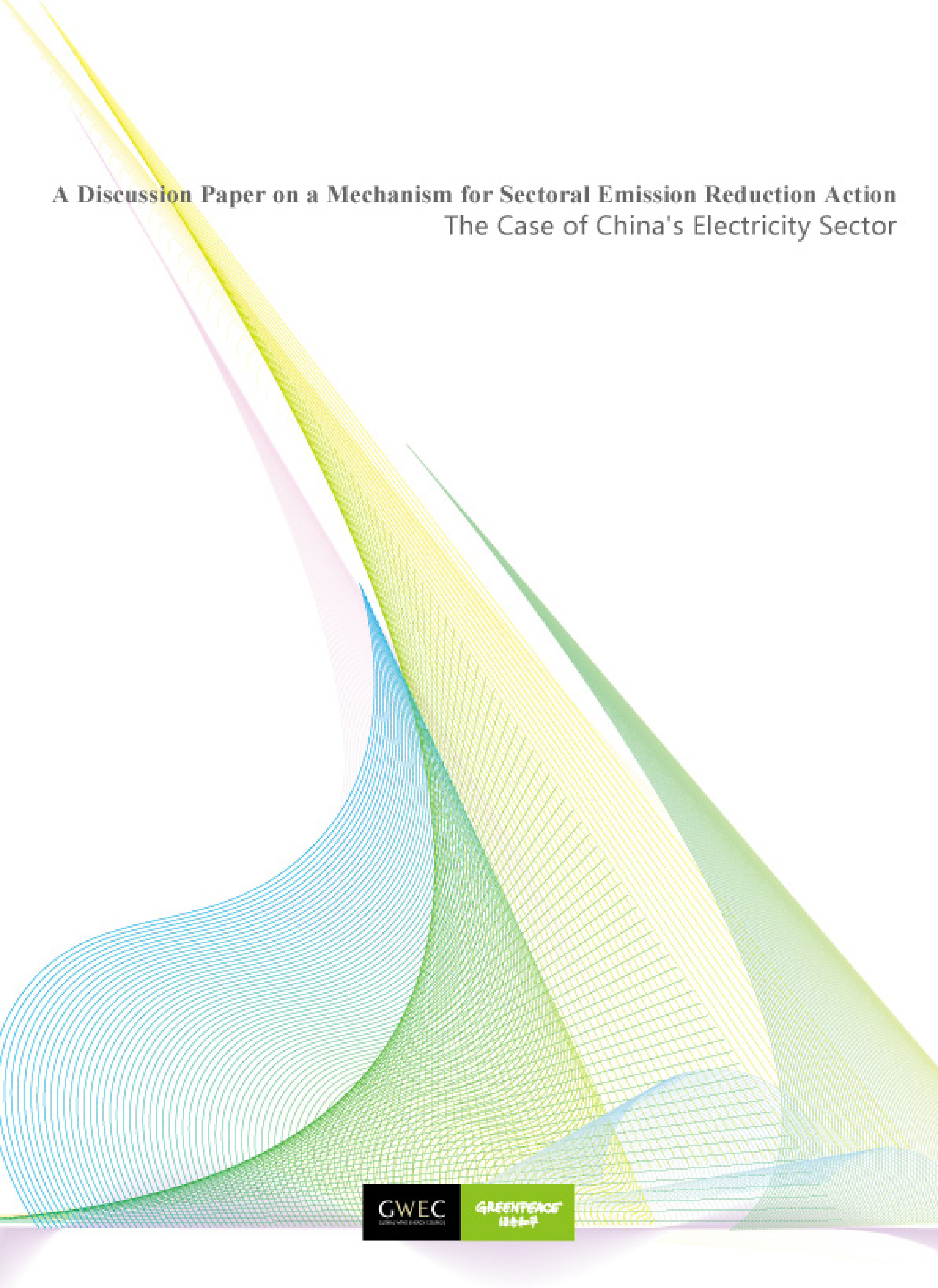
A Discussion Paper on a Mechanism for Sectoral Emission Reduction Action

The Case of China's Electricity Sector



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Introduction

This work has grown out of a research project conducted by Dr. Jiang Kejun and his team at the Energy Research Institute in Beijing commissioned by Greenpeace China and the Global Wind Energy Council. The scenarios outlined here are one of the main outputs of this study, and are results obtained using the detailed results of the IPAC model which is developed by Energy Research Institute, Beijing. The background study is still being finalized, but will be made available (in Mandarin) by early next year. The analysis of those modeling results and their possible application in relation to the UNFCCC as outlined in this discussion paper are the work of the authors listed on the cover page.

1. Background

1.1 Climate negotiation and sectoral mechanism

At the climate negotiations in Bali in December 2007 (UNFCCC COP13/COPMOP3), Parties agreed the Bali Roadmap, a two year process to finalize a new climate agreement at COP 15 in Copenhagen in 2009.

In the Bali Action Plan, developing countries agreed to “measurable, reportable and verifiable nationally appropriate mitigation actions”, provided they received measurable, reportable and verifiable technology, finance and capacity-building support from industrialized countries. The sector-based approach for incentivizing further mitigation actions in developing countries has been widely discussed as part of the post-2012 framework. One task before the 2009 Copenhagen climate meeting is to analyze the potential and cost-effectiveness of this approach.

Sectoral Approaches

While ‘sectoral’ approaches have been widely discussed, there are many different proposals that go by this name. Some of the main ones include:

1) A sectoral approach for Annex I countries in a post 2012 period to replace the existing system of economy-wide emissions caps. This approach has received very little support, raising concerns that it would undermine the effectiveness of the existing regime, and risks letting Annex I countries out of their existing legally binding emissions reduction commitments.

2) There are also discussions about a transnational sectoral approach, which is seen as a response to so-called ‘carbon leakage’ issues. The idea is again difficult to implement as it runs contrary to the UNFCCC principle of common but differentiated responsibilities, and would be difficult to reconcile with economy-wide targets for industrialized countries

3) A third option which has received interest from a number of Parties are voluntary national ‘no-lose’ targets for sectors in industrializing countries, which could make use of the international carbon market to finance emission reductions below an agreed ‘no-lose’ target for the sector. The target is ‘no-lose’ in the sense that there would be no compliance penalties for failing to reach the target.

In this paper, we look at the mitigation and financing potentials from the third approach, and focus on the electricity sector, as it is a very large emitting sector, there are many technologies available for improving emissions performance, and it is reasonably immune to direct competitiveness concerns. We believe it has significant potential benefits both for sustainable development in developing countries and for the global atmosphere. However, we emphasize that it is a proposal for a voluntary mechanism, therefore countries must be convinced that it is in their best interests in order for it to proceed.

The sectoral approach analyzed in this paper employs what is known as a “sectoral no-lose target” (SNLT), coupled with a “sectoral crediting mechanism” (SCM). The basic idea is quite simple. Conceptually, it is quite similar to treating an entire sector in a developing country as a CDM project. It would begin with an analysis of the projected business-as usual emission profile of the sector for the crediting period, followed by a calculation as to the effect of existing domestic policies and measures on that emissions profile. An analysis would ensue to establish the expected impact of the both existing and planned domestic measures, with the result being the agreement of a presumably somewhat more ambitious sectoral “no-lose” target for the whole sector. It would be “no-lose” in the sense that there would be no compliance penalties incurred if the planned reductions did not take place. Emissions reductions *below* the no-lose target would generate carbon credits eligible for sale on the international carbon market.

Purpose of this Paper:

- The purpose of this paper is to look at the mitigation potential from sectoral action as well as how much carbon revenue could potentially be generated to offset the additional costs. We look at the potential for the electricity sector in China on the basis of the IPAC model from Energy Research Institute (ERI). We emphasize that there are many methodological and political issues that would need to be worked out, and that above all, this would be a *voluntary approach*. The purpose is to show the potential for both mitigation and carbon finance using this approach, and it would then be up to individual countries to weigh the benefits of this approach and decide whether it was suitable for them.

- China is chosen as a case for this research as both the emissions and the potential for reductions in China’s electricity sector is huge. We are not trying to establish a sectoral cap for the Chinese electricity sector, but to demonstrate the potential of such a mechanism by using China as an example; which, due to its large size, is a perfect example to show the emission reduction potential and the benefits which could be obtained.

Benefits of Sectoral Mechanism:

There are many potential advantages to a sectoral no lose target and associated crediting mechanism when compared with existing CDM arrangements:

- While well short of economy-wide emissions caps for industrializing countries, it provides measurable global CO_2 emissions reductions and should stimulate fundamental structural change in the electricity system of the countries who participate;

- Rather than just providing a percentage point or two to the rate of return of individual projects, it would create the conditions for the establishment of a development ‘pipeline’ for low carbon and energy efficiency technologies, including policy frameworks providing a greater degree of market certainty;

- Any country with substantial emissions from the electricity sector could participate and attract substantial carbon finance, providing for a more equitable distribution of carbon investment throughout the developing world;

- There would be no need for complex and expensive ‘additionality’ considerations,

- Data should be reasonably easily available, and monitoring should not be too difficult; although this would vary greatly between countries, and many would need assistance establishing a credible system;

- This mechanism would provide a vehicle and built-in incentive for very substantial technology transfer through the market, potentially much larger than that provided through the CDM.

- Rather than the potential perverse incentives in the existing arrangements, this system would provide a clear, positive incentive for domestic policies and measures for power sector decarbonisation and energy efficiency.

- If the baselines and targets are established with reference to both emissions intensity and a**bsolute emissions** rather than purely on an emissions intensity basis (as has been discussed by some), energy efficiency measures would not need to be bundled into projects, but would be incentivized across not only the power generation sector but throughout the economy; thus ensuring a built-in incentive to drive the efficiency measures which are needed to reduce demand growth, which will be a critical part of achieving emissions reductions in the power sector.

Why the electricity sector:

While the power sector is far from being the only greenhouse-gas culprit, it is the largest single source of emissions, accounting for about 40% of CO_2 emissions, and a little over 25% of overall emissions, making it the largest contributor to global anthropogenic greenhouse gas emissions.

China has made major efforts in recent years to address the emissions intensity of its economy, to promote efficiency in its energy generation sector, and to promote both renewable energy and energy efficiency. However, the Chinese electricity sector is a very large source of CO_2 emissions, one of the largest single sources of emissions globally. An ambitious but also feasible sector-wide action plan for the Chinese electricity sector linked to the international emission trading system could help China's sustainable development, as well as contributing significantly to global greenhouse gas reduction goals.

1.2 China's electricity sector

a) General overview: When the Peoples' Republic of China was founded in 1949, the total installed electrical generation capacity was just 1.85GW. By 2000, this capacity had reached 300GW, and after a severe power shortage in 2003, an unprecedented growth in the construction of electricity generation capacity was undertaken. The total installed capacity reached about 400 GW in 2004, increasing to 500 GW in 2005, 600 GW in 2006 and about 700 GW in 2007. The 713 GW total installed capacity in 2007 is narrowing the gap with the 986 GW installed capacity in the US (2006), which is the largest in the world. Anticipated installations in 2008 would bring the total to about 800 GW.

b) Energy Mix: In 2007, the installed electricity generation capacity thermal power reached 554 GW, hydro power reached 145 GW, , nuclear power reached 8.85 GW and renewable sources reached more than 7 GW. Due to the small base of renewable energy and nuclear power, the change of shares of both are not substantial (nuclear accounts for about 1.2% of the total power generation capacity and non-hydro renewable about 1%, with wind power as the main source) despite their fast growth rates.

Many large coal fired power plants were installed during this period to satisfy rapidly increasing demand. As a result, the share of thermal power increased slightly from 75% in 2000 to 78% in 2006. As the development of hydro power was slower, its share of the total installed power generation capacity dropped slightly.

