

# An Analysis on the Hindrances of the Implementation of the CTG Switching Policies in Rural Areas in Hebei Province: A Smith Policy-Implementing-Process Framework

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## Abstract

To improve the air quality, Chinese governments issued a series of policies to carry out the coal-to-gas (CTG) transition. However, the implementation of CTG switching policies has been hindered in practice, which has caused a lot of negative effects. Therefore, this essay aims to analyze the hindrances of the implementation of CTG switching policies in rural areas in Hebei province by using Qingzhou Town as a case, employing interviews on officials from implementing organizations and the questionnaire survey method for rural residents. The Smith Policy-Implementing-Process Framework (the Smith model) was used as the theoretical framework to provide a complete analysis of policy implementation hindrances regarding idealized policy, implementing organization, target group, and environmental factors. According to the survey results, there were 10 main hindrances including the problem with policy design, such as simplified policy goal and one-size-fits-all problem; the lack of flexibility, excessive implementation by the implementing organization; target group's weak environmental awareness, insufficient economic incentives, and low level of participation and policy understanding; several environmental factors, such as the imperfect supervision and performance evaluation mechanism, the ineffective market mechanism, limited gas resource channels, and insufficient infrastructure.

## Keywords

Coal-to-Gas, Policy Implementation, Hindrances, The Smith Policy-Implementing-Process Framework

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## 1. Introduction

Currently, a natural gas revolution is taking place worldwide. The regional atmospheric environmental problems of pollutants characterized by fine particles (PM<sub>2.5</sub>) are very serious in China. Therefore, to improve the air quality, a coal-to-gas (CTG) transition is carried out by the Chinese government. The CTG transition refers to using natural gas (including conventional and unconventional natural gas, etc.) to replace low-energy utilization and high pollutant emissions of coal-fired coal in residential and industrial production (State Council, 2013). However, the implementation of policies has been hindered in practice, which has caused a series of negative effects.

This essay aims to answer the question that what are the hindrances of the implementation of the coal-to-gas switching policies in rural areas in Hebei province. The answer to this question is key to foster the implementation of CTG switching policies. To complete the current research, hindrances and the reasons behind them are supposed to be explored, and empirical evidence is supposed to be provided.

This essay is against this background, taking Qingzhou Town as a case, through interviews and questionnaire surveys to explore the hindrances of the implementation of the CTG switching policies in Hebei province, based on the Smith Policy-Implementing-Process Framework.

This paper was organized as follows: Section 2 reviewed existing literature to find out the gaps and make it clearer how this paper fills these gaps. The theoretical framework was also introduced in this section. Section 3 discussed the research design and the reasons for making this design. Section 4 conducted the research study, shown in the results. Section 5 discussed the results on the basis of the Smith Policy-Implementing-Process Framework. The final section summarized findings, and contributions, and made suggestions for further studies.

## 2. Literature Review and Theoretical Model

### 2.1. Literature Review

Since the 1990s, studies focused on the factors influencing CTG enforcement and highlighted the role of economic factors and environmental constraints, such as investment, high cost of gas production, and the price mechanism in shaping Chinese energy development (Lin, 1998). After the 2000s, several national circumstances including urbanization, a rapidly growing population, and industrialization were considered in energy development (Ren, Zeng, & Zhou, 2004). In recent ten years, insufficient storage of natural gas, constrained access to natural gas infrastructure, and methane leakage from the natural gas industry have been paid more attention (Minchener, 2011; Qin et al., 2017). Besides, political considerations were also included in the mechanism for influential factors, such as energy security issues, and governments' strict control over unreasonable distribution (The Oxford Institute for Energy Studies, 2017). In addition, a study in 2019 explored whether and how individuals cooperate with the implementa-

tion of CTG switching policies depends on their beliefs about others' beliefs or "second-order beliefs" (Schuldt et al., 2019). They conducted face-to-face interviews with a socioeconomically diverse sample, and concluded that second-order beliefs, especially those regarding proximal reference groups strongly predicted individuals' policy support.

