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POLICY MODELLING AND SIMULATION OF THE DEVELOPMENT OF CHINA'S SHALE GAS

by

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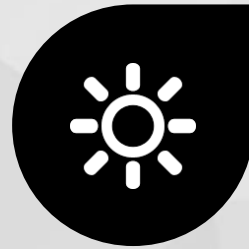
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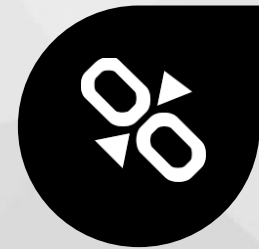
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Special issue



Main findings



Implications for policy

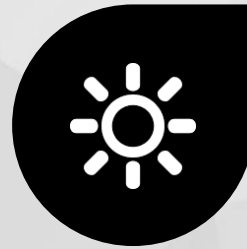
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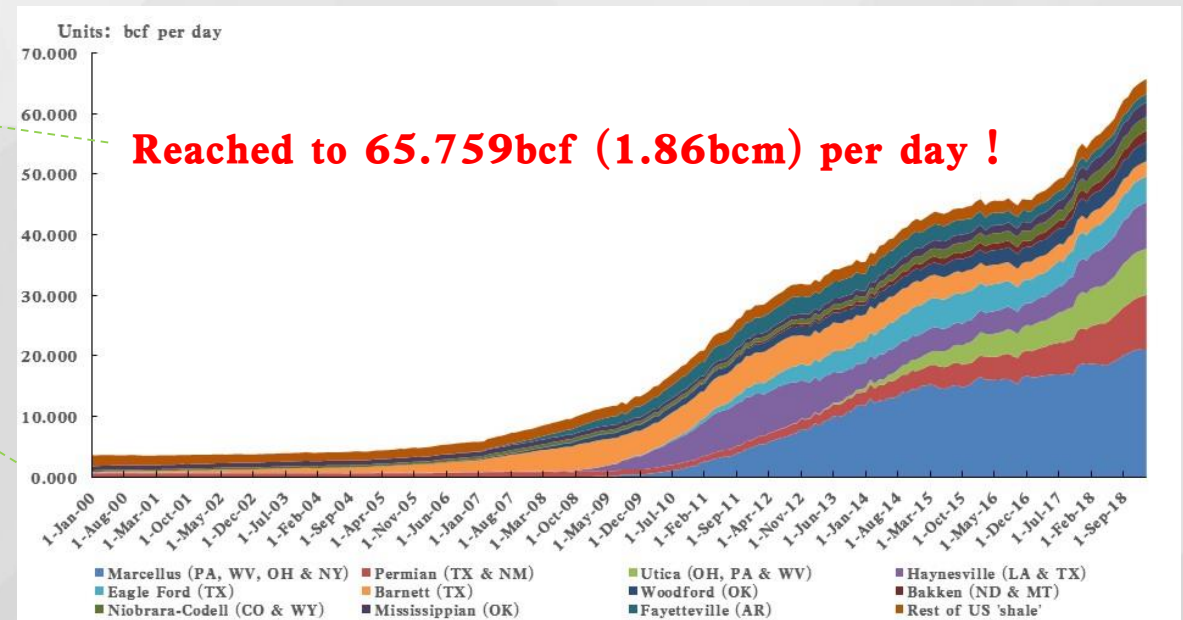
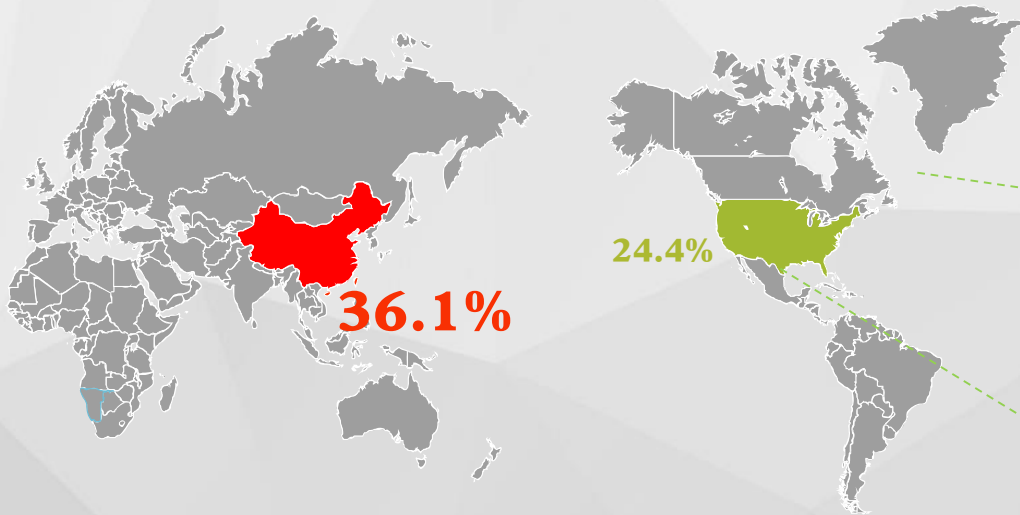