According to the current government plans, by 2010 China's installed electricity generation capacity will reach 593 GW for coal, hydro will reach 190 GW, natural gas 36 GW, nuclear 10 GW, wind power 10 GW, and bio mass power 5.5 GW. However, these targets, particularly the renewable energy targets, will be surpassed by significant margins. The Medium and Long Term Plan for Renewable Energy Development set a target for wind power of 5 GW by 2010 and the 11th Five Year Plan of Renewable Energy doubled that figure. Total installed wind power generation capacity will reach 10 GW by the end of 2008, and at least 20 GW by 2010. With this trend, by 2020, the total installed wind power generation capacity will easily surpass the 30 GW target set by the Medium and Long Term Development Plan for Renewable Energy. Conservative estimates put the figure between 80GW and 100 GW, and it could be much higher.

C) Technology:

Coal-fired power: There have been major improvements in the efficiency of coal-fired power generation in China, with a total of 7 ultra super critical coal plants of 1000MW capacity installed by 2007. By April 2008, more than 60, 600-1000MW ultra supercritical power plants were under construction in China. Government regulations require that all new coal fired power plants larger than 600MW meet the efficiency standards of ultra supercritical plants, and these are now becoming the mainstream for the Chinese electricity sector; which, combined with the shutdown of many small, old and inefficient plants has substantially improved the efficiency of the coal-fired power sector.

Integrated Gasification Combined Cycle (IGCC) is another advanced technology which has recently been introduced in China. Contracts were signed in February 2008 to build the largest IGCC units in the world, and a dozen new projects are awaiting approval by the National Development and Reform Commission (NDRC).

At the same time, Gas and Steam Combined Cycle power units have also been introduced, with the commissioning in July 2007 of the 300MW plant operated by the Angang Steel Corporation.

Hydro: Chinese hydro power went through a rapid development phase in the 1980s and 1990s, and now the technology is relatively mature. In addition to large hydro projects, there are also a large number of small hydro projects, many of which have been supported by the CDM.

Nuclear power: There are a total of 11 units in operation at present with a total capacity of 9.1GW. The Long Term Development Plan for Nuclear Power (2005-2020), released in October 2007, set a target of 40GW installed capacity by 2020; with another 18GW under construction by that time. This means that 30GW to 50 GW of nuclear power capacity will be constructed within the next 15 years, growing five times faster than in the past.

Wind energy: Wind power is the most developed renewable power technology in China. The wind sector has experienced explosive growth in recent years, and registered more than 100% growth in both 2006 and 2007, reaching a total installed capacity of 5.9 GW by the end of 2007, with anticipated cumulative installed capacity in excess of 10GW by the end of 2008, and more than 20 GW by 2010.

As a result of supportive government policies, most notably the Renewable Energy Support law which entered into force in 2006, China is now home to the world's largest wind turbine manufacturing industry, consisting of both domestic manufacturers and international companies, including such well known names as Vestas, Gamesa, Suzlon, Nordex and General Electric.

While international companies had a majority market share in the early part of this decade, domestic manufacturers took the majority of the market in 2007, led by Goldwind and Sinovel. Both companies entered the top 10 ranking of global turbine manufacturers in 2007, with Goldwind reaching #8 and Sinovel #10.

d) Policy:

Medium and Long Term Energy Conservation Plan (2004-2020): passed in November 2004, this Plan mainly sets energy saving targets and defines key areas for development with targets for both 2010 and 2020.

For the electricity sector, the Plan requires that the coal consumption of coal-fired power generation for the whole sector drops to 360g/kWh by 2010 and 320g/kWh by 2020. The target for 2010 was already reached in 2007. As in other sectors, the situation changes very quickly in China and the Government needs to keep updating the targets.

The 11th Five Year Plan: The 11th Five Year Plan sets clear and strict environmental targets, cutting the energy consumption per unit of GDP by 20%, and major pollutant emissions by 10% between 2005 and 2010. This is a binding target for Chinese energy and economic development. To be specific, the standard coal consumption of per RMB 10000 of GDP should drop from 1.22 tons in 2005 to 0.98 tons of coal equivalent in 2010 (constant 2005 RMB). The average annual reduction of energy intensity during the 11th Five Year Plan is 4.4%, cutting 8.4 million tons of SO_2 and 360 million tons of CO_2 emissions. By 2010, the energy consumption per unit of production of major energy consuming Chinese industries should come close to or achieve the same level as the OECD average at the beginning of the 21st century.

The comprehensive work plan for energy conservation: On June 3, 2007, the State Council released a comprehensive work plan on energy saving, with updated targets, providing further guidelines for energy conservation work in the country. The plan outlines a variety of means for achieving these objectives, including: pushing the reform of natural resource prices; carrying out oil and natural gas price reforms; optimizing the differentiation of electricity tariffs between peak and off-peak times; and encourages renewable power development with relevant pricing policies. It also raises emission fees for highly polluting companies, raising the SO_2 emission price from RMB 0.63 per kg in 2007 to RMB 1.26 per kg in three years (2010).

In August 2007, the regulations for promotion of non-hydro renewables were enacted. The "**Renewable Energy Medium and Long term Development Plan**" specified targets of 1% of power generation from non-hydro RE sources by 2010 and 3% by 2020.

2. Emissions scenarios for the Chinese electricity sector

Four development scenarios for the Chinese electricity sector are examined here to evaluate technology development and emissions profiles under different policy or technology conditions. They are: Business As Usual (BAU); a Policy Baseline Scenario; a Low Energy Demand Scenario, and an Advanced Technology scenario. All scenarios are from the IPAC model of the Energy Research Institute (ERI), China.

2.1 BAU

- Assumptions:

BAU scenario is based on the policy before 2001. In this scenario, technology is progressing slowly, as the pressure from energy supply, environmental and climate change is not taken into consideration. Energy Efficiency is improving slowly.

Table 2.1.1 Policy Assumptions in BAU

Energy intensity target	Decrease by 4.7% by 2010, compared to 2005
Energy saving	Continue energy saving policies announced around 2000
Fuel tax	No fuel tax until 2020
Energy tax	No energy tax
Export tax	No export tax
Renewable energy policy	Developed based on long-term development plan announced in 1996

- Electricity generation technology mix:

In BAU scenario, the total installed capacity would reach 1929 GW by 2030. Coal-fired generation would remain dominant, at 70%.

Table 2.1.2 Technology Penetration in Electricity Sector

	2005		2010		2020		2030	
	Installed capacity (GW)	Electricity generation (TWh)	Installed capacity (GW)	Electricity generation (TWh)	Installed capacity (GW)	Electricity generation (TWh)	Installed capacity (GW)	Electricity generation (TWh)
Coal	375.88	1954.6	761.06	3590.8	1159.39	5458.1	1423.41	6660.4
Oil	13.11	63.6	20.43	91.9	28.66	129	30.6	137.7
Gas	2.27	12.5	8.7	39.5	17.58	81.5	62.87	284
Hydro	121.33	396	195.69	645.8	248.27	869	290.12	1015.4
Nuclear	8.55	59.9	12.81	89.7	25.22	176.5	47.94	335.6
Wind	1.19	2.5	6.41	13.5	25.84	54.3	69.25	146.3

Biomass	1.11	5	2.99	13.5	4.53	20.4	5.74	25.8
Total	523.44	2494.1	1008.09	4484.7	1509.49	6788.8	1929.93	8605.2

- CO_2 emission per kWh

The CO_2 emission profiles per technology are shown in Table 2.1.3,.

Table 2.1.3 CO_2 Emission Factor in BAU (kg CO_2/kWh)

	Coal Fired	Oil fired	Natural gas fired	All electricity average
2005	0.996	0.779	0.541	0.803
2010	0.969	0.767	0.534	0.796
2020	0.939	0.756	0.515	0.775
2030	0.909	0.745	0.506	0.729

- Emissions pathway

In this scenario, based on the power generation in table 2.1.2 and emission intensity per kWh in table 2.1.3, the carbon emissions of the power generation sector are calculated. Emissions would increase by 76 % between 2010 and 2030.

Table 2.1.4 Carbon Emission from BAU Scenario (Gt CO_2)

	2005	2010	2020	2030
BAU	2.01	3.57	5.27	6.30

- Co-benefits

Table 2.1.5 shows the SO_2 and NO_x emission in BAU scenario

Table 2.1.5 SO_2 and NO_x Emission from Electricity Sector (million tons)

	2005	2010	2020	2030
SO_2	6.49	8.83	5.51	2.19
NO_x	6.41	9.64	10.89	7.09

2.2 Policy baseline scenario[1]

The Policy Baseline Scenario reflects existing policies and measures, and considers current efforts of the Chinese Government to increase efficiency and control emissions.

- Assumptions:

This scenario takes into consideration China’s continued economic development under the current model. No other energy related policies are considered except those already adopted or very likely to be enacted in the near future. Key policy

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[1] IPAC model of NDRC Energy Research Institute.

design components include: the current national target of reducing energy intensity by 20% between 2005 and 2010, although it is not expected at this stage that this ambitious target will be fully achieved; the continuation of current energy saving policies; a start to the fuel tax later this year, and the continuation of existing renewable energy support mechanisms. No new supportive policies for renewable energy development, the redirection of national investment and or changes to patters of production and consumption are included.

Table 2.2.1 Policy Assumptions in Policy Baseline Scenario

Energy intensity target	20% intensity target fails to reach by 2010 , 5.6% by 2010
Energy saving	Continue with policies from before 2004, which is reforming energy pricing, removing subsidies, energy efficiency standards, sectoral energy efficiency targets
fuel tax	Start from 2009
Energy conservation standard	Implementing energy efficiency standards for industrial products and electric appliance, with a moderate improvement rate
Export tax	Reduce tax rebate for high energy consuming products
Energy conservation supervision	No specific government agency on energy conservation except one division in NDRC.
Renewable energy policy	Renewable energy medium and long term development plan
Regional development policy	Economic development focused, with starting concerning on sustainable development
Consumption style	Same trend as OECD countries in past decades
Recycle economy policy	Moderate policies

Under such a scenario, the total energy demand of the society would increase to over 2.5 times the 2005 level.

Table 2.2.2 Forecast of the Energy Demand for the Whole Society (Gt of oil equivalent)

	Primary energy demand	End-use energy demand
2005	1.53	1.18
2010	2.41	1.80
2020	3.37	2.46
2030	3.87	3.00

- Electricity generation technology mix:

Under this scenario, the total installed capacity would reach 1845 GW by 2030. The share of coal fired power plants would stay stable at around 70% of total installed capacity until 2030.

Table 2.2.3 Table 2.3.3 Technology Penetration in Electricity Sector for Policy Base Scenario

	2005		2010		2020		2030	
	Installed capacity (GW)	Electricity generation (TWh)	Installed capacity (GW)	Electricity generation (TWh)	Installed capacity (GW)	Electricity Generation (TWh)	Installed capacity (GW)	Electricity Generation (TWh)
Coal	375.88	1954.6	718.34	3393.9	1051.32	4954.4	1259.52	5876.1
Oil	13.11	63.6	19.35	87.1	18.86	84.9	18.21	82
Gas	2.27	12.5	9.6	43.5	35.21	163.2	83.46	377
Hydro	121.33	396	197.91	653.1	270.43	946.5	327.82	1147.4
Nuclear	8.55	59.9	13.06	91.4	28.91	202.4	60.88	426.2
Wind	1.19	2.5	19.69	41.4	43.48	91.4	77.59	163.9
Biomass	1.11	5	7.74	43.5	14.51	84.9	18.21	122.9
Total	523.44	2494.1	985.69	4353.9	1419.24	6527.7	1845.69	8195.5

- CO_2 emission per kWh

The CO_2 emission profiles per technology are shown in Table 2.2.4.