Furthermore, several research studies focus on the effects of CTG transition. Industrial efficiency of coal and natural gas were compared (Hu et al., 2010). It was concluded that after the transition, boilers and industrial resources were more effectively controlled. And in the recent 5 years, life-cycle comparison of water consumption and greenhouse gas emissions between coal and gas were made (Chang et al., 2015). It was concluded that this transition is a good opportunity to deliver climate benefits with proper methane leakage control (Qin et al., 2018). The life cycle assessment and life cycle cost methods were also applied to compare the environmental impact and economic cost of household energy usage before and after the CTG transition, and concluded that the environmental impact of energy consumption for rural households in northern China will be reduced by 50% - 60%, while the economic cost will increase in 2000 RMB per year (Li et al., 2020). Another study presented a quantitative assessment of the water footprint for Chinese CTG industries and proved that large-scale development of CTG projects would present significant risks to local water resources (Wang et al., 2019a). In addition, through the evaluation of the CTG transition's effects on economic activities, prices, and consumption, the assumption about growth rates in electricity generation from renewables is identified as the key determinant (Arora, Caibc, & Jones, 2016).

In general, existing literature on China's CTG transition focuses on the factors influencing its enforcement, and its impacts. Although potential challenges have been identified, there is a lack of empirical evidence on hindrances of the implementation of CTG switching policies. Moreover, the influential factors identified in previous studies (Lin, 1998; Minchener, 2011; Schuldt et al., 2019) mainly regard the policy environment issues; nevertheless, hindrances being caused by the policy content and the policy executors are ignored. There is a need for a more systematic and complete study on hindrances of policy implementation. Furthermore, most studies took the policy implementation in the whole China range as the research object, deeper factors and specific characteristics are required to be explored. Therefore, this essay analyzed the hindrances of the implementation of CTG switching policies systematically, based on the Smith Policy-Process-Implementing Framework to include more factors, such as the target group issue, the policy content issue. The policy implementation in Hebei rural area is selected as a case to provide a deep and detailed analysis, and survey methods are employed to provide empirical evidence.

## **2.2. Theoretical Model**

At the end of the 1970s, scholars started to establish theoretical models based on individual case studies for analyzing the process of policy implementation. T.B.

Smith was one of the earliest scholars to build models for the policy implementation process (the Smith model). He suggested that there are four important components in the policy implementation process. The first one is the idealized policy which is relevant to the form, type, program, and images of the policy. Second, the implementing organization works as the implementing subject, among which there are three key factors including the structure and personnel, the leadership of the administrative organization, and the implementing program and capacity. Third, the target group is defined as those who are required to adapt to new patterns of interaction by the policy. And the final one is the environmental factors which refer to those factors influencing or being influenced by the policy implementation. The interaction between these components produces tensions, affecting the effects of policy implementation, and fostering or hindering the effects of policies through feedbacks (Smith, 1973) (Figure 1).

As the classic policy implementation model, each component in the Smith model is quite typical. And these are two situations that are suitable to apply this mode: the internal factors in the policy implementing process will influence a lot to the effect of implementation; the policy is implemented from top to bottom. CTG switching policies belongs to these two situations, since superior governments set tasks, subordinate administrative staffs finish these tasks, during which various factors affecting the implementing effects. Therefore, the Smith model is chosen as the theoretical model.

Previous studies applying this theoretical model to analyze the hindrances of policy implementation from the perspective of powers and interests (Wang, 1998), study the restraining factors and path choice (Jiang, 2017), simply research the policy implementation process (Deng & Xu, 2012; Huang, 2018). Compared with existing literature using the Smith model, this essay not only analyzes the hindrances of the policy implementation, but also explores the deep reasons behind these hindrances.

