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Target Allocation for China's Provinces:
Energy Intensity in the 12th Five-Year Plan

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Official National Intensity Target. With the 2011 spring meeting of the National Peoples Congress and Premier Wen Jiabao's announcements on the 12th Five-Year Plan (12th FYP), China is now tasked with improving national energy intensity of its economy (energy per unit of GDP) by 16% over the next five years.[1] To achieve the national goal, targets will be allocated sub-nationally to provinces, cities, sectors and enterprises. In the past 11th FYP, provincial targets were set based on rapid assessment and negotiation, and most were set close to the national target of 20% reduction in intensity over the five-year period. Some provinces exceeded their targets and developed robust management systems for ongoing improvement. Other provinces struggled and took extreme short-term measures to reach their targets. For the 12th FYP, the Chinese government seeks to use a more **scientific methodology** to better estimate the varying **potential for energy saving** across the provinces, to facilitate a **structural shift** to low-carbon development, as well as to achieve an **equitable** distribution of targets.

Attention Now on Provincial Targets. With announcement of the national energy intensity target, attention is turning to local-level targets. For more than a year, many groups have been evaluating experience from the past 11th FYP and conducting analysis for improved allocation of targets in the 12th FYP.   At the provincial level, local Development and Reform Commissions (DRCs) and Economic and Trade Commissions (ETCs) have been working with local universities—such as the Henan DRC and Zhengzhou University—to recommend specific target levels and make a case for their methodology and criteria.

New Sector-based Methodology. In addition to analysis by the provinces, several groups have been developing methodologies to support the allocation of targets: the Development Research Centre of the State Council, the National Development and Reform Commission (NDRC), the Energy Research Institute (ERI), Tsinghua University, the US Lawrence Berkeley National Laboratory (LBNL), and others. The analysis presented here comes from methodology developed by LBNL, with collaboration from ERI, in a recently released report.[2] The methodology uses a **sector-based approach** considering China's goals and circumstances, and international experience in target setting, such as the European Union three-sector (Triptych) approach for allocation of the Kyoto Protocol carbon target among EU Member States. In the EU experience, a transparent, scientific methodology helped the Member States reach agreement and track progress. Final targets were based on negotiation as well as the scientific methodology, such that political considerations were layered over a strong analytical foundation. In addition to consideration of equity and

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[1] Key Targets of China's 12th FYP." China Daily. 2011.3.5. http://www.chinadaily.com.cn/xinhua/2011-03-05/content_1938144.html ; "China Unveils Economic Plan With Focus on Raising Incomes and Reining in Pollution." New York Times. 2011.3.4. http://www.nytimes.com/2011/03/05/world/asia/05china.html?_r=2&pagewanted=1&hp

[2] The full LBNL report is available in English at: http://china.lbl.gov/publications/target-allocation-methodology-provinces-china and in Chinese at: http://china.lbl.gov/publications/target-allocation-methodology-provinces-china-chinese-version .

improved estimates of the potential for energy saving, the new sector-based methodology for China's intensity target is designed to show **effectiveness**—that the combination of provincial targets meets the national goal—and to provide greater **transparency** in target allocation by utilizing **measurable**, readily-available data.

Three Energy Sectors and GDP.   Because energy intensity varies dramatically among different sectors of the economy, and because absolute energy consumption differs widely among provinces and economic sectors, it is important to divide the targets by end-use sectors. The allocation methodology for China's intensity target disaggregates total provincial energy use into three end-use sectors:
(1) **Industrial Energy** (heavy and light),
(2) **Residential Energy**, and
(3) **Other Energy** (transport, service sector, agriculture, etc.).
These sectors focus on end-use energy consumption under the jurisdiction of the provinces. The three energy sectors, in combination with **total** provincial **GDP**, yield provincial economic energy intensities.

