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How do the appliance energy standards work in China? Evidence from room air conditioners

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Abstract

China has been the world's largest producer and consumer of air conditioners, and more and more RACs[1] would be owned by China's households along with the rapid economic development. Air Conditioner is also considered as one of the largest potential contributors to energy reduction among home appliances because of the huge energy consumption. Therefore, the national energy efficiency standards were issued to promote the use and production of high-efficient RACs. According to China's energy efficiency standards, this paper investigated the electricity savings and CO_2 emission reductions from RACs over the period of 2005-2025. The results indicate that the rural RAC market which develops more slowly than the urban one still has great potential, and government has to revise subsidy policies to make the standards more effective, especially for rural areas. In 2025, the total electricity consumption of RACs is projected to be 598-674TWh, while the amount without energy efficiency standards is 753TWh. From 2005 to 2025, the energy efficiency standards for RACs can save 1430-2540TWh electricity and reduce 908.3-1610.1 Mt CO_2 emissions in different scenarios. Finally, we suggest that the standards should be revised every 4 or 5 years with higher revision pace of 8% to 10%.

Key words: Room air conditioner; Electricity saving; Energy efficiency standard; CO_2 emission reduction

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[1] The RACs is short for room air conditioners.

1. Introduction

In recent years, China has become the largest manufacturer and consumer of air conditioner in the world. The production output of RACs kept a high growth rate since 1992, and up to 2011 it has reached 140 million units (see Fig. 1). In 2009, every one hundred urban households owned 107 units of RACs, exceeding those of refrigerator, washing machine and some other household appliances. In 2011, the diffusion rates[2] of RAC in urban and rural households reached 122 and 23, respectively. Meanwhile, the average growth rates of rural and urban diffusion rates were 29.9% and 30.4% during the statistical years, respectively. With fast development of China's economy and urbanization, the number of RACs will keep rising in the future. On the other hand, China is one of the most important exporting countries of RACs, and in 2012 it delivered 43.82 million to other countries, which indicates that China is playing an important role in the global RAC market.

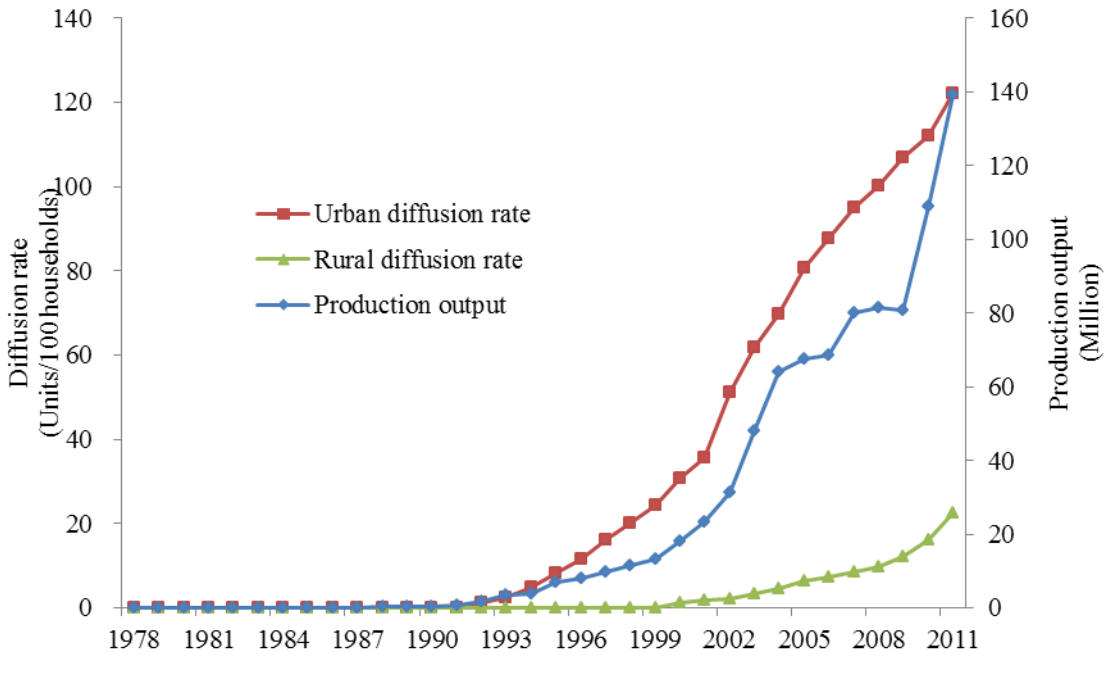

Fig. 1. The diffusion rate and the production output of RACs in China from 1978 to 2011

Sources: National Bureau of Statistics of China 1996-2012.

According to the National Bureau of Statistics of China, the total energy consumption in China was 3.41 billion tons of coal equivalent in 2012, 3.0% more than the previous year. The average annual growth of China's energy demand will be 6.70%, 2.81%, and 5.08% during the period of 2010-2020 in three scenarios, up to 6.25, 4.16, and 5.29 billion tons of coal equivalent in 2020 [1]. Owing to the limited energy reserves, China is one of the few

[2] The diffusion rate is the amount of RACs owned by per one hundred households.

countries in which the coal dominates the energy consumption [2] and becomes the largest energy consumer and emitter of energy-related CO_2 in the world. Furthermore, the electricity consumption of RACs is estimated to account for 30% of the peak summer load in some large and medium-sized cities. Thus, if air conditioner is used effectively, it will contribute to saving energy and reducing the CO_2 emission much more than any other home appliances in China [3]. In order to improve the energy efficiency of RACs, Chinese government issued the national energy efficiency standard of GB 12021.3-1989 in 1989, aiming to promote the use and production of high-efficient RACs. Up to now, there have been four versions of the standards, named GB 12021.3-1989, GB 12021.3-2000, GB 12021.3-2004 and GB 12021.3-2010.

