel production companies should develop new production technologies to improve the economy of bio-ethanol and energy-saving performances.

On 30th June 2006 after the above discussions, NDRC Department of Industry Deputy Director General Xiong Bilin chaired a meeting to consider a bio-ethanol-mixed gasoline project. At the meeting, stakeholders' opinions were integrated into a consensus that "the ethanol fuel introduction project can be rated high in terms of technology, economy and public welfare and will contribute to sustaining China's development and stabilizing a clean energy system for economic development." The participants in the meeting agreed that the NDRC department should play a central role in promoting cooperation between stakeholders to further expand the ethanol industry.

2. Bio-fuel diffusion policy

(1) Position of bio-fuel policy in medium to long-term renewable energy development plan

According to an announcement by NDRC Energy Bureau Director General Xu Dingming as discussed above, the target for renewable energies' share of primary energy demand is set at 10% for 2010 and at 16% for 2020. Mr. Xu's remarks and NDRC releases on the plan are summarized in Table 1.

Table 1 China's medium to long-term renewable energy development plan (2020)

Energy Sources	Unit	2010	2020
Total Primary Energy Supply (TPES)	Million tce	2,700	3,310
Renewable Energy Share of TPES	%	10	16
Total Renewable Energy Consumption	Million tce	270	530
Hydro	Thousand MW	180.0	300.0
Wind	Thousand MW	5.0	30.0
Photovoltaic	Thousand MW	0.3	1.8
Biomass Generation (Agriculture & Forestry)	Thousand MW	5.5	30.0
Solar Water Heater	Million m ²	150.0	300.0
Biogas	Billion m ³	19.0	48.0
Solid biomass fuel	Million tones	10.0	50.0
Bio-ethanol	Million tones	2.0	10.0
Bio-diesel	Million tones	0.2	2.0

Note The target of bio-ethanol and bio-diesel is difference by source.
Sources: Xinhua News Agency 6-20-2006, Zhong Guo Dian Li Bao (China Electric Power News) 6-25-2006

The medium to long-term renewable energy development plan calls for the promotion of all major renewable energies. It features specific targets for the diffusion of bio-fuel. In China, renewable energies, though still designed for rural electrification, are becoming a strategic factor as alternative energy sources for energy security.

(2) Strategic implementation of bio-fuel policy

Through experimental introduction and diffusion projects for bio-ethanol fuel, relevant people in various areas have begun to support the introduction of bio-ethanol fuel. In response, the central government is planning to include bio-fuel as a key policy tool into its national energy policy. But how to secure materials for ethanol fuel production has become a major problem regarding the diffusion of bio-ethanol fuel. As discussed above, the stakeholders' proposal given to the central government states that annual ethanol production could be expanded to 6 million tons by 2010 even under the present food production conditions. In its medium to long-term renewable energy development plan, however, the central government sets an ethanol production target at 2 million tons for 2010. The target for 2010 is put at 5 million tons in the "bio-ethanol utilization plan" that is reportedly expected to be announced in late 2006 for the 11th five-year development plan. These different targets indicate that stakeholders' bargaining over the ethanol fuel introduction is still going on within the central government.

At a committee on alternative energy research⁸ that the NDRC Energy Bureau launched in December 2005, an argument says the diffusion of ethanol fuel should be expanded in a manner to pose no threat to the national food supply and land utilization. The NDRC has acknowledged that a new policy should be established for supply of non-food ethanol materials (cassava, sorghum, sugarcane, sweet potato, etc.) as the ethanol fuel production system that competes with food production could affect food supply. In this respect, the NDRC has announced a three-phase bio-fuel policy development plan including the development of technologies utilizing cellulose plants.

- Phase 1 (11th 5-year plan 2006-2010): Commercializing technologies
- Phase 2 (12th 5-year plan 2011-2015): Expanding production capacity
- Phase 3 (13th 5-year plan 2016-2020): Expanding diffusion on a full-fledged basis

⁸ The NDRC launched this committee under instructions from the State Council on December 28, 2005, to work out a future policy for development of alternative energies in China. Its deliberations continued until September 2006. Within 2006, the committee was scheduled to iron out an alternative energy policy and recommend specific policy measures to the central government.