Implications for policy



Context

Total technologically recoverable shale gas resources is 200 trillion cubic feet(5.66 trillion cubic meters)



- 1978 Energy Accidental Profit Act
- 1980 Energy Accidental Profit Act
- 1990 Comprehensive Coordination of Tax Distribution Act
- 1992 Energy Tax Act
- 1997 The Taxpayer Load Reduction Act

Since 2005, the U.S. government has increased its policy support for the development of difficult-to-extract natural gas; Government has forced mining companies to allocate 25% more to land owners

Policies stimulate shale gas exploration and development in US



Tab. 1 China's Fiscal and Tax Policies of Shale Gas Industry

Issued time	Title of policies	Main contents
2007	Regulations for the Implementation of the PRC Enterprise Income Tax Law	Tax rate is 25%.
2012	Development and Reform Commission[2012]612	Exempting fees for the use of shale gas mining rights and compensation fees for mineral resources, and tariffs of imported equipment.
2012	Finance and Construction [2012]847	The standard of central financial subsidy is 0.4 yuan/m ³
2012	Land and Resources Development [2012]159	Exempting fees for the use of shale gas mining rights and compensation fees for mineral resources
2013	State Taxation Administration[2013]27	VAT rate is 17%.
2014	Finance and Tax[2014]73	The applicable tax rate of natural gas resources tax is raised to 6%.
2015	Finance and Construction [2015]112	The standard of central financial subsidy is 0.3 yuan/m ³ during 2016-2018, 2019-2020 is 0.2 yuan/m ³
2016	National Energy Administration Oil and Gas [2016]255	Increase policy support and fully mobilize enterprise enthusiasm
2018	Finance and Tax[2018]26	the national tax on shale gas resources reduced by 30%

the fees remitted account for a small proportion of total costs, which neither significantly reduce the mining costs nor motivate the relevant enterprises

with the existing import value-added tax, the reduction of import tariffs will not significantly reduce the purchase cost of imported equipment.

- the high threshold of the regulations, most enterprises are difficult to enjoy subsidies
- due to policy costs and lack of restraint mechanism, the shale gas activities will not enjoy the subsidy from local governments.

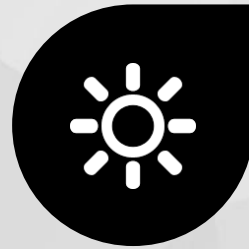
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In response to global climate change, actively promoting low-carbon transformation is the inevitable choice for China's energy development. China is relying on its rich shale gas resources with strong willingness to meet its great desire for shale gas resources development. The target output, which is 30 billion cubic meters in 2020 and 80-100 billion cubic meters till 2030, set in Shale Gas Development Plan(2016-2020)(SGDP) issued by National Energy Administration is a typical example.

