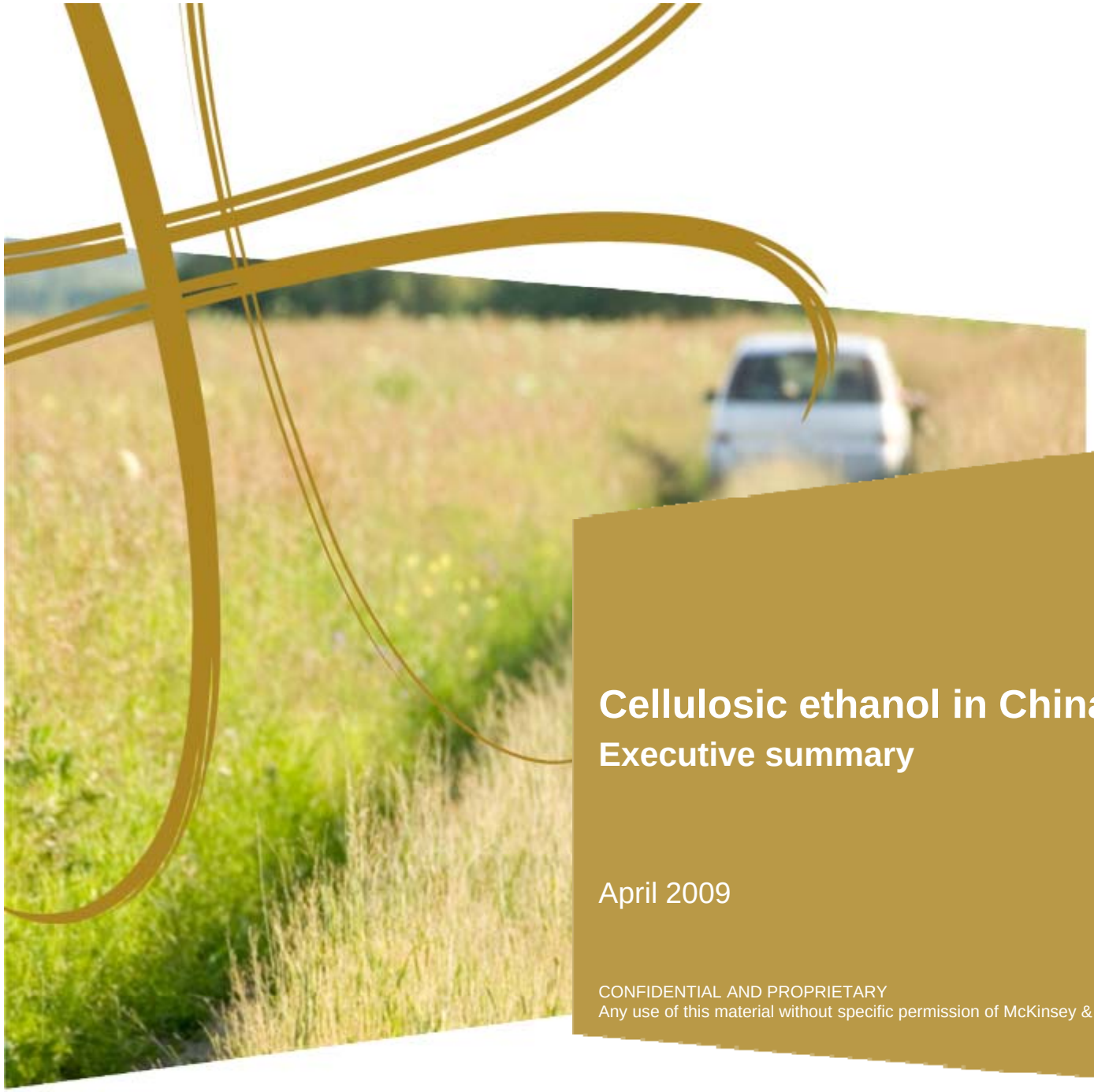


novozymes
Rethink Tomorrow

Cellulosic ethanol in China

Executive summary

April 2009

What is the 2nd Generation (2G) bioethanol?