Table 2.2.4 CO_2 Emission Factor in Policy Baseline Scenario ($kgCO_2/kWh$)

	Coal Fired	Oil fired	Natural gas fired	All electricity average
2005	0.996	0.779	0.541	0.803
2010	0.952	0.767	0.492	0.769
2020	0.912	0.756	0.452	0.718
2030	0.862	0.745	0.411	0.646

- Emission pathway

In this scenario, based on the power generation in table 2.2.3, and the emissions intensity per kWh in Table 2.2.4, carbon emissions of the power generation sector are calculated. Emissions would increase by 60% between 2010 and 2030.

Table 2.2.5 Carbon Emissions from Policy Baseline Scenario (Gt CO_2)

	2005	**2010**	**2020**	**2030**
Policy Baseline Scenario	2.01	3.32	4.66	5.31

- Co-benefits

Additionally, increased power generation efficiency and diversity of sources will lead to reduction of SO_2, a major air pollutant and the cause of acid rain. The impact on NO_x reduction is small, however.

Table 2.2.6 SO_2 and NO_x Emission from Electricity Sector (million tons)

	2005	2010	2020	2030
SO_2	6.49	8.74	5.30	2.08
NO_x	6.41	9.54	10.37	6.69

2.3 Low energy demand scenario[2]

The purpose of this scenario is to analyze the possibilities for energy conservation, emission reductions and supply diversification, with major efforts undertaken at the policy and investment levels, as well as the reform of energy prices. This requires a fundamental change of thinking and planning, seeking to control energy demand growth, and ultimately carbon emission growth. It will lead to a very different energy structure, with major co-benefits in terms of air pollution reduction. This is a very ambitious scenario, requiring strong leadership and major investment.

- Assumptions:

The major factors considered here include: the optimization of the economic structure, including a decrease in the share of high energy consuming industries in the economy; the wide dissemination of current energy conservation technology; and the aggressive diversification of the electricity generation mix. By 2020, the energy efficiency of major high energy consuming industries would reach or surpass the level of the advanced level of developed countries, and new building construction would need to reach a high energy efficiency standard. In general, this would reflect a shift towards highly efficient and clean production; and aggressive standards to encourage a public focus on energy efficiency in the home and the workplace.

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[2] IPAC model of NDRC Energy Research Institute.

Table 2.3.1 Policy Assumption of Low Energy Demand Scenario	
Energy intensity target	Reach “”eleventh five year plan”20% intensity target, and continue making ambitious energy saving effort by implementing policies announced by government after 2004(see Jiang et al, 2008)[3]. It will be around 48% reduction in 2020 compare to 2005 level
Energy saving	Strengthen current policies and apply them to broader areas
fuel tax	Start in 2009 at 1.3 RMB/liter，raise to RMB 4-5/liter by 2020
Energy tax	Introduce from 2012-2014, raise gradually
Energy conservation standard	Raise energy efficiency standard of products, with rapid improvement rate, new standard will be announced every 2 to 4 years; and cover wide range of industrial produces and final consumer products Apply the Japanese way, top runner model, of setting advanced technology as standard and close down obsolete facilities. Set timetable of phasing out inefficient products, such as incandescent light bulb by 2010.
Export tax	Restrict the export of high energy consuming products
Investment in energy conservation	Raise government investment drastically, by 2020 accumulated investment from government will be around 200billion yuan.
Energy conservation supervision	Strengthen supervision, implement existing energy standards; establishing energy conservation administration office in all related Ministries, all local government; establishing energy conservation centers in national and local level.
State investment policy	The government invest in sustainable development, build infrastructure and subway and other areas(education, healthcare and rural development). Develop grids, smart grids, etc. Guiding private investment to high value added and low consuming sector to improve economic structure.
Investment policies on private investment	Encouraging private investment to high value added sector, and clean production, emerging new high efficiency technologies and low emission technologies
Renewable energy policy	Fully support renewable energy development, with policy targeting, easy approve process, National planning and electricity price subsidy, guidance of private investment
Regional development policy	Setting stricter local pollution standard
Consumption style	The public buy low energy consuming and low carbon emission Products, and affect market and actions of enterprises: using less plastics bags, choosing clean transportation Using less one time products, and buying local food (reduce energy Consumption of transportation)
Circular economy policies	Recycle, reuse and reduce resource consumption, as a basic economy and industry policy, all major industry solid waste will be reused; start to regulate recycle of building material.

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[3] Jiang Kejun, , Hu Xiulian, Zhaung Xing, Liu Qiang, Liu Hong(2008) Energy Efficiency Improvement in China, Climate Policy, to be published.

This ambitious scenario results in a large deviation in terms of primary energy demand increase. By 2030, primary energy demand would be 98% higher than 2005 level, a dramatic decrease from either the BAU or Policy Baseline scenario.

Table 2.3.2 Forecast of the energy demand (Gt of oil equivalent)

	Primary energy demand	End-use energy demand
2005	1.53	1.14
2010	2.07	1.50
2020	2.74	1.90
2030	3.04	2.10

- Energy technology mix outcome:

In this scenario, because of strict energy saving measures and greater support for renewable sources, coal-fired power will lose its dominant role, dropping to 43% in 2030, in very sharp contrast with the Policy Baseline scenario.

Table 2.3.3 Technology Penetration in Electricity Sector for Low Energy Demand Scenario

	2005		2010		2020		2030	
	Installed capacity (GW)	Electricity generation (TWh)	Installed capacity (GW)	Electricity generation (TWh)	Installed capacity (GW)	electricity generation (TWh)	Installed capacity (GW)	Electricity Generation (TWh)
Coal	375.88	1938.4	719.71	3550.1	741.12	3602.1	689.09	3307.6
Oil	13.11	62.4	12.98	58.4	12.49	56.2	11.64	52.4
Gas	2.27	24.9	19.76	89.9	68.18	321.9	130.07	621.7
Hydro	121.33	396	203.79	606.5	348.77	1077	432.19	1362.2
Nuclear	8.55	59.9	16.69	116.8	66.89	468.3	150.69	1054.8
Wind	1.19	2.5	23.27	49.4	100.88	216.6	180.86	405.2
Biomass	1.11	10	5.13	21.6	26.48	111.2	43.24	181.6
Total	523.44	2494.1	1001.33	4492.7	1364.81	5853.3	1637.78	6985.5

- CO_2 emission per kWh

The CO_2 emission profiles per technology are shown in Table 2.3.4.

Table 2.3.4 CO_2 Emission Factor in Low Energy Demand Scenario ($kgCO_2/kWh$)

	Coal Fired	**Oil fired**	**Natural gas fired**	**All electricity average**
2005	0.996	0.779	0.541	0.803
2010	0.972	0.790	0.492	0.740
2020	0.897	0.779	0.444	0.567
2030	0.760	0.756	0.403	0.420

- Emission pathway

Under this scenario, the carbon emissions of the sector will plateau between 2010 and

2020 and decrease slowly in the decade following 2020. In the year 2030, total emissions will be 12% lower than the 2010 level. This means a substantial deviation from the Policy baseline scenario, 29% in 2020 and 45% in 2030.

Table 2.3.4 Carbon Emission from Policy Baseline Scenario (Gt CO_2)

	2005	2010	2020	2030
Low Energy Demand Scenario	2.01	3.32	3.32	2.93

- Co-benefits

The much greater efficiency of fossil fuel power plants and larger share of renewable energy leads to significant pollution reduction co-benefits. SO_2 emissions will drop over 80% and NOx 44% compared with 2005 levels.

Table 2.3.5 SO_2 and NO_x Emission from Electricity Sector (million tons)

	2005	2010	2020	2030
SO_2	6.46	8.18	3.63	1.13
NO_X	6.39	8.95	7.11	3.58

2.4 Advanced technology scenario

- Assumptions:

This scenario makes no specific additional policy assumption, but rather focuses on further improving the technology mix in order to maximize the potential of power generation efficiency, and minimize carbon intensity, in both cases to a higher degree than in the Low Energy Demand Scenario. The potential of lower carbon emission technologies will be further explored: renewable energy and nuclear reach their maximum potential; decentralized power supply systems are widespread; low efficiency coal-fired technology will be replaced by renewable energy or high efficiency coal fired technology; some coal fired plants employ CCS; China become one of the global leader on low carbon technology.

- Energy technology mix outcome:

In this scenario, total installed capacity of renewable energy, including wind, solar, biomass and hydro will reach 45.4% of the entire power generation sector by 2030, with wind energy accounting for 15.7% of total installed capacity of the sector.

Table 2.4.1 Technology Penetration in Electricity Sector for Advanced Technology Scenario *[4]

	Installed capacity (GW)	Electricity generation (TWh)	Installed capacity (GW)	Electricity Generation (TWh)	Installed capacity (GW)	Electricity generation (TWh)	Installed capacity (GW)	Electricity generation (TWh)
Coal	375.88	1938.4	717.88	3550.1	690.54	3602.1	607.59	3307.6
Oil	13.11	62.4	12.98	58.4	12.49	56.2	11.64	52.4

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[4] In this scenario, solar PV installation by 2020 will reach 3.5 GWp, with 4 TWh generation capacity. By 2030, the install capacity will reach 10GWp, with 11.5 TWh generation capacity.

Gas	2.27	24.9	19.76	89.9	70.66	321.9	138.84	621.7
Hydro	121.33	396	203.79	606.5	333.27	1077	442.17	1362.2
Nuclear	8.55	59.9	16.69	116.8	83.62	468.3	164.66	1054.8
Wind	1.19	2.5	27.5	49.4	171.77	216.6	265.05	405.2
Biomass	1.11	10	5.13	21.6	30.66	111.2	49.9	181.6
Total	523.44	2494.1	1003.73	4492.7	1393.01	5853.3	1679.85	6985.5

- CO_2 emission per kWh

The CO_2 emission profiles per technology are shown in Table 2.4.2.

Table 2.4.2 CO_2 Emission Factor in BAU (kgCO_2/kWh)

	Coal Fired	Oil fired	Natural gas fired	All electricity average
2005	0.996	0.779	0.541	0.803
2010	0.972	0.790	0.492	0.736
2020	0.828	0.779	0.444	0.513
2030	0.729	0.756	0.403	0.352

- Emissions pathway

Carbon emissions in the electricity sector will drop sharply in the 2010s and 2020s. By 2020, emission reductions compared to 2010 are nearly 10%, and by 2030 more than a quarter. Compared to the Policy Baseline Scenario, the deviation in carbon emission would reach 35% in 2020 and more than half in 2030.