However, there exists some problems, such as insufficient subsidies, less preferential effect of existing tax and fee policies for shale gas, and no obvious effect of tax reduction

Based on these circumstances, We focus on the fiscal and taxation policies to promote the development and utilization of shale gas, and explore the prospects and implementation paths of shale gas utilization in China.

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Hypothesis & Model

- (1) The behavior of variables in the model shows **time consistency**
- (2) the model only considers main variables affecting conventional gas consumption, and does not consider the role of other majeure.
- (3) existing geological reserves will not restrict shale gas large-scale production in the future

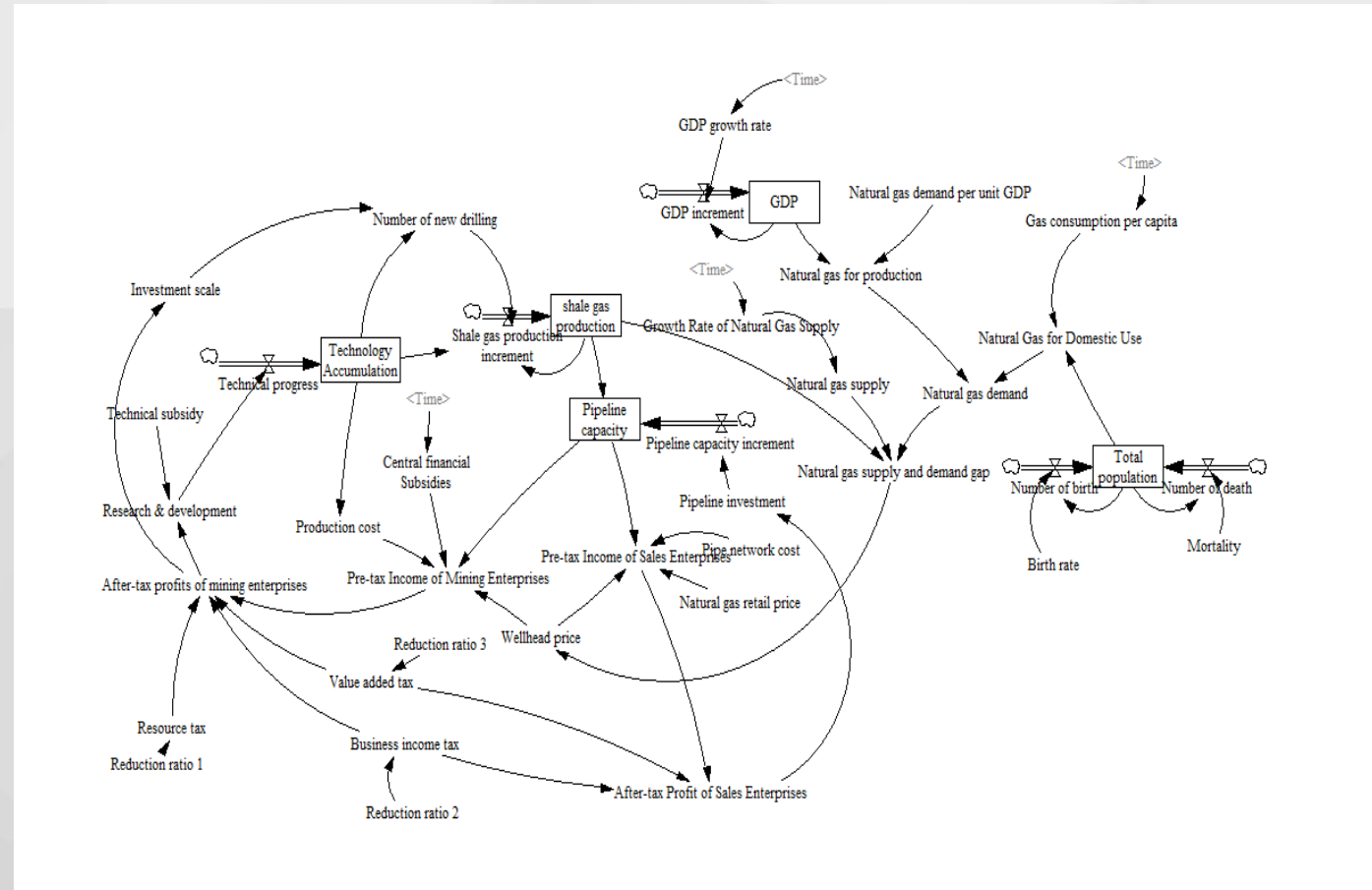


Fig. 1 System dynamics model of production-transportation-consumption of shale gas in China



Model operation test

	Actual value	Stimulated value	Error Rate (%)
2014	13	13	0
2015	45	39.86	11.42
2016	78.82	67.47	14.4
2017	97	91.97	5.19
2018	102.9	114.48	11.25
2019		135.46	
2020		154.85	
2025		382.11	
2030		782.79	

Tab. 3 Comparison of simulated and actual of shale gas production in China
(Unit: 10^8m^3)

The model is reliable and can be used to simulate shale gas development in China.

