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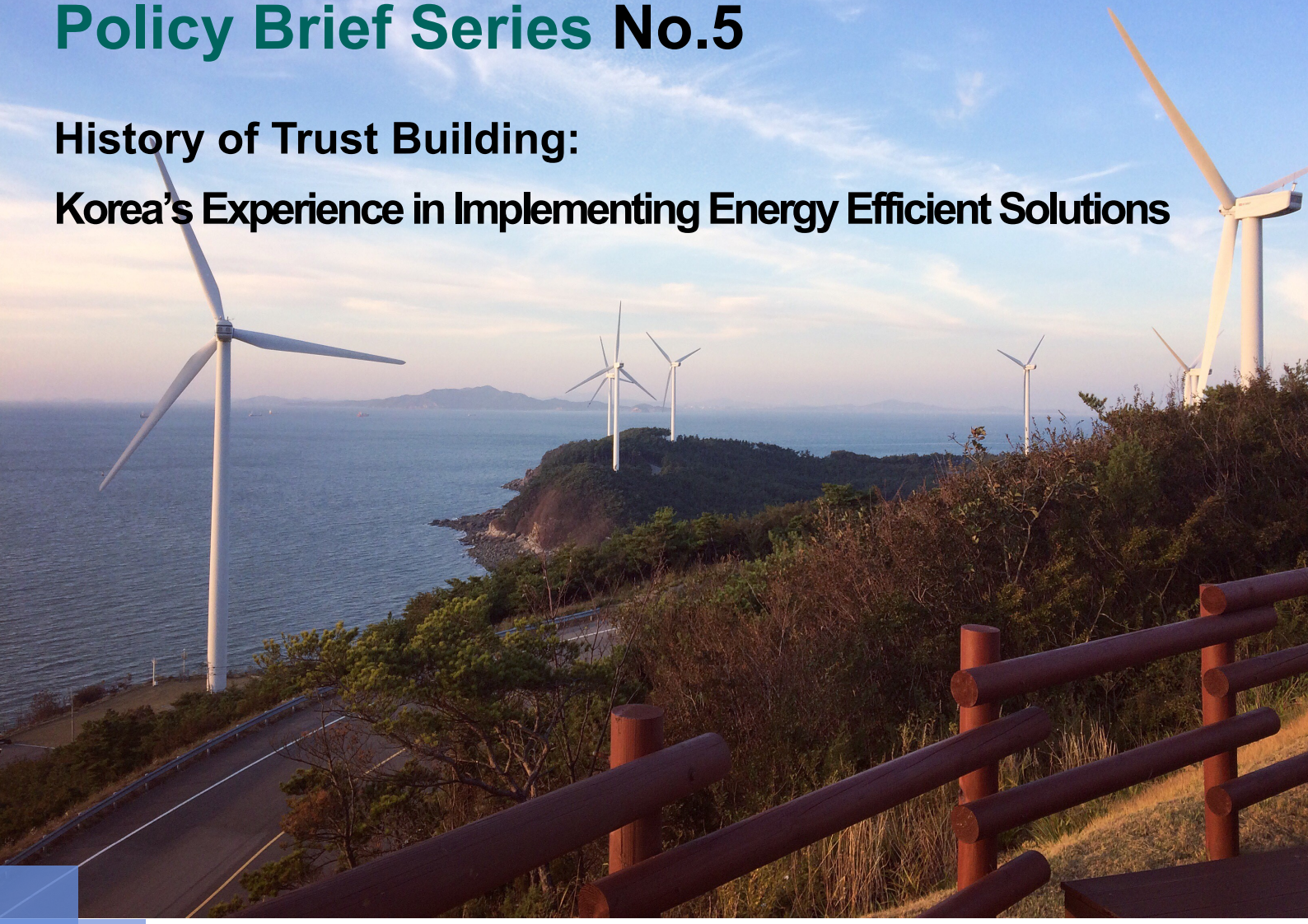
History of Trust Building:

Korea's Experience in Implementing Energy Efficient Solutions



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Korea's Experience in Implementing Energy Efficient Solutions

Acronyms

BETM	Building Energy and Greenhouse Gas (GHG) Target Management
BAU	Business As Usual
CHP	Combined Heat and Power
EAC	Energy Audit Company
EBRD	European Bank of Reconstruction and Development
EIC	Energy-Intensive Company
ETS	Emission Trading Scheme
GAC	Green Architecture Centre
GETM	GHG Energy Target Management Scheme
HEV	Hybrid Electric Vehicle
ICE	Internal Combustion Engine
ICT DSM	Information and Communication Technology Demand Side Management
IIC	Inter-American Investment Corporation
KEA	Korea Energy Agency
KEMCO	Korea Energy Management Corporation
MDB	Multilateral Development Bank
MOLIT	Ministry of Land, infrastructure and Transport
MOTIE	Ministry of Trade, Industry and Energy
ODA	Official Development Aid
PHEV	Plug-in Hybrid Electric Vehicle
SEFF	Sustainable Energy Financing Facility
SME	Small and Medium-sized Enterprise
SEV	Space Efficient Vehicle
TOE	Ton of Oil Equivalent
TPES	Total Primary Energy Supply

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Executive Summary

Energy efficiency is called the Fifth Fuel. It has great potential to ease the burden of heavy investment on energy supply and address climate change by reducing green house gas emissions. Many developing countries are facing serious energy shortages due to rapid economic growth leading to ever-rising energy demand. Korea is an energy-intensive country with very few energy resources. The bitter experiences of two oil crises given its energy-intensive economic structure have made the Korean government determined to push for comprehensive energy efficiency programmes. In that sense, learning from Korea, a country which transitioned from an Official Development Aid (ODA) recipient to donor, about its know-how on implementing energy efficiency to meet the increasing energy demand will be helpful to developing countries facing energy-related challenges.

