

China Sustainable Energy Program

**ENVIRONMENTALLY FRIENDLY PRICING SOLUTION
FOR COAL-FIRED POWER PLANTS**

Draft Final

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Environmentally Friendly Pricing Solution For Coal-fired Power Plants

Executive Summary

The general objectives of *the restructuring scheme of power industry*, issued by State Council in 2002, are to break monopoly, introduce competition, enhance efficiency, reduce cost, and establish scientific and rational pricing mechanism. Optimize resources distribution, develop power industry, and accelerate construction of nationwide power networks, separate business management from government supervision, form open and healthy power market system under fair and open competitive conditions. Core tasks of the reform is “separating power plants from power transmission and distribution networks and determining generation prices through bidding”. The pollution caused by S₀₂ and sulfur dioxide is very severe in China and S₀₂ is mostly emitted by power sector. Therefore, we should focus on control of S₀₂ emission in power sector. In order to avoid environmental disadvantages brought by the reform, establish fair and competitive bidding mechanism no matter for “clean electricity” and “dirty electricity” under new power industry system, and push forward sustainable development of power sector, *National power sector restructuring plan approved by State Council should involve Environmentally Friendly Pricing Standards(EFPS) for Coal-Fired Power Plants formulated by National Environmental Protection Administration*. Under auspices of China energy sustainable program sponsored by *The Energy Foundation, USA, Study of Environmentally Friendly Pricing Solution For Coal-fired Power Plants* began to be carried out by Chinese Academy For Environmental Planning since September 2002.

Theory, Basis & Principle

1. Friendly pricing solution for coal-fired power plant is to charge differently according to emission performance standards in the process of separating power plants from power transmission and distribution networks and determining generation prices through bidding. Generally, to those with high concentration of emission or those exceed prescribed standards, grid company should give them a lower settlement price than government-set price, as is called EFP. Because environmentally friendly-pricing is mainly based on EP(S₀₂ emission per unit of power), it is virtually EP-based friendly pricing. In this report, EFPS is analogous with GPS because EFPS is on the basis of Generation Performance Standards (such as S₀₂ emission per unit of power), and thus EFPS can be regarded as GPS.

2. Friendly pricing is based on Polluter Pays Principal, external cost internalized theory and damage compensation theory. Under traditional production pattern, enterprises are restricted by market prices and conditions when they use/using capital, raw materials and other resources, while not when they use environmental resources because of lack of their prices. Enterprises consider only the costs of capital, machines, raw materials and human resources but not that of pollution costs. Therefore, air pollution caused by power plants are spill—effect of power generation and we

should incorporate environmental costs to rationalize decision-making. Damage compensation theory is that pollution emission from enterprises results in damage to public health and environmental resources. Enterprises should take responsibility for their actions and compensate for the damage, and according to the compensation standards will have impact on pollution emission. Implementation of EFPS can not fully compensate for the value of environmental resources, but the compensation can stimulate environmental resources users to moderate their pollution and make good use of increasingly scarce resources. Administration can promote producers and consumers to incorporate environmental costs in decision-making by adjusting compensation fee and make external costs internalized.

3. Environmentally friendly-pricing policy is fundamentally based on the legal basis of *Air pollution prevention and control law* approved by Standing Committee of the National People's Congress, and *The Tenth Five-year Plan for National Environmental Protection* approved by State Council, *National power sector restructuring plan*, *The Tenth Five-year Plan for Prevention and Control of Acid Rain and SO₂ in Two Control Zones* and *Emission Standards for Coal-burning Thermal Power Plants(ESCTPP)* being set underway. *The Tenth Five-year Plan for National Environment Protection*, *National power sector restructuring plan* and *The Tenth Five-year Plan for Prevention and Control of acid rain and SO₂ in two control zones* give a firm introduction of environmentally friendly-pricing policy, and *Emission Standards for Coal-burning Thermal Power Plants* being revised give an feasibility analysis to the *ESCTPP*.

4. Environmentally friendly-pricing standards aims to encourage and protect fair competition, to avoid unfair competition in determining generation prices through bidding, to urge power sector reduce pollution emission so that air quality and eco-environment be improved, to accelerate progress of power generation technological restructuring in power sector, of green pricing policy as well. At the same time, the standards should pay attention to the operability functioning and be simple and combine with contemporary regulation.