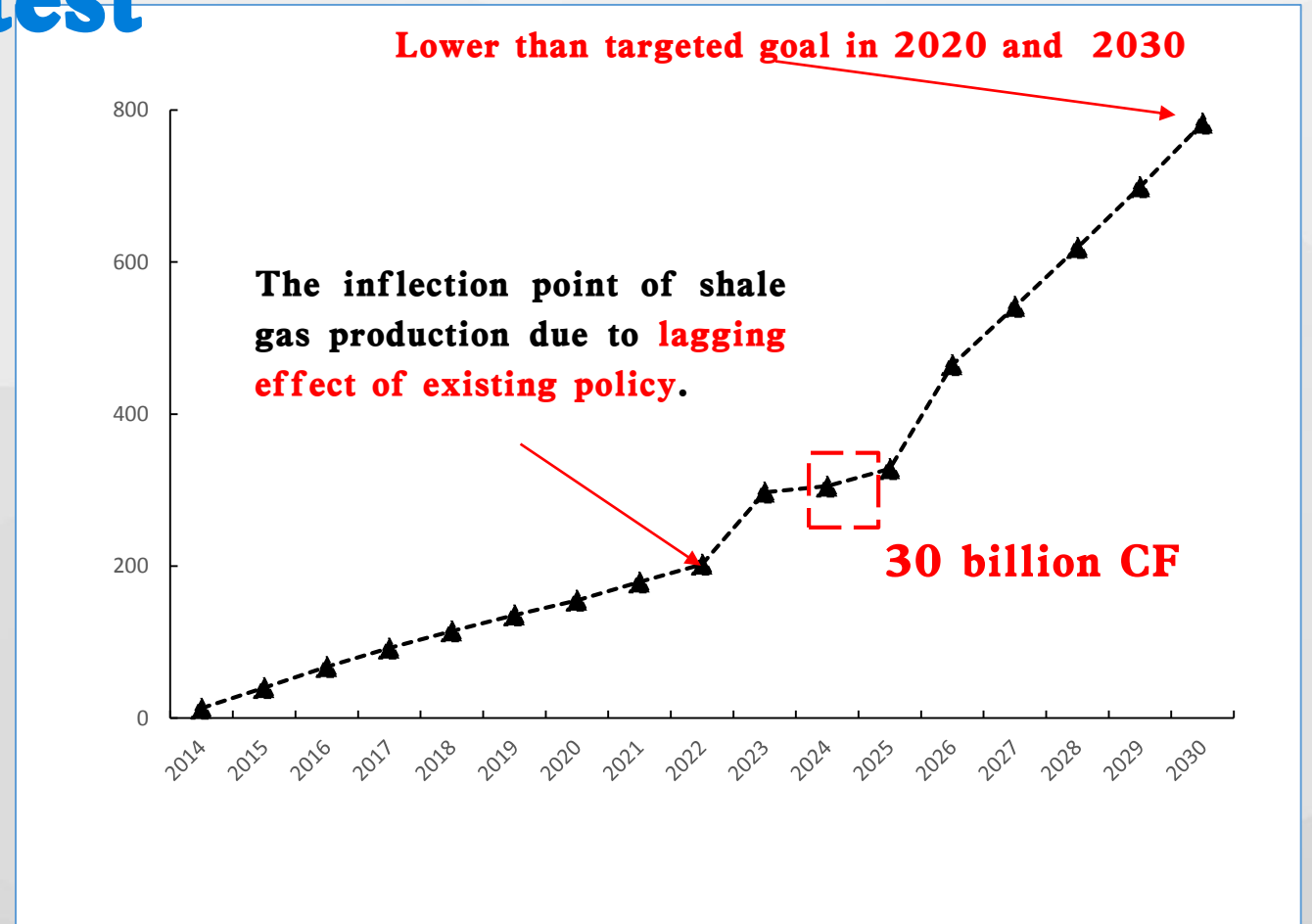