2G bioethanol – Fuel from residues

2G bioethanol is also called cellulosic ethanol, and is produced from

- **Agriculture residues**, e.g., corn stalks
- **Forestry residues**, e.g., leaves and husks of corn plants, wood chips, etc
- **Cultivated energy crops**, e.g., switch grass

- 1G bioethanol uses food as the feedstock, e.g., corn
- 1.5G bioethanol uses nonfood agriculture products as feedstock, e.g., cassava

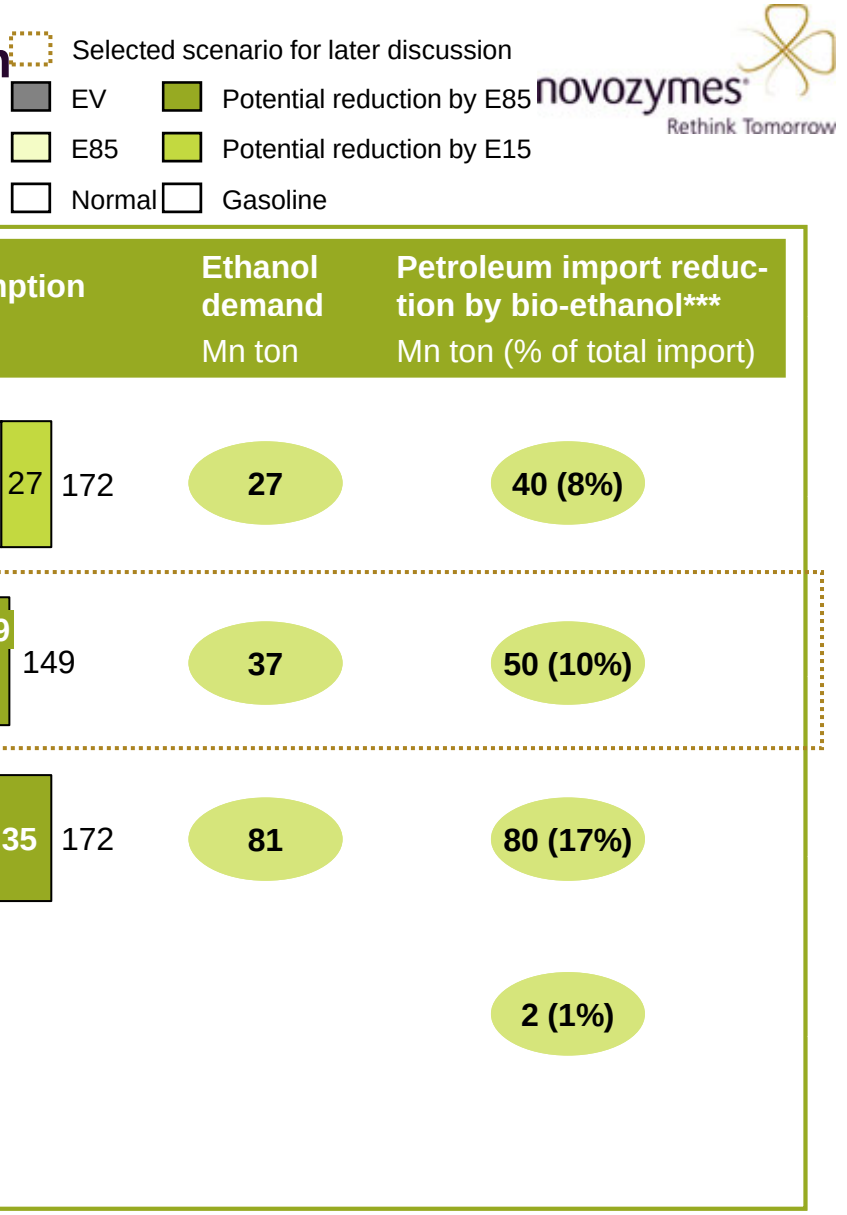
Technology will be ready by 2010

Novozymes will be **the first** company to supply commercial quantities of enzymes to produce cellulosic bioethanol

