结构变化的节能潜力

Energy Saving Potential of Structural Change

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背景　Background

- 近年来，高耗能工业超常规发展，造成全国煤电运全面紧张，出现了自1978年以来前所未有的严峻局面。既给经济发展和人民生活造成了不良影响，也因以煤为主的化石燃料的消费大量增长而形成了严峻的环境压力。
- 党中央在十一五发展规划建议中提出，在优化结构、提高效益和降低消耗的基础上，实现2010年人均国内生产总值比2000年翻一番；资源利用效率显著提高，单位国内生产总值能源消耗比“十五”期末(即2005年末)降低20%左右。

- Energy demand is outpacing energy supply, and over-reliance on coal and excessive growth of energy-intensive industries have negatively impacted quality of life and the environment.
- CPC Central Committee proposes the following in the "11th Five-Year Plan":
  - Optimize structure, improve efficiency, and reduce consumption, to double GDP between 2000 and 2010.
  - Reduce energy consumption per unit GDP by 20%, relative to the “10th Five-Year Plan” (end of 2005).

背景　Background

- 由于目前国内外学术界对技术(能源利用效率)节能和结构(产业结构、部门结构、产品结构等)节能的作用（对节能量或对能源强度变化的贡献）研究结论差异很大。早期研究成果的结论是技术节能占20～30%，而结构节能占70～80%。但近几年研究成果大部分则认为，中国自1990年以来结构变化的节能贡献很小，甚至为负作用，节能主要依靠效率(或称技术)作用。因此，有必要进行深入地研究，以期得到符合客观实际的结论。同时，也为2010年节能目标中的结构节能作用提供可信依据。

- Further research is needed on the role of technology (energy efficiency) vs. structure (industrial structure, sector structure, product structure) in producing energy savings
- Currently, research findings vary:
  - Early results: technology accounts for 20-30% of reduced consumption; structure accounts for 70 - 80%.
  - Recent research results: structural changes have had a small or even negative effect on energy saving; technology plays the main role.

计算结构节能贡献份额与效率节能贡献份额的方法论研究
Methodology for Calculating Structural and Efficiency Contributions to Energy Savings

- 节能的结构贡献、效率贡献定义
  - 结构节能贡献：由于结构变化而引起的总能源强度变化。
  - 效率节能贡献：由于能源利用效率变化而引起的总能源强度变化。

- **Definitions:**
  - **Structural Contributions:**
    - **Overall energy intensity change induced by structural change**
  - **Efficiency Contributions:**
    - **Overall energy intensity change induced by energy efficiency change**

计算结构节能贡献份额与效率节能贡献份额的方法论研究
Methodology for Calculating Structural and Efficiency Contributions to Energy Savings

- 若采用部门层次进行研究：
  - 部门能源强度变化(部门能源消费量/部门增加值)对总能源强度变化的影响
  - 部门结构变化(部门增加值/GDP)对总能源强度变化的影响
  - 部门能源强度变化包括：(1)能源利用效率变化(产品节能)；(2)产品结构变化；(3)产品附加值变化。

- **Sector-level analysis:**
  - **Impact of sector energy intensity change (sector energy consumption /sector added value) on overall energy intensity.**
  - **Impact of sector structural change (sector added value/GDP) on overall energy intensity.**
  - **Three factors impacting sector energy intensity: (1) change in energy efficiency; (2) change in product structure; and (3) change in product added value.**

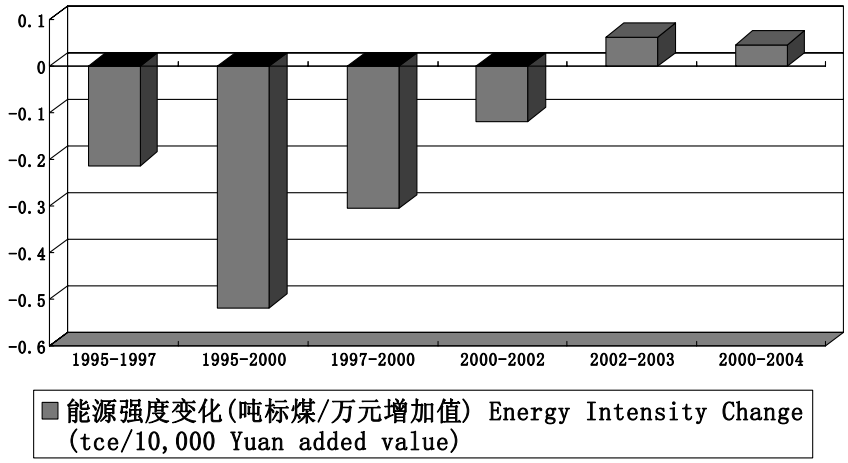
计算结果：1995～2004年结构节能贡献与能源效率贡献(29个部门)