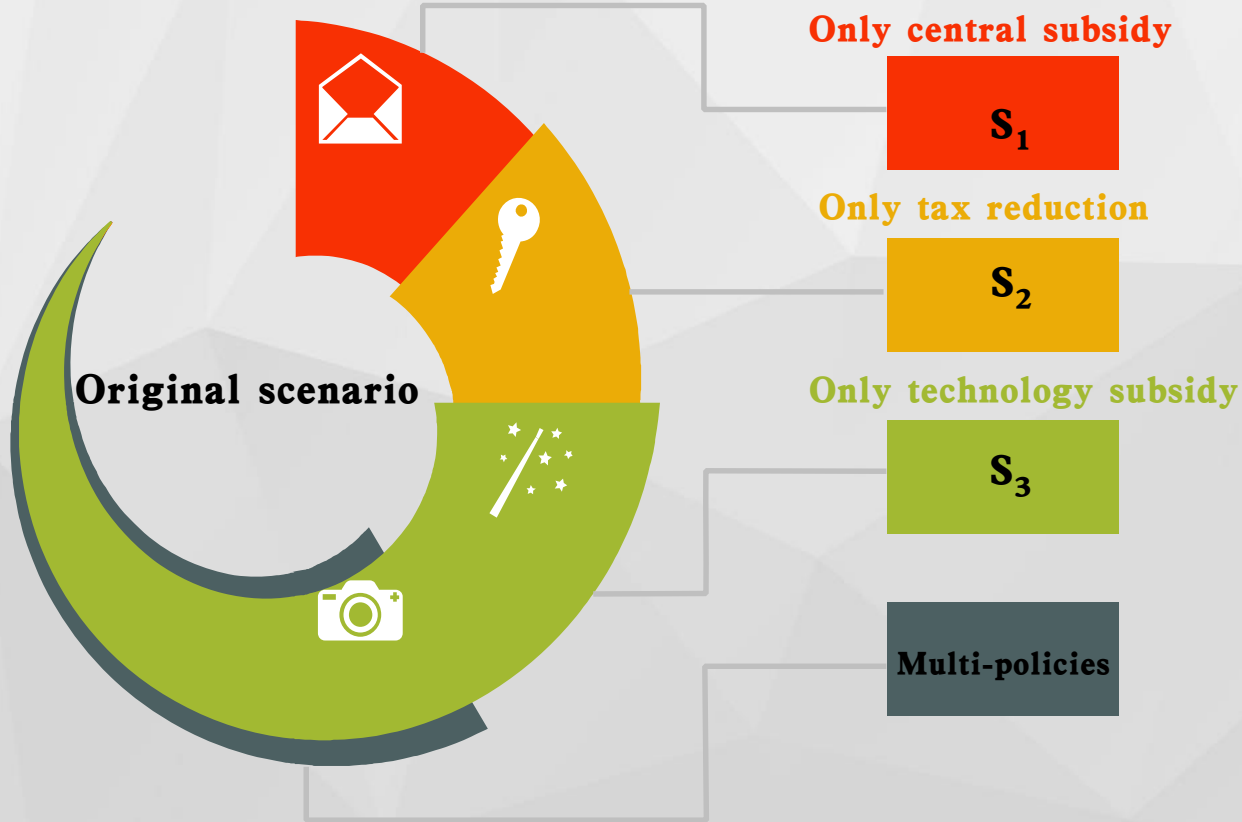


