

Financial crisis, economic development, power-saving and the reduction of the hotbed gases' emission are a long-term prospect for the emission's reduction in China

Power consumption causes economic development and becomes the main pollution source, including air pollution. Power consumption appreciably responds to the economic fluctuation. Different historic crises' gravity and abrupt economic recession show up in power consumption and hotbed gases' emission. In this article the analysis of the relations among the financial crisis, economic development, power-saving and the emission's reduction has been carried out and it shows that the financial crisis will inevitably lead to the power consumption's reduction and to the emission's reduction. But the crisis is a short term phenomenon, and the economic growth takes time. As in any developing country, in China the pressure of the reduction of hotbed gases' emission is intensifying. As for power-saving and emission's reduction, it is necessary to discuss these phenomena in details; and it is also necessary to develop the low-carbon way, not to ignore it

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In 2007 the American hypothec crisis transformed into a financial one which in 2008 affected the industrial branch, grew into the economic crisis extending all over the world. As the China's economy is a part of the international one, China's economic development, power-saving, and the emission's reduction suffered.

In the course of history important crises' events negatively influenced economic development, but at the same time they made for power-saving and the polluting emission's reduction.

In China the high rate of economic growth, power-saving and the emission's reduction is extremely desirable, all the steps of the eleven-year plan are carried out under strict

requirements. According to the practical results for the recent 3 years we can see that the economic development was carried out successfully, but power-saving and the emission's reduction were not achieved. However since August of 2008 economic growth has shifted into low gear, power consumption has abruptly reduced, so power-saving and the emission's reduction don't seem to be a priority problem. In fact, at the times of economic crises power consumption and hotbed gases'¹ emission are considerably reduced, but at the times of economic growth they increase again. It proves that the economic crisis' influence on economic

¹ Hotbed gases' – the gaseous constituents of the atmosphere of natural or anthropogenic, that absorb and re-emit infrared radiation (ents. "Science").

development caused the reduction of power consumption and polluting emission. But it is a temporary phenomenon, the economy will necessarily develop, so power-saving and emission's reduction are long-term strategic prospects which cannot be ignored. It is especially necessary to realize the importance of the hotbed gases' (HG) emission in full measure. The decision on the emission's reduction should correspond to the development requirement concerning the creation of the international climate's mode.

1. Historical figures' interpretation.

In the society based on agriculture the human opposition to the nature was low, power consumption of minerals was limited, so it is possible to exclude the polluting emission's influence of such type of the society. The reasons of the society's fluctuation are natural disasters and struggle for treasures of the soil. After the industrial revolution the economy has undergone rapid development; more minerals' energy was spent, polluting emission accumulated. However during industrialization the natural elements' influence on the economy gradually slackened, and the economic growth changed as a result of the economic crisis. Under such conditions abrupt power consumption's reduction and polluting emission's increase took place.

We studied the dynamic tendency of the hotbed gases' emission per head in some countries of the world for the middle of the XIX century. However, the quality of statistical data of the XIX century was not sufficient to detail the historical dynamics. In the XX century technique to obtain statistical data gradually improved and become more accurate. This allowed the following conclusions.

Firstly, the crisis caused the economic decline, the power consumption's reduction, so the level of hotbed gases' emission changed. In Germany and Japan which participated in World War II, after the capitulation power consumption abruptly reduced, so the hotbed gases' emission decreased to 80%. In 1990 (after the USSR disintegration) the Russian economy declined, and power consumption decreased

for about 40%. In China "three-year natural disasters" took place after the defeat of the "big advance" in 1960, power consumption abruptly reduced and the hotbed gases' emission greatly decreased. Energy crises in 1973 and in 1986 led to the global power consumption's reduction and to the hotbed gases' emission decrease. Owing to the "American depression" in 1920 power consumption and the hotbed gases' emission abruptly decreased for 1/3.

Secondly, the higher is the economic globalization's degree, the more the global economic crisis influences it. The less developed countries lagged behind in economy, less participated in the global international activity, so they were influenced in a lesser degree, than the industrialized European and American countries.

Thirdly, though the quantity of the hotbed gases' emission per head changes under different crises' influence, in general, the tendency is growing up. After crises the emissions quickly accumulate and reach new levels.