Calculation Results: Contributions of Structural and Efficiency Change to Energy Savings during 1995-2004 (29 sectors)

年份 Year	能源强度变化(吨标煤/万元增加值) Overall Energy Intensity Change (tce/10,000 Yuan added value)	方法4 Method 4		方法2 Method 2	
		效率 Efficiency (%)	结构 Structure (%)	效率 Efficiency (%)	结构 Structure (%)
1995-1997	-0.213	34.2	65.7		
1995-2000	-0.517	39.7	60.3		
1997-2000	-0.305	55.0	45.0		
2000-2002	-0.118	78.8	21.2		
2002-2003	0.063	13.0	87.0		
2000-2004	0.046	4.0	96.0	6.3	93.7

计算结果：1995～2004年能源强度变化(29个部门)

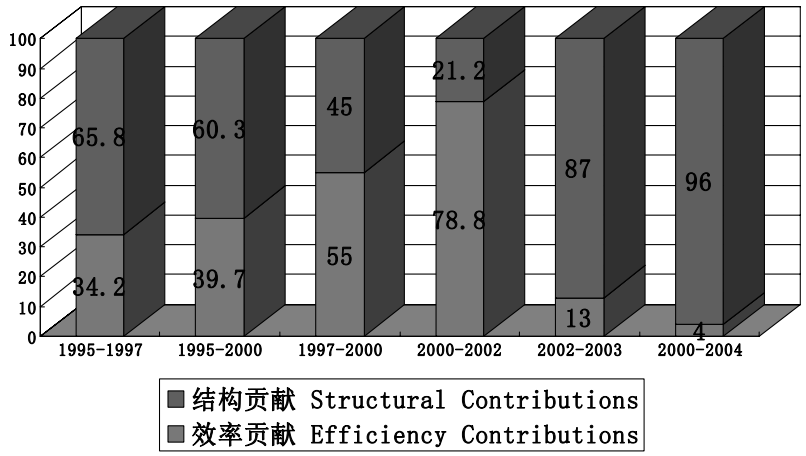
Calculation Results: Energy Intensity Change during 1995-2004 (29 sectors)



计算结果：1995～2004年结构节能贡献与能源效率贡献(29个部门；方法四)

Calculation Results: Contributions of Structure and Efficiency Change to Energy Savings during 1995-2004

(29 sectors: Method 4)



结　论 Conclusions

- 1995～2000年总能源强度下降中，结构节能贡献还是很大的，大多在60%以上。
- 2002～2004年总能源强度呈上升趋势，结构推动总能源强度上升，结构对节能起反向作用。这是因为2002年以后部门结构重型化造成的，尽管此阶段能源利用效率仍起着节能作用，使总能源强度下降，但下降幅度抵消不了因结构重型化而引起的能源强度上升幅度。
- 计算效率节能与结构节能贡献必须要以高能耗产品的能源消耗为支撑点。最好将效率(技术)节能与结构节能贡献计算做到产品层次(主要高耗能产品)，研究成果将更能反映实际情况。

- **1995-2000: overall energy intensity declined; structural change contributed 60%.**
- **2002-2004: overall energy intensity increased, mainly induced by structural change (rapid growth of heavy industries counteracted energy-saving effect of energy efficiency improvement).**
- **Energy consumption of energy-intensive products is the key to calculating the contributions of structural and efficiency changes.**
- **Therefore, product-level analysis would produce more accurate results.**