Figure 2 Scenario simulation of shale gas production in China under current policy scenario (10^8m^3)

Scenarios setting



Items	Original scenario	S ₁	S ₂	S ₃	Multi-policies
Central subsidies (yuan/m ³)	2012-2015, 0.4; 2016-2018, 0.3; 2019-2030, 0.2	2018-2021, 0.6; 2022-2030, 0.2	2012-2015, 0.4; 2016-2018, 0.3; 2019-2030, 0.2	2012-2015, 0.4; 2016-2018, 0.3; 2019-2030, 0.2	2012-2015, 0.4; 2016-2018, 0.3; 2019-2020, 0.2; 2021-2030, 0.1
Tax reduction	<i>R1=0</i> <i>R2=0</i> <i>R3=0</i>	<i>R1=0</i> <i>R2=0</i> <i>R3=0</i>	<i>R1=1</i> <i>R2=1</i> <i>R3=1</i>	<i>R1=0</i> <i>R2=0</i> <i>R3=0</i>	<i>R1=0.5</i> <i>R2=0.2</i> <i>R3=0.3</i>
Technology subsidy (yuan)	0	0	0	3 billion	3 billion

Note that, R1, R2, R3 stands for the reduction ratio of resource tax, enterprise income tax and value-added tax, respectively

Goal: 30 billion m³ in 2020 and 80-100 billion m³ in 2030,
set in SGDP issued by National Energy Administration



Main Findings

>>Single policy scenarios

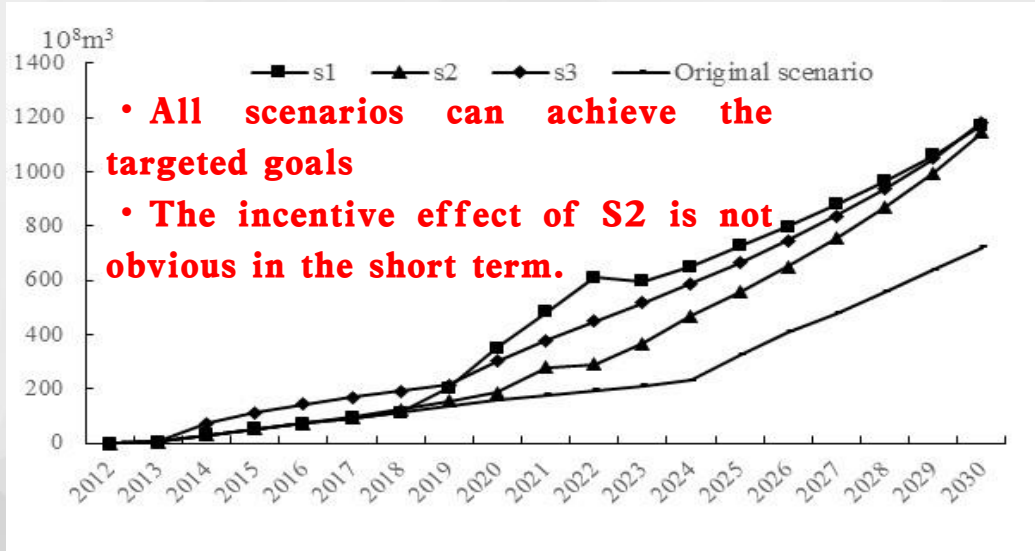


Fig. 3 Simulated shale gas production under single fiscal or taxation policy scenario in China