Sectoral Indicators.   The methodology developed for China considers several indicators to estimate potential energy savings and targets for each sector. All of the indicators, such as Residential Energy *per capita*, enable comparison across provinces of different sizes. Some indicators are snap-shots in time, while others indicators represent trends over time. In practice, the choice of indictors was constrained by limitations on publicly-available data at the provincial level.   Working within these constraints, LBNL utilized the following indicators for each sector:
▪ **Industrial Energy:** industrial energy intensity (energy per unit value-added output), trends in growth rates, GDP per capita.
▪ **Residential Energy**: per capita residential energy use, weather-related adjustments for heating and cooling, convergence to a common per capita level in 2030.
▪ **Other Energy:** trends in growth rates, GDP per capita.
▪ **Economy (GDP)**: trends in growth rates, GDP per capita.

Along with the sectoral indicators, the sectoral structure of energy and GDP (e.g., the share of Industry in total energy and in total GDP) influences the overall target for each province. Since half of China's provinces have an industrial energy share of 70% or higher, the Industrial sector is especially important for intensity target allocation. Table 1 summarizes energy and economic indicators and structure for each province.

Importantly, the sector-based allocation approach looks distinctly at energy use, as well as the mixed metric of economic energy intensity (energy per unit of GDP). Energy use is allocated among the sectors and provinces, then combined with GDP projections to yield overall energy intensity targets. An intensity target gives provinces flexibility in how to achieve their target. They can use a mix of two main strategies: (1) enhancing physical energy efficiency and energy conservation; and (2) shifting economic structure toward low-energy activity and higher value-added activity. However, energy—and carbon—are real, physical quantities, and sound policies must grasp that physical reality.

Table 1. Economic and Energy Indicators for China's Provinces

Province	Target 2010 Intensity (tce/ 10,000 RMB)	Energy Use Ranking	Industrial Share of Energy	Industrial Share of GDP	Industrial Energy Growth Trend in 11th FYP	GDP (10000 RMB) per capita	Residential Energy (kgce) per capita*
Beijing	0.64	20	42%	27%	low	58,204	568
Tianjin	0.89	26	68%	60%	medium	46,122	451
Hebei	**1.56**	**3**	**81%**	**53%**	**medium**	**19,877**	**297**
Shanxi	**2.21**	**8**	**83%**	**60%**	**high**	**16,945**	**303**
Inner Mongolia	**1.86**	**10**	**72%**	**52%**	**high**	**25,393**	**407**
Liaoning	**1.47**	**6**	**73%**	**53%**	**high**	**25,729**	**349**
Jilin	1.15	17	69%	47%	high	19,383	275
Heilongjiang	1.16	16	67%	52%	medium	18,478	260
Shanghai	0.73	13	58%	47%	low	66,367	418
Jiangsu	**0.74**	**4**	**82%**	**56%**	**medium**	**33,928**	**177**
Zhejiang	**0.72**	**7**	**74%**	**54%**	**medium**	**37,411**	**244**
Anhui	0.97	14	78%	45%	medium	12,045	160
Fujian	0.79	15	70%	49%	medium	25,908	241
Jiangxi	0.85	24	73%	52%	high	12,633	145
Shandong	**0.99**	**1**	**75%**	**57%**	**medium**	**27,807**	**214**
Henan	**1.1**	**5**	**80%**	**55%**	**high**	**16,012**	**185**
Hubei	**1.21**	**9**	**70%**	**43%**	**medium**	**16,206**	**174**
Hunan	1.12	12	69%	43%	low	14,492	188
Guangdong	**0.67**	**2**	**67%**	**51%**	**high**	**33,151**	**264**
Guangxi	1.04	21	74%	41%	high	12,555	119
Hainan	0.81	30	59%	30%	high	14,555	107
Chongqing	1.14	27	68%	46%	medium	14,660	188
Sichuan	**1.22**	**11**	**69%**	**44%**	**medium**	**12,893**	**176**
Guizhou	2.6	19	69%	42%	medium	6,915	277
Yunnan	1.44	18	73%	43%	medium	10,540	160
Tibet	ND	31	ND	29%	low	12,109	404
Shaanxi	1.18	22	65%	54%	medium	14,607	206
Gansu	1.81	25	74%	47%	medium	10,346	214
Qinghai	2.55	29	78%	53%	high	14,257	429
Ningxia	3.31	28	85%	51%	high	14,649	268
Xinjiang	1.69	23	69%	47%	medium	16,999	337

Notes: Unless otherwise noted, all data from 2007. Economic data expressed in fixed 2005 RMB. tan = very high; pink = high; yellow = medium; blue = low.
*Residential Energy per capita is weather corrected. **BOLD** = largest energy-consuming provinces. Targets for boxed provinces are discussed below.

