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Compliance and Verification of Standards and Labelling Programs in China: Lessons Learned

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ABSTRACT

After implementing several energy efficiency standards and labels (30 products covered by MEPS, 50 products covered by voluntary labels and 19 products by mandatory labels), the China National Institute of Standardization (CNIS) is now implementing verification and compliance mechanism to ensure that the energy information of labeled products comply with the requirements of their labels. CNIS is doing so by organizing check testing on a random basis for room air-conditioners, refrigerators, motors, heaters, computer displays, ovens, and self -ballasted lamps. The purpose of the check testing is to understand the implementation of the Chinese labeling scheme and help local authorities establishing effective compliance mechanisms. In addition, to ensure robustness and consistency of testing results, CNIS has coordinated a round robin testing for room air conditioners. Eight laboratories (Chinese (6), Australian (1) and Japanese (1)) have been involved in the round robin testing and tests were performed on four sets of samples selected from manufacturer's production line.

This paper describes the methodology used in undertaking both check and round robin testing, provides analysis of testing results and reports on the findings. The analysis of both check and round robin testing demonstrated the benefits of a regularized verification and monitoring system for both laboratories and products such as (i) identifying the possible deviations between laboratories to correct them, (ii) improving the quality of testing facilities, (iii) ensuring the accuracy and reliability of energy label information in order to strength the social credibility of the labeling program and the enforcement mechanism in place.

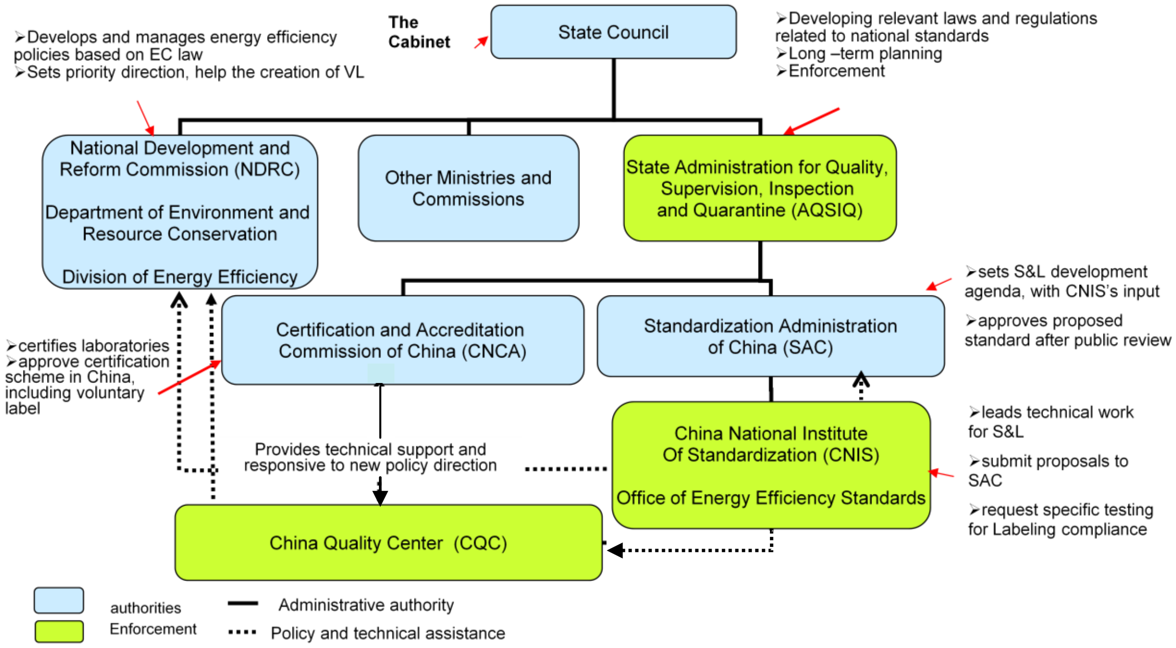
Introduction

To enhance energy security, reduce carbon dioxide emissions and address wider environmental concerns, China framed, in the Law on Energy Conservation (NPC 2007), energy efficiency as primary goal of the State's energy strategy. Thus, the Eleventh Five-Year Plan for National Economic and Social Development emphasizes the importance of conservation as an element of China's 'scientific concept of development'(Barnsley 2008).