Fourthly, the emission's level per head appeared to be in the direct dependence of the development, i.e., the higher is the economic development's level the more is the hotbed gases' emission. In comparison with the advanced European and American countries, in the developing countries such as China and India, the hotbed gases' emission per head is at a rather low level.

Fifthly, when the development reaches the certain stage, the tendency of the HG emission's increase per head slows down, restrains and even descends. For the recent 20 years the Japanese and English HG emission per head practically has not increased, and the German carbon emission per head is at a level of the negative growth.

Why is the economic crisis capable to provide power-saving and emission reduction? In *table 1* the change of the Chinese power consumption during the financial crisis in the Eastern Asia in 1997 is represented. The hotbed gases' emission per head in China in 1997 first grew, then abruptly reduced, and in 2001 rose again. Analyzing the figures in table, it is possible to define the internal

Table 1. Change of growth of the Chinese power consumption during the financial crisis in the Eastern Asia (1997 – 2000)

Year	Coal	Oil	Natural gas	Electricity	General power consumption
1995	8.3	8.0	2.2	9.9	8.3
1996	2.8	9.9	12.1	0.3	4.1
1997	-3.0	10.3	12.7	2.8	0.2
1998	-7.8	1.1	2.9	5.6	-4.9
1999	-15.7	6.5	8.0	-2.7	-9.3
2000	-5.2	7.9	7.9	9.9	-0.3
2001	10.5	2.5	11.5	24.1	9.4
2002	19.5	7.4	7.7	6.7	14.8

Source: China Energy Data Report 2004, LBNL, ERI/NDRC, 2006.

reasons of the emission's reduction as a result of the financial crisis.

Firstly, the financial crisis lowered the volumes of power consumption. The level of power consumption was reduced from 8.3% in 1995 to 4.1% in 1996, and up to 0.2% in 1997. At the crisis' peak in 1999 the volume of the general power consumption's reduction reached the point of 9.3%. As a result of the general power consumption's reduction the amount of the polluting emissions was reduced.

Secondly, we can see that the crisis more seriously influenced the structure of carbonic energy which is the main polluter. In 1997 the negative growth occurred, and at the crisis' peak in 1997 it reached the point of 15.7%.

However the purer and more convenient forms of energy such as oil, natural gas and hydroelectric power practically didn't undergo the crisis' influence. In connection with the fact that coal as a highly polluting type of energy underwent a stronger economic crisis' impact, its consumption was reduced, and in general energy became purer and the volumes of the polluting emissions shifted into low gear.

Thirdly, after the economic crisis the market conditions worsened and small-scale enterprises with outdated technologies, low efficiency and absence of competitiveness first of all went bankrupt. And large-scale enterprises with up-to-date technologies and high efficiency have the opportunity to cope with the crisis. Thus by macroeconomic means enterprises with low efficiency and high level pollution were eliminated.

Why has the economic crisis caused the general power consumption's reduction and the usage of "pure" types of power resources? The economic crisis has reduced economic activities of the society, the general consumption has shifted into low gear, and the general volume of power consumption reduced. However the change of power consumption differs among different economic bodies. Population's consumption was influenced a little, and public service establishments practically were not influenced. Industry, especially raw material heavy industry, was under the strongest influence. Population and public service establishments use oil, natural gas and electricity. Industry, especially heavy industry, is based on cheaper and polluting forms of power such as coal. That is why during the crisis the general power consumption was reduced and tends to become "more refined".

2. The purpose, its achievement and the effect of power-saving and emission's reduction in the Chinese "eleven-year plan".

Among all the parameters of the "eleven-year plan" the problem of power-saving and emission's reduction is the most difficult. Owing to the fast economic growth in 2006 and 2007 power consumption advanced up-tempo, and it caused great emission of polluters. In the second half of 2008 the global financial crisis affected China; in the fourth quarter of the same year there was economic recession. It looks as if the pressure of power-saving and emission's reduction disappeared after the economic crisis had occurred.

In the beginning of 2006 “eleven-year” plans for the national economy and social development of China were published; power-saving and emission’s reduction program was ratified, it was ascertained that in 2010 power consumption in gross national product will shift into low gear to 20%, in comparison with the year of 2005, as the volume of the main polluter, sulfur dioxide (SO₂) and the volume of chemical oxygen consumption will shift into low gear to 10% in comparison with the previous period. But all these parameters will be realized with great difficulties.