Framework of Pricing Discount

5. EFPS adopt four scenarios as following: real discount by higher price(RDHP), real discount by lower price(RDLP), virtual discount by bidding of part of cost(VDBPC), virtual discount by bidding of total cost(VDBTC). According to study and discussion of experts and relevant administrations, RDLP is preferentially adopted, and that is to determine the prices by bidding, as to those admitted to transmit electricity across power network, prices should be settled according to SO₂ EP. RDLP is applied to those with bad EP, discount prices is signed in a contract in advance or decided during trading, and obviously lower price can be regarded as a kind of compensation. RDLP is completely coincide with internationally-applicable PPP.

6. Friendly-pricing standards is to be executed mainly by coal-fired power plants, organic waste-buring power plants, oil-fired power plant, CHPs, IPPs and those not in accordance with industry policies, Heat energy of CHPs should be converted into power output. All the electricity across the network should be settled by discount, those self-consumed is also inculded.

7. At the opening stage of implementation, SO₂ is solely taken into account, and with systematic development, other pollutants (such as NOx, mercury, CO and CO₂) will be involved. “Two control zones” in which more than 70% of SO₂ emission by power industry is concentrated, are emphasises in respect of SO₂ emission and required to cut down 20% emission during *tenth five-year*. Therefore, power industry is burdened with complicated task and necessary to strength economic incentives. Adjustment modulus is determined to be 1.2 in the first scenario: linear scenario.

8. Clean up cost is the main criterion for formulating friendly-pricing standard and the basis of normal. FDS aims to control pollution and better environmental quality, so treatment cost is the basis of normal value. Based on existing datas of sulferizaion cost, we get the analytic results of economic costs of different desulfurization technology after judging all kinds of indicator system. The result is that desulfurization cost in china arranges from 0.8 to 5.5 cents/kwh on average in accordance with scale, sulfer-content of coal and EPS.

Choices of Pricing Discount Scenarios

9. Scenario 1: Linear Discount. Gas desulfurization is the most important method to control SO₂ emission for PE, but the desulfurization equipment can not remove all the SO₂. EP after desulfurization at present is usually below 3g/kwh, many below 1g/kwh; furthermore, fairly speaking, these PE have paid pollution control costs and SO₂ emission fee, so the threshold of discount is set at 3g/kwh. PE with EP below 3g/kwh need not share discount, while those exceeding 3g/kwh should accept discount according to its EP. According to the economic analysis of the pollution control, the average cost is 0.157 cent for cutting EP of SO₂ by 1g/kwh, so the friendly pricing standard should be 0.1 cent per kwh except the SO₂ emission fee. Scenario 1 is the recommendation one and easy to operate.

10. Scenario 2: Grading Pricing Discount: Different desulfurization rate stands for different EP and different treatment cost. Different technology should be adopted by different target in scenario. Detailed standard is as following: PE outside two control zones exceeding 3~7 g/kwh, 7~10 g/kwh, 10~15 g/kwh or 15 g/kwh above adopt discount parameter: 0.3 cent/kwh, 0.5 cent/kwh, 1 cent/kwh or 2 cent/kwh respectively; PE inside two control zones exceeding 3~7 g/kwh, 7~10 g/kwh, 10~15 g/kwh or 15 g/kwh above adopt 0.4 cent /kwh, 0.6 cent /kwh, 1.2 cent /kwh or 2.4 cent/kwh respectively.

11. Scenario3: GPS-Exceeded Pricing Discount. It is applied only for coal-burning

thermal power plants exceeding EPS and not for those within standards. Whether EP is good or not is judged by the gap between actual emission amount and EPS. Those exceeding standards heavily should adopt wet process desulfurization, the rate of desulfurization must be above 90%, the average cost of desulfurization is RMB1.5~2.0 cent/kwh. Taking the difference of Two-control zones into account, detailed standard is 1.5 cent/kwh outside two control zones and 2.0 cent/kwh inside.