Cellulosic ethanol could pose big benefits to China

 **Energy security**	Cellulosic ethanol could potentially reduce petroleum import with **40-80 million tons** by 2020, which will decrease China's dependence on imported petroleum by 8-17%
 **Social**	Create income of **RMB 32 billion** per year, which will result in **6 million jobs** by 2020
 **Economic and trade balance**	Chinese players would be the major beneficiaries along the cellulosic value chain, including **RMB 90 billion domestic engineering and construction** market and global expansion
 **Environ-ment**	CO_2 abatement potential of cellulosic ethanol totals **~90 million tons** by 2020 with a favorable economic benefit

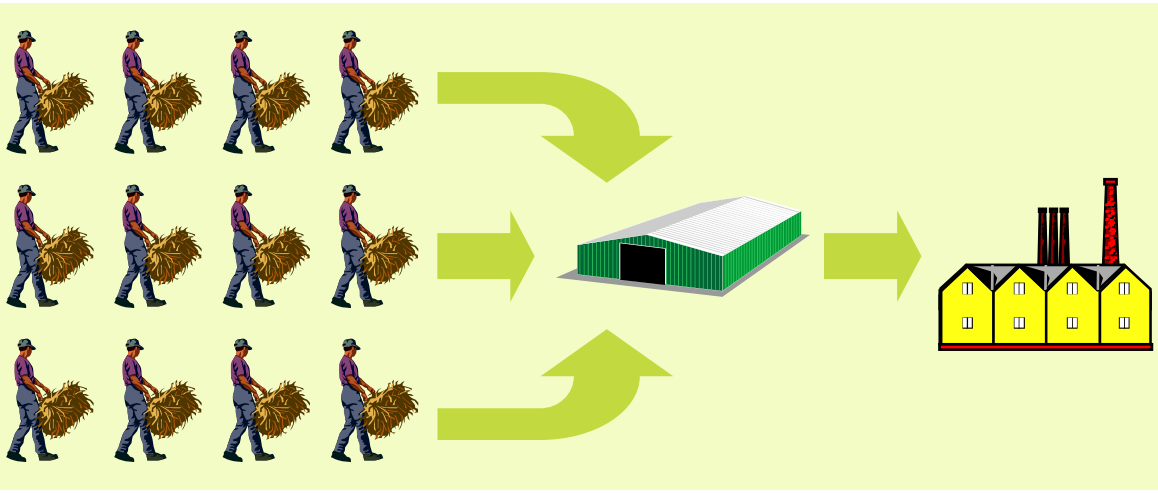
Cellulosic ethanol could reduce petroleum import with 40-80 million tons by 2020



* E15 is fuel mixture of 15% ethanol and 85% gasoline; E85 is fuel mixture of 85% ethanol and 15% gasoline
** Assume EV comprises 50% of new vehicles and E85-modified comprises 25%
*** Assume 1 ton gasoline reduction results in 1.5 ton of crude oil reduction

Source: Expert interview; CEIC; Team analysis

37 mn tons of cellulosic ethanol could create ~32 billion of direct income in 2020, equivalent to 6 million job creation



	Field collection	Agency collection	Cellulosic ethanol plant
Direct jobs created	5,600,000*	100,000	100,000
Income per person RMB/year	4,800	16,000	38,000
Total income RMB billions	26	2	4

- **32 billion of direct income increase** could be achieved in 2020**, which will result ~6 million direct job creation** (~50% will happen in inner-land)
- Additional **farmers in remote areas** could be benefited if energy crops are grown for cellulosic ethanol production

* Equivalently, ~11 million farmers could increase annual income by RMB 2,400 (or 50%) by working 2 months per year