The disputes on the matters of power-saving and emission’s reduction have continued for the recent years. The examples of the years of 2007 and 2008 can hardly be called comforting. Under such conditions the State Committee of Development and Reforms of China carried out the estimation of the middle period of the “eleven-year plan’s” realization (Hu Anjan, 2008). The result showed that the main parameters of the socio-economic development have reached or even have exceeded the established level, but the volumes of power-saving and emission’s reduction has lagged behind the planned ones. According to the State Bureau of Statistics, the figures showed that in 2005 – 2007 the general power consumption for a unit of gross national product has the tendency to reduce, their volumes were 0.57%, 1.33% and 3.27%, this didn’t meet the requirements of power-saving and emission’s reduction.

In the first half-year of 2008 the tendency of the first two years of the “eleven-year plan” proceeded. Since the fourth quarter the turn in the tendency of economic growth appeared, power consumption abruptly reduced. In general, power consumption gradually reduced; in the first quarter the volume of reduction made 2.62%, in the first half-year it made 2.88%, in the first three quarters it made 3.46%. For the first three quarters the emission’s reduction in China was lowered to 2.7% и 4.2% agreeably, in comparison with the similar period of the previous year.

In the fourth quarter of 2008 the global financial crisis affected China so the power

consumption’s reduction was observed. This case was very much alike with the similar case during the financial crisis in the Eastern Asia in 1997; the emission’s reduction ran its natural course. According to the Chinese Union of Generating Enterprises (2009), the figures showed that at the end of the third quarter, in September, 2008 electricity consumption of all China abruptly reduced. The volume of the electric capacity’s increase was only 3.4%. Then the electricity consumption’s reduction grew. In October, 2008 there was a 4%-decrease in volumes of one-month electric capacity. It was the first negative sign of electricity consumption’s reduction for the recent 10 years since 1999, except celebrating Spring Holiday. In November electricity consumption throughout the country reached 257,550000000 kilowatt; in comparison with the previous period the reduction made 7.49%. Regulating facilities of electricity at the power stations which are under the regulation of the nation-wide power grid are reduced for 7% in comparison with the previous period. In provinces of Shanjsi, Hunanj, autonomous Mongolia, Guichzhou, Yunjnanj, etc., where industrial enterprises with a high level of power consumption concentrate, the volume of power consumption reduced greatly, in comparison with the previous period. Among them the volume of the decrease dropped for more than 30% a month in a province of Guichzhou, and it dropped for 20% in autonomous Mongolia. In 2008 at the Chinese kilowatt power stations the average quantity of hours of the equipment’s use made 4, 677 hours, it is 337 hours less, in comparison with the previous period.

In general, in 2008 the volume of increase of the electric capacity and the power consumption by the whole country were 5.18% and 5.23% respectively, it is less than the speed of increase in gross national product of the year of 2008 (9%). It means, that since 1999 the factor the electricity resiliency (production, consumption) for the first time has become lower than “one” (resiliency factor of power consumption = growth of power consumption / growth of gross national product). In 2009 the

structure of power consumption shows the differences in the financial crisis' influence on different branches. According to the Chinese Union of Generating Enterprises, the figures showed that in January and February, 2009 electricity consumption by the first category industry made 11,241,000,000 kilowatt, in comparison with the previous period it increased for 4.88%; electricity consumption by the second category industry made 349,314,000,000 kilowatt, in comparison with the previous period it reduced for 10.19%; electricity consumption by the third category industry made 62,752,000,000 kilowatt, in comparison with the previous period it increased for 7.66%. Electricity consumption by the inhabitants of cities and villages made 73,910,000,000 kilowatt, in comparison with the previous period it increased for 10.91%. The volumes of electricity consumption's reduction by the light and the heavy industries, in comparison with the previous period, made 10.57% and 10.37% respectively. Electricity consumption by different regions has increased. The provinces where the electricity consumption's increase, in comparison with the previous period, exceeded the average level throughout the country (-5.22%), concentrate in the central and in the western parts, for example, Guichzhou (38.24%), Hunanj (11.60%), Yunjnanj (3.91%) and Sychuanj (-2.22%); and in the advanced parts power consumption abruptly reduced. The factor of power stations' start-up in a province of Guangdong was only 70%, and 30% of power stations were stopped.