Table 2.4.3 Carbon Emission from Advanced Technology Scenario (Gt CO_2)

	2005	2010	2020	2030
Advanced Technology Scenario	2.01	3.31	2.99	2.46

- Co-benefits

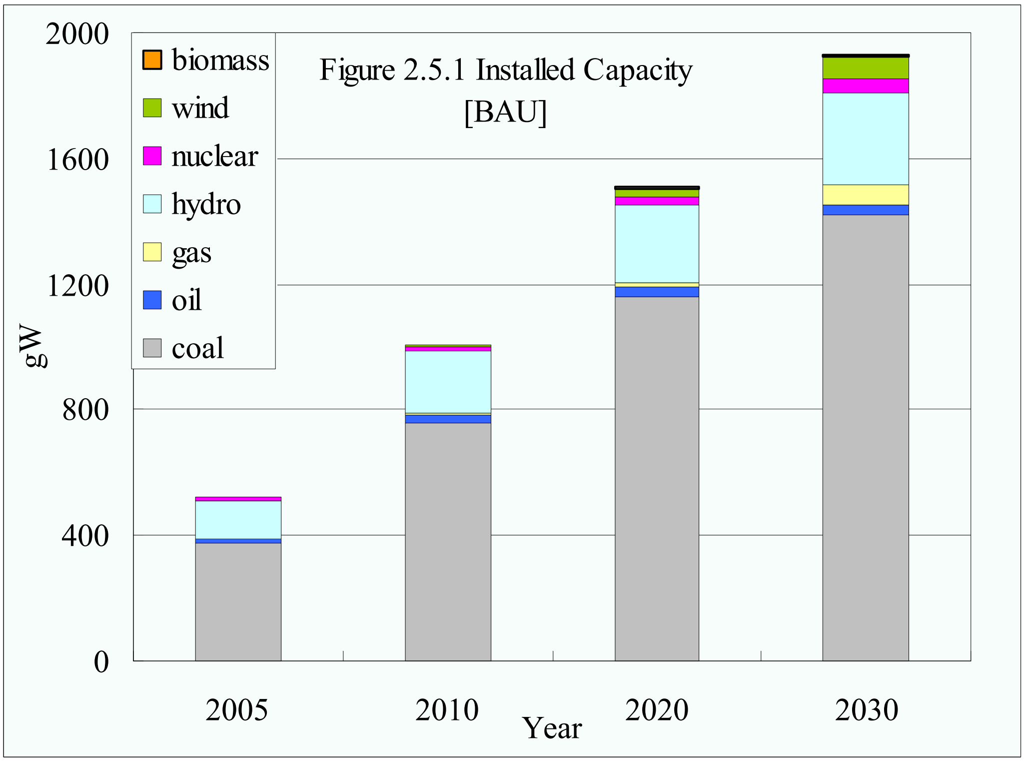
This will bring more air pollutant emission reduction as well.

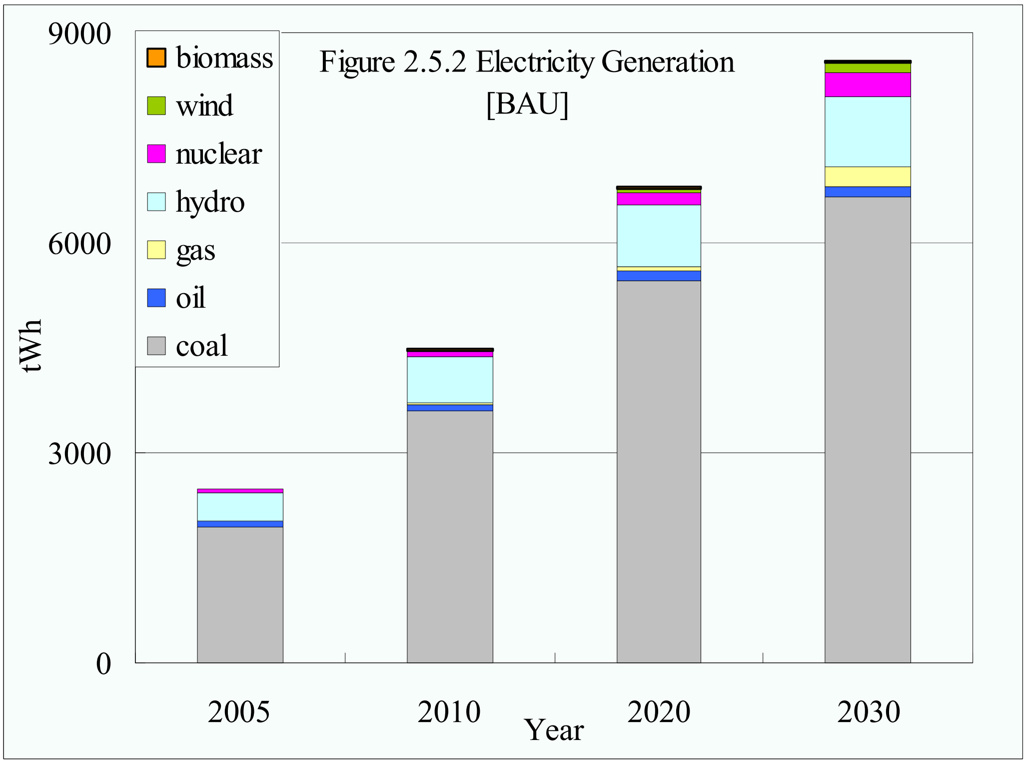
Table 2.4.4 SO_2 and NO_x Emission from Electricity Sector (million tons)

Emission (million tons)	2005	2010	2020	2030
SO_2	6.46	8.18	3.38	0.99
NO_x	6.39	8.95	6.61	3.15

2.5 Summary of the findings in this chapter

The following figures provide a graphic summary of the different scenarios





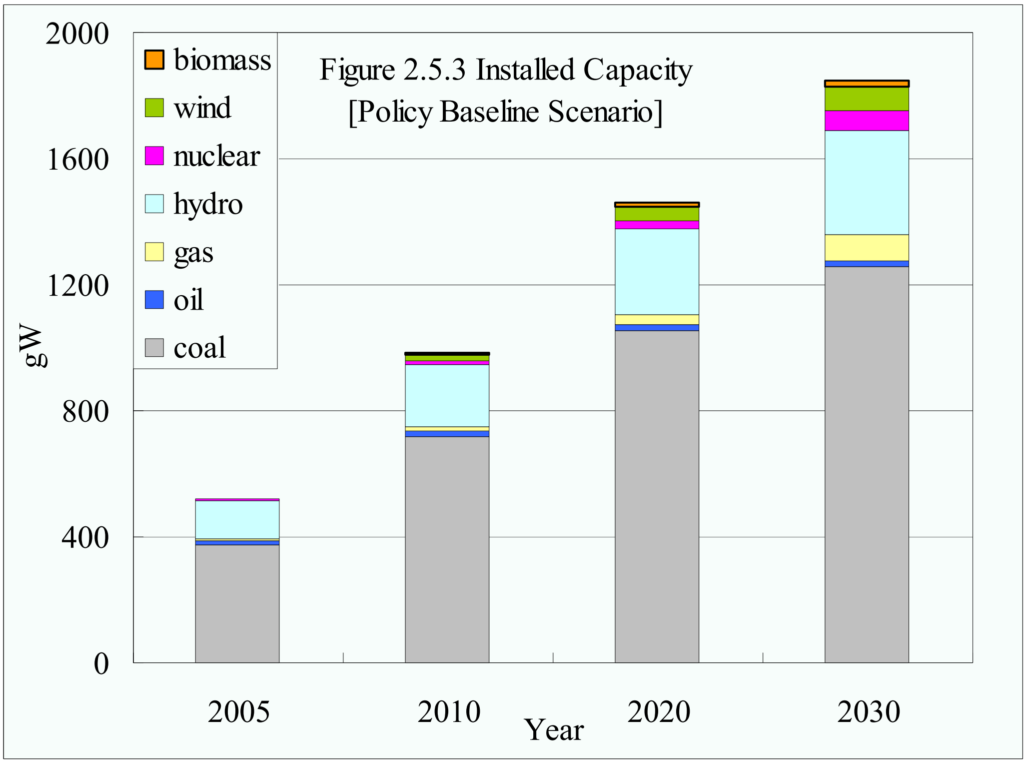


Figure 2.5.3 Installed Capacity [Policy Baseline Scenario]

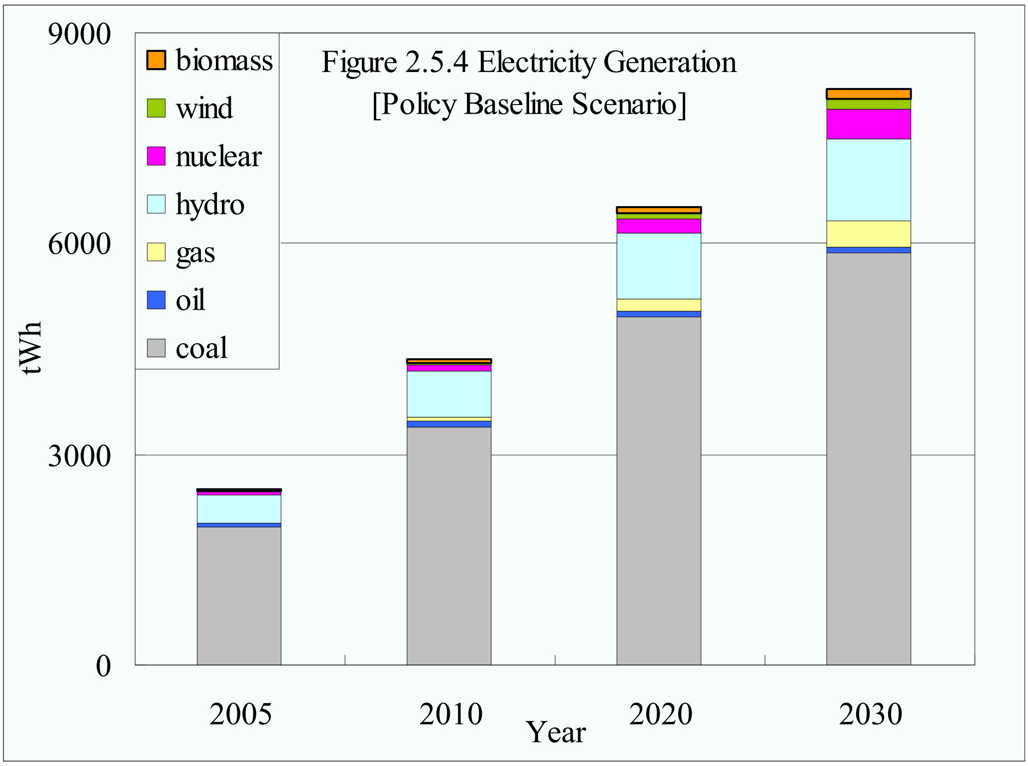


Figure 2.5.4 Electricity Generation [Policy Baseline Scenario]

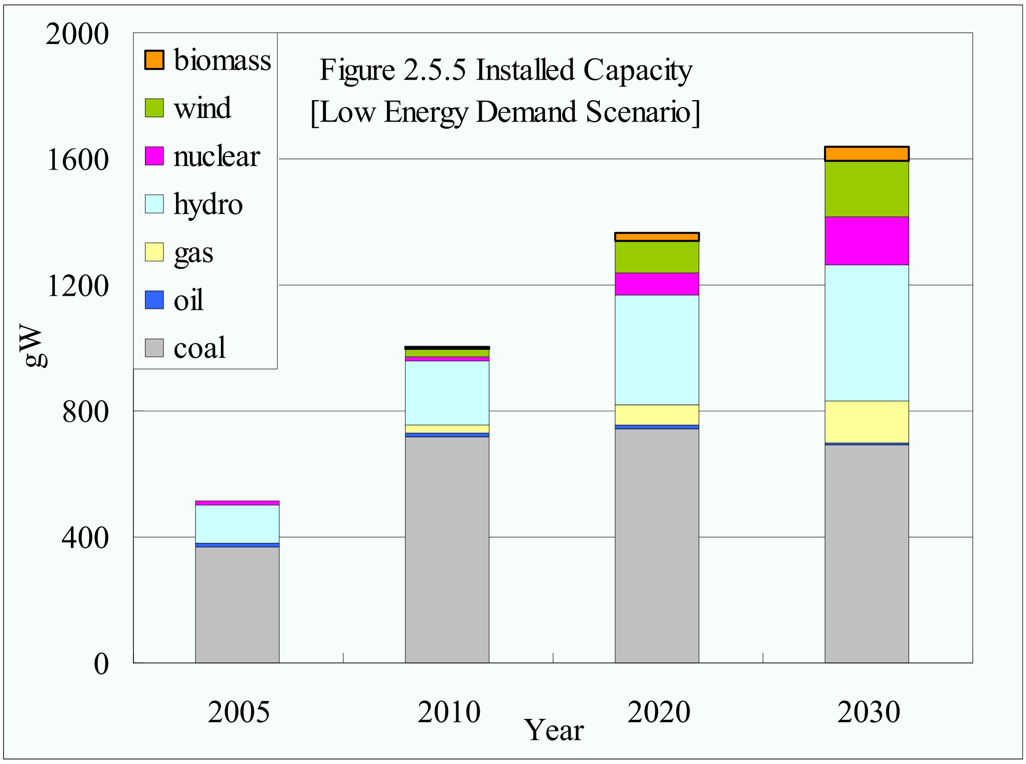


Figure 2.5.5 Installed Capacity
[Low Energy Demand Scenario]
biomass
wind
nuclear
hydro
gas
oil
coal
gW
2000
1600
1200
800
400
0
2005
2010
2020
2030
Year