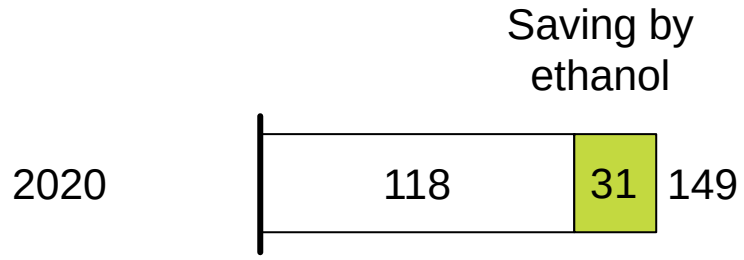
Source: Interview with experts; Team analysis

Impact: Economic benefits

37 mn tons of cellulosic ethanol could also create a RMB 90 billion of engineering and construction business opportunity

2020 China gasoline consumption

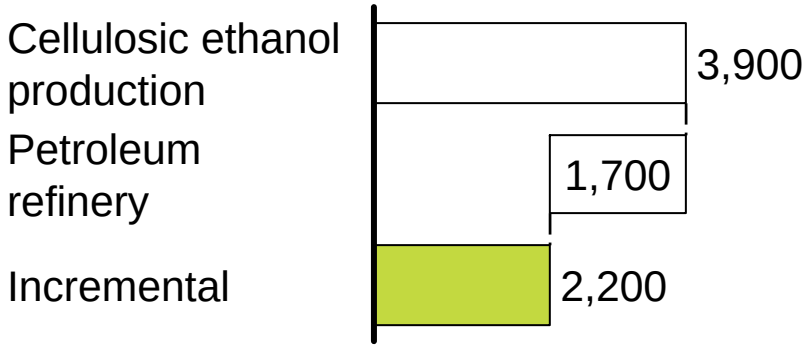
Million tons



China produces 37 million tons of cellulosic ethanol in 2020

Engineering and construction investment

RMB/ton



Oil companies and other engineering and construction companies would be the major benefitted entity

~90 billion RMB domestic engineering and construction market

Capex in 2007

- Sinopec: RMB 100 billion
- PetroChina: RMB 180 billion

Source: Annual reports: Lit search; Team analysis

Chinese players would be the major beneficiaries along the value chain

	Feed-stock plantation	Logistics	Technology	Produc-tion	Blending	Distribu-tion/retail
Core partners	中粮 COFCO		中粮 COFCO; novozymes Rethink Tomorrow	Sinopec	Sinopec	
Major activities	▪ Co-develop and invest in the **R&D**, which lead to **co-owned IPRs** ▪ Co-develop the **pilot plants** for potential commercialization					
Major benefits	**COFCO and Sinopec** could ▪ Capture **~75% value along the value chain*** ▪ Develop IPRs for both domestic and international engineering and construction market in forms of either engineering and construction projects or licensing					
Other Chinese players benefitted	Small-medium scale biomass logistic companies		Local bioethanol players ▪ Henan Tianguan ▪ Anhui BBCA Biochemical ▪ Shandong Long-live biotechnology			