Utilization of Discounted Fund

12. Discount revenue is closely related to difference in generation type. Statistics show that EPS vary greatly all over the country, coal in northeast area is lower than in southwest area in sulfur content, and according EP is much better. By calculation and analysis, discount revenue of these three scenarios are 4.7 billion yuan, 6.6 billion yuan and 6.5 billion yuan respectively. Total avenue including SO₂ emission fee will amount to 8.7 billion yuan, 10.7 billion yuan and 10.6 billion yuan if SO₂ emission is levied by 0.63 yuan/kg and 80%. As is estimated primarily, average cost of PE will be driven up by 0.7~0.8 cent/kwh after carrying out environmentally friendly-pricing.

13. Levy, utilization and management of discount revenue are crucial for firming up implementation and ensuring the effectiveness. Levy must coincide with present settlement system, and discount revenue must be used for environmental protection program. It is suggested that discount revenue should be kept in special account of State Treasury to raise SFDSR, any individual or unit is forbidden to detain, inappropriate or embezzle.

14. SFDSR is mainly used for pollution control and sustainable development in power sector in the form of appropriate funds and subsidies. The programs covered are: FGD; CEM; ETS; RE; R&D or clean coal-combustion power-generating technologies.

Impacts of Pricing Discount

15. The implementation of friendly-pricing standards will influent PE in two aspects: 1)Under contemporary pricing system, price linkage to other products is not so tight and clean-up cost is not included in electricity price, so that PE will suffer profit loss; 2) After pricing reform of electricity, power generation price will be determined by market, clean-up cost can be pushed forward to end-users. The reform will effect different sectors variably because of difference in power consumption. According to input-output analysis, industries having large power consumption (e.g. gas production and supply sector, selection of metal mine, smelting sector and forging and extending) will suffer or benefit a lot from friendly-pricing policy.

16. Coal is indispensable resources to power industry. After implementation of friendly-pricing standards, sulfur content will reflect in coal price more distinctly in two ways :1)coal quality is to be tied to desulfurization cost directly, that is to say, coal with highquality will have a higher price and it will facilitate scientific and rational distribution of resources. 2)Usage and distribution of coal will adjust according, thus more high quality coal will put into power generation.

Coodination of Environmental Policies

17. EPS evaluation is feasible under present management level and the the criterion consists of two factors: 1) evaluation of SO₂ emission, that is virtually total emission, which has legal validity, so we can fully take it for basis deciding whether total emission amount measures up. 2) power generation amount.Power amount with network admission of each PE is certain. PE and grid company must settle electricity amount according to network-admitted amount.Power amount self-consumed can be decided by relevant regulations and ususally has a certain range.Generation output by self-supplied power plants can get from datas of working conditions.

18. Emission fee and Friendly-pricing standards are both based on theory of external costs internalized. Theoretically, if emission fee is as high as marginal treatment cost guided by restriction on total volumet, levy of SO₂ emission can fulfil the same objective. At present, SO₂ emission fee is too low to stimulate PE cutting down SO₂ emission and it can reach only 0.63 yuan/kg three years after new standards implemented. Friendly-pricing standardsl is a helpful complementarily to emission fee system in pollution control.

19. Compared to the operational process of traditional emission fee, friendly pricing has changed a lot, the environmental protection administration is in charge of the emission fee collecting, and connects to the polluter directly. On the other hand, frienly pricing standard mainly be reckoned by power network. It's absolutely necessary for environmental protection administration and power network to cooperate to execute FPS, and the main problem is linking up the different standard from each other. FPS have clear advantage in term of management cost, it's easy to operate and the operation cost is lower; but it could make some trouble of disjoining the operation and supervision in term of excuting the environmental law. To avoid this kind of problem, we try to coodinate the relation of them by formulate the FPS. The three senarios all consider the emission fee, taking out the emission fee from the FPS. And the FPS is 0 in scenario 1 and scenario 2 if the PE has an EP below 3g/kwh.

20. Emission trading as one of the economic tools for environmental management acts to minimize the sum of social clean-up costs through trading among PE with different costs. Considering contributiong time of the Emission Trading and EFPS, EFPS should be operated behind Emission Trading and polluting emission should be defined as after-trading emission. In addion, there is a gap between them both in the following aspects as: available scope, operating foundation, management

costs and fund raising. Emission Trading can provide mobility for PE during operation.

21. Since 1997, power industry reform was launched. Tentative cities and provinces covered Shanghai, Zhejiang, Shandong, Liaoning, Jiling and Hei longjiang. Some have set up techonological foundation for friendly-pricing standards by exploited trading system of power techonologies. In view of techonology, what must be focused on is R&D of data transmission system and accuracy of emission quantity and power generation amount.