Target Allocation Scenarios & Results.   Recognizing that different indicators may yield somewhat different target allocations, LBNL analyzed three main scenarios, each scenario using different indicators for each sector. **All scenarios meet the official national intensity target of 16%** and are based on the official GDP targets for the 12th FYP. Within each energy sector, energy growth rates and savings rates were assigned by placing the provinces into **three groups**. For example, to allocate Industrial Energy among the provinces, Scenario 1 made three groups of provinces based on past industrial energy growth trends (high, medium, and low growth) and targeted savings for three groups of provinces based on the indicator of industrial energy intensity (high, medium, and low intensity). Grouped rates, rather than individual provincial rates, were utilized to smooth out idiosyncrasies in the data and to simplify target allocations. This is similar to the EU Triptych approach, where member states were placed into two groups for each energy sector, and rates were determined for each group rather than individual states.

Scenario 1 – Trend Analysis and Targeted Savings.   Scenario 1 emphasizes targets based on each province's potential for energy saving, along with consideration of economic development trends. Scenario 1 considers equity based on past performance and potential for improvement. In Scenario 1, recent trends are assumed to continue during the 12th FYP, i.e., that fast growing provinces will still be growing relatively quickly. In all scenarios, Industrial Energy annual energy consumption growth rates for the 12th FYP are markedly lower than in the recent past. Provinces that have reduced energy intensity in the past are recognized for their achievement, while provinces that still have highly energy-intensive industry are asked to save more in the Industrial Energy sector for the 12th FYP. Residential energy per capita, corrected for each province's weather conditions, is targeted to converge, so that all residents eventually achieve a common level of comfort.   Development of the service sector is encouraged by allotting more growth in Other Energy to poorer provinces.

Scenario 2 – Equal Rates and Targeted Savings.   Scenario 2 recognizes the dynamic nature of China's provinces and considers that future developments during the 12th FYP period may not follow historical trends; instead, equal (national average) growth rates in energy consumption are assigned to all provinces, in each sector. Scenario 2 still aims to set targets based on each province's potential for energy saving, and to encourage the service sector.

Scenario 3 – GDP-based Growth and Equal Savings. Scenario 3 gives highest priority to the provinces' level of economic development, in terms of GDP per capita, as an indicator for target setting. Scenario 3 considers equity mainly in economic terms, and does not set targets based on the potential for energy saving, nor on recent trends.

Draft Allocations Circulating.   A news report from mid-March indicates that NDRC circulated a **draft target allocation plan** to local DRCs and ETCs to ask for comments, before the national intensity target was officially announced. The draft plan （"十二五"节能指标初步分解) calls for China's 31 provinces to be divided into **five groups**, with a target assigned to each group.[3]   Overall, the draft targets range from 10% to 18% reduction of energy intensity from 2010 to 2015.

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[3] **"十二五"节能指标初步分解 指标细节存争议** *[Debate over details of the Draft 12th FYP energy saving target decomposition]*. 2011.3.16. http://content.caixun.com/CX/01/fi/CX01file.shtm

LBNL Analysis of Target Scenarios and Draft Targets. Table 2 presents the resulting energy intensity targets for the provinces under three scenarios, and compares them to the proposed official targets for the 12th FYP. Overall, from Table 2 we see that the draft official targets have a tighter range of targets than the scenarios, which is more politically feasible although less representative of the wide range of energy and economic conditions among the provinces. The results of the three allocation scenarios show that all three scenarios will meet the national target, but it is not known how the proposed official targets for the provinces will contribute to the national total (see the bottom of Table 2).