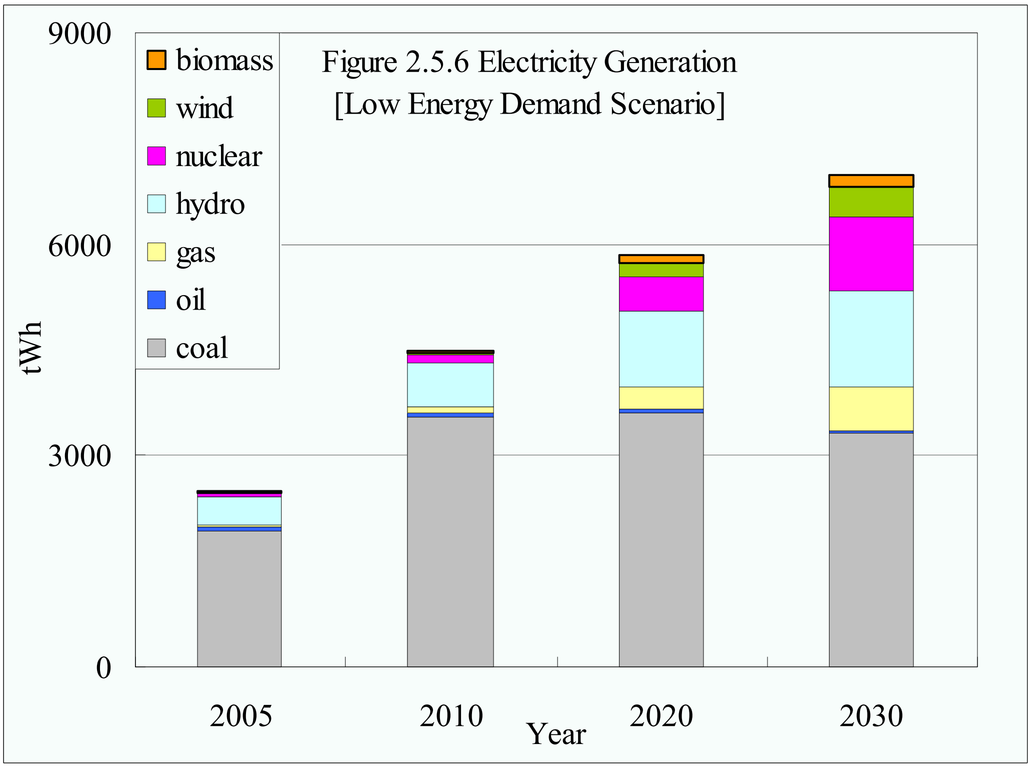


Figure 2.5.6 Electricity Generation
[Low Energy Demand Scenario]
biomass
wind
nuclear
hydro
gas
oil
coal
tWh
9000
6000
3000
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2005
2010
2020
2030
Year

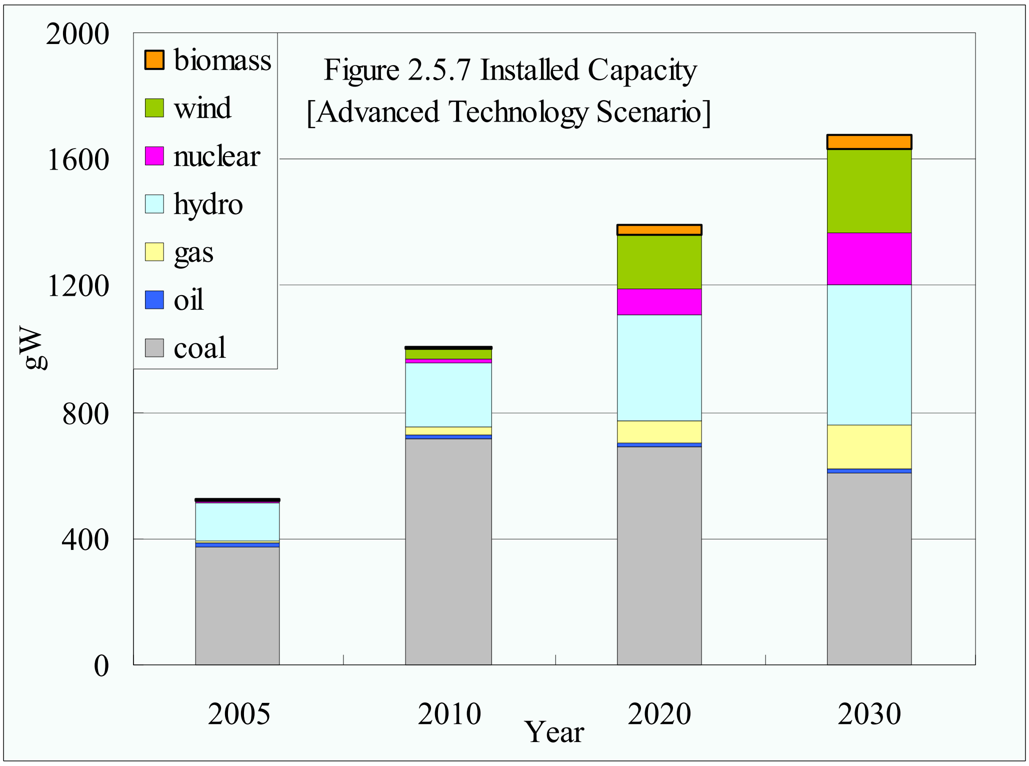


Figure 2.5.7 Installed Capacity
[Advanced Technology Scenario]

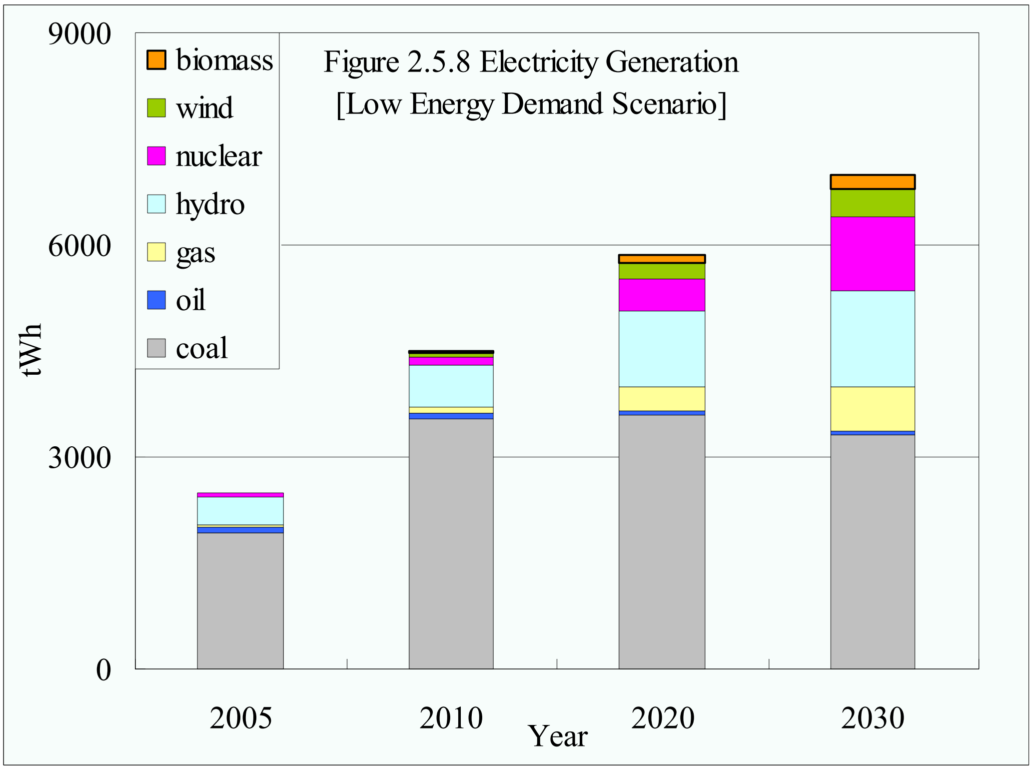


Figure 2.5.8 Electricity Generation
[Low Energy Demand Scenario]

3. Defining no-lose target

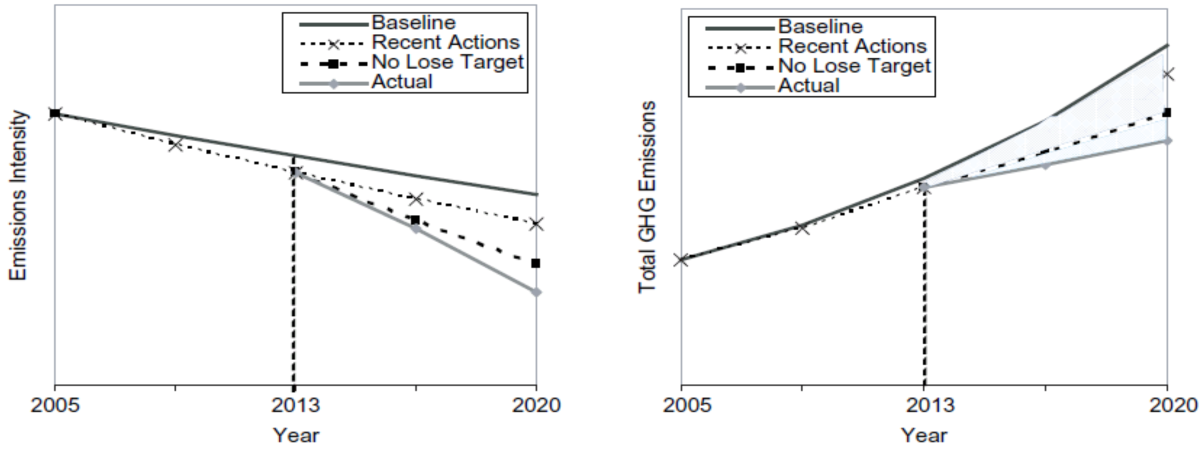
3.1 Defining a sectoral mechanism/Sectoral No Lose Target(SNLT)

The idea of a sectoral 'no-lose' target coupled with a sectoral crediting mechanism has been much discussed, both in terms of improving the effectiveness of the CDM, and in terms of increasing the amount of carbon finance available for mitigation in the context of the post-2012 climate agreement. It is expected that a dramatic increase in the scale of carbon finance will be necessary for Annex I countries to meet the deep reduction targets that they must adopt to meet rigorous climate protection goals, as well as to dramatically increase the investment in low and zero carbon technologies in developing countries. Important work on this idea was done first by the Center for Clean Air Policy and the OECD Annex 1 Experts Group, and more recently in the followup to the Gleneagles Dialogue, among others.[5]

Generally speaking, under this approach, participating countries would establish a voluntary, sector-wide "no lose" GHG intensity target (e.g., GHG / ton of steel) in one or more major energy and heavy industry sectors. If a participating country does not meet the voluntary target, no sanctions are incurred. Emissions reductions achieved beyond the pledged target would be eligible for sale as emissions reductions credits (ERCs) to developed countries. The ERCs, similar to CERs, would be recognized as a reduction unit representing one ton of CO_2 and could be traded on the international carbon market in the same way as CERs, ERUs or AAUs.