Proposals for Implementation

22. RDLP is suggested to be adopted. Discount prices is signed in a contract in advance or decided during trading according to SO₂ emission. Scenario 1 is preferentially chosen, that is to say, , we should enforce discount to those exceeding 3g/kwh, taking into account the difference inside and out two control zones. And the FPS must be carried out strictly especially in Two Control Zones, but the difference can't be too great to result in edge ball of PE geography layout.

23. Institutions concerned should possess full awareness about toughness of reduction of SO₂ emission in the coming 20 years. As is forecast primarily, the scale of coal-burning thermal power plants will doule the present scale:250 billion watt in the next two decades, so we are obliged to formulate a couple of powerful economic incentive ways to reduce SO₂ emission and emission fee policy solely is far away from this objective.

24. EFPS definitely a good and effective economic policy which can hasten reduction of SO₂ emission. For those exceeding SO₂ emission standard, Emission fee and friendly-pricing, two broadswords as a metaphor are a operational way to establish fair competitive market. Emission Fee and Friendly-Pricing should not substitute for each other, but should be a supplement to each other and be carried out simultaneously. It is proper to discard the idea "emission fee can not be carried out with friendly- pricing at the same time, we should make good use of emission fee to strength frienly-pring, for example, environmental protection institutions varify the total SO₂ emission of coal-buring thermal power plants.

25. Environmental protection institutions, SPIRC and SDRC should cooprare with each other closely. Two control zones are ideal for tentation of linear pricing scenario, it concides with the objective of cutting down 20% SO₂ emission during the tenth five-year and it is practical under the legal system lack of validity. Friendly-pricing standards must correspond to EP or EPS.

26. Environmental protection institutions and grid companies are suggested to check and ratify EP jointly. SO₂ emission verified by environmental protections institutions as evidence of EP when total emission is levied; while settlement with

grid company as evidence of total power generation, that of self-generated power plants can be obtained directly from datas of working condition.

27. It is suggested that discount capital should be handed over to specific account of State Treasury for use of funding SFDSR. SFDSR mainly contribute to pollutin control and energy sustainable development in subsidies and discount loans. Environmental protection administration play a important role in capital management and program inspection.

28. Accuracy of emission amount, calculation of total power generation and R&D of data transmission system is supposed to be ensured. It is suggested that State Environmental Protection Administration(SEPA)and State Power Industry Regulatory Commission(SPIRC) should work closely to establish an integrated monitoring system referring to total SO₂ amount levy, environmentally-friendly pricing, SO₂ emission trading, emission licence granted to coal-buring thermal power plants.

29. Because the total emission control is more rigorous than ever before, control task is increasingly tougher to power industry in the next 2 decades,especially with the rapid develoment of coal-fired power plants. Chinese government should formulate mid and long term plan and allocate total control amount in advance to power plants respectively.

30. No matter which scenario is adopted, it is closely related to check and ratify of EP and tatal emission.Environmental protection institutions should fasten its step to make nationwide CEM furnishing plan. In order to push forward the installation and managemet of CEM, it is advisable to spare a certain portion from emission levy and discount capital for CEM installation, management and supervision.

31. In order to realize dynamic effect of friendly-pricing policy and bring out its adjustment effectiveness, friendly- pricing system is suggested to be revised a period after its implementation (e.g.2006) , in the form of increasing the fee, detailed the standards, adding more pollutants to the standards, improving EPS.

32. Before *Emission Standards for Coal-burning Thermal Power Plants* concerning SO₂ emission standards is framed, it is suggested that the first two scenarios of the three is applied to power plants with SO₂ emission performance exceeding 3g/kwh and evaluation period of time should coincide with the settlement period of time with grid company..