The draft targets appear to be a mix of scenarios in Table 2—there is no clear connection to any one energy or economic indicator (refer to Table 1) in the proposed official targets. While a news report indicates the proposed official targets are based on each province's level of economic development, only some of the provincial targets are consistent with Scenario 3, which emphasizes economic development (in terms of GDP per capita) for target setting. Below, we highlight the targets and implications for a few of China's largest energy-consuming provinces: Guangdong, Shandong, Henan, Sichuan, and Inner Mongolia.

Guangdong.   Guangdong is China's second-largest energy-consuming province, and experienced high growth in industrial energy consumption during the 11th FYP, yet has the lowest industrial energy intensity, 1.09 tce/10000 RMB (refer to Table 1). One of China's wealthy provinces, Guangdong has a high GDP per capita, yet the residential energy consumption per capita is moderate. In terms of energy and economic structure, Guangdong's Industrial share of energy (67%) and Industrial share of GDP (51%) are a few percentage points below the national average.   Recognizing Guangdong's achievement of the lowest energy intensity, the province is allotted a target of 14% in Scenario 1 (see Table 2). If emphasis is placed on its high level of economic development, rather than its potential for further energy savings, Guangdong is challenged with a target of 18% in Scenario 3, as well as in the draft official target.

Shandong. Shandong—the largest energy-consuming province—has a larger share of Industrial energy (75%) than Guangdong, a more moderate historical growth rate, and a medium (rather than low) industrial energy intensity (refer to Table 1). As a result, Shandong is allotted a tougher saving rate and a lower growth rate for Industrial energy than Guangdong (in Scenario 1). This means that Shandong is estimated to have greater potential for energy saving in its industrial sector, even as its economy develops and shifts more toward tertiary sector activities. Shandong has made important and lasting progress toward an energy-efficient economy during the 11th FYP, and these efforts can continue to bear fruit in the upcoming years. In Residential energy (8% of total energy) and Other energy (12% of total), Shandong's Residential energy per capita is already near average, and its GDP per capita is already higher than many other provinces.   Because Shandong's energy structure is so dominated by Industrial energy, the targeting for the industrial sector strongly influenced its overall intensity target of 17% in Scenario 1. If emphasis is placed on its high level of economic development, Shandong would be challenged with a tougher target of 19% in Scenario 3. Interestingly, the draft official target for Shandong is consistent with Scenario 1 (potential for saving), rather than Scenario 3 (level of economic development), in contrast to the proposed target for Guangdong.

Henan. Henan is now China's most populous province and its 5th largest energy consumer. Industrial energy has an extremely high share of the province's consumption (80%) and a high growth rate in recent years, with a medium intensity (refer to Table 1).   The centrally-

located province has a moderate level of economic development, with a GDP per capita of roughly 16,000 RMB annually, yet a low use of Residential energy per capita. For the 12th FYP, Scenarios 1 through 3 give Henan lower-than-national intensity targets of 14% or 15% (see Table 2). The lower targets recognize that Henan is still a developing province and has already achieved some improvement in its industrially-heavy energy intensity.   The proposed 16% official target for Henan is a little higher than all three scenarios, closet to Scenario 2, which considers that past growth trends may not continue during the 12th FYP.

Sichuan. Until the Chongqing metropolitan region was separated, Sichuan had the largest population of the provinces.   Less industrialized than Henan, Sichuan's share of Industrial Energy is lower (67%) while its intensity is also moderate, making it the 11th largest energy consumer among the provinces (refer to Table 1). Sichuan is a relatively poor province with a low level of GDP per capita. In recognition of both its low level of economic development and moderate energy intensity, Sichuan is allotted relatively low targets for the 12th FYP in Scenarios 1 through 3, ranging from 11% to 14% (see Table 2). In contrast, the draft official target is much higher for Sichuan, at 16%. The reason for the higher target is not clear, as the official targets are said to emphasize each province's level of economic development.