预测计算2005～2010年五种经济发展和能源需求情景下，效率节能与结构节能贡献份额

Estimating the contributions of structural and efficiency change to energy savings during 2005-2010 under five scenarios

- 思路一：改变投资规模及投资结构，以扭转2002～2005年间高耗能工业发展过快、能源供需全面趋紧的严峻局面。2003年以来，不仅资本形成率迅速上升，高达44%左右，而且向高耗能工业倾斜，钢铁、水泥、铝业、铁合金、焦炭行业投资规模急剧膨胀，出现过热现象，随后国家采取了调控措施，投资增长逐年回落，但有些行业仍偏高，需进一步调整。

1. **Change investment scale and structure to reverse the rapid-growth trend of energy-intensive industries and the imbalance between energy demand and supply during 2002-2005.**

Further adjust and control overheated industries. Since 2003, the rate of capital formation has reached 44%, and has favored energy-intensive industries (steel, cement, aluminum, ferroalloy, coke). Investment growth rates have declined for some industries, due to government control measures.

不同年份一些部门投资额变化情况(亿元、%)
Investment in Some Sectors (100 million, %)

	2003		2004		2005	
	投资额 Investment	年增长率 Annual growth rate	投资额 Investment	年增长率 Annual growth rate	投资额 Investment	年增长率 Annual growth rate
电力 Electric Power	3183	15.9	4854	52.5	6490	33.7
钢铁 Iron & Steel	1445	96.2	1789	23.8	2281	27.5
水泥 Cement	405	113.4	582	43.6	806	38.5
铝业 Aluminum	250	86.6	308	23.4	263	-15.0
铁合金 Ferroalloy	157	1057.3				
焦炭 Coke	186	409.4				

预测计算2005～2010年五种经济发展和能源需求情景下，效率节能与结构节能贡献份额

Estimating the contributions of structural and efficiency change to energy savings during 2005-2010 under five scenarios

- **思路二：**需调整产业、部门、产品结构。我国长期存在结构偏重的局面，近几年更趋严峻。重复建设、盲目建设，造成一些工业产品生产能力利用率不足，存在不同程度生产过剩问题。而且产品生产结构严重失衡。

- **2. Adjust industrial, sector, and product structure.**

- **China's economy has long been dominated by heavy industries, and this situation is getting more serious in recent years: redundant construction, blind construction, industrial production capacity underutilization, and varying degrees of overproduction. Moreover, a serious imbalance lies in the structure of production.**

2003年主要工业产品生产能力及利用情况

Major Industries' Production Capacity and Utilization, 2003

	2003年产量 Annual Output	2005年产量 Annual Output	2003年底生产能力 Production Capacity	2003年底生产能力利用率(%) Capacity Utilization
氮磷钾化肥(万吨) Inorganic fertilizer (10,000 tons)	3881	5220	6625.8	58.6
水泥(万吨) Cement (10,000 tons)	86208	106400	114227.7	75.5
生铁(万吨) Iron (10,000 tons)	21366.7	33040	25516.2	83.7
粗钢(万吨) Steal ingots (10,000 tons)	22233.6	35239	25765	86.3
钢材(万吨) Steel products (10,000 tons)	24108	39691	30302	19.6
家用洗衣机(万台) Washing machine (10,000 sets)	1964.5	2953	3244.3	60.6
家用电冰箱(万台) Refrigerator (10,000 sets)	2242.6	2986	3240.6	69.2
空调器(万台) Air-conditioner (10,000 sets)	4821	6764	7317	65.9
移动电话(万部) Mobile phone (10,000 sets)	18231.4		26895.7	67.8
电子计算机(万部) Computer (10,000 sets)	3216.7		5825.1	55.2

预测计算2005～2010年五种经济发展和能源需求情景下，效率节能与结构节能贡献份额

Estimating the contributions of structural and efficiency change to energy savings during 2005-2010 under five scenarios

- **思路三**：分析历史年份的进出口规模及进出口结构，分析其对能源消耗的影响，以期调整符合国情的进出口结构和规模，既保证进出口在经济增长中的作用，又能减少能源消耗。