Chinese energy efficiency policy has been designed with both targets: ultimate energy savings target and compliance. On one hand, from an organizational point of view [PRC 2007], the department for standardization under the State Council, in coordination with other departments under the State Council (Figure 1), is in charge of organizing the development and the revision of labeling and standards' requirements for appliances and equipments. So far, China has developed a fairly comprehensive labeling and standards program: over 50 products are covered by voluntary endorsement program; household appliances with high energy consumption (air conditioners, domestic refrigerators, clothes washers, and unitary air conditioners) and 15 other products are regulated under mandatory labeling programs, and minimum efficiency standards (MEPS) have been developed for over 30 products. Thus, products failing to meet mandatory energy efficiency requirements are prohibited from the Chinese market (PRC 2007].

On the other hand, to maximize savings from standards and labeling programs and to make sure that projected energy savings occur, AQSIQ (State Administration of Quality, Supervision, Inspection and Quarantine) has the authority over the supervision and the inspection of energy efficiency information. In 1990, AQSIQ (previously the State Bureau of Technical Supervision) issued the Management Method for Energy Standardization to define the enforcement authority for energy standards. It stipulates in its articles 8 and 10 that AQSIQ offices at the national, regional and provincial level and their inspection institutions have clear authority to enforce mandatory energy efficiency standards. This document lays out the authority and the responsibility of AQSIQ to plan and undertake spot checks of products for energy efficiency.

Figure 1: Organizations within China's S&L program



From the compliance perspective, enterprises manufacturing, importing, or selling energy-using products which fail to meet compulsory energy efficiency standards will be ordered to stop production, imports, or sales (NPC 2007). The corresponding products and illegal gains will be confiscated, and the persons involved will be fined 1-5 times of money equal to the illegal gains. If the situation is serious, the Industrial and Commercial Administrative Department will revoke the business license. Also, for the products covered by mandatory label, no labeling, irregular labeling, no recording of product energy efficiency parameters at CNIS' database before labeling, misleading or false labeling will all result in liability under Law on Energy Conservation. No labeling results in a fine of 10,000-30,000 RMB[1], no recording or irregular labeling results in a fine of 10,000-30,000 RMB, misleading or false labeling results in a fine of 50,000-100,000 RMB. For more serious situation, the Industrial and Commercial Administrative Department will revoke the business license.

This paper describes the methodology used in undertaking both check testing and round robin testing. Also the paper provides analysis of testing results and reports on the findings. Conclusions are drawn and recommendations made for further improvement of compliance and verification of standards and labelling (S&L) programs in China.

Lessons learned from 2006 and 2007 check testing

China first built up a strong infrastructure to develop and implement standards and labeling programs. Thus a mandatory energy information label program of five grades (1 highest, 5 lowest) was launched in 2005. Initially covering two products (refrigerators and air conditioners), the program was expanded in 2007 to include clothes washers and unitary air conditioners. Currently the program covers 19 products in addition to 50 products covered by endorsement label and over 30 products under MEPS regulation.

[1] 10,000 RMB=US$1465

Then to ensure the integrity of the labeling program, the Chinese National Institute for Standardization (CNIS), with technical support from CLASP through LBNL and financial support from METI (Ministry of Economy, Trade and Industry in Japan) initiated the first check-testing program in 2006 to measure how well the labeled information matches the claimed energy performance for household refrigerators/ freezers and room air conditioners.

Methodology

Three major cities were selected for check testing: Beijing in northern China, Guangzhou of southern Guangdong province and Hefei of central Anhui province. The selection of the cities was based on their geographic distribution as well as the existence in each city of an active market for household appliances and local manufacturers participating in the energy labeling program. Also the easy access to national standards testing laboratories located within each city was considered in the selection of the cities.

The samples, 54 in total (Table 1) were purchased from retail markets in Beijing, Guangzhou and Hefei. The relatively small sample size of approximately 1% of the total number of product models in the energy labeling program was due to budget constraints. The samples selected were tested in three national test laboratories in those same three cities.

Table 1: Tested Product Samples by Region and Type in 2006 [Zhou et al 2008]

	Beijing	Guangzhou	Hefei	Total
Refrigerators	14	0	7	21
Freezers	0	1	10	11
Air conditioners	N/A	16	6	22
Total	14	17	23	54

Tests were performed in two rounds for products that failed the first test. As a second phase of this effort, CNIS repeated the check testing program in 2007 for 73 samples including clothes washers and freezers (Table 2).