The general position of power consumption is reflected in the electric branch's condition. In 2008 the total power consumption by China made 2,850,000,000 ton. of coal, it increased for 4%, in comparison with the previous year. Coal consumption throughout the country made 2,740,000,000 ton., it increased for 3%; crude oil consumption made 360,000,000 ton., it increased for 5.1%; natural gas consumption made 80,700,000,000 m³, it increased for 10%, electricity consumption made 3,450,200,000,000 kilowatt, it increased for 5.6%. China imported 179,000,000 ton. of crude oil to the same period, it was 9.6% more,

in comparison with the previous year; the cost made 129,300,000,000 american doll. At the same time China imported 38,850,000 ton. of oil, the increase made 15%, in comparison with the previous year, the cost made 30,000,000,000 american doll.

The total power consumption and the results evidently coincided with the situation during the financial crisis in the Eastern Asia in 1997. The results are that the effect of power-saving and the emission's reduction is undoubtedly remarkable. Though in the first six months of 2008 the effect of power-saving and the emission's reduction was non-comforting, in the second half-year under the financial crisis' influence power consumption in gross national product for the whole year of 2008 was reduced for 4.59%, in comparison with the previous year. The quantity of oxygen chemical consumption's emission and of sulfur dioxides (SO₂) decreased for 4.42% and 5.95% agreeably. Due to the successful effect of the emission's reduction in 2008, the total amount for three years has come nearer to the purpose: power consumption in gross national product should be reduced for 10.08%; the quantity of oxygen chemical consumption's emission and of sulfur dioxides (SO₂) should be reduced for 6.61% and 8.95% agreeably.

The Ministry of the Environment Protection of China (Chzhou Shensyanj) ratified the program on the emission's reduction in 2009: the quantity of oxygen chemical consumption's emission and of sulfur dioxides (SO₂) will be reduced for more than 2 and 3% agreeably, in comparison with 2008; we should also add that it is necessary to reduce 1,900,000 ton. of sulfur dioxide (SO₂) and 1,120,000 ton. of oxygen chemical consumption, to lower them for 9% and 8% agreeably, in comparison with 2005. We can be pretty sure that these parameters will be easily carried out without any special effort due to the financial crisis. Moreover, it is even possible to suppose that the economic crisis provided power-saving and the emission's reduction for China.

However, it is necessary to remember that the crisis' condition will pass, but the problems

will not disappear, and the problem of the reduction of the hotbed gases' emission may become even more serious.

3. The long-term prospect on the reduction of the hotbed gases' emission.

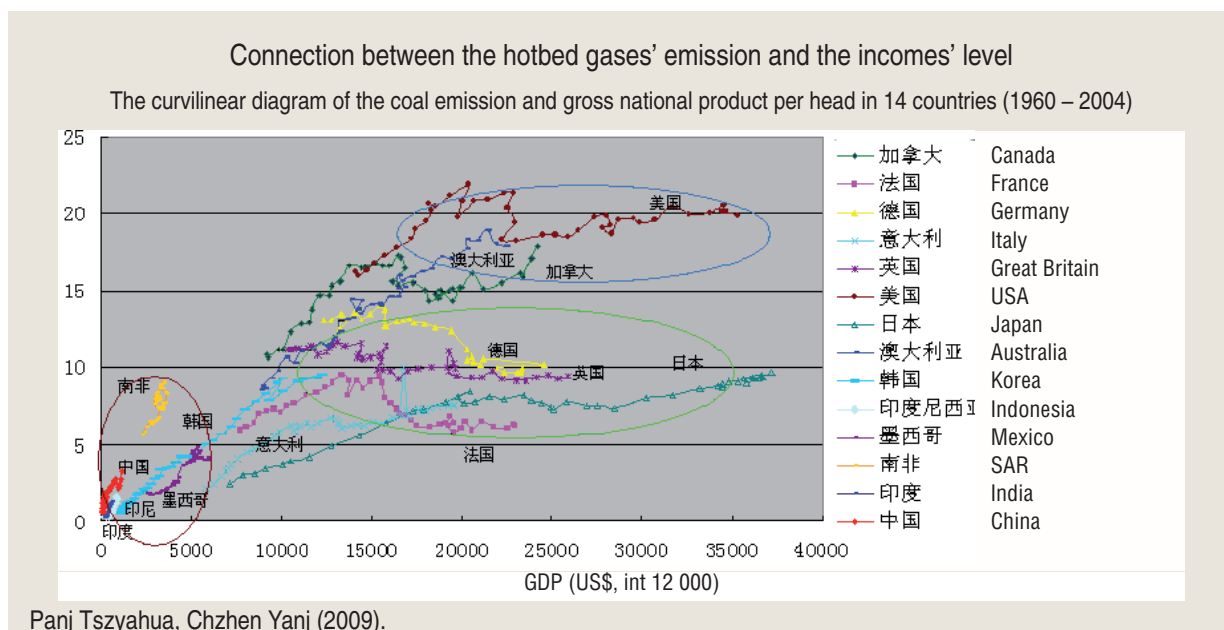
In spite of the fact that the purpose of power-saving and the emission's reduction in China was successfully achieved due to the economic crisis, it does not mean that the long-term objective of the reduction of the hotbed gases' emission in China will be naturally carried out. Objectively speaking, the reduction of the hotbed gases' emission does not fully comply with the emission's reduction by power-saving. Power-saving reduced power consumption and naturally reduced the amount of polluting emissions and the hotbed gases' emission, in this sense they correspond. However sulfur dioxide, dust and other atmospheric pollution can be controlled with technical and engineering ways, for example, by means of the desulfurization equipment. Though hotbed gases can be collect with the engineering way and can be dug in the ground, nowadays there is no commercial basis for that. Besides the norm of the pollution's level by sulfur dioxide can be controlled when the income is about 10,000 american doll. per head. And hotbed gases' emission has been rising for a long time even