The sectoral GHG emission target pledges made by any participating developing country would need to result from a proposal based on an internationally agreed methodology, and with the kinds of reporting and verification mechanisms currently established for CDM projects.

Figure 3.1.1 Sectoral No Lose Target



(Source: Schmidt, J.*etal.*2006)

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[5] See, for instance: Schmidt, J., Helme, N., Lee, J., Houdashelt, M. 2006a. *Sector-based Approach to the Post-2012 Climate Change Policy Architecture.* Future Actions Dialogue Working Paper, Center for Clean Air Policy, Washington, DC.; Baron, R. and Ellis, J. (2006) *Sectoral crediting mechanisms for greenhouse gas mitigation: institutional and operational issues*. OECD/IEA Paper; Ward, M. et al. (2008) *The role of sector no-lose targets in scaling up finance for climate change mitigation activities in developing countries*,UK DEFRA

Figure 3.1.1 illustrates the basic structure of the SNLT: A baseline or BAU emission pathway, as well as a 'recent actions' pathway, showing the results of domestic policies and measures. The no-lose target would be at or below the recent action line, but the precise level would need to be defined through an agreed methodology, and take into account other aspects of the post-2012 agreement, such as technology and capacity building agreements. Developing a detailed methodology for the final establishment of the no-lose target is beyond the scope of this exercise.

The bottom line shown in the figure shows the actual emissions, which would need to be finally determined at the end of the crediting period, and the difference between this line and the 'no lose target' would be the final quantity of ERCs available for trading on international carbon markets.

This paper uses this approach to explore the potential for the electricity sector in China: first, analyzing the potential scope of the mechanism in light of the scenarios explored in section 2; then estimating ranges for carbon finance which could potentially be generated; comparing these with the estimated abatement costs; and finally comparing these with the existing arrangements for power sector mitigation financed under the CDM.

The scenarios explored in section 2 are measured on an absolute emissions basis based on intensity factors in the electricity sector, but with the realization that our ability to precisely predict the future is fundamentally limited. When quantifying the future emissions performance of the electricity sector in a rapidly developing economy, there will be a large degree of uncertainty attached to any specific emissions pathway. In the case of power generation, it is very difficult to make accurate forecasts of electricity production and demand a decade or more into the future. Therefore while we are using absolute emissions projections for the sector under different scenarios, this is merely to explore the mitigation potential in the sector. Scenarios, however, only give us a general guide for the future trend of total emissions. In the end a 'hybrid' approach may be the best option, i.e., a target which is adjusted periodically on the basis of actual GDP growth and other factors. However, there is one overwhelming argument in favor of using absolute emissions numbers, and that is the clear built in incentive for energy efficiency.

3.2 Considerations in defining no-regret target

Table 3.2.1 shows the development of the annual emission profile of the electricity sector from 2005 to 2030, as per the four scenarios in Chapter 2.

Table 3.2.1 CO2 Emission From Electricity Sector (Gt CO_2)

	BAU	Policy baseline scenario	Low energy demand scenario	Advanced technology scenario
2005	2.00	2.01	2.01	2.01
2010	3.57	3.32	3.32	3.31
2020	5.27	4.66	3.32	2.99
2030	6.30	5.31	2.93	2.46

Table 3.2.2 shows the cumulative emissions of the four scenarios over the time periods

described.

Table 3.2.2 Cumulative Emission in Different Period Under Different Scenario (Million ton)

	BAU	Policy Base Scenario	Low Energy Demand Scenario	Advanced Technology Scenario
2005-2010	13,929	13,309	13,290	13,270
2010-2020	44,170	39,915	33,177	31,480
2020-2030	57,823	49,864	31,266	27,225

Figure 3.2.1 illustrates the four scenarios for China's electricity sector. The "no-lose" target would fall at or more likely below the policy baseline scenario, depending on the agreed methodology. The difference between the Policy Baseline Scenario and Low Energy scenario defines the most likely scope for the operation of the sectoral crediting mechanism, but the range of emissions reductions all the way to the Advanced Technology scenario is also measured as an upper limit to the potential scope of the mechanism

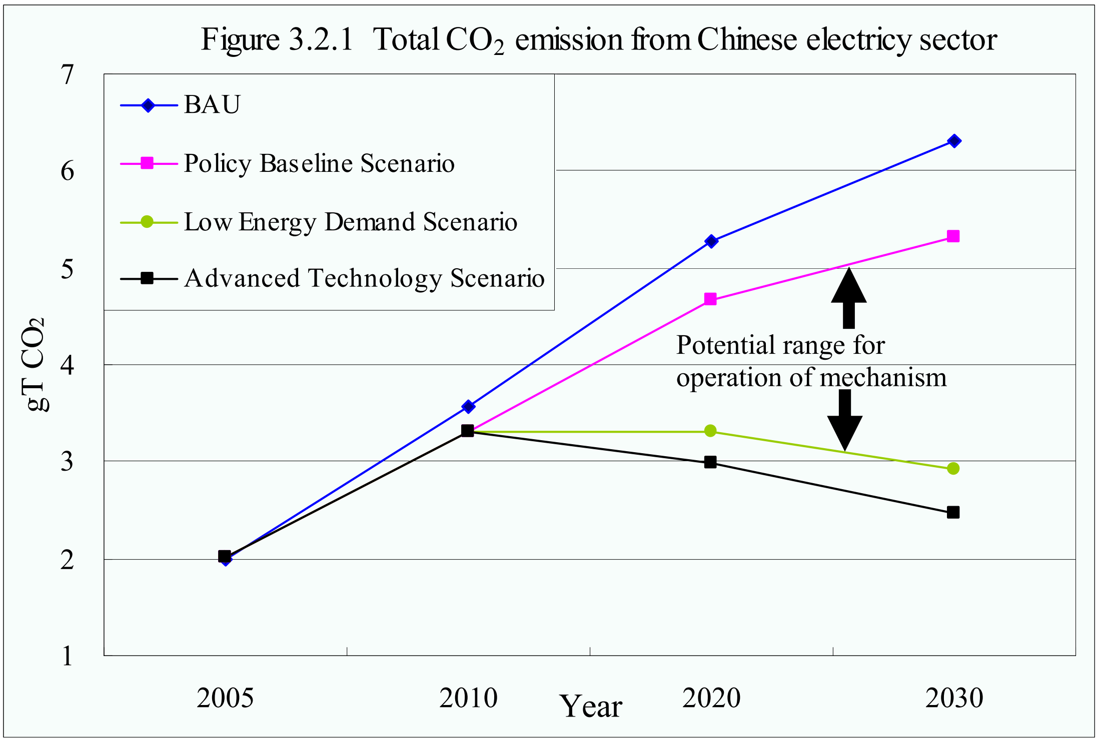


Table 3.2.3 lists the possible combinations of the SNLT and actual emissions outcomes, thereby defining three different ranges for mitigation potential.

Table 3.2.3 Matrix of different combination of SNLT and Actual Emission options

SNLT Actual Emission	Policy Base scenario	Low Energy Demand Scenario
Low Energy Demand Scenario	ERC scenario A	-
Advanced Technology Scenario	ERC scenario B/ERC Max	ERC Scenario C

Setting the SNLT at the Policy Baseline scenario and actual emissions at the Low Energy Demand scenario defines ERC scenario A. This gives us the most likely scope for the potential operation of the mechanism. The range defined by setting the SNLT at the Policy Base Scenario and the actual emissions at the Advanced Technology scenario is ERC Scenario B, which shows the maximum possible scope of the mechanism. ERC scenario C is defined as establishing the SNLT at the level of the Low Energy Demand scenario and the actual emissions at the level of the Advanced Technology scenario.

Table 3.2.4 Emissions reductions credits (ERCs) Amount in Different ERC Scenarios

	ERC Scenario A: SNLT at the Policy Baseline scenario; Actual emissions at the Low Energy demand scenario (million ton)	ERC Scenario B or ERC Max: SNLT at Policy Base/actual emissions at Advanced technology scenario (million ton)	ERC Scenario C: SNLT at Low energy demand scenario/actual emissions at advanced technology scenario (million ton)
2005-2010	19	39	20
2010-2020	6,738	8,435	1,697
2020-2030	18,598	22,639	4,041

Table 3.2.4 shows the maximum quantity of ERCs which could be generated under the various scenarios in the designated time frames. The maximum quantity of ERCs is from table 3.2.2, with assumption of the SNLT at two different levels.

3.3 Max benefit analysis and the abatement cost analysis

This section uses different carbon price assumptions to estimate the maximum potential carbon revenues when setting the SNLT at Policy Baseline level, and at Low Energy Demand level. The forecast of future carbon prices ranges from 15-50 Euro. In this analysis, three indicative prices are used:

a) 15euro/ ton: current EUA and sCER price
b) 30euro/ton
c) 50euro/ton

Table 3.3.1 provides an abatement cost analysis arising from the modeling exercise done by the ERI.

Table 3.3.1 Cumulative Abatement Cost (Million Euro)			
	Low energy demand scenario as compared to policy baseline scenario(Million Euro)	**Advanced technology scenario as compared to low energy demand scenario**	**Additional cost from policy baseline to Advanced technology**
2005-2010	14,850	4,725	19,575
2010-2020	87,500	31,100	118,600
2020-2030	75,850	69,400	145,250

We now compare the abatement cost estimates from the model with the potential carbon revenue which could be derived from the employment of a Sectoral no-lose target and Sectoral crediting mechanism.