### 3. Methodology

This essay selected the implementation of CTG switching policies in Qingzhou Town which is a rural area in Hebei province as an individual case, so that in-depth and detailed surveys can be conducted, specific characteristics can be considered. Hebei province was chosen since it is the province with the most serious air pollution, and the province where CTG switching policies are being implemented most rapidly. And for selecting Qingzhou Town, there were two reasons. First, the coal-to-gas switching policies were implemented in Qingzhou town since July 2017; therefore, compared with the policy implemented in other towns, it is more continuous and complete in Qingzhou town. In addition, considering data accessibility, Qingzhou town is my hometown; thus, it is more convenient to conduct surveys and collect primary data here. When analyzing the results, public documents such as public communication, original policy documents, media articles are combined with primary data I gained, to give a more clear and deep discussion.



Committee Director was also included in the interview. Moreover, to overcome the limitation of options in the questionnaire, 2 rural residents in Qingzhou Town were interviewed via in-depth semi-structured phone interviews, between November and December 2019. While each interview broadly followed the list of interview questions, the semi-structured nature allowed for flexibility to reveal specific issues in greater detail and can enable interviewees to uncover unanticipated information and novel insights. Information acquired from interviews was cross-checked with our results from questionnaires and public documents.

## 4. Results

### 4.1. Results of the Questionnaire Survey

The results of the questionnaire survey are listed (Table 1).

According to the results, respondents have a low-level participation of the CTG switching policies. First, their understanding of the CTG policies was insufficient. 13.40% of the respondents indicated that they almost knew nothing about the CTG policies; 50.52% of the respondents claimed that they “know a little”. Moreover, the channels through which they gain information about CTG switching policies were limited. Relatives and friends, mass media, and village cadre visits were the three main channels for obtaining information. Only 25 people learned about the policy through policy briefings. Since most channels were not official and formal, the accuracy of information gained from these channels was relatively low. Furthermore, the respondents’ environmental awareness was weak. 48.98% of the respondents indicated that “it is not necessary and has no obvious effect on environmental improvement”; another 16.33% of the respondents said not very clear, nor care about its impact on the environment.

From the results, it can be known that the degree of satisfaction of respondents to the CTG switching policies was not high, and the economic considerations and the rigid implementing method were the main factors affecting their satisfaction. The proportion of respondents with a satisfaction level of average and below was about 64.28%. 54.08% of respondents selected heating costs as the most important factor affecting their degree of satisfaction. The heating subsidies were also concerned by 46.79% of respondents. From the basic information about respondents’ families, the heating costs were high. 65.30% of respondents spent more than 2000 yuan. However, 77.55% of households received subsidies even less than 200 yuan. Regarding the methods and attitudes of enforcing staffs, 60.20% of interviewees believed that “the means of execution are appropriate, but the methods lack flexibility”; followed by “appropriate means of enforcement, but mechanical and single” taking up for 33.67%.

### 4.2. Results of the Interview

Interview responses were transcribed from the interviewer’s notes and mobile recording (Table 2).

**Table 1.** The results of the questionnaire survey.

Sections	Questions	Options	Selected times
Basic information	1) What is the annual income of your family?	0 - 5000 yuan	16
		5001 - 10,000 yuan	22
		10,001 - 20,000 yuan	38
		>20,000 yuan	22
		0 - 1000 yuan	6
	2) What is the amount of heating cost between 2018 and 2019?	1001 - 1500 yuan	12
		1501 - 2000 yuan	19
		2001 - 3000 yuan	39
		3001 - 4000 yuan	16
		>4000 yuan	6
	3) What is the amount of the subsidies for heating?	0 - 200 yuan	76
		201 - 400 yuan	7
		401 - 600 yuan	2
		601 - 800 yuan	6
801 - 1000 yuan		6	
The participation in the coal-togas policies	4) How well do you understand the coal-togas switching policies?	>1000 yuan	0
		Know very well	13
		Basic understand	22
		Know a little	50
	5) What channels did you use to obtain information about CTG policies? (multiple choice)	Almost know nothing	13
		Government websites	33
		Mass media	38
The satisfaction with the coal-togas switching policies	6) From the environmental perspective, what do you think about the necessity of the CTG transition?	Policy briefing	25
		Heard from relatives, friends	46
		Village cadres visited	37
		Other channels	13 (Broadcast in village)
		Very necessary, it is effective in environmental protection	34
7) How satisfied are you with the new heating method of coal to gas?	Not necessary, its environmental effect is not obvious	48	
	Do not know, and I do not care about its environmental effects	16	
	Very satisfied	10	
	Quite satisfied	25	
		Generally satisfied	36
		Less satisfied	22
		Dissatisfied	5