in the countries where the income is 30,000 american doll. per head.

In figure the connections between the incomes per head and carbon dioxide's emission per head of 14 main economic objects for the recent years are represented. Some features are evident.

First, the level of incomes per head rose with the increase of the hotbed gases' emission at the incomes' level of 15,000 american doll. When it reached 15,000 american doll., the hotbed gases emission's amount per head reduced. In some countries, for example, in France and Germany, there even were the cases of reduction of the carbon dioxide's emissions at the population incomes' increase. But the general tendency is the direct connection between the population's incomes and the average hotbed gases' emission.

Secondly, on the identical level of the development the levels of the hotbed gases' emission differ. The level of emission in North America and Australia is higher than in Europe and Japan where the level of incomes is equal. The reason is that North America and Australia are rich in natural resources and Europe and Japan aren't, but it is not quite correct. The true reason is in the directing policy. Europe and Japan paid attention to the public opinion, emphasized the power efficiency, raised the tax



for energy and climate. The price for gasoline in Europe is higher, than in America. It is proved, that the difference the ways of production and lifestyle led to the great difference in the volumes of emission.

Thirdly, the incomes' level in the less advanced countries, such as China and India, is low, and it causes the low level of emission per head. In the South African Republic, Korea and Mexico the emission's level has already reached the European one, but the average incomes' levels differ greatly.

Thus, if less advanced countries don't follow the "low-carbon" way, there can be an opportunity of huge hotbed gases' emission which will threaten the world climate. Also it is necessary for the advanced countries to lower the emission's level and to assist the less advanced countries in following the low-carbon way.

The historical figures proved that the emission of the advanced countries were slowed down and even decreased, and the emissions of the less advanced countries rose with the incomes' increase. What about the tendency of emission in the future?

In *table 2* the real emission in 1999 and 2006 in the main countries and the prognosis of the total volume of emission in 2030 are represented. In comparison with the emission's level in 1990, the emission of the advanced economic

objects almost hasn't increased; the negative growth in Russia, EU and other countries with the "turning point" economy has appeared. And in developing economic targets emissions has greatly increased – over 16 years more than once, and in China – in 1.5 times.

According to the prognosis of the International Power Corporation, if 2030 no steps on the emission's control are taken, the volume of emission will stay at the same level, and in some countries such as Japan, continue negative growth. In bright contrast to these emissions in developing countries will increase by almost two, and in India – more than twice. By 2030 in the emission structure the advancing countries will occupy the bigger part. The total amount of the China's emission will be equal to the sum of the USA's emission and the emission of 27 EU countries.