- Bio-ethanol fuel utilization targets

2005 (actual): 1.02 million tons (about 1,292 million kl)⁹
2010 : 2.00 million tons (about 2,534 million kl)¹⁰
2020 : 10 million tons (about 12,668 million kl)

- Bio-diesel fuel utilization targets

2005 (actual): about 60,000 tons
2010 : 200,000 tons
2020 : 2 million tons

For the immediate future, the bio-fuel policy development plan calls for surveying and reassessing crop acreages and working out energy crop productions plans, implementing large-scale production tests for bio-fuel made from energy crops other than farm products for basic foods, developing bio-fuel law and distribution systems and developing bio-fuel technologies and establishing a bio-fuel industry system. These measures are cited as those that should be carried out promptly.

The Chinese government has designated alternative energies for priority development under the 11th five-year development plan in a bid to enhance policy support for biomass and coal conversion technologies.

**(3) Interim law for financial support for renewable energy development¹¹
(financial support)**

The central and local governments have so far provided financial support for the expansion of the ethanol industry. The interim law for financial support for renewable energy development, as announced on June 16, 2006, made it clear that financial support priority should be given to a bio-fuel industry using non-food energy crops¹². Particularly, bio-ethanol and bio-diesel are rated high as alternatives to oil. There is a consensus that national campaigns should be implemented to promote these alternative energies. Relevant financial support includes the following two measures:

Free loan

- Free loans cover projects for developing standards in new areas.

⁹ The tonnage figure was converted into kiloliters, based on the ethanol density of 0.789 g/ml.

¹⁰ Discussions are going on concerning a plan to raise the target to 5 million tons for 2010.

¹¹ The interim law for financial support for renewable energy development is one of the regulations for the China renewable energy law established on May 30, 2006.

¹² The interim law for financial support for renewable energy development, as announced on June 16, 2006, calls for giving financial support priority to projects for utilizing renewable energies for three areas (alternative energies to oil, air-conditioning systems for buildings and electricity generation).

- If total project cost exceeds a free loan ceiling, the excess may be born by project investors.

 Preferential loan

- Preferential loans may mature in one to three years and carry interest rates of not more than 3%.

3. Future Challenges

(1) Enhancement of production capacity

The central government has given bio-ethanol production licenses to four companies that have been designated for such production. At the end of 2005, the four companies' annual production capacity totaled 1.02 million tons. The 27 municipalities (in four provinces – Shandong, Jiangsu, Hebei and Hubei), which have already introduced bio-ethanol, have also been trying to diffuse E10 throughout the four provinces. At the same time, the government is considering designating cities in other provinces than the four for the bio-ethanol introduction. The government is reportedly expected to give ethanol fuel production licenses to several more companies to meet regional demand that is certain to increase in the future. Several major ethanol producers, including CNPC as well as China National Cereals, Oils and Foodstuffs Import and Export Corp. (COFCO), the largest Chinese food trader, are working with the government energetically to obtain ethanol fuel production licenses.

We must pay attention to the engagement of CNPC and Sinopec with ethanol production. The two oil companies have invested in the four companies designated by the central government for ethanol production or have been involved in some ethanol production plans. Particularly, CNPC has been positively working to enter an upstream sector for ethanol fuel, as indicated by former CNPC President Ma Fucui's inspection of cassava production in Guangxi Autonomous Region. Mr. Ma now serves as vice minister for the Office of the National Energy Leading Group. Since cassava is not a food crop for China, one may focus attention on cassava as an energy crop and strategically utilize cassava that is produced widely in Guizhou and Guangdong Provinces and Guangxi Autonomous Region in southern China. In cooperation with Guangxi COFCO Biomass Energy Co., Ltd., a COFCO subsidiary, CNPC has started the construction of a bio-ethanol production plant with an annual production capacity of 200,000 tons (Phase 1) in a coastal economic development zone of Nanning, Guangxi Autonomous Region. NDRC has already approved the project where production will be expanded. In fact, the government of Guangxi Autonomous Region plans to boost the

region's annual production capacity for cassava-based ethanol fuel to 500,000 tons¹³ by 2010. The regional government has finalized the plan and is waiting for a go-ahead from the central government.