All the enzymes would be produced in China

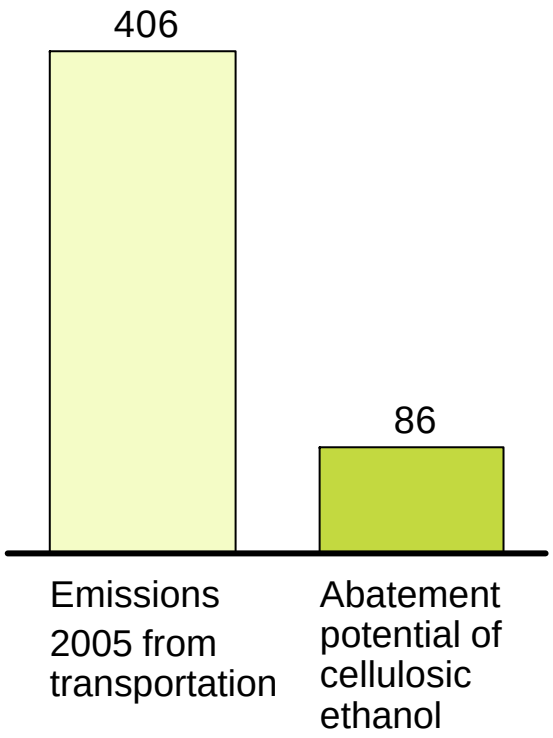
Source: Interview; Team analysis

Finally, 37 mn ton cellulosic ethanol would reduce CO_2 emission by ~90 mn tons

Cellulosic ethanol could reduce 86 million CO_2 emission

China CO_2 emission and abatement

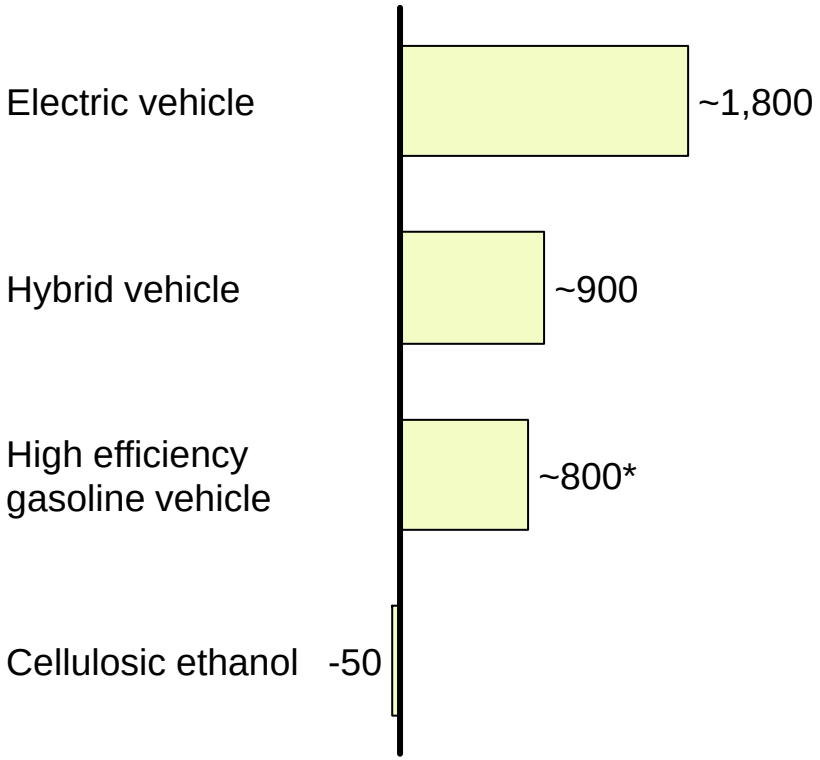
million tons CO_2e



Cellulosic ethanol is economically favorable compared to other abatement techs in transportation