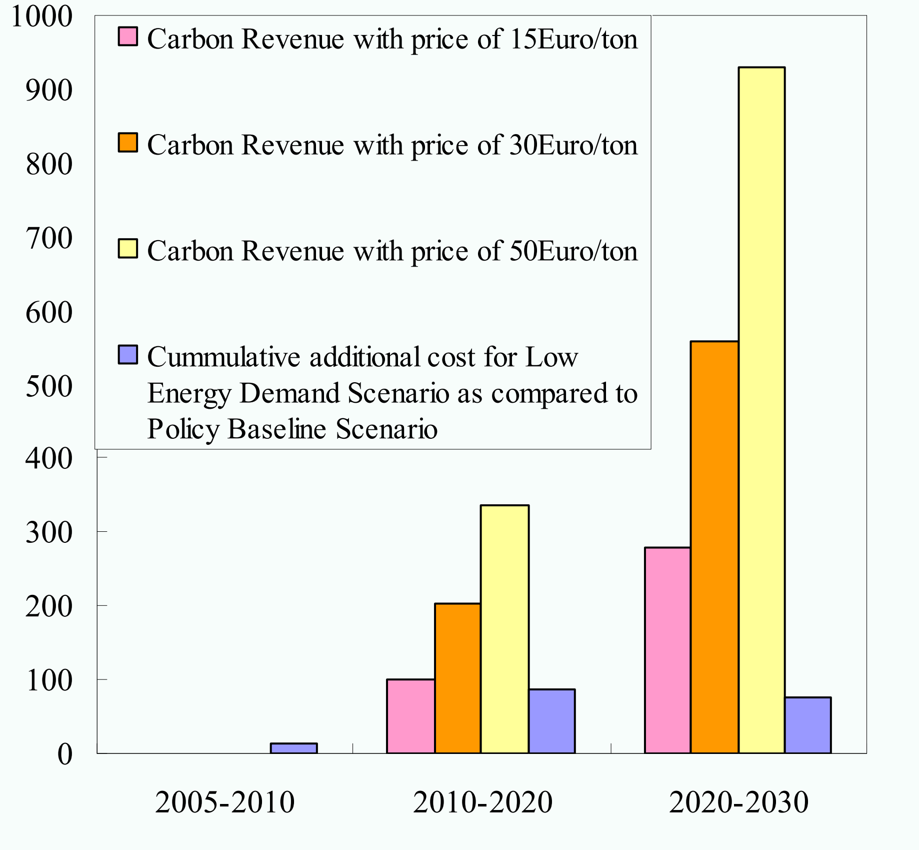
The potential carbon revenue from the mechanism is then compared to the abatement costs as outlined in Table 3.3.1 above.

a) Potential carbon revenue and comparison with the abatement costs for ERC scenario A, when SNLT is at the policy baseline scenario and actual emissions are at the low energy scenario:

Table 3.3.2 Carbon Revenue for ERC Scenario A: SNLT at Policy Base + Actual Emission at Low Energy Demand Scenario				
	Max ERCs (million ton)	**Carbon price assumption 15 Euro/ton**	**Carbon price assumption 30 Euro/ton**	**Carbon price assumption 50 Euro/ton**
		Carbon revenue (M Euro)	**Carbon revenue (M Euro)**	**Carbon revenue (M Euro)**
2005-2010	**19**	285	570	950
2010-2020	**6,738**	101,070	202,140	336,900
2020-2030	**18,598**	278,970	557,940	929,900

Table 3.3.2 shows carbon revenue with different price assumptions, for ERC Scenario A, when SNLT at Policy Base and actual emission at Low energy demand scenario. In the period of 2010-2020, max revenue is 101billion Euro, assuming a carbon price of 15euro/ton. The same number goes up to 336 billion euro, at a 50 Euro/ton carbon price assumption.

Figure 3.3.1 Comparison of carbon revenue with abatement cost in ERC scenario A (Billion Euro)



b) Carbon revenue and comparison with the abatement for ERC scenario B, when SNLT is at the policy baseline scenario and actual emissions are at the advanced technology scenario

Table 3.3.3 Carbon Revenue for ERC Scenario B: SNLT at Policy Base + Actual Emission at Advanced Technology Scenario

SNLT at policy Base	Max benefit	Carbon price assumption 15 Euro/ton	Carbon price assumption 30 Euro/ton	Carbon price assumption 50 Euro/ton
		Carbon revenue (M Euro)	Carbon revenue (M Euro)	Carbon revenue (M Euro)
2005-2010	**39**	585	1170	1950
2010-2020	**8,435**	126,525	253,050	421,750
2020-2030	**22,639**	339,585	679,170	1,131,950

Again, the carbon revenue is huge, as this scenario depicts the maximum ERC amount. In 2010-2020, the number goes up to 126billion Euro at carbon price of 15 euro/ton. The same number goes to 421billion Euro, when it comes to a 50 euro carbon price assumption.

Table 3.3.3 shows the carbon revenue at different price assumption in comparison with abatement cost. The revenue exceeds the abatement cost over ten times.

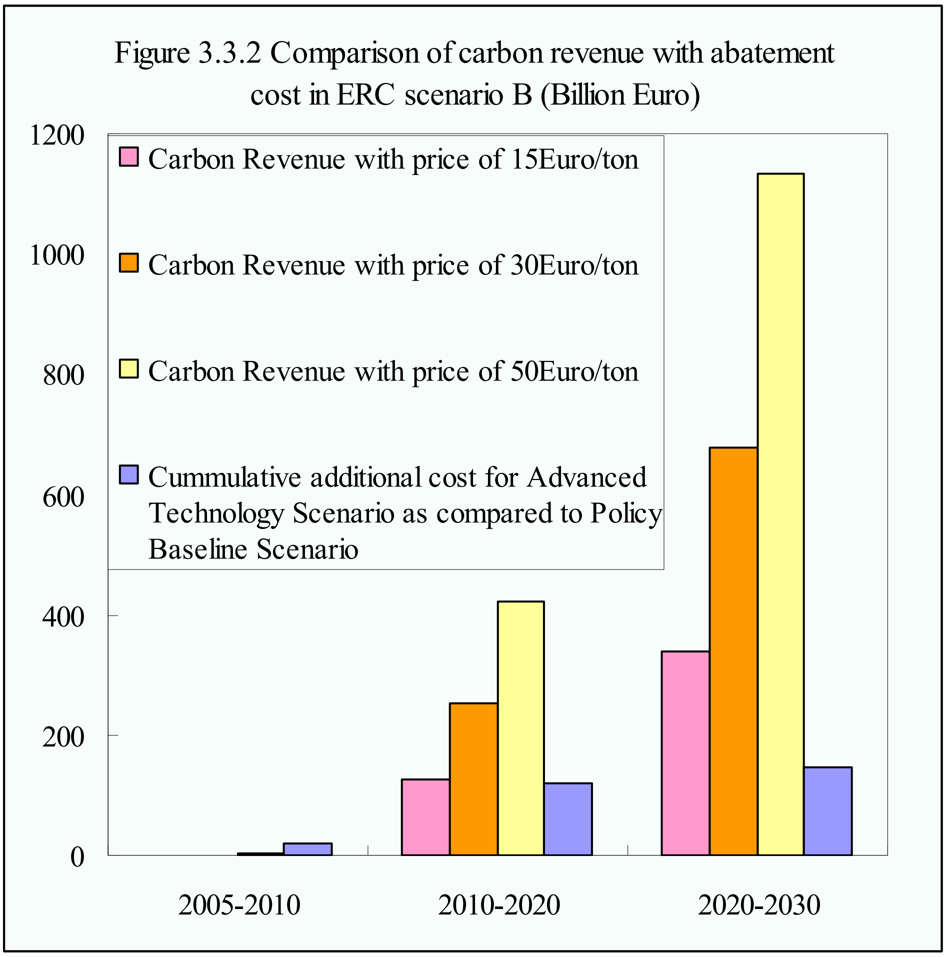


Figure 3.3.2 Comparison of carbon revenue with abatement cost in ERC scenario B (Billion Euro)

Figure 3.3.2 shows a comparison of carbon revenue with the cost to go from policy baseline to advanced technology. It shows that at different price assumption, in post 2012 period, the carbon revenues, in all three price assumptions, all exceeded the cost to move from policy base scenario to advanced technology scenario.

C) Carbon revenue and comparison with the abatement for ERC scenario C, when SNLT is at low energy demand scenario and actual emission at advanced technology scenario

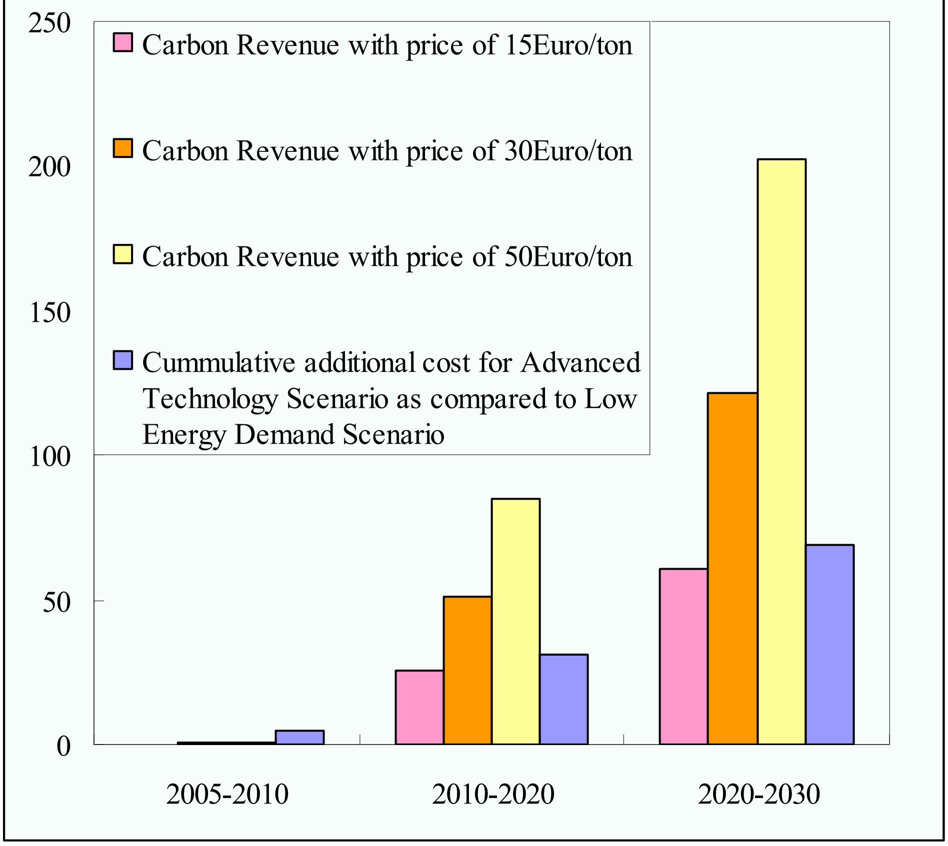
Table 3.3.3 shows the ERC revenue when SNLT is set at low energy demand and actual emission at advanced technology scenario. As mentioned before, this is the most ambitious target setting and most optimistic actual emission estimation, so the result from this ERC scenario could just be used as a reference.

Table 3.3.4 Carbon Revenue for ERC Scenario C: SNLT at Low Energy Demand Scenario + actual emission at Advanced Technology Scenario

SNLT at policy Base	Max benefit	Carbon price assumption 15 Euro/ton	Carbon price assumption 30 Euro/ton	Carbon price assumption 50 Euro/ton
		Carbon revenue (M Euro)	Carbon revenue (M Euro)	Carbon revenue (M Euro)
2005-2010	20	300	600	1,000
2010-2020	1,697	25,455	50,910	84,850
2020-2030	4,041	60,615	121,230	202,050

As shown in Table 3.3.4, during 2012-2020, the carbon revenue could reach 25billion euro at carbon price of 15 euro/ton, or 84 billion at carbon price of 50euro/ton. This again is a tentative number.

Figure 3.3.3 Comparison of carbon revenue with abatement cost in ERC scenario C (Billion Euro)



3.4 Comparison between benefits from CDM and sectoral mechanism from carbon market: current CDM projects in pipeline 2010-2020 Vs. ERC scenarios A, B, C, 2010-2020.

The Clean Development Mechanism has made a solid and in some cases surprisingly large contribution so far during the first commitment period of the Kyoto Protocol and no doubt will continue to have a significant role to play in the post-2012 regime. However, the project-based nature of the mechanism means that it will not attract investment sufficient to deliver either the kinds of broad structural changes which are necessary to assist developing countries in decarbonising their major emitting sectors, nor will it provide the kind of mitigation potential necessary to meet the rigorous targets which are necessary in the period from 2012 – 2020 and beyond. The additionality requirement as currently applied, while an important means to ensure the environmental integrity of the project based mechanism, doesn't really work when addressing the wholesale transformation of major sectors. As an example, while everyone agrees that helping to finance the development of wind power or small hydro in China, what does 'additionality' mean when China has the fastest growing wind power market in the world? The climate regime needs to recognize and support that development in a broader way.

However, the CDM has been an important source of revenue, and the purpose of this section is to compare the potential revenue from the sectoral crediting mechanism with the current revenue from the CDM projects in electricity sector in China.