Tab.4 The development of shale gas industry and subsidy costs under single fiscal or taxation policy (unit: 100 million yuan)

	S ₁			S ₂			S ₃		
	C	A _u	A _m	C	A _u	A _m	C	A _u	A _m
2018	80.5	56.1	134.2	144.6	44.6	255.1	30	48.3	214.8
2019	126.4	77.5	210.6	198.9	33.3	381.4	30	51.3	326.7
2020	209.4	116.0	350.3	289.4	50.5	542.0	30	57.4	476.3
2021	96.8	5.1	584.9	402.4	25.3	784.1	30	79.9	674.2
2022	96.2	95.0	806.6	607.8	106.4	1023.6	30	134.1	898.0
2023	104.5	111.9	1122.7	830.0	105.7	1375.6	30	198.4	1170.3
2024	120.8	132.9	1472.0	1136.2	140.7	1790.0	30	281.5	1484.9
2025	134.9	203.3	1833.1	1557.4	238.8	2277.1	30	375.4	1853.4
2026	149.0	306.8	2221.9	2049.7	380.8	2849.0	30	515.8	2242.5
2027	164.7	402.0	2689.2	2612.6	510.8	3568.2	30	651.6	2714.8
2028	181.7	544.2	3178.4	3277.8	736.7	4350.7	30	839.5	3218.3
2029	200.3	708.3	3724.7	4049.1	979.3	5287.1	30	1049.4	3796.5
2030	221.2	894.3	4337.3	4950.3	1273.6	6372.8	30	1291.6	4453.8

Tab.5 Comparison of single fiscal or tax policies

Items	S ₁	S ₂	S ₃
Subsidy costs	★★★	★	★★★★
Industrial profits	★	★★★★	★★★
Space for increasing production	★★★	★	★★★★
Implemented flexibility	★★★★	★★★	★

Note: C represents costs of government subsidies. A_u and A_m is the after-tax income of upstream mining enterprises midstream sales enterprises, respectively.

S2 > S3 > S1



Main Findings

>>Multi-policies nested scenario

Items	Standards
Central subsidy	0.1 Yuan/m ³
Technical subsidy	3 billion Yuan/year
Tax reduction	Resources tax, enterprise income tax, VAT are 50%, 20% and 10% respectively

- ✓ Planning objectives can be achieved.
- ✓ Shale gas industry has good prospects.
- ✓ Subsidy costs increase with the increase of shale gas production, but less than that of S2.

The dual goals of reducing government costs and increasing industry profits can be achieved.