Table 2: Tested Product Samples by Region and Type in 2007 [Zhou et al 2008]

	Beijing	Guangzhou	Hefei	Total
Refrigerators	5	18	N/A	23
Freezers	N/A	7	N/A	7
Air conditioners	5	N/A	17	22
Clothes Washers	18	3	N/A	21
Total	28	28	17	73

Regarding the grades, products were sampled from their most common label grade levels: refrigerators were all selected from grade 1, freezers were from grades 3, 4, and 5, and the samples for air-conditioners and clothes washers were more widely distributed and lacked a focus on any particular grades.

For each product family, when tested the obtained values could not differ from the claimed ones by more than the following tolerances (Zhou et al 2008):

For refrigerators*:*

1) the measured effective volume should not be smaller than 97 percent of the rated effective volume;
2) the measured electricity consumption of the refrigerators, refrigerator/freezer, frost free refrigerators, frost-free freezer, frost-free frozen food storage cabinet, and frost-free food freezers should be less than 115 percent of the rated power consumption and the

measured electricity consumption of the freezer should not exceed 110 percent of the rated value and

3) the measured electricity consumption should be less than or equivalent to the maximum allowable value and the energy efficiency index (EEI) from the test result should not exceed the maximum EEI designated by the energy grade level of the refrigerator as noted on the label.

For room air conditioners:

1) the measured cooling capacity should not be smaller than 95 percent of the rated value;
2) the measured cooling consumption power should not exceed 110 percent of the rated value and
3) the measured EER should be equivalent to or more than the minimum allowable value requested by the labeled energy efficiency grade.

For clothes washers:

All technical parameters should not exceed what is claimed on the energy label

According to the Management Method of the Energy Efficiency Label, when product fails the check testing, the non compliance is notified to the manufacturers by issuing a "rectification notice". The "rectification notice" specifies the necessary rectifications along with the associated deadlines for completing the work such as submitting two additional samples per non-compliant product model for re-testing and the payment for the re-test. In addition, the China Energy Label Management Center (CELMC), which is managed by CNIS, has the right to suspend the registration of the energy label of any manufacturer that could not complete the rectification or whose products still failed to meet the relevant requirements. For serious violations, CELMC may not approve the testing report of the energy-labeled product provided by the company, and a third-party testing of the product would be required. For enterprises that are members of the Energy Labeling Enterprise Credibility Alliance, a written notice is released, and their membership might be suspended if the above issues are not solved after two consecutive years. At the same time, the names of those enterprises not completing the rectification work within specified deadlines would be shared with the local quality supervision departments at all levels to ensure the resolution of issues arising from the testing. Non-compliant companies are sampled and tested intensively in the following energy label testing year.

Analysis of 2006 & 2007 check testing results

In spite of the tolerances considered above to comply with the labeling criteria, some products failed the tests (Table 3). However, in comparison with the 2006 testing results, the 2007 check testing showed a significant improvement in compliance across product types and regions. In fact, the number of noncompliant product models (after the second round of testing in each year) decreased from 11 out of 54 in 2006, to only three out of 73 models in 2007. It should be mentioned that the re-tests were performed on products submitted by the manufacturers which raises the issue of manufacturers' commitment to not over rate their products[2].

Table 3: Comparison of compliance rate by product type and city for each year[3][Zhou et al 2008]

[2] It is difficult to say if products failed in the 1st round because they were over rated. However, to alleviate the doubt over the manufacturers' commitment to not over rate energy efficiency information, the 2nd round of testing should include products taken from the market.

[3] The compliance rate given in Table 3 includes the re-testing round.