Inner Mongolia. This large province stretching across China's north-central border saw a surge in economic activity during the past 11th FYP, which raised GDP per capita to a high level (more than 25,000 RMB annually), and raised the province to the 10th largest energy consumer (refer to Table 1).   However, the surge in economic activity came from rapid growth in Industrial energy consumption. Promotion of mining and heavy industry caused Inner Mongolia's energy intensity (2.31 tce/10000 RMB) to be among the highest in the country and its share of Industrial energy to reach a high level of 72%. Thus the recent path of economic development for Inner Mongolia is in contradiction with goals for a low-energy, low-carbon economy. For the 12th FYP, Scenarios 1 through 3 assign Inner Mongolia fairly high intensity improvement targets, ranging from 18% to 21% (see Table 2). In contrast, the draft official target for Inner Mongolia is a low value of 15%. The lower target does not seem to be based on common indicators for economic development or energy, as Inner Mongolia has both a high level of GDP per capita and very high energy intensity. A possible explanation is that some provinces may be designated as heavy industry provinces, due to their reservoirs of high-carbon fuels, namely coal. However, this approach has not been formally stated.

Negotiation Ahead. The next five years will be a mix of past momentum and strong new efforts toward a low-energy, low-carbon economy.   The sector-based methodology developed for China offers a scientific and transparent approach for allocating intensity targets among the provinces for the 12th FYP. The scenarios presented here show target outcomes based on measurable indicators, which can also help to track progress toward the targets. The comparison with draft official targets gives some insight on NDRC's criteria for target allocation. The methodology presented here provides a strong basis for negotiating, final target setting, and implementation support.

Table 2. 12ᵗʰ FYP Energy Intensity Target Scenarios and Draft Official Targets for the Provinces

Province	12th FYP Target Scenarios (LBNL Analysis)				12th FYP Draft Official Targets	
	Trend Analysis & Targeted Savings (S1)	Equal Growth & Targeted Savings (S2)	GDP-based Growth & Equal Savings (S3)		Draft 12th FYP Provincial Targets	NDRC Proposed Group
Beijing	-14%	-17%	-18%		-17%	II
Tianjin	-19%	-17%	-21%		-18%	I
Hebei	**-18%**	**-17%**	**-16%**		**-17%**	**II**
Shanxi	**-20%**	**-21%**	**-17%**		**-16%**	**III**
Inner Mongolia	**-18%**	**-21%**	**-20%**		**-15%**	**IV**
Liaoning	**-18%**	**-19%**	**-21%**		**-17%**	**II**
Jilin	-15%	-16%	-15%		-16%	III
Heilongjiang	-14%	-13%	-13%		-16%	III
Shanghai	-15%	-16%	-18%		-18%	I
Jiangsu	**-17%**	**-16%**	**-20%**		**-18%**	**I**
Zhejiang	**-18%**	**-17%**	**-20%**		**-18%**	**I**
Anhui	-13%	-13%	-9%		-16%	III
Fujian	-16%	-16%	-19%		-16%	III
Jiangxi	-10%	-10%	-7%		-16%	III
Shandong	**-17%**	**-16%**	**-19%**		**-17%**	**II**
Henan	**-14%**	**-15%**	**-14%**		**-16%**	**III**
Hubei	**-16%**	**-15%**	**-14%**		**-16%**	**III**
Hunan	-17%	-14%	-13%		-16%	III
Guangdong	**-14%**	**-15%**	**-18%**		**-18%**	**I**
Guangxi	-10%	-13%	-10%		-15%	IV
Hainan	-5%	-6%	-6%		-10%	V
Chongqing	-15%	-14%	-14%		-16%	III
Sichuan	**-14%**	**-13%**	**-11%**		**-16%**	**III**
Guizhou	-17%	-18%	-12%		-15%	IV
Yunnan	-20%	-18%	-12%		-15%	IV
Tibet	ND	ND	ND		-10%	V
Shaanxi	-15%	-14%	-13%		-16%	III
Gansu	-17%	-15%	-9%		-15%	IV
Qinghai	-17%	-18%	-14%		-10%	V
Ningxia	-19%	-21%	-16%		-15%	IV
Xinjiang	-16%	-15%	-12%		-10%	V
Provincial Projections of National Target	**-16.0%**	**-16.1%**	**-16.2%**		**ND**	
Official National Target	**-16.0%**	**-16.0%**	**-16.0%**		**-16.0%**	

Notes: pink = high; yellow = medium; blue = low. **BOLD** = 15 largest energy-consuming provinces. ND = No Data.