Table 2 Chinese ethanol producers' capacities

	Location	Company Name	Main Material	Ethanol Production Capacity (10,000 tones/year)		
				2005	2006	2007 ~
Designated	Heilongjiang	China Resources Alcohol Co., Ltd.	Maize	10	37	37
	Jilin	Jilin Fuel Ethanol Co., Ltd.	Maize	30	44	60
	Henan	Henan Tianguan Fuelethanol Co., Ltd.	Wheat	32	50	50
	Anhui	Anhui BBCA Biochemical Co.	Maize	30	44	44
Planned	Jilin	Jilin Tuopai (a joint venture with Jilin Fuel Ethanol)	Maize	4	4	4
	Guangxi	Guangxi COFCO Biomass Energy Co., Ltd. (Nanning)	Cassava	-	-	20
	Guangxi	Guangxi COFCO Biomass Energy Co., Ltd. (Guigang)	Cassava	-	-	20
	Hebei	China National Cereals, Oils and Foodstuffs Import and Export Corp. (COFCO)	Sweet potato Maize	-	-	30
	Hubei	Henan Tianguan Fuelethanol Co.	Sweet potato	-	-	10
	Inner Mongolia	China National Cereals, Oils and Foodstuffs Import and Export Corp. (COFCO)	Maize	-	-	30
	Inner Mongolia	Shuntong Biotechnology Co.,Ltd	Maize	-	-	10
	Guangdong	Qingyuan Longtang Town Jinsha Industrial Zone	Cassava Sugarcane	-	-	10
				Total	106	179

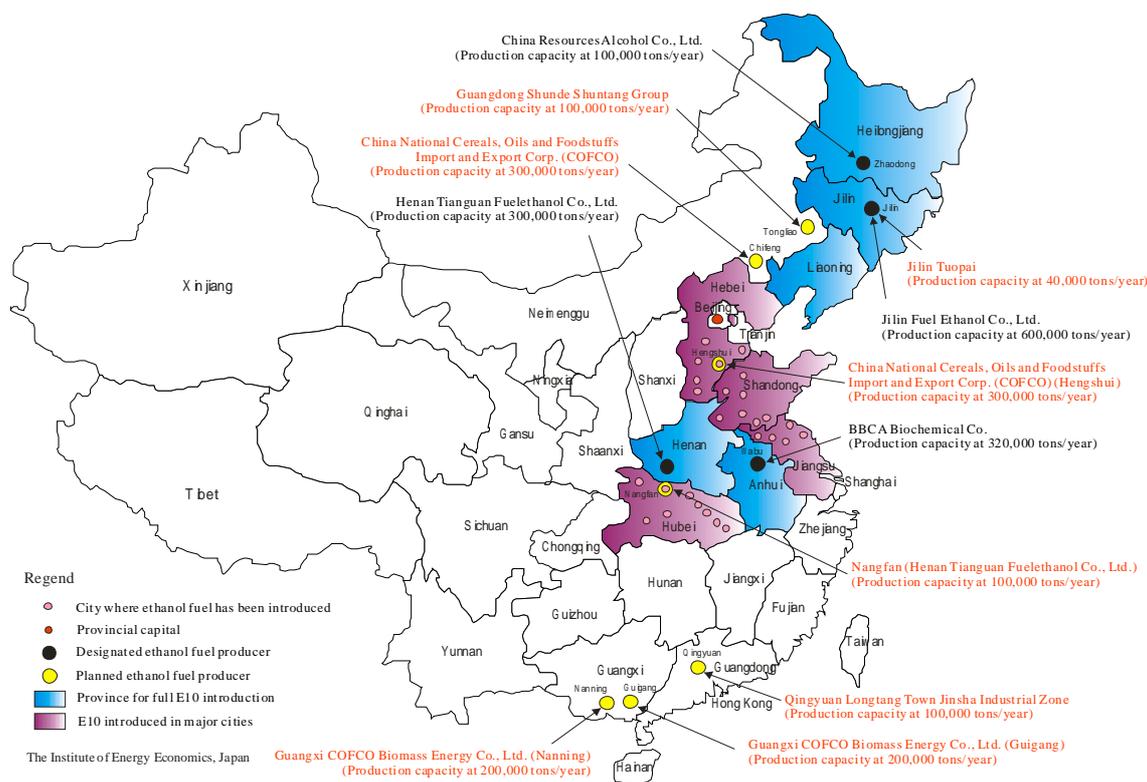
Source: The author compiled the table based on various materials.