Table 3.4.1 shows the current total CDM in electricity in electricity sector. 71% of the projects are at validation, while only 23% registered. If we assume all the projects will become registered and will issue credit, as indicated in Table 3.4.2, the total CER issue up to 2012 is 2.64 Gt, while same projects between 2013-2020 is 1.65Gt.

Table 3.4.1 Current CDM Projects in Pipeline in Electricity Sector, China.

By 1st. Nov, 2008

	CDM projects at different stage in the pipeline	CER by 2012	CER between 2013-2020
Number of projects at Validation	1008	624.2	1078.8
Projects for correction	70	49.7	72.2
Number of registered	331	296.9	459.1
Request review and under review	16	22.7	40.9

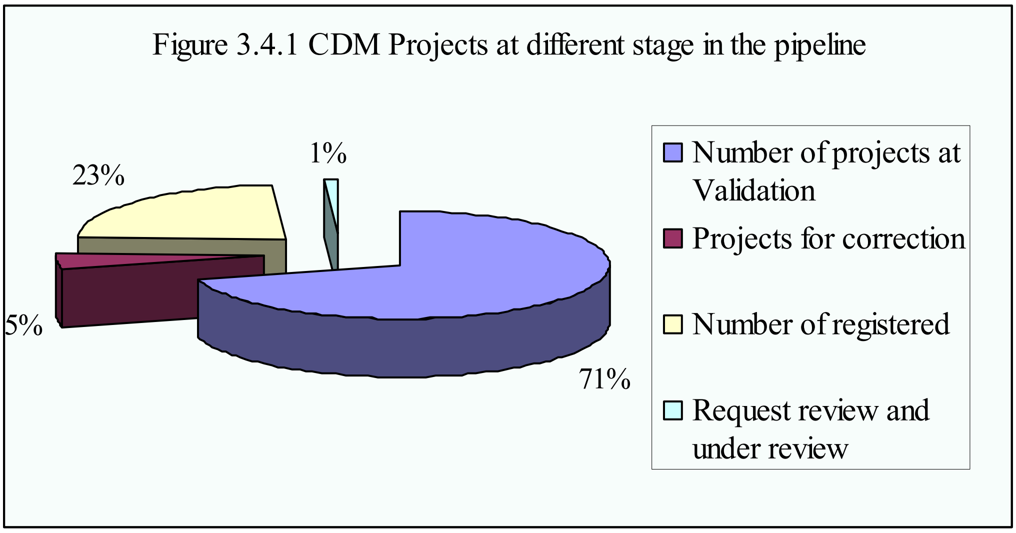


Table 3.4.2 CER by 2012, 2020 and 2013-2020 with Current Projects in Pipeline

Total CER By 2012 (Million Ton)	Total CER by 2020 (Million Ton)	CER delivered in 2013-2020 (Million Ton)
993.8	2,645	1,651.2

Now, if we take the number of CER to be delivered by 2012, assuming different carbon prices, as 15euro/ton, 20 euro/ton and 30euro/ton, the total carbon revenue is shown in table 3.4.3. The maximum revenue from first commitment period fall into the range between 1.5 billion Euro to 2.9 billion euro, with different price assumption.

Table 3.4.3 Carbon Revenue of CDM Projects in Electricity Sector in China—up to 2012

Credit by 2012(Mt CO_2)	Carbon revenue with price at 15 Eruo/ton		Carbon revenue with price at 20 Eruo/ton		Carbon revenue with price at 30 Eruo/ton	
	Carbon revenue1 (Million Euro)		Carbon revenue 2 (Million Euro)		Carbon revenue 3(Million Euro)	
993.8	14907		19876		29814	
Adjustment CDM face value depreciation	-35%	9,689.55	-35%	12,919.4	-35%	19,379.1

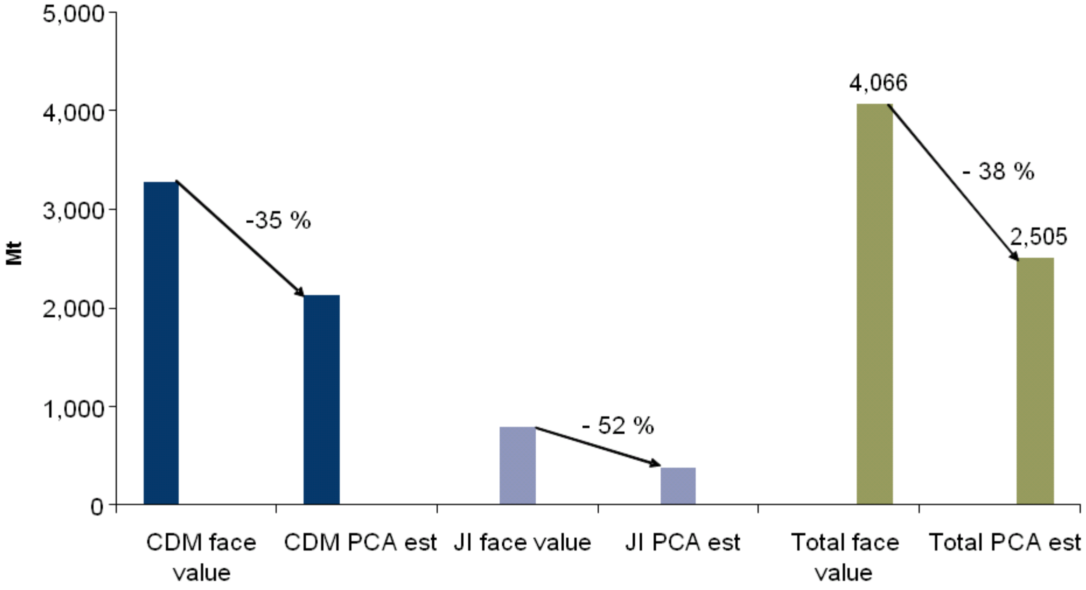
The same analysis is done for the credit to be issued during 2013-2020 period, assuming that the second commitment period continues and the current registered projects will have continue crediting period beyond2012. Table 3.4.4 shows the result of carbon revenue from CER to be delivered 2013-2020. Price assumption for 2013-2020 is the same as the one used in Table 3.3.2 , Table 3.3.3 and Table 3.3.4. The carbon revenue in 2013-2020 period from CDM ranges between 2.4 billion-8.3 billion Euros. On the basis of 2013-2020 CER, a 25% increase in the CER is employed as a assumption to convert the number into timeframe of 2010-2020. The carbon revenue ranges from 3.1billion Euro to 10 billion Euro, using the same price assumption.

Table 3.4.4 Carbon Revenue from Current CDM in the Pipeline from 2013-2020 Period

Credit from current projects in pipeline from 2013-2020	Carbon Revenue with price at 15 Euro/ton		Carbon Revenue with price at 30 Euro/ton		Carbon Revenue with price at 50 Euro/ton	
	Carbon Price assumption 1(Euro/ton)	Carbon Revenue1 (Million Euro)	Carbon Price assumption 2(Euro/ton)	Carbon Revenue assumption 2(Million Euro)	Carbon Price assumption 3(Euro/ton)	Carbon Revenue 3(Million Euro)
1,651	15	24,768	30	49,536	50	82,560
Carbon Revenue from Current CDM in the Pipeline from 2010-2020 Period						
Credit from current projects in pipeline from 2010-2020 (Estimation) (25% increase on the basis of 2013-2020 number) (Mt)	**Carbon Price assumption 1(Euro/ton)**	**Carbon Revenue1 (Million Euro)**	**Carbon Price assumption 2(Euro/ton)**	**Carbon Revenue assumption 2(Million Euro)**	**Carbon Price assumption 3(Euro/ton)**	**Carbon Revenue 3(Million Euro)**
2,064	15	30,960	30	61,920	50	103,200
Adjustment CDM face value depreciation	-35%	20,124	-35%	40,248	-35%	67,080

However, according to a Point Carbon research, the CER face value usually has a 35% depreciation, as the CER issuance may be 35% less than originally designed in PDD. Thus, a 35% depreciation is added to adjust the CER delivered both period. The adjusted number for CER to be delivered by 2012 ranges between 0.97Billion to 1.93 billion Euro.

CER to be delivered between 2010-2020 ranges between 2-6.7 billion.



(Source: Point Carbon[6])

Table 3.4.5 shows that the comparison between the revenue from sectoral mechanism and the revenue from current CDM projects (CER to be delivered 2013-2020). It shows that the revenue from sectoral mechanism exceeds that of the CDM projects in current pipeline. One can argue that more projects will be added in the coming years, which will make the revenue soon exceed the current projects. However, first the current CDM in pipeline included only 23% of projects registered, while the rest 71% of projects are at validation, as indicated in Figure 3.4.1.So the current estimation of CER to be delivered is based on an estimation that all projects at validation will be registered, which is a quite positive assumption. Secondly, the potential for proving the additionality in future CDM application will become more different as technology penetration makes it increasingly difficult to pass additionality test, same has already happened to hydro projects. A sectoral mechanism can avoid the additionalitionality test at a project, which in the long run will grant more opportunities.

Table 3.4.5 shows a comparison of the carbon revenue from CDM projects in pipeline, credits 2010-2020, and the carbon revenue from different ERC scenarios. It's easy to find that sectoral mechanism yields a revenue over ten times higher than that of CDM projects.

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[6] Gassan- Zade, O. 2008, The Market For the Flexible Mechanisms: Carbon Till 2012 and Beyond. (Conference presentation).URL: http://www.rec.org/REC/Programs/ClimateChange/Docs/green_investment_2008_04_24/7_the_market_for_the_flexible_mechanisms_to_2012_and_beyond_gassan_zade.ppt#1254,1,The market for the flexible mechanisms: Carbon till 2012 and beyond

Table 3.4.5 Comparison of Revenue from Current CDM Projects in Pipeline and Sectoral Mechanism: CER to be Delivered 2010-2020 and ERC Scenario A, B, C

Carbon Price (Euro/ton)	Revenue from Current CDM projects in Pipeline, CER generated from 2010-2020 (Billion Euro)	Revenue from Sectoral mechanism 2010-2020 (Billion Euro)		
		ERC Scenario A	ERC Scenario B	ERC Scenario C
15	2.0	101.07	126.525	25.455
30	4.0	202.14	253.05	50.91
50	6.7	336.9	421.75	84.85

4. Conclusions

As stated at the outset, the utility of adopting a sectoral 'no-lose' target combined with a sectoral crediting mechanism is predicated on the need for Annex I countries to adopt very rigorous emissions reductions targets for the period up to 2020 and beyond. If there was one clear take-home message from the IPCC's Fourth Assessment Report it was that if we 3want to preserve a chance to avoid the worst ravages of climate change, then emissions must peak globally as much before 2020 as possible and begin to decline thereafter.

As an added difficulty, there are a number of Annex I Parties which have not lived up to their obligations to date, and although a number of them have lately started talking about meeting tough targets, what they can achieve domestically will not be enough, and additional emissions credits will be required to meet the minimum range defined by the IPCC (and adopted as an indicative range by Annex I Parties) of 25-40% emissions reductions by 2020.

As can be seen from the analysis above, both the mitigation and carbon finance potential from employing an SNLT/SCM mechanism could be very large, much larger than the current arrangements, and it could have significant advantages for developing countries seeking to attract finance, technology and capacity building to meet their own sustainable development goals.

More work needs to be done on the methodologies for determining the sectoral no-lose targets, and means to adjust the hypothetical baselines to the real increase in economic growth and other factors, but as we can be seen from this analysis of the potential in the Chinese electricity sector the potential economic benefits would be more than sufficient to meet the abatement costs of very significant emissions reductions.