	Beijing		Guangzhou		Hefei		Overall	
	2006	2007	2006	2007	2006	2007	2006	2007
Refrigerators	85.71%	100%	N/A	83.33%	71.43%	N/A	80.95%	95.65%
Freezers	N/A	N/A	100%	100%	50%	N/A	54.55%	100%
RACs	N/A	100%	93.75%	N/A	83.33%	100%	90.91%	100%
Clothes washers	N/A	94.44%	N/A	66.67%	N/A	N/A	N/A	90.48%

At the regional level, Beijing not only achieved higher compliance rates for refrigerators (from 86 percent to 100 percent), but also achieved 100 percent compliance for air-conditioners and 94 percent for clothes washers. Further, the 2006 performance and compliance rates varied between models sold in high-end, first- tier appliance retailers versus those sold in second- and third-tier retailers, with those sold in high-end retailers having higher compliance. In 2007, this result was not replicated. However, because the vast majority (69 out of 73) of the sample was taken from a single high-end retailer, it is not clear that this actually signifies an improvement in the compliance of lower-tier retailers (Zhou et al 2008). Also, in contrast to 2006, the three non-compliant models for 2007 had relatively high actual energy ratings. These three models all had energy ratings of 1 or 2, whereas more than half of the 2006 non-compliance product models had the lowest energy rating of 5. In fact, all of the appliances with low energy ratings of 4 or 5 were able to meet their energy performance requirements in either the initial testing or re-testing in 2007. Thus, compared to 2006, the recent absence in the market of non-compliant appliances that could not meet the minimum energy savings standards (Grade 5) is a significant achievement (Zhou et al 2008).

Overall, limitations exist in the analysis of 2006 and 2007 check testing. The sample selection was very small. The product models tested were representative of only 1 percent of the total number of product models and are not representative of the entire country and the market (Zhou et al 2008). In addition, sample testing was conducted only in the markets of three top-tier cities: Beijing, Guangzhou and Hefei, and was largely from top-tier retailers. This is especially true for smaller manufacturers who have fewer models on the market and often sell to smaller cities or rural areas. In fact, test samples included models from 48 different manufacturers, out of a total of more than 200 manufacturers of household refrigerators and air conditioners in China. Many of these 200 manufacturers are small enterprises with low production volume (Zhou et al 2008). Finally, the analysis of test results for 2006 and 2007 check testing suggests that the testing results can vary significantly when products are tested in different laboratories (Zhou et al 2008).

Key findings

From a legal perspective, the existing basis for monitoring and enforcement seems to be sufficient in China. In fact, multiple laws and regulations define the responsibility of each government agency and specify a system of fines and penalties for non-compliance. However to implement a regular strong monitoring mechanism and to ensure a better coordination of monitoring activities and timely application of penalties in cases of non compliance, an independent agency dedicated to monitoring, compliance and verification would make monitoring activities more vigorous in China and help avoid any conflict of interest situation with the implementation agency. Regarding the sampling, the 2006 and 2007 check testing covered only few products from the three top-tier cities and from the top tier retailers. A wider variety of products from across the whole market and country would result in greater compliance. Budget limitations could be addressed by including the check testing cost (buying the appliances and testing them) in the fees paid by the manufacturers to register their products for the labeling scheme. Finally, improving the consistency of test results between test laboratories is a necessary step in setting up a comprehensive national check testing program. This can be achieved through a round-robin testing scheme that includes national and international laboratories and capacity-building activities.

Ongoing activities to strengthen compliance

1. Regional check testing program

Based on the outcomes of 2006 and 2007 check testing, CNIS developed an implementation plan to expand the national verification sampling programs to the provinces and to include more products (Table 4).

Table 4: 2009 check testing program by products and location

	room air conditioners Fix speed	Refrigerator	Computer display	Electric heater	Speed-variable RAC	motor	electromagnetism oven	Self-ballasted lamp
Location	Nanjin, Jiangsu	1.Shanghai 2.Shandong	Shanghai	Jiangsu	Shanghai	1.Sichuan 2.Shandong	Shandong	1. Sichuan 2. Jiangsu
Number of sample	> 5	1. > 10 2. > 5	> 10	> 5	> 6	1. > 5 2. > 10	1. > 5	1. > 15 2. > 15

However the 2009 check testing program has been delayed. (Author's' note: The analysis of the results and the outcomes of 2009 check testing will be included in the presentation at the summer study if available.)

2. Round Robin testing for room air conditioners

The 2006 and 2007 check testing showed that testing results can vary significantly when products are tested in different laboratories which raised the issue of consistency and accuracy of the testing (Zhou et al 2008). In order to identify the possible differences between laboratories for the purpose of correction, ensuring consistency, reliability, accuracy, and social credibility of energy label information, and ultimately promoting the effective implementation of China Energy Efficiency Label System, a round robin testing (RRT) program was launched in China in 2009.