The central government had originally planned to produce ethanol fuel using degraded food. However, the four designated ethanol producers have faced difficulties in securing ethanol materials as food inventories have recently declined fast. Henan Province's Tianguan Fuelethanol Co., Ltd. is implementing an ethanol material supply strategy including plans to secure 133,000 hectares of farmland for maize by 2007 and produce cassava at a 50,000-hectare leased farm in Laos. In a bid to boost its ethanol fuel market share, Tianguan Fuelethanol also plans to produce ethanol in the regions where E10 is likely to be introduced – Guangxi Autonomous Region (production capacity planned at 150,000 tons a year), Hunan Province (200,000 tons), Guangdong Province (200,000 tons) and Sichuan Province (150,000 tons). China Resources Alcohol

¹³ Guangxi Autonomous Region's cassava-based ethanol production potential is estimated at between 1.8 million and 2.1 million tons a year.

Co., Ltd. in Heilongjian Province has signed ethanol material purchase contracts with nearby farms to secure stable supply of such materials. The other two designated ethanol fuel producers are also carrying out their respective material-securing strategies.

Figure 1 Introduction and Production of E10 Ethanol-mixed Gasoline in China



Source: The author made the map based on various materials.

Various regions are willing to introduce ethanol fuel and there are conflicting reports. It is difficult to grasp the complete picture of ethanol fuel introduction trends in China. But it is clear that the central government has paid attention to non-food ethanol materials for the enhancement of ethanol fuel production capacity. At present, the central government has yet to designate additional ethanol fuel production companies. Given reported facility construction plans, however, annual production capacity in and after 2007 can be estimated at 3.13 million tons. Among non-food ethanol materials, cassava produced in southern China as well as sorghum that can be produced nationwide has a great potential.

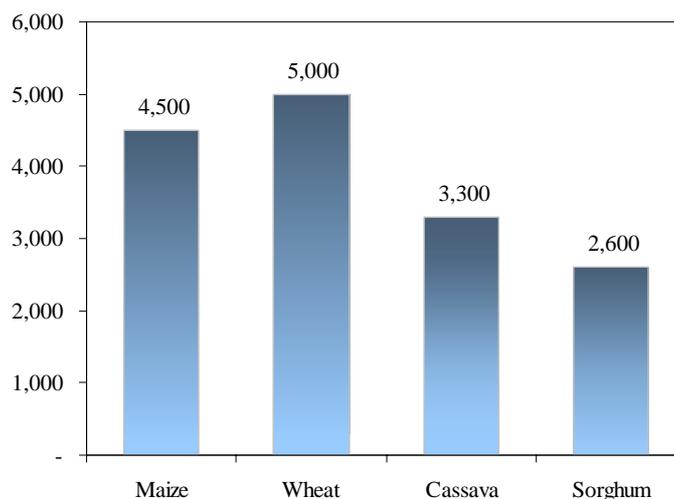
(2) Technology development and costs

Concerned that ethanol fuel production using food crops could affect the food

supply problem; the Chinese government is willing to accelerate the expansion of ethanol fuel production using non-food crops. It is attempting to expand production of energy crops such as sugarcanes, cassava and sorghum. Pilot projects for sorghum-based ethanol production are going on in Heilongjiang, Inner Mongolia, Shandong, Xinjiang and Tianjin. The government is thus trying to develop a stable ethanol supply system. Attracting attention is an Academy of Science and Technology announcement that major progress has been achieved in the development of technology for producing ethanol fuel using sorghum straw. The unit cost of ethanol production using sugar-rich sorghum straw is about 2,600 yuan per ton (about 36,400 yen per ton at an exchange rate of one yuan for about 14 yen in September 2006), far lower than ethanol production using maize or wheat. Sorghum-based ethanol production would have little impact on food supply.

Figure 2 Ethanol production cost by material

(Unit: yuan/ton)



Note: Degraded maize is assumed for the cost estimation.

Sources: National Engineering Research Center for Distillation Technology, China Petroleum Information Net (September 1, 2006)

The development of technology for ethanol production using cellulose plants has depended on small-scale tests and has not led to commercial production, but many companies are proceeding with joint research and development projects with universities or research institutes. Among them, the Henan Tianguan group gives priority to the development of ethanol production technology using cellulose plants like straw. It has built a facility with an annual production capacity at 3,000 tons, which can make 1 ton in ethanol from 6 tons in maize straw with the conversion rate at some 18%. Zesheng Bioengineering Technology Co., Ltd. Province has announced its successful

joint pilot project for annual production of 3,000 tons in ethanol using cellulose plants and is now planning to expand the annual production capacity to 60,000 tons, but commercial production may be premature.