Energy efficiency of household appliances has attracted concerns from researchers and policymakers (Waide et al. [4], Meier [5], Rosas-Flores et al. [6], Young [7]). In the early years, some literature focused on reviewing the appliance efficiency programs and introducing the process and theory of standards in different countries (Harrington and Wilkenfeld [8], Nakagami and Litt [9], Geller [10], Turiel [11], Mahlia et al. [12], Martin [13]). Recently, researchers are paying close attention to the issues associated with energy efficiency standards such as energy savings, emission reductions, economic benefits and so on (Atanasiu and Bertoldi [14], Gaspar and Antunes [15]). Koomey et al. [16] assessed the potential energy, dollar, and carbon impacts of the minimum efficiency standards for residential appliances in the US. Mahlia et al. [17] predicted the potential mitigation of emissions through energy efficiency standards for RACs in Malaysia. There are also some other studies on energy efficiency standards in Malaysia (Saidur et al. [18], Masjuki et al. [19], Varman et al. [20]). Borg and Kelly [21] investigated the effect of appliance energy efficiency improvements on domestic electric loads in European households. On the other hand, the manufactures and consumers are the important roles affecting the utilization of high-efficient household appliances (McInerney and Anderson [22], Ouyang and Hokao [23], Galarraga et al. [24], Wijaya and Tezuka [25], Ma et al. [26]).

However, to the best knowledge of the authors, there are very few studies on the energy efficiency standards for RACs in China. Lin [27] reviewed the historical development of China's programs and the most recent activities and documents, and analyzed their impacts on appliance efficiency and energy consumption. Lin and Rosenquist [28] analyzed the cost-effectiveness of GB 12021.3-2004 and the impact on energy savings and CO_2 emission reductions, but it mainly studied the economic feasibility of the standards using life-cycle costs (LCC). Zhou et al. [3] estimated the energy saving and the CO_2 emission reduction potential of China's 37 appliances standards, including RAC, but the analysis of GB 12021.3-2010 was not available. In addition, it is necessary to investigate whether the existing revision pace and revision period are appropriate.

This paper aims to analyze the potential electricity savings and CO_2 emission reductions from RACs in China during 2005 to 2025, according to the energy efficiency standards of GB 12021.3-2004[29] and GB 12021.3-2010 [30]. Also, the revision pace and period will be investigated, whether they are set properly. The rest of this paper is organized as follows. Section 2 puts forward the methodology. Section 3 introduces scenarios and data. The results and discussions are displayed in section 4. The last part presents the conclusions.

2. Methodology

2.1 Research framework

The research framework of evaluating the effect of energy efficiency standards for RACs is shown in Fig. 2.