Methodology

CNIS appointed a leading domestic air conditioner manufacturer to produce 3 sets of split air conditioners with fixed speed motors (cooling capacity of 3520 W and heating capacity of 4000 W). In addition 1 sample (cooling capacity of 5300 W and heating capacity of 6060 W) initially tested in Australia was included for testing in the Chinese laboratories. The product selection was based on the maturity of the market and the large energy consumption. In fact, the air conditioner market in China is growing rapidly to become the third largest air conditioner market following the United States and Japan, accounting for 12% of the world air conditioner market share. The annual volume of air conditioners is increasing year-on-year, with annual power consumption of air conditioners up to 100 billion kWh. At the same time, air conditioner use accounts for about 40% of peak electricity load, which aggravates the peak-valley difference and reduces the grid load factor, resulting in the policy of "switching off power grids to limit power usage" in two-thirds of provinces in China in 2003. Air conditioner systems in buildings in China take up 40% to 60% of the total power consumption of the entire building (Cao 2010).

The requirements and testing conditions considered for testing are those described on GB/T 7725-2004 "Room Air-Conditioner"; GB 12021.3-2004 "The Minimum Allowable

Values of the Energy Efficiency and Energy Efficiency Grade for Room Air-Conditioner" and CEL-002-2004 "Energy Efficiency Labeling Implementation Rules for Air-Conditioners".

In total, eight laboratories were involved in the RRT, six of them in China and two others located respectively in Japan and Australia.

However for the purpose of this paper, we analysed the results only of four of the Chinese laboratories that use both calorimeter room and enthalpy methods for testing. The results of the Japanese laboratory have not been included in our analysis because damage to shipped models that may have resulted in measurement problems. The results of testing at the Australian laboratory have been included in the calculation of the mean value.

Finally, over the 58 tests scheduled in the 4 Chinese laboratories considered in this analysis, only 43 have been performed. Failures in some testing facilities and the failure of Sample 2 at the last laboratory explain the 15 tests (in red in Table 5) that have not been performed (Pierrot 2010).

Table 5: Tests performed during the RRT

Sample	1				2				3				4			
Method	Calorimeter		Air enthalpy		Calorimeter		Air enthalpy		Calorimeter		Air enthalpy		Calorimeter		Air enthalpy	
Mode	Cooling	Heating	Cooling	Heating	Cooling	Heating	Cooling	Heating	Cooling	Heating	Cooling	Heating	Cooling	Heating	Cooling	Heating
Lab nº 1	OK		OK	OK					OK		OK	OK	OK		OK	OK
Lab nº 2	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
Lab nº 3			OK	OK			OK	OK			OK	OK			OK	OK
Lab nº 4	OK	OK			OK	OK			OK	OK			OK	OK		

Analysis of the RRT results

For the purpose of this project, laboratory # 4 was chosen as a reference laboratory. This means to analyse the test results, the measured value of each characteristic at different laboratories should be compared to the reference value of each characteristic measured at the reference laboratory. However, this laboratory did not perform the tests using the air enthalpy method (Table 5) so the mean value methodology was used to analyse the results. The analysis below is based on the calculation of the mean value for each characteristic and for each test configuration [sample (1 to 4), test mode (cooling or heating) and test method (calorimeter room method or air enthalpy method)]. With the low number of measurements – in some cases down to 2 measurements only – the trueness of the values obtained for each parameter is not guaranteed (Pierrot 2010). The probability that the mean values obtained are close to the "true" value of the parameters increases with the number of results obtained, but it is not possible to calculate it within this study. In order to get the maximum information to analyse the differences between laboratories, we have tried to calculate the latent cooling capacity for each measurement in cooling mode (Pierrot 2010). The following analysis is presented by samples and by laboratory.