(3) Ethanol fuel introduction through international cooperation

Nanyang of Henan Province has been selected for an ethanol fuel impact verification project as part of the European Union-supported BEST (bio-ethanol for sustainable transport) project. In a bid to further diffuse ethanol fuel, the EU has launched a project¹⁴ to verify the ethanol fuel utilization's impact on the environment and society and is willing to promote it as a clean development mechanism project. The EU is selecting ethanol fuel-introducing cities in the world for financial support for the diffusion of ethanol fuel. In China, the EU has selected Nanyang of Henan Province as a model for ethanol fuel diffusion and provided the city with 380,000 euros in financial support. Nanyang has spent the fund on the development of 100 flex vehicles¹⁵ and some public transportation buses for ethanol fuel consumption and an ethanol fuel supply system including modified gasoline stations. Nanyang is cooperating with Tsinghua University in implementing the project. China has thus indicated its proactive engagement with environmental improvements and international cooperation as well as its domestic alternative energy policy through its bio-ethanol introduction.

(4) Big Two oil companies' engagement with bio-ethanol introduction

The Chinese government has led the bio-ethanol introduction in cooperation with provincial governments and China's Big Two oil companies. The bio-ethanol fuel diffusion would be difficult without the proactive cooperation of the Big Two oil firms – CNPC and Sinopec. Behind the fast diffusion of bio-ethanol fuel, however, we see oil companies racing to take advantage of the bio-ethanol diffusion for expanding their respective downstream oil market shares. CNPC has been closely engaged with the bio-ethanol policy of the central government and ethanol production and sales, gaining a more advantageous position than Sinopec. Meanwhile, Sinopec has teamed up with Chinese coal industry leader Shenhua Group to cooperate with the government in large-scale production of CTL (coal to liquid) fuel. It apparently is willing to give priority to utilizing its oil refining know-how for developing clean coal technologies for fuel conversion. In this sense, the coal industry may take part in the auto fuel market in the future.

China's objectives of the ethanol fuel introduction as part of its renewable energy

¹⁴ The EU's BEST (bio-ethanol for sustainable transport) project is part of its Sixth Framework Program.

¹⁵ These vehicles can run with ethanol-mixed gasoline irrespective of specific ethanol content.

strategy are rather complicated, including the alternative fuel supply, the environmental improvement and the promotion of agriculture. Bargaining between stakeholders and government agencies for various energies is affecting ethanol fuel policy decisions.

4. Conclusion

Finally, the author would like to pick up some key points of China's bio-ethanol introduction and future policies. Since the commercialization of bio-ethanol has many upstream and downstream sector problems, all bio-ethanol policies are not necessarily expected to be implemented smoothly. The most difficult problem facing China in respect to bio-ethanol is how best to procure materials for ethanol production. Test ethanol fuel introduction and diffusion projects in the past five years have used degraded food crops as main materials for ethanol production. The future direction of the ethanol fuel diffusion is expected to depend on how to secure materials. China's annual production capacity for ethanol for automobiles stood at 1.02 million tons in 2005. By April 2006, the central government provided more than 2 billion Yuan in subsidies for projects to produce ethanol and blend it with gasoline for sales. Subsidies in 2006 reportedly total about 1,373 Yuan per ton. The huge subsidies for the specific sector have come under fire from other sectors. We would also like to take note of the Big Two Chinese oil companies' great influences over the introduction of alternative auto fuels and relevant policy decisions. Such influences are hardly subjected to media reports. Meanwhile, coal has begun to attract attention as a key strategic energy source in coal-rich China as methanol, DME (dimethyl ether), CTL and other coal-based alternatives to oil have diffused quickly. As various domestic problems and factors are complicated under the circumstances, bio-ethanol introduction will not be smooth in China.

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<References>

1. "Raising renewable energies' share to 16% by 2020," *People's Daily Online*, 6-17-2006.
2. "To ensure the spirit of National Energy Leader Group to assesses the promotion of ethanol gasoline as automobile fuel", May 10, 2006
3. The Law of Renewable Energy Promotion Fund, State Council, May 30, 2006
4. Notification of opinions on the implementation of energy-saving measures in 10 priority areas under the 11th five-year development plan, NDRC [2006] 1457 号, July 25, 2006
5. "China, People's Republic of Bio-Fuels An Alternative Future for Agriculture 2006," U.S. Department of Agriculture, August 8, 2006