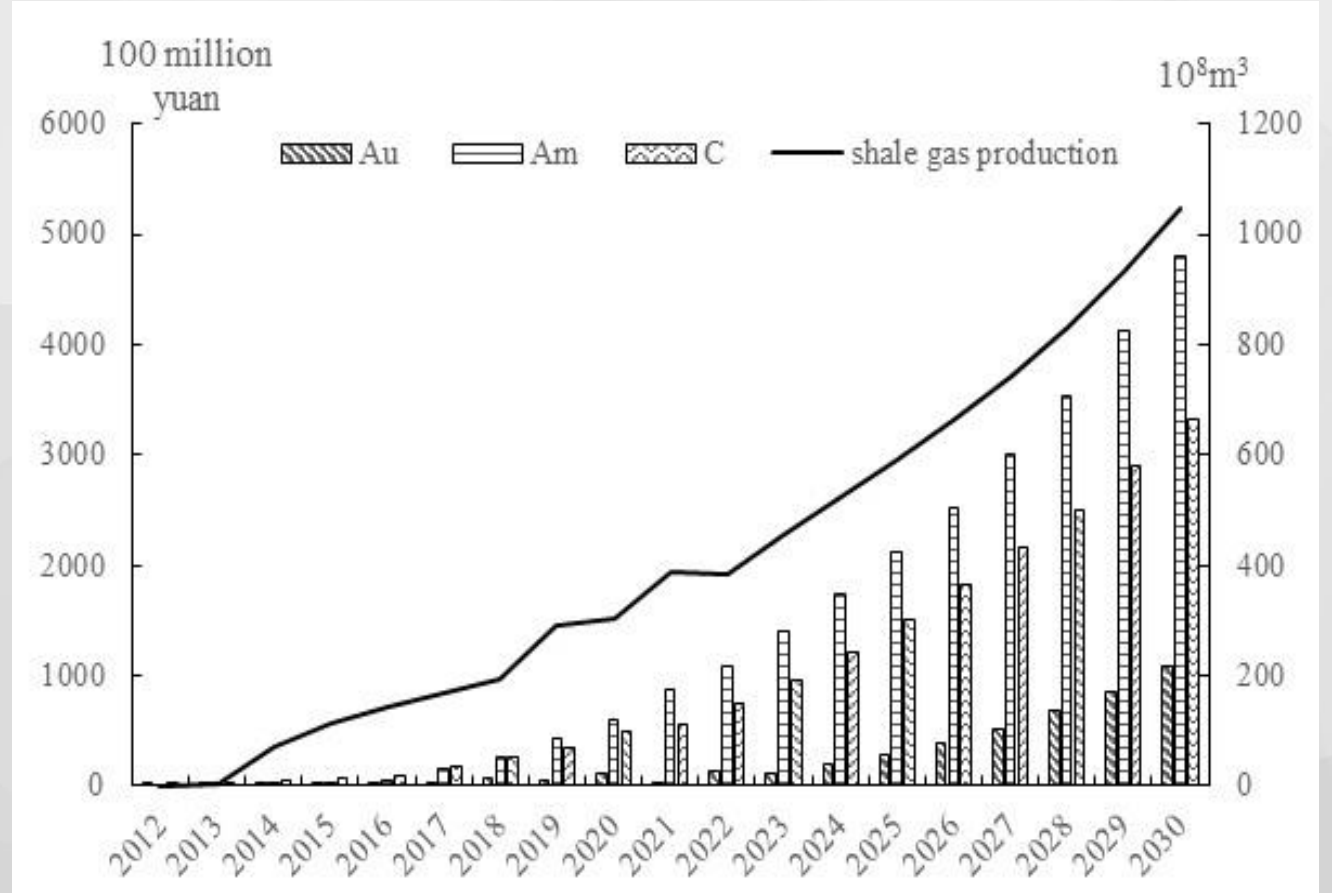


Figure 4 Shale Gas Industry and Policy Costs of in China under Multi-policies Nested Scenario

Note: C represents costs of government subsidies. A_u and A_m is the after-tax income of upstream mining enterprises midstream sales enterprises, respectively.

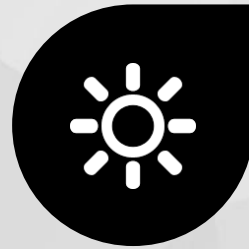
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Implications for policy



Implications for policies

Rational distribution of tax deduction ratio to ensure profits of shale gas enterprises

B

China's tax reduction policy for shale gas industry is not yet perfect, only 30% of the resources tax of shale gas mining enterprises is exempted.

The finding suggests that Chinese government should improve tax reduction policies for shale gas industry development, including VAT, enterprise income tax and resource tax.

C

Increase technical subsidies appropriately

For the successful experience in the United States, Chinese government can increase technical subsidies to encourage shale gas development

A

Raise the standard of central direct subsidy appropriately and encourage local governments to subsidize early shale gas exploitation.

The current direct subsidy for shale gas is expected to reflect the policy effect in 2024, which is not conducive to the realization of the targeted production goals in 2020. We suggests that the subsidy standard for shale gas of 0.3yuan/m³ be extended to 2024, and the subsidy standard can be reduced to 0.2yuan/m³ after 2025 as appropriate.



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Thanks for you listening !