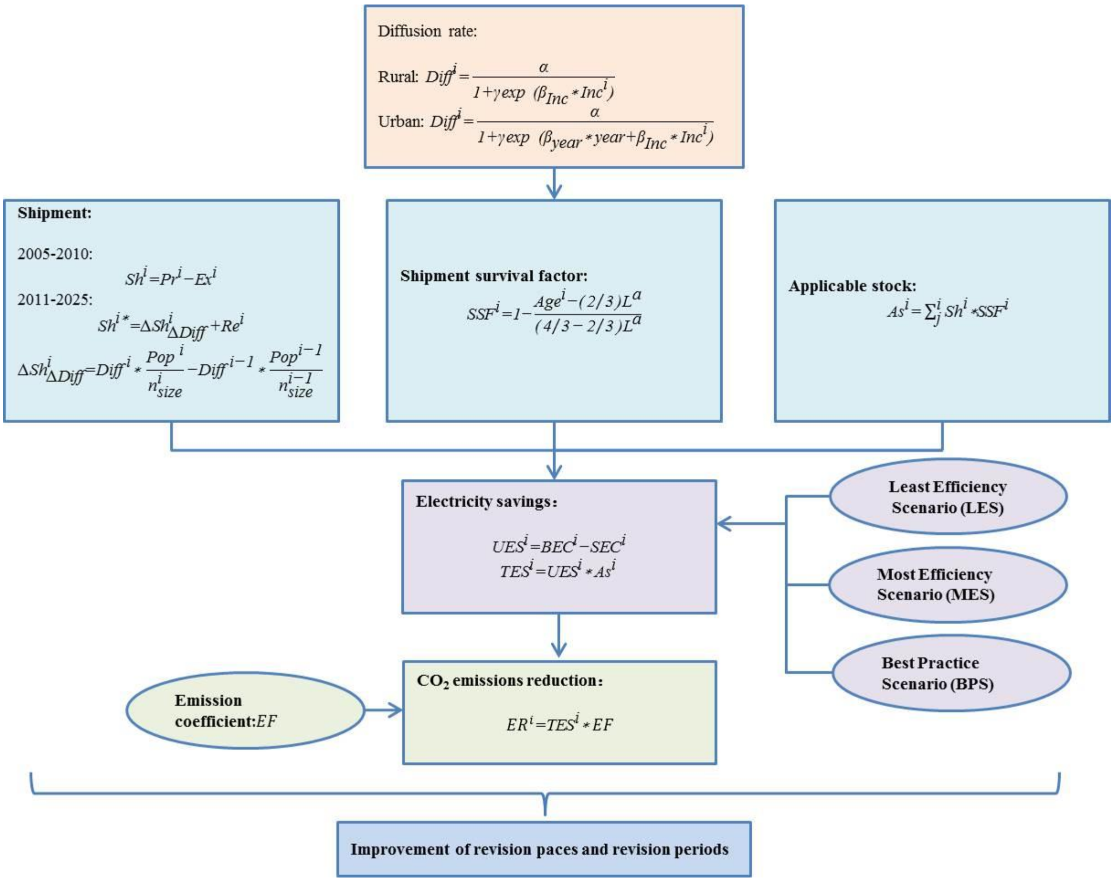

Fig. 2. Evaluation framework of energy efficiency standards for RAC

Firstly, the rural and urban diffusion rate functions are established, and the regression coefficients are obtained according to the historical data. After the diffusion rates are predicted, the shipment in 2011-2025 can be obtained. And the shipment in 2005-2010 is derived by the difference between the production output and export amount. Then the shipment is combined with shipment survival factor to get the applicable stock. In the light of the shares of different grades, three scenarios are set and the electricity savings are obtained. With the emission coefficient, the CO_2 emission reduction is derived. Finally, the revision paces and revision periods are evaluated and improved.

2.2 Diffusion rate

In this paper, the diffusion rate is a function of household income [31]. All parameters are determined for urban and rural households separately for the following reasons: (1) The economic development patterns in rural and urban are quite different [32], so the development trends of RACs can not be analyzed in the same way; (2) The statistics of economic development and the diffusion rate of RACs in rural and urban are separately collected in the statistical yearbook. The expression of diffusion rate is given as follows:

$$Diff^{i} = \frac{\alpha}{1+\gamma\exp(\beta_{Inc} * Inc^{i})} \qquad (1)$$

In the case of urban households, a dummy variable β_{year} for the year is added to the equation, because RACs are becoming more available and affordable [31]. The formula is given as:

$$Diff^{i} = \frac{\alpha}{1+\gamma\exp(\beta_{year} * year + \beta_{Inc} * Inc^{i})} \qquad (2)$$

In Eq. (1) and (2), $Diff^{i}$ is the diffusion rate of RACs in year i. The parameter α is the saturation level per 100 households and for rural households α is defined as the diffusion in urban household at the same income level. Inc^{i} is the net income per household in rural and the disposable income per household in urban in year i.

2.3 Applicable stock

2.3.1 Shipment

The annual shipments of RACs in 2005-2010 are calculated based on the domestic production output and export data.

$$Sh^{i} = Pr^{i} - Ex^{i} \qquad (3)$$

where Sh^{i} is the shipment of RACs in year i; Pr^{i} is the domestic production output and Ex^{i} is the export amount in year i.

The annual shipments of RACs in 2011-2025 are determined by the growth of diffusion rates and the number of retired ones in the current year [32]. It is calculated by:

$$Sh^i = \Delta Sh^i_{\Delta Diff} + Re^i \tag{4}$$

$$\Delta Sh^i_{\Delta Diff} = Diff^i * \frac{Pop^i}{n^i_{size}} - Diff^{i-1} * \frac{Pop^{i-1}}{n^{i-1}_{size}} \tag{5}$$

where Re^i is the number of retired RACs in year i; Pop^i is the population and n^i_{size} is the household size in year i.

2.3.2 Shipment survival factor

The shipment survival factor is a function of the annual retirement rate and the retirement function [12]. A retirement function, also known as survival curve, is used to estimate the retirement rate of appliances. In the linear function, no appliances retire in the first 2/3 of the average life, so the shipment survival factor is 100%. All units retire by 4/3 of the average life and the shipment survival factor is 0 after 4/3 of the average life. In other cases, the percent moves linearly from 100% to 0 and the equation is:

$$SSF^i = 1 - \frac{Age^i - (2/3)L^a}{(4/3 - 2/3)L^a} \tag{6}$$

where SSF^i is the shipment survival factor; Age^i is the age of RACs in year i and L^a is the average life.

2.3.3 Applicable stock

From the initial year j on, the RACs which meet the standards start to enter the market. Taking the shipment survival factor into consideration, in the following years $j+1, j+2..., j+n$, the applicable stock is the sum of the shipment in a specific year multiplied by the corresponding shipment survival factor from the initial year j to the specific year. And the expression can be written as:

$$As^i = \sum_j^i Sh^i * SSF^i \tag{7}$$

where As^i is the applicable stock in year i.

2.4 Electricity savings and CO_2 emission reductions

The electricity saving of energy efficiency standards is defined as the difference between the baseline electricity consumption and the electricity consumption after implementing energy efficiency standards. The unit electricity saving per year is calculated by:

$$UES^i = BEC^i - SEC^i \quad (8)$$

where UES^i is the unit electricity saving in year i (KWh/year); BEC^i is the unit baseline electricity consumption[3] (KWh/year) and SEC^i is the unit electricity consumption with standards (KWh/year).

According to Eq. (8), the total electricity saving for RACs in year i is:

$$TES^i = UES^i * As^i \quad (9)$$

where TES^i is the total electricity savings in year i after implementing energy efficiency standards (KWh/year).

In this paper, the CO_2 emission reduction is related to the electricity saving through the equation below:

$$ER^i = TES^i * EF \quad (10)$$

where ER^i is the CO_2 emission reduction (kg) in year i and EF is the emission coefficient (g/KWh). Because of the development of hydro power and nuclear power, the CO_2 emission coefficient has been reduced in recent years and it is 633.6 g/KWh in this paper (converted from the carbon emission coefficient 48 kg/GJ in Fan et al. [33]).

3 Scenarios and data

3.1 Scenarios

In this work, three scenarios named Least Efficiency Scenario (LES), Most Efficiency Scenario (MES) and Best Practice Scenario (BPS) are set to estimate the impacts of the energy efficiency standards. In LES and MES, all the RACs which are put into market are at grade 3 and grade 1, respectively, during 2005 to 2025.