## Continued

		The change in heating cost after transition	53
		The amounts of subsidies for heating	46
		More convenient after transition	30
	8) What are the factors affecting your satisfaction? (Multiple choice)	The change in indoor temperature	31
		The security of the facilities	54
		Others_____	6 (unstable gas supply) 4 (slow progress)
		Enforced by compulsory means with bad attitude	6
	9) What do you think about the methods and attitudes of enforcing staffs?	Appropriate means of enforcement, but Mechanical and single	59
		Enforce with flexibility, fully respecting users' wishes and rights	33

Table 2. The results of interviews.

Interviewee	Number	Question	Response
The director of the Development and Reform Commission in Qingzhou Town.	D1	What do you think is the problem in the design of Hebei's CTG switching policies?	"First of all, the policy goal of CTG conversion is simply understood as increasing the share of renewable energy. For example, 'a net reduction of 40 million tons from 2012 to 2017 in the coal consumption' is one of the goals of the Hebei Province Air Pollution Prevention Action Plan Implementation Plan as one of the specific targets. Secondly, the policy has a one-size-fits-all problem. Hebei Province claimed that within three years, the urban-rural bulk coal replacement in the whole province will be basically achieved. However, some adobe houses are still reserved in the rural areas of Hebei Province, making it difficult to carry out pipeline transformation."
	D2	What do you think is the main problem with the implementation of CTG switching policies?	"I think the main problem is the excessive execution led by the campaign-style implementation. The instructions are passed level by level under the bureaucracy. Each level of government increases the number of tasks to ensure to gain the winner in the competition with other governments at the same level."

## Continued

	D3	What is the main financial source for the clean energy development?	<p>“So far, the development of clean energy mainly relies on government funds, because we have not mastered the core technology and has not formed an industrial scale, and the investment risk is relatively high. Venture capital institutions and commercial banks and other investment institutions are prohibitive. Without the support of funds, the technology is difficult to progress, so clean energy financing fall into a vicious circle.”</p>
The director of the Energy Department in Qingzhou Town Government	E1	Whether the supply of the natural gas for the CTG transition is sufficient?	<p>“From the upstream of the natural gas in the Beijing-Tianjin-Hebei region, long-distance gas pipelines such as the West-East Gas Pipeline of the CNPC system and the Shaanxi-Beijing First, Second, and Third Lines are the main supply systems. The final gas source is the gas fields of Xinjiang and northern Shaanxi and Central Asian countries, and LNG imported from Tianjin and Tangshan by sea. Since November 28, 2017, the province’s natural gas supply has entered an orange warning, and the supply and demand gap has reached 10% - 20%. Local governments are required to limit gas and stop gas for industrial and commercial users to ensure civil natural gas supply.”</p>
	V1	Whether there is any flexibility during the implementation of the CTG switching policies?	<p>“In practice, we just implemented the policy, and there is not any change being made during implementation. Although there are residents reflecting their needs through telephone, for example, some poor households cannot afford the cost of CTG, but there has not been any response.”</p>
A village committee director	V2	Was there any supervision on the implementation of CTG switching policies?	<p>“The safety supervision bureau was mainly responsible for monitoring and evaluating the quality of the CTG switching projects, and the township government supervised the implementation progress of the project. The financial department will conduct a performance evaluation of the funds invested in each project, the amount of natural gas used, and the reduction of coal consumption. But obviously, the current performance evaluation mechanism is not in place.”</p>

According to the six questions and their responses, there were six main hindrances of the implementation of the CTG switching policies. First, about the policy design, the understanding of the policy objective seems to be over-simplified, and there seems to be a one-size-fits-all problem. Second, regarding the imple-

menting organization, there were two hindrances including excessive implementation and the lack of flexibility. Third, there were three hindrances caused by economic, political, and energy factors respectively. The development of clean energy in China still highly relies on government funds due to the lack of a well-constructed market mechanism. The supply of natural gas is insufficient because of limited channels. Besides, current performance evaluation mechanism on implementing organization has not been in place.