- **3. Analyze historical data on the structure and scale of imports/exports; examine how adjustments in structure and scale can affect energy consumption**

- **Adjust imports/exports structure and scale in order to reduce energy consumption while still guaranteeing its role in economic growth.**

方法 Methods

2005～2010年五种经济发展与能源需求情景分析（高、中、规划、粗放发展情景、实现20%节能目标）。利用投入产出模型(投入产出法是研究国民经济中各部门间的相互关系和依赖程度，以及一个部门发生变动对其他部门乃至整个经济的影响。是迄今为止研究国民经济部门相互关系的有效方法之一。表的横向表示各部门生产活动的结果，即产出的去向，包括中间消耗与最终产品使用，两者之和为总产出)，从满足最终产品的各项需求出发，调整最终产品结构（投资消费、进出口）以及部门间直接消耗系数，计算出四种情景下，29个部门的产出和总产出，以及各部门的能源消费量和总能源消费量。从而计算出7个产业部门的增加值以及能源消费量。

Five Scenarios for Economic Development and Energy Demand, 2005-2010.

- **Five development scenarios (high, moderate, planning, extensive development, achieving 20% energy intensity reduction target).**

- **Using input-output model (assume production meets demand), adjust the structure of final products (investment, import and export) and inter-sector coefficients**

- **Calculate sector output and total output, sector energy consumption and total energy consumption (29 sectors) under five scenarios**

- **Calculate the value added and energy consumption of the 7 energy-intensive industries.**

情景方案的最终产品设定条件(消费率、资本形成率和净出口率)
Parameters for Five Scenarios
(consumption rate, capital formation rate, net export rate)

情景 Scenarios	2000年			2010年		
	消费率 Consumption rate	资本形成率 Capital formation rate	净出口率 Net export rate	消费率 Consumption rate	资本形成率 Capital formation rate	净出口率 Net export rate
中方案 Moderate	61.0	36.4	2.5	62.0	36.0	2.0
高方案 High	61.0	36.4	2.5	60.0	38.0	2.0
规划方案 Planning	61.0	36.4	2.5	64.0	34.0	2.0
粗放方案 Extensive development	61.0	36.4	2.5	54.3	43.2	2.5
20%方案 Achieving 20% target	61.0	36.4	2.5	61.0	37.0	2.0

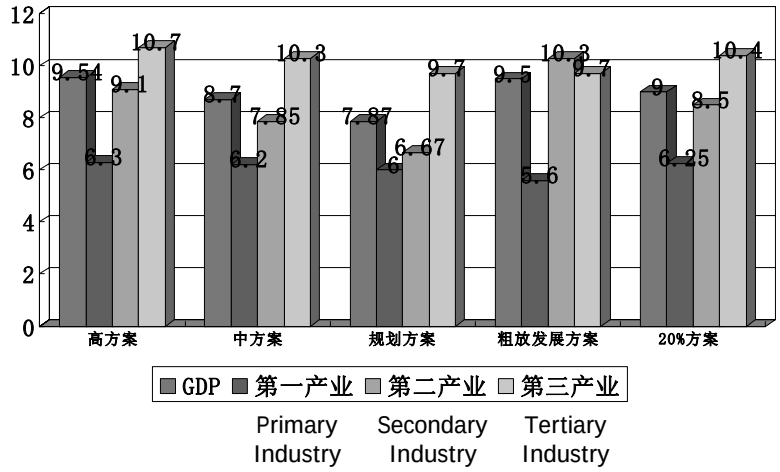
注：粗放方案即为2004年的水平。Note: Parameters for extensive development scenario adopt 2004 data.