However, the shares of different grades obey the market structure to the most extent in the BPS. According to the China National Institute of Standardization (CNIS), the ratio of energy-saving RACs has reached 60% in 2012, and it is expected to account for 80% in 2013. In recent years, the government has implemented subsidy policies for energy-efficient appliances including RACs. For instance, from June 1, 2009 to June 1, 2011, the National Development and Reform Commission and the Ministry of Finance proposed that 300-850 Yuan should be given to the residents who bought RACs with grade 2 or grade 1. In addition, the State Council ruled that the subsidy policy for home appliances should last for one year,

[3] There are not energy efficiency standards in the baseline situation.

from June 1, 2012 to May 31, 2013. Therefore, the shares of different grades in the BPS can be drawn up taking these polies into account.

Note that only grades 1, 2 and 3 are considered because grades 4 and 5 are too inefficient.

3.2 Data

In China, the RAC market is dominated by the split air conditioner with a cooling capacity smaller than 4500W [28]. Since 1995, the production of window-type systems has showed a declined tendency, while the production of split and cabinet-type equipment has steadily increased. Table 1 shows the production shares of air conditioners [34].

Table 1

Production shares of air conditioners in China

Category	Rated cooling capacity (W)	Share (%)	Share (%)
Single-package	C≤2500	6.2	26.3
(including heat pumps)	2500<C≤4500	17.1	
	C≥4500	2.9	
Split	C≤2500	3.5	73.7
(including heat pumps)	2500<C<4500	43.1	
	4500≤C<7100	19.5	
	C≥7100	7.7	

Different from the previous studies that a typical model is always chosen to represent all other types of household appliances, this paper takes the single-package of 2500<C≤4500 and the split of 2500<C<4500 and 4500≤C<7100 as the representatives of all types of RACs. Table 2 shows the shares of the three kinds of air conditioners in different years.

Table 2

Shares of three representative RACs from 2005 to 2025

Category	Rated cooling capacity (W)	Share (%)		
		2005-2009	2010-2014	2015-2025
Single-package	2500<C≤4500	20	15	10
Split	2500<C<4500	50	60	70
	4500≤C<7100	30	25	20

Based on Table 2 and the standards of GB 12021.3-2004(see Appendix Table A.1) and GB 12021.3-2010(see Appendix Table A.3), the baseline energy consumption of the three representative RACs in 2005 and 2010 can be obtained. The baseline EERs[4] in 2005 adopts the minimum allowable values of energy efficiency in GB 12021.3-2004(see Appendix Table A.2). For 2005-2025, it is assumed that the annual growth rate of EERs is 1% due to the technological improvement. When calculating the shipment survival factor, we set L^a as 12 years from 2005 to 2025. Based on recent field studies, 800 annual operating hours are used in the LCC analysis [28].

4 Results and discussions

4.1 Annual shipment and applicable stock

The annual shipments of RACs in 2005-2010 are derived based on Eq. (3). The domestic RACs production data are from China Statistic Book [35] and RACs export data are from China Light Industry Yearbook [36].

The data of Inc^i from China Statistic Book are used in Eq. (1) and Eq. (2) to estimate γ, β_{Inc} and β_{year}, and the parameters of the models are shown in Table 3. It indicates that the R^2 values are all greater than 0.95 and the forecast accuracy is proved to be satisfactory with error ratios of 0.039 and 0.062. Thus, they are acceptable to predict the future RACs diffusion rates.

Table 3

Regression results of diffusion rate for rural and urban households

	Rural	**P-value**	**Urban**	**P-value**
α	Urban Diff		130	
β_{year}	-		-0.411	0.000***
β_{Inc}	-1.367E-4	0.000***	3.305E-5	0.046**
$ln\gamma$	4.944	0.000***	821.774	0.000***
Error ratio	0.039		0.062	
R^2	0.970		0.986	

Note: ***p<0.001; **p<0.05; *p<0.10

[4] The EER is the ratio between the cooling capacity of an air conditioner running in cooling mode and the effective input power, under standardized operating conditions [34].

According to the growth trend over the past years, it is supposed that the growths of annual income per capita are 6.6% and 8.3% for rural and urban households, respectively. The households' sizes remain the current level for 2012-2025. Accordingly, the diffusion rates of 2012-2025 are predicted and $\Delta S^{i}_{\Delta Diff}$ are calculated. The data of populations and household sizes are from China Statistical Yearbook and the population forecasts are from Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat [37]. According to Eq. (7), the annual applicable stocks are calculated as shown in Fig. 3 as well as annual RAC shipments.

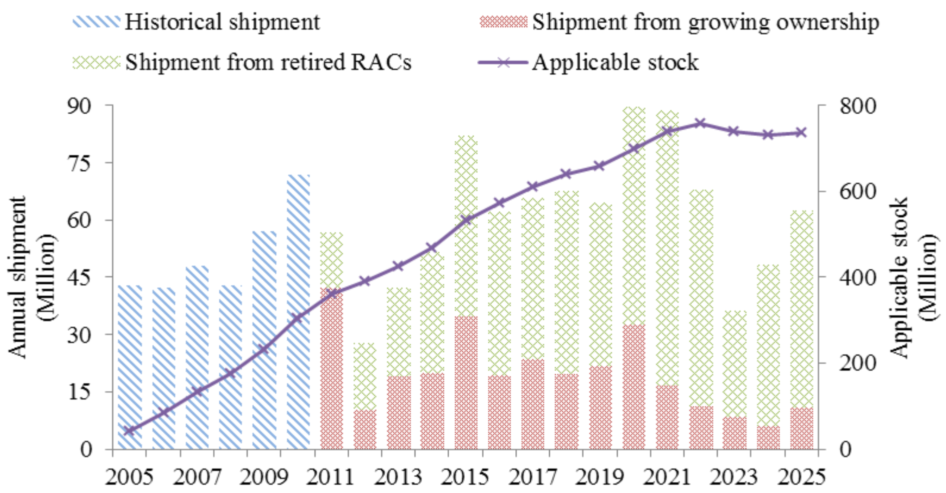

Fig. 3. Annual shipments and applicable stocks of RACs for 2005-2025

In Fig. 3, the applicable stocks refer to the RACs, which follow the energy efficiency standards. Especially, the applicable stocks in 2005 are the new RACs entering the market and implementing the standards, excluding the existing RACs without the standards.