By sample

The maximum differences for each parameter between the measurements in different laboratories are given for each sample (Tables 6). The maximum differences are particularly high[4] for all parameters and all samples except for the cooling capacity measured with the air enthalpy method and the heating capacity measured with the calorimeter method of sample 4. A difference of 7% in the EER for sample 4 may change the energy efficiency grade of the room air conditioner. The high differences for the electrical inputs are probably not due to the measuring devices themselves, as all laboratories use the same high quality apparatus. Therefore, deviations are more likely to come from differences in the installation and settings of the sample and/or differences in test conditions not reflected by the readings of the air sampling devices. The differences observed for the latent cooling capacities may come from the method used to indirectly estimate the value of this parameter. Without direct data from the laboratories, it is difficult to reach any conclusion about this point. These differences may have little effect on the final results of the EER, but they indicate that the measurement of the dehumidifying capacity can be improved. More difficult to explain are the differences for the airflow rate that might be caused by errors in individual measurements or errors in calculation of the air flow, air flow losses between the sample and the air flow measuring device, problems due to the installation of the duct and/or the measurement of the static pressure. Nevertheless the limited differences for the cooling and heating capacity do not show differences that could have been expected with so great difference in the air flows. It is possible that the differences are within the uncertainty of the measurement observed during this round robin testing and then the effect of the airflow rate differences cannot be separated from the other sources of uncertainties. From the results sorted by sample it is not possible to reach a satisfactory explanation for these differences in the airflow rate measurements (Pierrot 2010).

By laboratory

In this section, the results of each laboratory are compared (Table 7) with the average values obtained during the RRT for each parameter/method. The differences with the “true” values of the parameters might differ. When analysing test results by laboratory, it appears that some final results seem to be under or over evaluated[5], but the average differences in these cases are close to 2% which is still a reasonable value, similar to the differences found in other round robin tests (Pierrot 2010). Further comparison tests would be necessary to confirm these tendencies. Periodic round robin tests are required by ISO/IEC 17025 and further results may help to confirm if there are differences statistically confirmed. Nevertheless, the laboratories which seem to present systematic differences should consider revisions to their testing procedures and facilities in order to determine if some measurements can be improved. The main differences appear once again for the airflow rates measured with the indoor air enthalpy method. It should be noticed that the measurement of the air flow observed during the tests may differ in the same laboratory according to the type of indoor unit.

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[4] The expressions “high”, “low”, “normal”, “very high” used in the analysis refers to the international experience on the analysis of round robin testing between the European, Asian and Australian laboratories

[5] In our analysis when we say that a parameter is under/over evaluated, we mean that the mean value of the measurements of the laboratory is lower/higher than the average value calculated for all the laboratories.

Regarding the uncertainty of measurement, the calculation method used by the Chinese laboratories is described in CNAS-GL08 “Guidance on evaluating the uncertainty in electrical apparatus testing” and the document related to the “Evaluation and expression of cooling capacity uncertainty by air enthalpy method”. The methodology followed in these documents is adequate for the calculation of the uncertainties of Type B (i.e. the uncertainties coming from the measuring devices during the test) but doesn’t apply to uncertainties of Type A (operators, installation, atmospheric pressure, etc...). However, the estimation of the uncertainty of measurement has not been given for all the results provided by the laboratories and when given, some of the uncertainties are much lower than the international known values for each device.

Key findings

The analysis of the RRT results showed a good level of quality for the measurement of the efficiencies and the capacities of air/air air conditioners. However some improvements can be obtained for both methods (air enthalpy and calorimeter room). The differences of the results between different laboratories are compatible with the maximum uncertainty of measurement for these tests; although the maximum difference of 7% obtained for the energy efficiency seems high and may impact the labelling program. The higher the maximum difference in the test result, the higher the possibility that the same model tested in different laboratories will show different results and will be rated at different grades. Actions designed to reduce this difference by improving the quality of the tests would be beneficial. Periodical round robin tests performed on a regular basis, as described in ISO/IEC 17025:2005, would be the preferable way to check the effectiveness of the improvement and to verify that the quality of the tests remains constant. A maximum difference of 25.0 % has been observed for the airflow rate measured by different laboratories for the same indoor unit. This difference is very high and should be carefully assessed and explained. A specific round robin test designed for this purpose would probably be necessary to achieve this goal. No significant difference has been observed between the average capacities and efficiencies measured by the calorimeter method and the air enthalpy method. This result is unexpected considering the differences in the airflow rate measurement and the fact that uncertainty calculations and experience in other parts of the world indicate that the calorimeter room method is more accurate than the air enthalpy method. In addition some improvements concerning the installation and the settings of the samples are worth studying.