## 5. Discussion

### 5.1. Hindrances Caused by the Policy Design

According to the interview D1, there were two main problems with the design of CTG policies. First, the policy objective has a tendency of simplifying the concept of the energy transition. It can be seen that a number of policies related to CTG transition have the main goals of reducing coal shares and increasing natural gas shares (Zhu, 2015). This single quantitative goal has led to problems such as the ignorance of facility safety, reconstruction costs, and target group satisfaction during policy implementation.

Moreover, there is a one-size-fits-all problem in policy design, while ignoring different conditions across various areas. For example, rural houses do not have the conditions for pipeline renovation. Residents are supposed to be given more freedom to choose (Wang et al., 2019b). Besides, the practice of Beijing Guohua and Huaneng Thermal Power Plants has proved that through online monitoring, large-scale coal-fired thermal power plants can meet the basic requirements for environmental protection. Due to the problem of insufficient natural gas supply, natural gas cogeneration technology is not suitable as the main heat supply source plant. Therefore, it seems unreasonable to use natural gas to replace coal as the main heating method in all regions of the country at this stage.

### 5.2. Hindrances Caused by the Implementing Organization

From the results of the questionnaire survey and interviews, it can be known that implementing organizations lack flexibility. The result of the final question in the questionnaire shows that 60.20% of respondents suggested that although the means of implementation are appropriate, the methods lack flexibility. According to the interview V1, even if some villagers have made suggestions, the implementing organization basically did not make any adjustments or respond, since they only are responsible to the higher authorities.

In addition to the lack of flexibility, excessive implementation is another problem existing in the implementing organization of CTG transition (Interview D2). In the Chinese-style authoritarian political system of the party-state, the competitive selection is the main way to produce local officials, thus, promotion is the most important political incentive for local cadres. Although environmental protection has been used as hard indicators and incorporated into the local cadre assessment indicator system by local governments. However, these quan-

titative indicators have many obstacles in the process of conversion into specific environmental effects. First, some local governments often sacrifice other environmental indicators to meet the requirements of priority indicators. Second, the pressure transmission under the bureaucratic system has resulted in too much pressure when the instructions come to the bottom level of governments, which may lead them to pay too much attention to data, while ignored the real effects (Ran, 2013).

### **5.3. Hindrances Caused by the Target Group**

The environmental awareness of the target group is relatively weak, which is also one of the factors hindering the implementation of the CTG policies. The results of the questionnaire indicated that most of the respondents believe CTG projects have little effect on environmental protection or do not care about their environmental impacts. This might be because the educational level of rural residents in China was generally low (Xu & Ge, 2020). Their low environmental awareness made them have few incentives to cooperate with CTG policies which are a series of policies that may sacrifice other conditions to protect the environment.

In addition to the weak environmental awareness, the lack of economic incentives due to low subsidies is another important reason for the low willingness of the target group to cooperate. According to the result of the questionnaire survey, 77.55% of respondents received less than 200 yuan subsidies. And through the comparison between the amounts of heating costs and subsidies, it can be observed that for most households, the amounts of subsidies accounts for less than one-tenth of the heating costs. However, the answers to the question that what are the factors affecting your satisfaction illustrated that the change in heating cost and the amounts of subsidies are two important factors ranking in the second and third positions. Therefore, the high heating costs reduced the target group's incentives.

Moreover, according to the results of the fifth and sixth questions in the questionnaire, the target group's knowledge and participation in CTG policies are obviously insufficient. Most of the respondents to the questionnaire survey did not even have a basic level of knowledge of CTG transition. Besides, most rural residents learned about these policies through relatives and friends, which may lead to information distortion. Besides, interview V1 indicated that suggestions made by the target group did not been adopted, which is another reason for low-level participation of the target group.