Why does the problem of the hotbed gases' emission in the less advanced countries such as China seem more serious from the prospect point of view?

The oil crisis in 1970 led to the fast development of the low-carbonic power (natural gas and nuclear energy) which replaced coal and oil and reduced hotbed gases' emission. Here the increase of the power efficiency is equal to the reduction of power consumption, i.e. is equal to the reduction of the hotbed gases' emission.

Table 2. Historical change and future tendency of the hotbed gases' emission in the main countries of the world (one million tons of carbon dioxide)

	1990	2006	2030	% total in the world
Total in the world	20,988	28,003	41,905	100%
The Organization of economic cooperation and development	11,083	12,873	15,067	36.0%
27 countries of EU	4,063	3,983	4,176	10.0%
Japan	1,071	1,213	1,182	2.8%
The USA	4,863	5,670	6,891	16.4%
Countries with the "turning point" economy	3,649	2,395	3,230	7.7%
Russia	2,180	1,587	1,973	4.7%
Advancing countries	6,467	12,865	22,919	54.7%
China	2,211	5,606	11,448	27.3%
India	589	1,250	3,314	7.9%

Among the countries-members of OECD there are the EU states, the USA and the new industrial countries such as Korea, Mexico, Singapore, etc.; among the less advancing countries are China and India. In connection with the content of government units and the proportion of countries that they took in the world, more than 100%.
Sources: IEA, 2008, Barbier, E. 2009.

During the same period the incomes' increase and the population's growth caused the growth of power consumption which led to the increase of the total hotbed gases' emissions. In 1980s the opportunity of power structure's regulation and high technologies raised the power efficiency and allowed reducing the hotbed gases' emission. At that time the quality of life improved, the population grew abruptly, so the volume of the world hotbed gases' emission rapidly increased.

Since 1990 up to the beginning of this century the opportunity of power structure's regulation has been limited for a long time, the technologies of power efficiency are the main stimulator of the reduction of the hotbed gases' emission. At that moment the increase of the hotbed gases' emission as a result of the improvement of quality of life was much higher than the increase of the emission as a result of the increase of the population's quantity.

The economic crisis could not settle the problem of the reduction of the hotbed gases' emission in China. Power structure in China is based on coal; the reason is that the nuclear electricity demands large-scale capital investment and some certain term; the increase of the commercial competitiveness of the regenerated power; in particular, the wind power and the sun power, also demands time for its realization.

Thus, the process of power refinement in China is a long and a hard process. The technology of the China's power efficiency has quickly been improved.

According to the eleven-year plan, even without the economic crisis' influence the parameters of the power's intensity will decrease for 20%. It means that under the conditions of the identical development power consumption and the hotbed gases' emission will abruptly decrease.

However, the incomes' increase will result in the improvement of the quality of life, the national brands' automobiles will be distributed, the living space will extend, the city development's level will be raised, and the quantity

of the China's population will increase. The increase of the living standard and the population's increase are the main reasons of the huge increase in the hotbed gases' emission in the less advanced countries. And for the advanced countries, the opportunity of the increase of the living standard is limited; the population's quantity is stable or even goes down. Power refinement and the increase of the power efficiency for the absolute quantity will reduce the hotbed gases' emission. It can explain why in the advanced countries the emission's reduction hasn't occurred.

4. Conclusion and discussion.

Different crises, irrespective of their type (economic crises or political fluctuations), always resulted in economic recession, reduced general power consumption, led to power refinement, increased power efficiency, and as a result the amount of the polluting emission was reduced.

This influence can be proved by the power consumption and the emissions in China during the financial crisis in Asia in 1997. The world economic crisis which transformed from the American hypothec crisis to the financial crisis provides power-saving and the emission's reduction in the present-day China. But such facilitation is temporary; as the prospect shows, the reduction of the hotbed gases' emission in China didn't undergo the crisis' influence. The increase in the population's number and the increase of the living standard will raise general hotbed gases' emission in China. In the structure of the hotbed gases' emission China will take its separate place.

As the financial crisis provides the emission's reduction temporarily, it is necessary for us to cope with the financial crisis as soon as possible, focusing on the economy's recovery and on the further development; to follow low-carbon way, to raise power efficiency, to improve power structure, to master refined power, so as limitation of the hotbed gases' emission wouldn't become strict restriction of the China's economic development.

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