情景方案的产品能源利用效率提高的设定条件
Parameters for Energy Efficiency Improvement

	高方案 High	中方案 Moderate	规划方案 Planning	粗放方案 Extensive Development	20%方案 Achieving 20% target
钢铁工业 Iron & Steel	6.0	6.0	6.0	6.0	9.0
有色金属Ferro alloy	1.5	1.5	1.5	1.5	12.0
化学工业 Chemical	5.0	5.0	5.0	5.0	7.0
建材工业Building Materials	7.5	7.5	7.5	7.5	15.0
电力工业Electric Power	5.9	5.9	5.9	5.9	13.9
纺织业Textile					8.0
轻工业Light Industry					12.0
交通运输 Transportation	3.0	3.0	3.0	3.0	5.0
其他行业Other	1.0	1.0	1.0	1.0	4.0
生活消费Living consumption					5.0

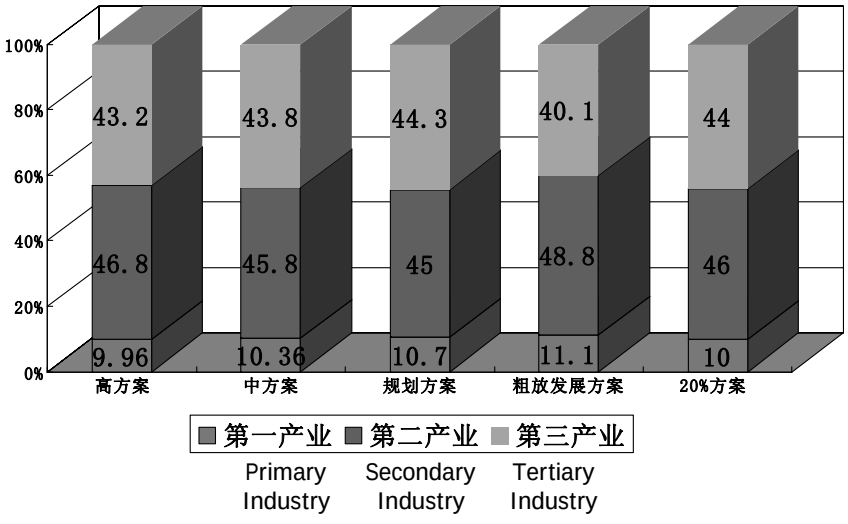
2010年五种方案各产业增长率(%)

Growth Rate for Industries under Five Scenarios for 2010



2010年五种方案三次产业比重(%)

Proportion of the Three Industries in 2010 under Five Scenarios(%)



2010年五种情景方案计算结果(结构调整+技术节能)

Calculation Results (Structural Adjustment + Efficiency Improvement)

	高方案 High	中方案 Moderate	规划方案 Planning	粗放方案 Extensive Development	20%方案 Achieving 20% Target
能源消费量(万吨标煤) Energy consumption(10,000tce)	307529.0	291579.1	276535.3	367610.6	278092.0
生产消费 Production Consumption	270527.7	255058.7	240542.4	327605.6	245026.6
生活消费 Living Consumption	37001.3	36520.4	35993.0	40005.0	33065.4
生活消费比重(%) Proportion of Living Consumption (%)	12.0	12.5	13.0	10.9	11.9
GDP(亿元、2002年价) GDP (100 mln Yuan, 2002 level)	252246.0	240936.4	230036.0	252921.1	247199.2
生产能耗强度 Production Energy Consumption Intensity	1.0725	1.0586	1.0457	1.2953	0.9912
是2005年的倍数 Times of 2005 level	0.858	0.847	0.836	1.041	0.797
总能耗强度 Overall Energy Intensity	1.2192	1.2102	1.2021	1.4535	1.1250
是2005年倍数 Times of 2005 level	0.875	0.869	0.863	1.046	0.809

2005～2010年结构节能与技术节能的贡献份额表

Contributions of Structural and Efficiency Change to Energy Savings, 2005-2010

情景 Scenarios	总能源强度变化(%) Overall Energy Intensity Change	结构贡献(%) Structure Contribution	技术贡献(%) Efficiency Contribution
高方案 High	-12.5	-8.9	-3.6
中方案 Moderate	-13.1	-9.6	-3.5
规划方案 Planning	-13.7	-10.3	-3.4
粗放发展方案 Extensive Development	4.6	8.1	-3.5
20%方案 Achieving 20% Target	-19.1	-13.2	-5.9

注：其中20%方案的结构贡献中，产品结构贡献为-4.0，部门结构贡献为-9.2。

Note: In Achieving 20% Target Scenario, product structure contributes -4.0%, sector structure contributes -9.2%.