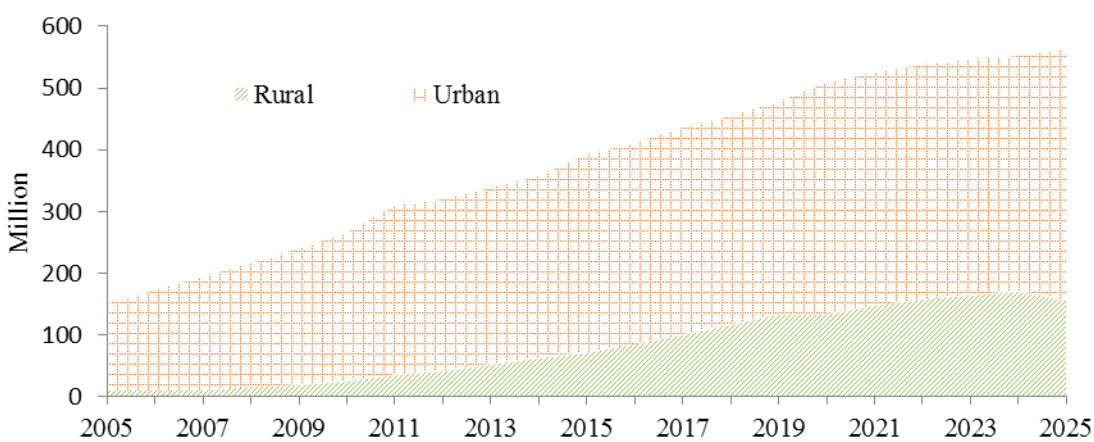

Fig. 4. The amounts of RACs in rural and urban areas for year 2005-2025

The numbers of RACs in rural and urban households are also calculated (see Fig. 4). It can be concluded that the rural RAC market developed more slowly than the urban RAC market since the rural owned 10.65 million units and the urban owned 140.39 million units in 2005. But from 2009, the rural market developed rapidly with the average rate of 15% owing to the increasing average income per capita. After 2020, it will develop relatively slowly and reach about 160 million units, but compared with the urban diffusion rate, which almost has reached the saturation point (about 128 units/100 households), the rural still remains low. In addition, the rural diffusion rate (about 100 units/100 households) at that time will almost reach the level of urban in 2007. Therefore, the urban diffusion rate will reach the saturation point in 2020, while the rural RACs market still has great potential.

4.2 Potential electricity savings and CO_2 emission reductions

The assumptions on efficiency improvement are based on the likely period (every 4-5 years) and improvement (5-10%, depending on the product) at each round of update considering the technical limitation of the technology [3]. Therefore, it is supposed that the energy efficiency standards will be revised in 2015 and 2020 and the EERs of all grades will be improved by 5%.

Fig. 5 illustrates the total electricity consumption of RACs from 2005 to 2025 in different scenarios. The total baseline electricity consumption of RACs will reach 753TWh in 2025. Meanwhile, the amounts of MES, LES and BPS are 598TWh, 674TWh and 631TWh, accounting for 79.4%, 89.5% and 83.7% of the total amount of baseline, separately. Fig. 6 shows the annual electricity savings of energy efficiency standards for 2005-2025. During those years, the accumulative electricity savings of LES, MES and BPS are noticeably huge, up to 1430TWh, 2540TWh and 1960TWh, with shares of 22.8%, 12.8% and 17.6% of the accumulative baseline electricity consumption. That is, the electricity savings of LES, MES and BPS can save 286, 508 and 392 plants, respectively, during 2005-2025, assuming a large coal-fired power plant operates 5000h 1000 MW per year.