Abatement cost, 2020**

RMB/tCO_2e

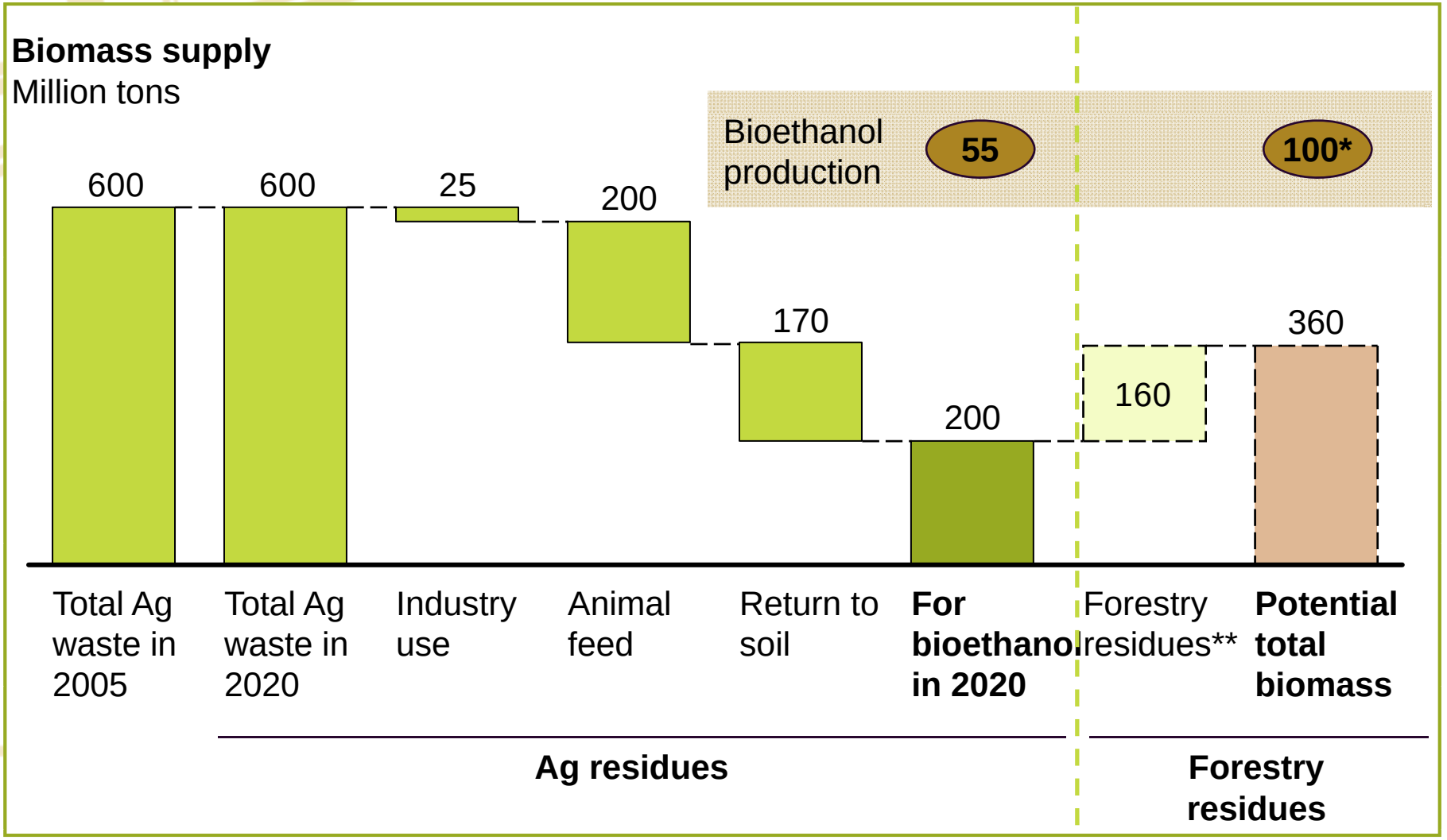


* Refer to most expensive high efficiency gasoline car here

** Refer to social cost

Source: '*China's Green Revolution*'

China could produce up to 100 mn tons of cellulosic ethanol from available residues alone – realizing even larger benefits



* Assume same transforming ratio for forestry residues as ag residues: 92 gallon/ton-dry

** China forestry residues have ~1bn ton biomass available in total, but burning, pulp and paper, returning to forest consumes most of it. 160mn ton is what left after all the other major consumptions.

Source: China Ministry of Agriculture; China Statistical Yearbook; China GHG inventory list; Expert interview; Team analysis

Cellulosic ethanol is ready for commercialization despite the challenges

Promising positioning

- Technology is ready
- Cost becoming competitive
- Middle and downstream distribution channel could be mostly leveraged from existing petro-system

Existing challenges

- RMB 90 billion investment needed within a short period to support build bioethanol plants
- Biomass supply
  - Large scale of sophisticated biomass logistic system to be build with in a short period
  - Cellulosic bioethanol would also face competition for biomass supply