Table 6: Maximum differences by sample

	SAMPLE 1			SAMPLE 2			SAMPLE 3			SAMPLE 4		
Parameter	**Calorimeter method**	**Air enthalpy method**	**Differences between the 2 methods**	**Calorimeter method**	**Air enthalpy method**	**Differences between the 2 methods**	**Calorimeter method**	**Air enthalpy method**	**Differences between the 2 methods**	**Calorimeter method**	**Air enthalpy method**	**Differences between the 2 methods**
Total cooling capacity	3.3 %	6.3 %	1.0 %	2.2%	4.0%	-0.2%	3.2%	5.1%	0.6%	7.9%	0.6%	1.2%
Power input in cooling mode	5.3 %	2.7 %	0.6 %	1.4%	2.6%	-0.8%	2.2%	2.5%	-0.8%	3.2%	3.9%	-0.9%
EER	6.7 %	3.7 %	0.4 %	0.8%	1.4%	0.6%	5.5%	6.3%	1.4%	7.0%	4.4%	1.8%
Latent cooling capacity	7.6 %	14.0 %		14.2%	11.6%		9.0%	11.6%		32.6%	30.1%	
Airflow rate in cooling mode	-	25.0 %		-	22.2%		-	24.4%		-	19.9%	
Heating capacity	2.6 %	2.9 %	1.5 %	1.2%	0.4%	2.2%	3.8%	1.3%	3.9%	1.0%	3.6%	0.4%
Power input in heating mode	3.4 %	2.6 %	0.5 %	0.8%	2.2%	1.2%	0.4%	4.4%	0.0%	5.4%	4.1%	-0.8%
COP	5.8 %	2.2 %	1.0 %	1.8%	2.6%	1.0%	3.4%	5.2%	3.8%	5.1%	4.4%	0.4%
Air flow rate in heating mode	-	14.9%	-	-	17.6%		-	22.6%		-	21.0%	

Table 7: Average differences by laboratory

	LAB1			LAB 2			LAB 3			LAB 4		
Parameter	**Calorimeter method**	**Air enthalpy method**		**Calorimeter method**	**Air enthalpy method**		**Calorimeter method**	**Air enthalpy method**		**Calorimeter method**	**Air enthalpy method**	
Total cooling capacity	-0.6%	-0.9%		0.8%	2.4%		-	-1.7%		0.4%	-	
Power input in cooling mode	1.5%	0.4%		-0.8%	0.1%		-	-0.4%		-0.4%	-	
EER	-2.1%	-1.3%		1.6%	2.2%		-	-1.2%		0.8%	-	
Latent cooling capacity	-8.1%	-8.8%		7.0%	1.4%		-	5.2%		-0.9%	-	
Airflow rate in cooling mode	-	4.0%		-	7.2%		-	-10.1%		-	-	
Heating capacity	-	-0.8%		-1.1%	-0.3%		-	0.9%		1.0%	-	
Power input in heating mode	-	0.4%		0.5%	-1.1%		-	0.8%		-1.1%	-	
COP	-	-0.9%		-1.5%	0.7%		-	-0.1%		2.1%	-	
Air flow rate in heating mode	-	3.8%		-	4.5%		-	-7.4%		-	-	

Outcomes and conclusions

The analysis of both check and round robin testing demonstrated the benefit of the establishment of a regularized verification and monitoring system for both laboratories and products. It is therefore recommended to put in place more self-sustaining Chinese funding for these activities, building upon initial check testing and round robin testing supported by international organizations (METI and Climate Works Foundation). The check testing cost could be supported by the manufacturers while the round robin testing could be included in the quality expenses of the laboratories that may comply with ISO/IEC 17025:2005 requirements. This would allow the expansion of the check testing program to target a wider variety of products according to the market distribution including those from smaller manufacturers in rural areas.

Regarding test methods, use of the calorimeter room is recommended over the air enthalpy method because the air enthalpy method has a greater uncertainty of measurement which may have an impact on the grade level of the appliances. In addition, it's highly recommended to revise the uncertainty of measurements and to include in the calculation method the uncertainties of Type A.

Finally, to avoid potential conflicts of interest between the activities related to the implementation of S&L programs and those related to monitoring, verification and compliance of S&L programs and to reduce the delay in compliance activities, an independent agency dedicated to monitoring and enforcement with adequate funding allocated to compliance activities is recommended.

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