33. Coal-burning thermal power plants affiliated to grid company are included in EFPS. Discount capital is suggested to be absorbed in SFDSR

Scenario 1: Linear Pricing Discount

Measures on Pricing Discount on Coal-fired Power Plants (draft)

General Provisions

- Article 1 This Regulation was promulgated for the purpose of realizing sustainable development in power sector by facilitating pollution control on coal-fired power plant, fostering fair competitive conditions in the form of “separating power plants from power transmission and distribution networks and determining generation prices through bidding.”, speeding restructuring in power industry and promoting the development of renewable energy.
- Article 2 This regulation is applicable nation-wide (except HongKong, Macao and Taiwan) to SO₂-emitted power plants, network admitted, self-generated power plants, IPPs, coal-fired power plants (hereinafter referred to as "PE" which can be a single or a plural, as the case may be), including coal-fired power plants, oil-fired power plants, CHPs and refuse-burning power plant, except natural-gas-fired power plants,
- Article 3 State Power Industry Regulatory Commission and Environmental Administrative department are in charge of the execution of the FPS to fossil fuel-burning power plants. SDRC, Ministry of Finance, National Grid Company, Southern Grid Company and environmental protection administration at city level and above should fulfill duties of strengthening implementation, management and supervision respectively.
- Article 4 EPS, also known as GPS is defined in this Regulation as amount of emissions per unit of power generation, usually g/kw.
- Article 5 EPS is defined in this Regulation as actual amount of emissions per unit of power generation, usually g/kw. EP is closely related to technology, scale, coal consumption per unit of power, fuels, quality and pollution control equipment. PE can meet the EPS in many different ways, such as install desulfurization equipment, using low-sulfur coal, changing power generation structure (such as increase water power generation and natural gas-burning power generation), and purchasing emission quota from PE having surplus.
- Article 6 EPS as referred to in this regulation is GB×××× *Emission Standards for Coal-burning Thermal Power Plants* promulgated jointly by State

Environmental Protection Administration(SEPA) and State Quality Inspection and Quarantine Bureau. in //dd//mm//2003

Checks and Ratifies on EPS of PE

- Article 7 PE should report total amount of power generation and of SO₂ emission, smoke and dust emission to superior administrative department, besides providing relevant monitoring data, in 15 working days after the begin of first month in every quarter of year, PE without continuous emission monitoring data should provide raw material balance report and relevant amount of pollution emission,
- Article 8 Based on reports as referred above, settlement kw amount issued by grid company and monitoring results by administrative department (Or authorized units) , Administrative department at city level or above in charge of environmental protection should check and ratify EPS of PE, issue an evaluation report on EPS and give EP the evaluation report in the form of a written notice in 15 working days after the end of first month in every quarter of year.
- Article 9 PE having any argument about evaluation report issued by administrative department responsible for environmental protection(or authorized units),could apply for a review within 7 days on the notice, environment administrative department on city level or above (or authorized units) should complete the review and issue new evaluation report in ten days on reception of reviewing application.
- Article 10 environment administrative department on city level or above (or authorized units)should submit the new evaluation report to settlement grid company, and to environment administrative department subordinate to provincial government and file with environment administrative department subordinate to State Council.
- Article 11 Emission dates collected from PE's continuous monitoring equipment, which must be recognized by environment administrative department on city level and above, are regarded as fundamental data of SO₂ emission; SO₂ emission of PE without continuous monitoring equipment is checked and ratified by environment administrative department on city level and above or by qualified environmental monitoring units, in accordance with pollution source monitoring methods raw material balance reckoning methods as regulated by the government.
- Article 12 Environmental impact report submitted to environment administrative department on city level or above should involve EP assessment of Newly built, rebuilt, and expanded coal-fired power plants.
- Article 13 If other fuels (e.g. natural gas) and energy (e.g. water power, wind power, solar energy and tide energy) are used auxiliarilly, the power amount

generated and SO₂ emitted by above all should be subtracted from total amount.

Article 14 Power amount consumed by PE self can not be subtracted from when amount of power generation in accordance with EPS is checked and ratified,

Article 15 If PE buy SO₂ emission quota from another one, purchased emission should be subtracted from its total emission when EP of the PE is under evaluation; and on the other hand, sold emission quota should be add to seller's total emission in the same case.

Settlement Price

Article 16 Those PE exceeding 3g/kwh as set in *Emission Standards for Coal-burning Thermal Power Plants* Settlement electricity should be deducted the discount from normal price according to scenario 1.