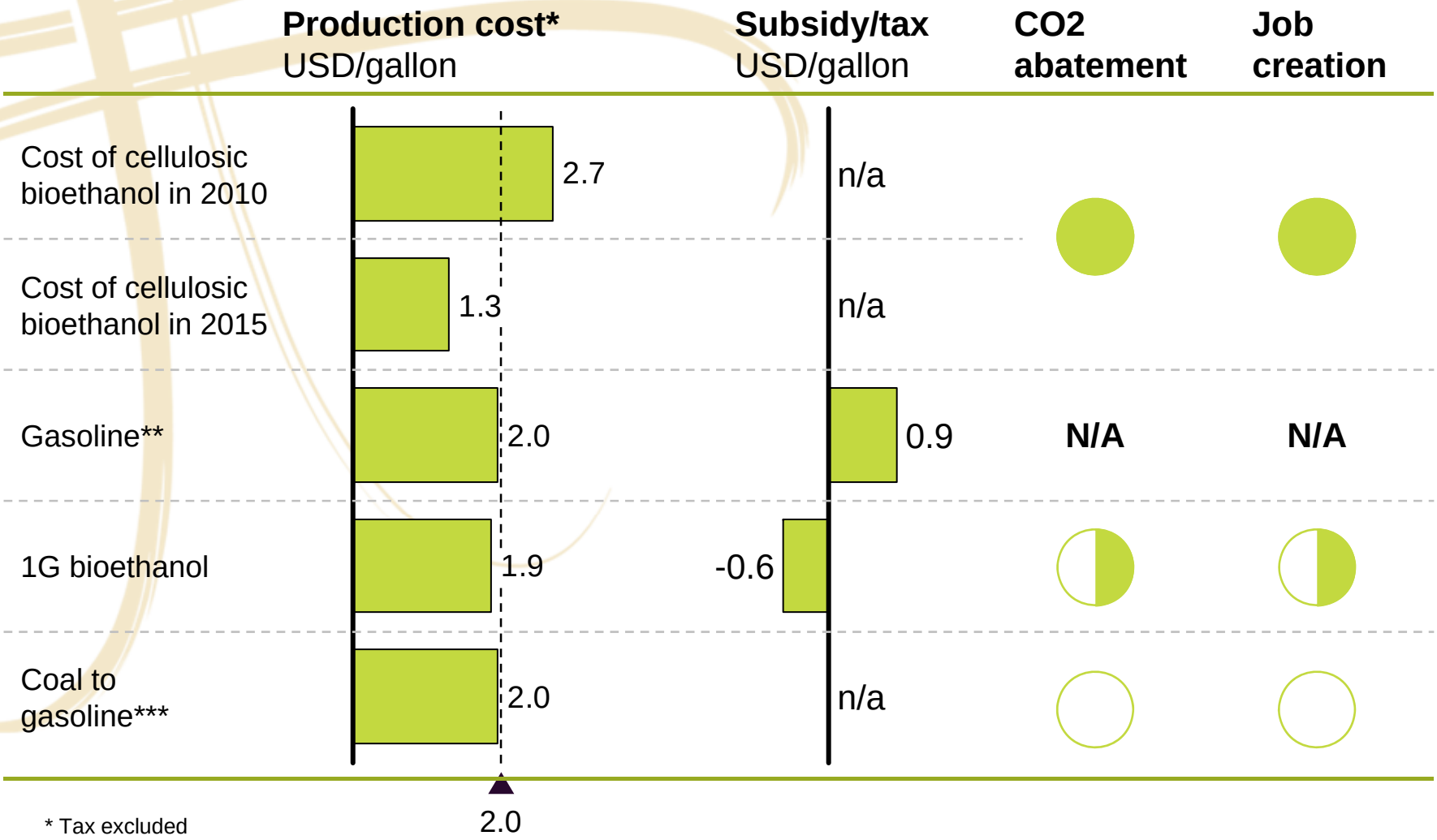
Significant progresses have been achieved along the value chain for commercialization

	Feedstock	Ethanol production	Midstream logistics	Downstream distribution
				
Over-view	▪ Grain harvest and biomass collection ▪ Shipment to conversion facilities and storage	▪ Biomass conversion ▪ Intermediary storage	▪ Shipping ethanol to end-markets ▪ Blending with gasoline blendstock	▪ Distributing to retail outlets ▪ Retail of ethanol or of blended gasoline (e.g., E85 gas stations)
Current situation	▪ Recent market forming in process	▪ Technology breakthrough	▪ Experience exists from transporting 1G bioethanol	▪ Few changes need to be made to switch to bioethanol