初步结论 Initial Findings

1. 1995～2000年总能源强度下降中，结构节能贡献还是很大的，大多在60%以上。2002年后总能源强度呈上升趋势，其中90%以上是由结构重型化引起能源强度上升，这时的结构对节能起负作用。

1. **From 1995 to 2000, overall energy intensity declined; structural change contributed 60%.**

   After 2002, there has been a general upward trend in energy intensity, 90% of which is attributable to the rapid growth of heavy industries. Thus, industry structure played a negative role in energy-saving efforts.

初步结论 Initial Findings

- 2. 同时实施结构调整节能和技术节能，在高、中、规划方案下节能的效果是：总能耗强度可分别降至87.5%、86.9%和86.3%（即节能率为12.5%、13.1%、13.7%），还不能达到节能20%的目标。其中技术节能分别为：3.6%、3.5%、3.4%。结构节能10%左右。

- **Implementing structural adjustment and technology energy-savings for "high," "moderate" and "planning" scenarios will produce energy saving of 12.5%, 13.1%, and 13.7%, respectively.**

****These results fall short of the 20% energy saving target.****

- **Of the total, technology energy savings will be 3.6%, 3.5%, and 3.4%, respectively.**

- **Structural energy saving will be around 10%.**

初步结论 Initial Findings

3. 粗放型发展的结果为产业结构继续重型化，第二产业及工业比重上升（即第二产业比重上升为48.8%，第三产业比重仍为40.1%）。

3. Under an extensive development scenario:

- **Industrial structure will be more severely heavy industry-dominated .**
- **The proportion of secondary industries will increase to 48.8%.**
- **The proportion of tertiary industry will remain at 40.1%.**

初步结论 Initial Findings

4. 从2005～2010年继续粗放型增长，则2010年的万元产值能耗不但不下降，还要从1.3900上升到1.4535，比2005年上升4.6%。

4. With continued extensive growth from 2005 to 2010, energy consumption per unit GDP will not only fail to decrease, but will increase from 1.3900 to 1.4535 (4.6% increase from 2005).

初步结论 Initial Findings

5. 要实现2010年20%的降耗目标，必须在高、中发展情景的基础上进一步优化结构，尤其是产品结构的优化，同时要加大技术节能力度，总体能耗强度下降至80.9%。这样到2010年，万元产值能耗将比2005年下降19.1%。行业结构调整的能耗下降为9.2个百分点，产品结构调整的能耗下降为4个百分点（行业与产品结构节能贡献份额为69%），技术进步的能耗下降为5.9个百分点（技术节能贡献份额为31%）。

5. **What is needed to achieve 2010 20% target:**

- **Continued structural adjustments based on high and moderate development scenarios (especially product structure)**
- **Increased energy saving through efficiency improvement**

This will yield an energy intensity decline of 19.1% in total:

- **Industrial structure: 9.2%; Product structure: 4%; jointly contribute 69% to total savings.**
- **Technology contributes 31% to the total savings.**

初步结论 Initial Findings

6. 要实现2010年20%的降耗目标，必须从结构节能与效率节能两方面进行，从1995年以来节能贡献份额以及2002～2010年五个情景方案的节能贡献份额分析来看，结构节能作用要大于效率节能，即要转变高投入、高消耗、高污染的粗放型经济增长方式。控制投资规模和调整投资结构以及进出口政策的调整等对20%目标的实现是有效的。当然，技术节能也是非常重要的，两者缺一不可。而且，行业部门、产品的能源利用效率提高存在较大潜力。工业部门尤其是高耗能工业部门与产品，建筑、交通运输等部门能源利用效率远远低于国际先进水平，节能潜力还很大。所以，在重视结构节能的同时，技术节能是不能忽视的。

- **Achieving the 2010 target will rely on structural and efficiency energy-savings (structural adjustment contributes more).**
- **Development must shift away from the "high input, high consumption, high pollution" path.**
- **More effective measures are needed to control the structure and scale of investment, and adjust import and export policy.**
- **Energy efficiency in China lagging behind international advanced levels; energy saving potential through technology is tremendous.**

谢　谢！

Thank You!