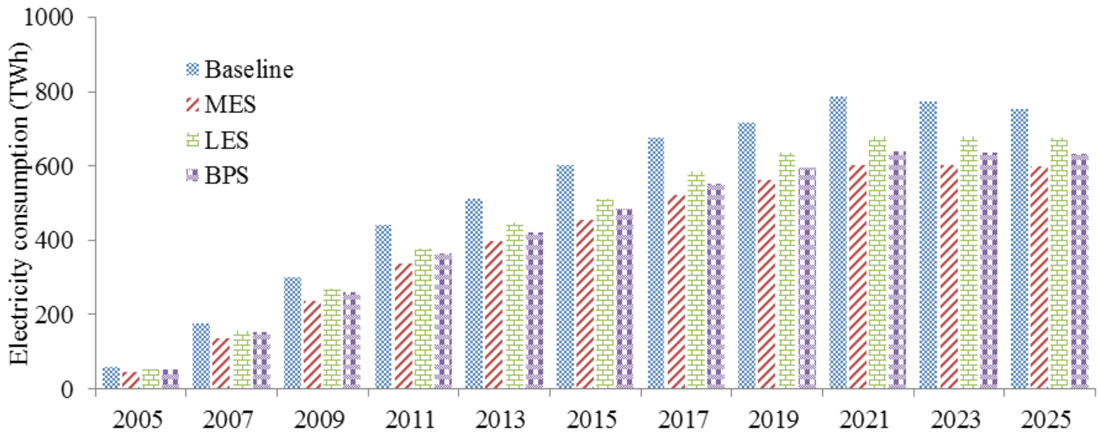

Fig.5. Annual electricity consumption of RACs during 2005 and 2025

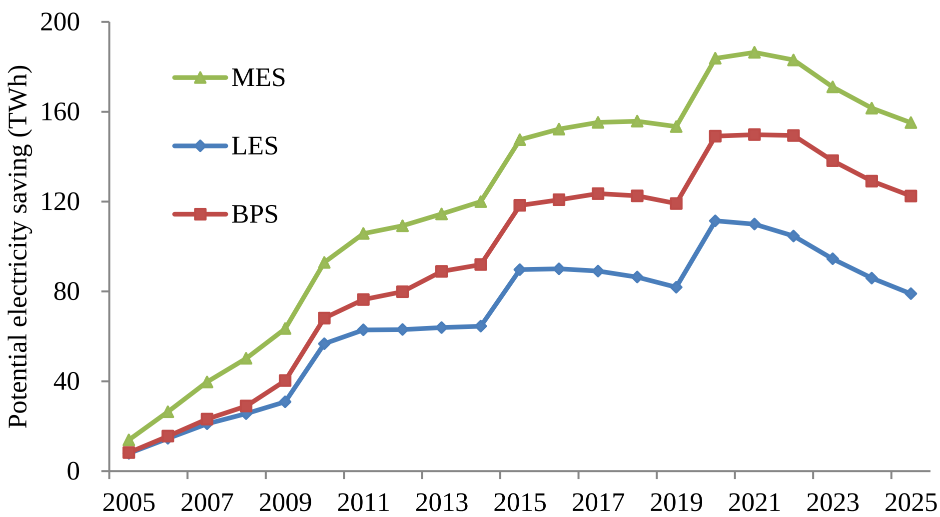

Fig. 6. Annual electricity savings of RACs in three scenarios for 2005-2025

It can be concluded from Fig. 6 that the annual electricity savings increase sharply at the beginning of the standards. Over time, the growth of electricity saving will decline due to the technical progress in the absence of the standards, which is similar to conclusions of other studies [19, 38]. With the encouragement of the policy, the electricity savings of BPS are obviously higher than the LES, but lower than the MES. Thus the policy should cooperate with the standards to make it more effective.

Fig. 7 shows the annual CO_2 emission reductions in three scenarios for 2005-2025. The trend of the CO_2 emission reductions is the same as the electricity savings because it is a proportion function of electricity savings. The accumulative CO_2 emission reductions in three scenarios are 908.3 Mt, 1610.1 Mt and 1244.3 Mt in 21 years, respectively.

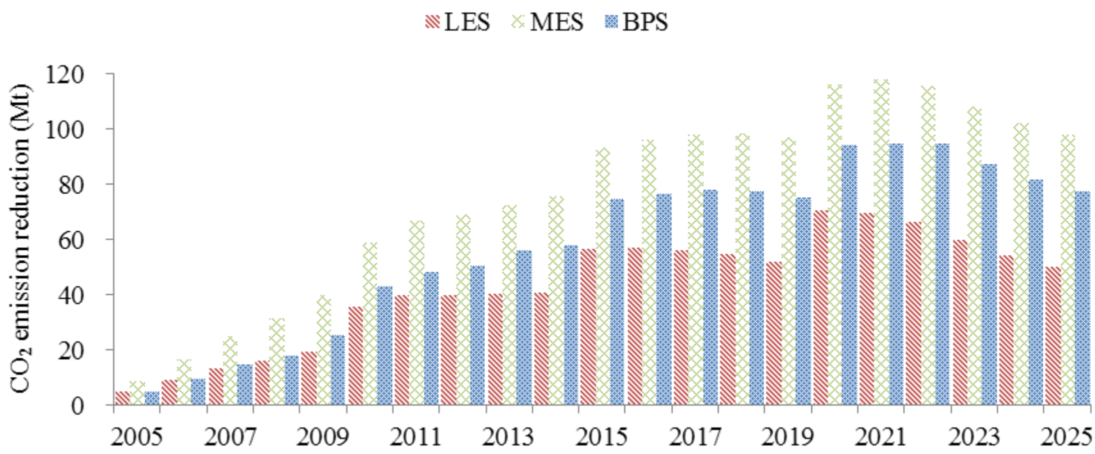

Fig. 7. CO_2 emission reductions in three scenarios for 2005-2025

Fig. 8 shows the potential annual electricity savings of RACs under different standard versions in BPS during the study period. The difference between the standards and the baseline is declining. It reveals that the baseline efficiency will approach the standards because of technical progress referred before, and it may equal 0 or even negative values if the standards are not revised (e.g. 2004 standard). In order to ensure the standards function well, it should be revised periodically. The lines of 2015 and 2020 revisions do not have the increasing trend, because the revision pace (5%) is relatively low. Therefore the standards should be revised at a proper pace because of the technological improvement.