Source: Team analysis

Cost are becoming competitive

Low Medium High



* Tax excluded

** Average Singapore FOB ex-work price exclude tax when crude oil price ranges from USD ~70bbl

*** Based Indirect CTL cost from Merrill Lynch report, with conversion rate of 40%, coal price of USD 2/mmBtu and transportation cost of USD 0.50/mmBtu

Source: Interview with experts; Team analysis

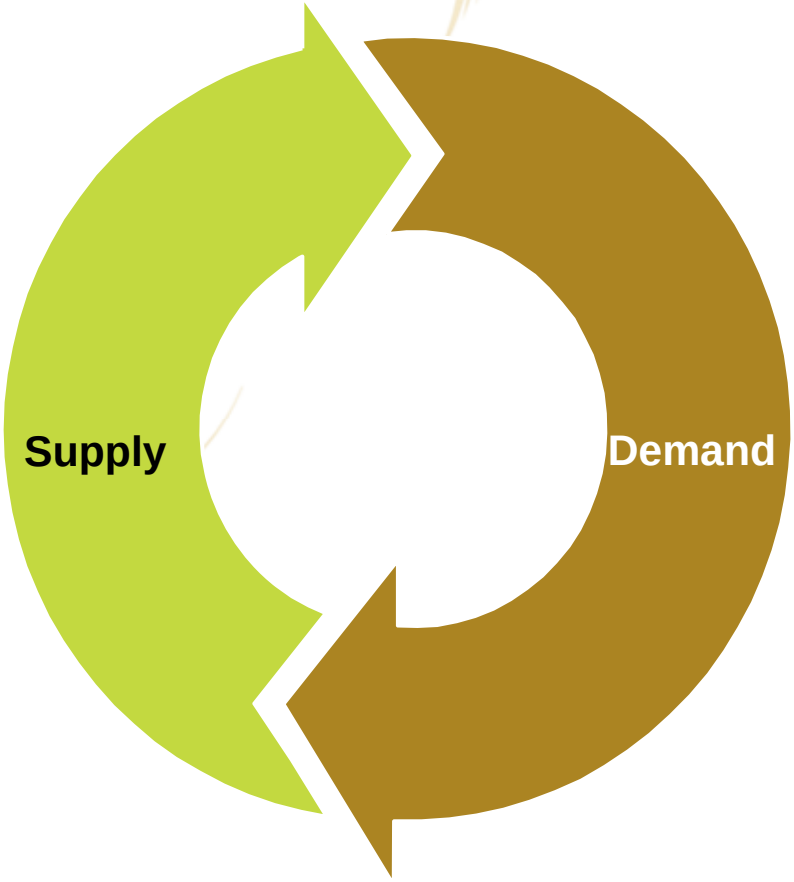
Government support is essential to transform this challenge into a self-sustainable future industry

Principle

- Secure demand during early stage and set aggressive target as market matures
- Support production capability simultaneously to lower the cost in a short period

Support production capability, by

1. Exempting the tax and/or subsidizing early stage plant of 2G bioethanol
2. Provide government guaranteed loan
3. Supporting biomass logistics development



Secure demand, by setting

4. Aggressive fuel standard and ensure implementation
5. Mandatory consumption of biofuel for public transportation and military vehicle
6. Favorable price for ethanol
7. Incentives for consumers

Timing is crucial

	2009-2015	2015-2020	2020-2025
Return and benefits to China	▪ Strengthen IPR positioning ▪ Create jobs in engineering and construction industry	▪ 32 billion of direct income increase ▪ ~90 million ton gasoline substitute in 5 years ▪ ¥90 billion engineering and construction market ▪ Global technology leading position ▪ >300 million tons CO_2 abate-ment in 5 years	▪ ~200 million ton gasoline substitute in total ▪ International 2G engineering and construction and licensing
Investment	▪ **Investment for R&D and plants building** ▪ **Strong government supports**	**5 year delay**	

Source: Team analysis