Article 17 Those PE exceeding 3g/kwh as set in *Emission Standards for Coal-burning Thermal Power Plants* should calculate discount capital according the following formula

$$M = K * A * (P - 3) * G$$

In the formula:

M----discount capital, yuan;

K----adjustment modulus of two-control zones, 1.2;

A----discount parameter, 0.001yuan/kwh;

P----actual EP, g/kwh;

G---amount of power generation, kw

Article 18 If PE buy SO₂ emission quota from another one, purchased emission should be subtracted from its total emission when EP of the PE is under evaluation; and on the other hand, sold emission quota should be add to seller's total emission in the same case.

Article 19 NGS, SGS or sub grid companies should complete discount settlement with all the network admitted, coal-fired power plants, self-generated power plants and IPPs in the second month of every quarter of year. Preferably, the settlement of EP by FPS should be settled simultaneously with electricity output.

Article 20 National grid company and southern grid company should hand over discount capital to Ministry of Finance in the second month of every

quarter of year, and submit the report to file with SPIRC, SDRC and Environmental Protection Administration.

Management and utilization of discount capital

Article 21 Discount revenue should deposit in special account of State Treasury, as sources of SFDSR, any individual or unit is forbidden to detain, inappropriate or embezzle.

Article 22 SFDSR is mainly used for pollution control and sustainable development in power sector in the form of appropriate funds and subsidies, including programs as following:

- (1) flue gas desulfurization (FGD);
- (2) emission monitoring (CEM);
- (3) Emission tracing system (ETS);
- (4) Renewable Energy (RE);
- (5) R&D of Clean coal-combustion power-generating technologies

Article 23 When need SFDSR, PE should formulate proposal and feasibility report, have them approved by subordinate power generation group company and finally submit them together to SFDSR management institutions

Article 24 The administrative department for environmental protection under the State Council shall, in conjunction with the department of finance and SDRC, formulate specific measures of SFDSR separately.

Article 25 Management institutions of SFDSR should report its utilization and management of prior year to State Power Industry Regulatory Commission (SPIRC), State environmental protection administration, State Development and Reform Commission and Ministry of Finance in the first quarter of every year.

Article 26 Auditing institutions should strengthen auditing supervision on capital usage and management of Special Fund for Development of desulfurization and Renewable energy (SFDSR),

Relief

Article 27 PEs suffering substantial economic loss due to force majeure is admitted to apply for half-discount or no-discount. Those fail to reduce emission quantity of SO₂, smoke and dust is not admitted to do so,

Article 28 Measures of half-discount or no-discount is set jointly by State Power Industry Regulatory Commission (SPIRC), State environmental administrative department, State Development and Reform Commission and Ministry of Finance.

Article 29 National Grid Company, Southern Grid Company and Environmental

Protection Administration under State Council proclaim the name list that are admitted of application for half-discount or no-discount, including main reasons.

Penalty

Article 30 If any PE practices fraud in monitoring report and evaluation report and cheats in applying for half discount or no discount, the department of environmental administration under the local people's governments at and above the county level should order the offender to make corrections within a specified time limit and impose a fine below 1 million.

Article 31 If any institution authorized by environmental protection administration practices fraud in compiling an evaluation report, the department of environmental administration under the local people's governments at and above the county level shall revoke its evaluation license and impose a fine below 1 million.

Article 32 If any monitoring institutions under the department of environmental administration under the local people's governments at and above the county level or any monitoring institutions authorized fails to reckon EP by monitoring pollution or calculate EP by raw material balance according to national regulations, or practices fraud in monitoring, the department of environmental administration under the local people's governments at and above the county level shall revoke its monitoring license and impose a fine below 1 million.

Article 33 Any state functionary of State Community of Power Industry Institutions, National Grid Company, Southern Grid Company, Environmental Administrative Department, financial department or Price formulating Administrations who, committing any of the following acts shall be investigated for criminal liability according to articles about negligence of duty or deliberately, indulges in malpractices for selfish gains and abuse of administrative authority; where a crime has not been constituted, he shall be imposed administrative sanctions according to law.

- (1) Who cheat in checking and ratifying assessment report;
- (2) Who break the rule and standards by approving half-discount or no-discount;
- (3) Who detain, inappropriate or embezzle SFDSR;
- (4) Who fail to perform supervision and management duties and do not impose penalties on breach, and result in severe damage sequently.

Article 34 This regulation is interpreted by State Power Industry Regulatory Commission, Environmental Administrative department subordinated to State Council and State Development and Reform Commission,

Article 35 This regulation will come into effect from 2003,