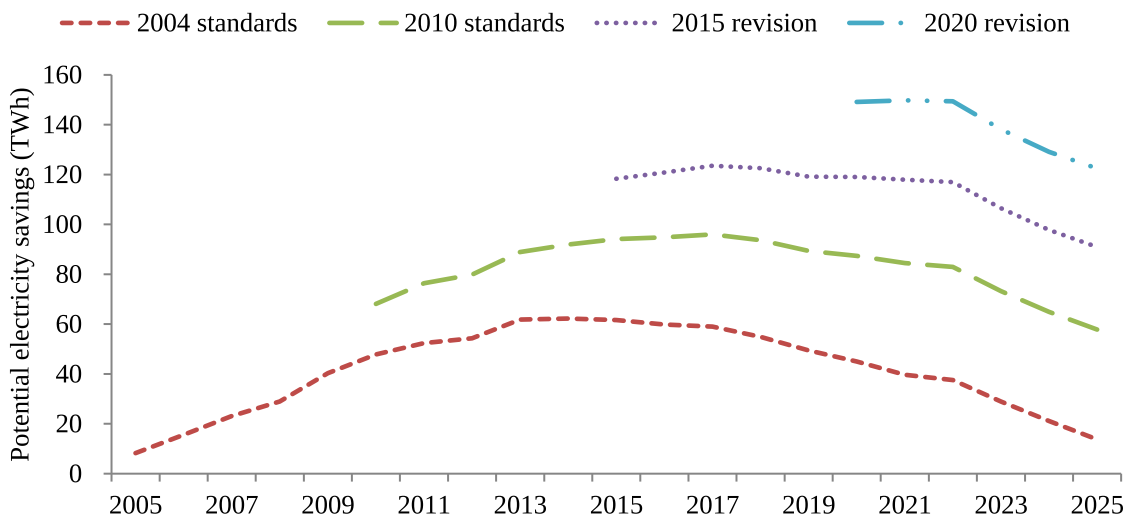

Fig. 8. Annual electricity savings of RACs under different standard versions in BPS

4.3 Improvements of revision paces and revision periods

In this part, two situations are assumed in the BPS:

1. The revision pace at each ground is set as 5%, 8%, 10%, and 0.2, respectively, and the revision period is 5 years. Especially, 0.2 means that the EERs of each grade increase by 0.2 compared with the last version.

2. The revision period at each ground is set as 3, 5 and 8 years[5] and the revision pace are 0.2 at each time.

Fig. 9 shows the annual electricity savings of different revision paces of 5%, 8%, 10% and 0.2 in BPS, respectively.

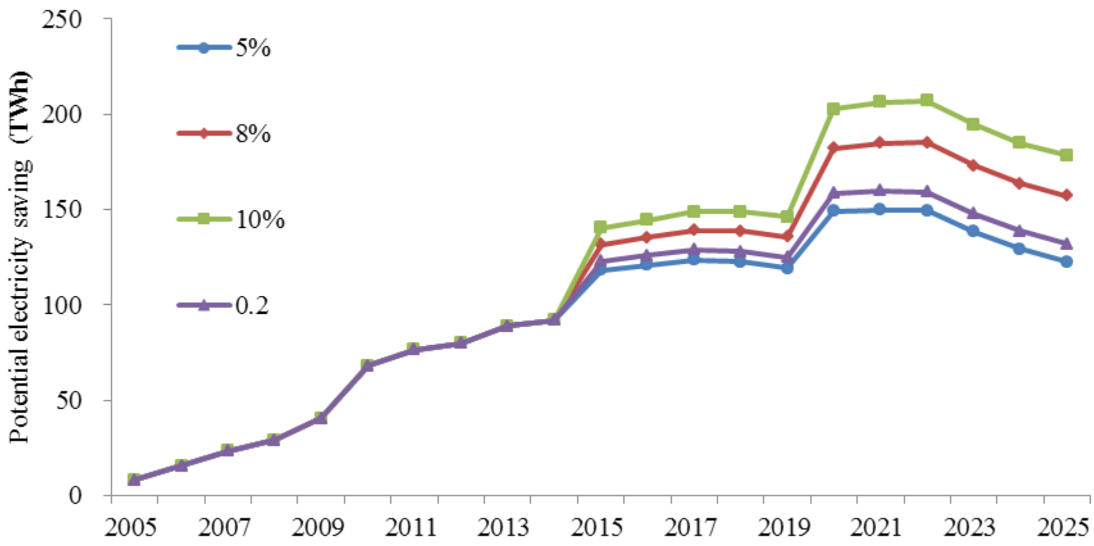

Fig. 9. Annual electricity savings of different revision paces in BPS

Because of the same applicable stock in every year, the four lines have almost the same trend, but are different in values. In practice, the EER of historical GB 12021.3-XXXX is improved by 0.2 than the previous one. But from Fig. 9, the line of "0.2" is only upper than the "5%". Therefore, the potential electricity savings of the practical case can increase with improving the revision pace. If the revision pace of 10% is taken, the accumulative potential electricity savings from 2005 to 2025 can increase by 18.4% compared with the actual situation.

Fig. 10 shows the annual electricity savings of different revision periods in BPS. If the standard is revised every 8 years, it can be seen from Fig. 10 that the potential electricity

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[5] The "3 years" situation means the energy standards are revised every 3 years, that is 2013, 2016, 2019, 2022 and 2025. Similarly, the "5 years" is revised in 2015，2020 and 2025, and the "8 years" is in 2018.

savings start to drop from 2021. It begins to drop in 2023 if the standard is revised every 5 years, but a rising trend starts again due to the revision in 2025. Apparently, there is almost no downward trend in the "3 years" situation. The accumulative electricity savings of the "3 years" situation are 23.8% and 47.5% more than those of the "5 years" and "8 years", respectively. From this perspective, the revision period should be less than 5 years. But taking the production line of the manufacture into account, the standard should not be revised too frequently. Therefore, standard should be revised every 4 or 5 years.