### **5.4. Hindrances Caused by Environmental Factors**

The implementation of any policy will inevitably interact with certain social factors and will be affected and restricted by the social environment (Ning, 2011). To some degree, incomplete political, financial, and infrastructure environments constrain the development of CTG transition. First, there is a lack of effective

supervision and performance evaluation mechanism of the implementation of CTG transition. Based on interview V2, the supervision is limited to the performance of gas companies; there is no agency to supervise the governments' behavior. Besides, the evaluation criteria merely pay attention to quantitative tasks, but ignore the satisfaction of the target group, lacking the attention on the connection between the policy, the target group and the policy environment. And this performance evaluation mechanism merely focuses on evaluating the results of policy implementation, instead of identifying deficiencies in policy implementation.

Furthermore, the interview D3 illustrated that there has not been an effective market mechanism for clean energy development in China. Subsidies for the development of natural gas and the development of clean energy in China mainly rely on the government. An effective investment and financing mechanism to promote the development of clean energy has not yet been established. The main reasons are low added value, backward technology, high investment risk, and the profit-seeking nature of investment institutions. In addition to this, the difficulty of financing commercial banks is another reason. Although the government strongly supports the development of the clean energy industry and encourages banks to relax credit policies, overcapacity has increased commercial banks' concerns about clean energy investment (Hu & Zhang, 2013).

Last but not least, limited gas resource channels, the insufficient infrastructure of gas storage and transportation are the direct reasons leading to gas shortage. From the interview E1, it can be known that the gas source channels in Hebei Province are limited, and not stable enough. After entering the winter in the past two years, the countries along the Central Asian that are the final source of Hebei's natural gas pipeline intercepted part of the gas supply to China, so the imported natural gas was reduced. However, due to the pay-as-you-go agreement, China cannot restrain this kind of behavior; at the same time, when the gas source is in short supply, the output of the liquid plant also needs to supplement the pipeline usage, and the LNG output of the liquid plant drops (Huang, 2018). Besides, the insufficient interconnection of the pipeline network and insufficient gas storage and peak shaving facilities also constrain CTG transition.

## 6. Conclusion

This essay found out that there were 10 main hindrances based on the Smith model by using the interview and questionnaire survey methods, including the problems with policy design, such as simplified policy goal and one-size-fits-all; the lack of flexibility and excessive implementation by the implementing organization; target group's weak environmental awareness, insufficient economic incentives, low level of participation and policy understanding; several environmental factors, such as the imperfect supervision and performance evaluation mechanism, the ineffective market mechanism, limited gas resource channels and insufficient infrastructure.

This essay has three main contributions to the study of China's CTG transition. First, this essay provided empirical evidence on the hindrances of the implementation of CTG policies. Second, based on the Smith model, this essay identified a more complete mechanism for hindrances regarding policy design, implementing organization, target group, and environmental factors. Moreover, through an individual case study, deeper factors and specific characteristics can be explored. Furthermore, not only hindrances of the implementation were identified, reasons behind these hindrances were also analyzed.

There were still several limitations in this essay. For example, the exploration of the interactive relationship between the four impact factors of the Smith model is not deep enough. Moreover, the research scope is relatively narrow. The sample size is not large enough. Further studies will continue to analyze the factors hindering the implementation of CTG switching policies, dig deeper into the institutional factors behind the implementation of chaos, and conduct a wider range of surveys and sampling.

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### Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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## Appendix: The Introduction of the Questionnaire

A Survey on the Implementation of CTG Policies for Rural Residents in Qingzhou Town, Hebei Province

Questionnaire (the original version is written in Chinese since the respondents do not know English. This version is a translation one.)

\_\_\_\_\_Village

Dear Sir or Madam:

To gain first-hand resources of the implementation of CTG switching policies, I ask your help to finish this questionnaire. I hope you can provide true information to let the researcher know your opinion. The survey is anonymous and there is no right or wrong. The information obtained is only for research purposes and will not cause you any trouble. Please fill in the truth, thank you for your cooperation!