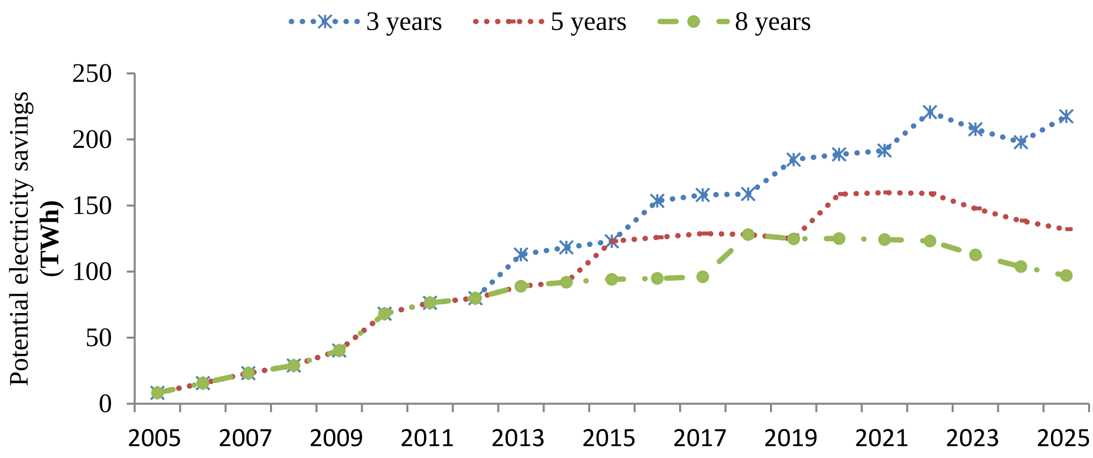

Fig. 10. Annual electricity savings of different revision periods in BPS

5 Conclusions

The present work evaluated the potential electricity savings, CO_2 emission reductions, revision pace and revision period of energy efficiency standards for RACs in China. And some conclusions are drawn as follows:

(1) Compared with the urban RAC market, the rural one develops slowly, but it has been growing rapidly with the average rate of 15% since 2009. According to the results, the diffusion rate in the urban RAC market will reach the saturation point in year 2020, while the rural market still has great potential.

(2) According to the results, in 2015, the total baseline electricity consumption of RACs is projected to reach 753TWh. Meanwhile, the amounts of MES, LES and BPS are 598TWh, 674TWh and 631TWh, accounting for 79.4%, 89.5% and 83.7% of the total baseline electricity consumption, separately. The quantity of electricity savings and CO_2 emission reductions are noticeably huge. During the calculation years, the accumulative electricity savings of LES, MES and BPS are 1430TWh, 2540TWh and 1960TWh and the accumulative CO_2 emission reductions are 908.3Mt, 1610.1Mt and

1244.3Mt in 2005-2025, respectively. However, the growth rates of electricity savings will decline over time due to the technical progress at the absence of the standards. It can be concluded that the energy efficiency standards benefit energy conservation and the environment to a great extent, but they should be adjusted regularly to catch up with the speed of technical progress.

(3) With the encouragement of the policy, the electricity savings of BPS are obviously higher than the LES, but lower than the MES. Thus to make the standards more effective, the policy should be built to cooperate with it. Especially, the subsidy policies should be implemented in rural area for two reasons: first, the rural RACs market has great potential, as mentioned before; second, because of the lower income in the rural than that of the urban, the rural purchasing power is low and the subsidy policies can stimulate the desire to purchase the high-efficient RACs.

(4) The EER of historical GB 12021.3-XXXX are improved by 0.2 than the previous one. But from results, if the revision pace of 10% is taken, the accumulative potential electricity savings from 2005 to 2025 can increase by 18.4% than the actual situation. A higher revision pace is advisable, but because of the technology limit, it should not be excessively high. Thus, 8% to 10% is appropriate.

(5) The accumulative electricity could be saved 23.8% and 47.5% more with the standard revision of 3-year period than 5-year and 8-year. From this perspective, the revision period should be less than 5 years. And taking the production line of the manufactures into consideration, 4 or 5 years are proper period for the revision.

The present work assessed the electricity savings and CO_2 emission reductions of the energy efficiency standards for RACs from 2005 to 2025, but it does not consider the effect of the standards on consumers and manufactures. In the future, the responses of the consumers and manufactures should be analyzed from the economic point of view.

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Appendix

Table A.1

Energy efficiency grade classification of GB 12021.3-2004

Category	Rated cooling capacity (W)	Energy-efficiency grade EER (W/W)[6]				
		5	4	3	2	1
Single-package		2.3	2.5	2.7	2.9	3.1
Split	CC≤4500	2.6	2.8	3.0	3.2	3.4
	4500<CC≤7100	2.5	2.7	2.9	3.1	3.3
	7100<CC≤14000	2.4	2.6	2.8	3.0	3.2

Table A.2

Minimum allowable values of energy efficiency of GB 12021.3-2004

Category	Rated cooling capacity (W)	Energy-efficiency grade EER of First tier (W/W)	Energy-efficiency grade EER of Second tier (W/W)
Single-package		2.3	2.9
Split	CC≤4500	2.6	3.2
	4500<CC≤7100	2.5	3.1
	7100<CC≤14000	2.4	3.0

Table A.3

Energy efficiency grade classification of GB 12021.3-2010[7]

Category	Rated cooling capacity (W)	Energy-efficiency grade EER (W/W)		
		3	2	1
Single-package		2.9	3.1	3.3
Split	CC≤4500	3.2	3.4	3.6
	4500<CC≤7100	3.1	3.3	3.5
	7100<CC≤14000	3.0	3.2	3.4

Reference

6 The EER of energy-efficient RACs also must be greater than or equal to the grade 2.
7 The minimum allowable value of energy efficiency is the same as that of the second tier of GB 12021.3-2004.

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