Korea Energy Agency (KEA) is an overarching agency in charge of designing and implementing solutions to energy efficiency challenges in the Republic of Korea. This paper looks into energy efficiency programmes managed by the Korea Energy Agency covering three sectors. These include: Energy Audit in the industrial sector; Building Energy and GHG Target Management (BETM) in the building sector; and Fuel and Tire Efficiency Labeling in the transport sector. The Energy Audit programme paved the way for industrial energy efficiency investment by identifying inefficiencies and recommending improvements in the facilities and operating practices. The BETM is a relatively new programme, targeting large emitters in the building sector and has contributed to the reduction of per unit energy consumption and GHG emissions. Fuel Efficiency Labeling was introduced to tackle the rapid increase of transport energy consumption as the total number of vehicles increased during the 1990s. In contrast to Fuel Efficiency Labeling, Tire Efficiency Labeling is a more recent programme introduced in the 2010s to promote the development, sale, and purchase of low-rolling resistance tires.

While implementing these programmes, KEA has kept close contacts with stakeholders and has modified regulations and programmes according to the changing market situation. The result is a trust built firmly between KEA and stakeholders. The trust building has been possible because of a clear legal framework underpinned by strong pillars of incentives and regulations, and financed by a stable flow of Energy and Resources Special Account funding. The implications of KEA's experience in implementing energy efficiency programmes can be summarized in the following four recommendations:

1. An overarching coordinating and leading agency is needed to implement systematic and comprehensive energy efficiency programmes across the sectors;
2. A dedicated fund is helpful to implement consistent and effective programmes that bear meaningful fruits in energy efficiency investment;
3. All the programmes of incentives and regulations should be firmly based on a transparent and predictable legal framework;
4. Coordinated efforts should encompass all relevant sectors, inducing all stakeholders to get involved. This does not preclude selecting and focusing on a few flagship programmes in the initial stage.

1. Introduction

Energy efficiency is called the Fifth Fuel, considering its enormous potential to address the increasing energy demand and global climate change challenges. But achieving progress toward energy efficiency has been a formidable task and low energy efficiency has been a stumbling block in some developing countries. In that context, Korea could be a suitable model for successfully implementing energy efficiency programmes, with its experience providing useful insights for developing country policymakers.

Korea is an energy-intensive country, the ninth in terms of oil consumption and eleventh in terms of energy consumption per capita. Its energy consumption has been continuously increasing with Korea's economic growth and its transition from an ODA recipient to donor country as shown in Table 1 and Graph 1. The Korean economy has heavily relied on energy-intensive industries such as steel, petro-chemicals, and cement. As a result, energy consumption in the industrial sector is extremely high, accounting for 63% of total national consumption (see Table 2). Korea managed to meet the sharp increase in energy demand with a combination of aggressive energy supply investment and various energy efficiency programmes. It also benefited from the sharp, sustained fall in energy prices in 2015.

Table 1. Key Energy Statistics

	Unit	2000	'10	'11	'12	'13	'14	'15	Average ***	
									'00~'10	'10~'15
GDP	Tril. KRW	821	1,265	1,312	1,342	1,381	1,426	1,463	-	-
Real GDP Growth	%	8.8	6.3	3.7	2.3	2.9	3.3	2.6	4.4	3.0
Primary Energy Use*	Mil. TOE	192.9	263.8	276.6	278.7	280.3	282.9	285.0	-	-
	(%)	(6.4)	(8.4)	(4.9)	(0.7)	(0.6)	(0.9)	(0.7)	3.2	1.6
Final Energy Use**	Mil. TOE	149.9	195.6	205.9	208.1	210.2	213.9	217.5	-	-
	(%)	(4.7)	(7.4)	(5.3)	(1.1)	(1.0)	(1.8)	(1.7)	2.7	2.1
Energy Intensity	TOE/ Mil. KRW	0.235	0.208	0.211	0.208	0.203	0.198	0.195	-	-
Imported Energy (growth)	Bil. USD	38	122	172	185	179	174	103	-	-
	(%)	(66.6)	(33.5)	(41.8)	(7.1)	(- 3.3)	(-2.6)	(-41.0)	12.4	-3.3
Share of Energy in Total Import	%	23.6	28.6	32.9	35.6	34.7	33.1	23.5	-	-
Dependence on Imported Energy	%	97.2	96.5	96.5	96	95.7	95.2	95.2	-	-

*Primary energy use refers to the direct use at the source, or supply to users without transformation of crude energy, that is energy that has not been subjected to any conversion or transformation process
**Final energy use is the total energy consumed by end-users, such as house holds, industry and agriculture. It is the energy which reaches the final consumer's door and excludes that which is used by the energy sector itself.
***Average refers to average of annual growth rate; (Final value - Primary value)^(1/time difference)-1
(TOE: Ton of Oil Equivalent, KRW: Korean Won (currency))
Source: *2016 Korea Energy Handbook,* Korea Energy Agency, May 2016.

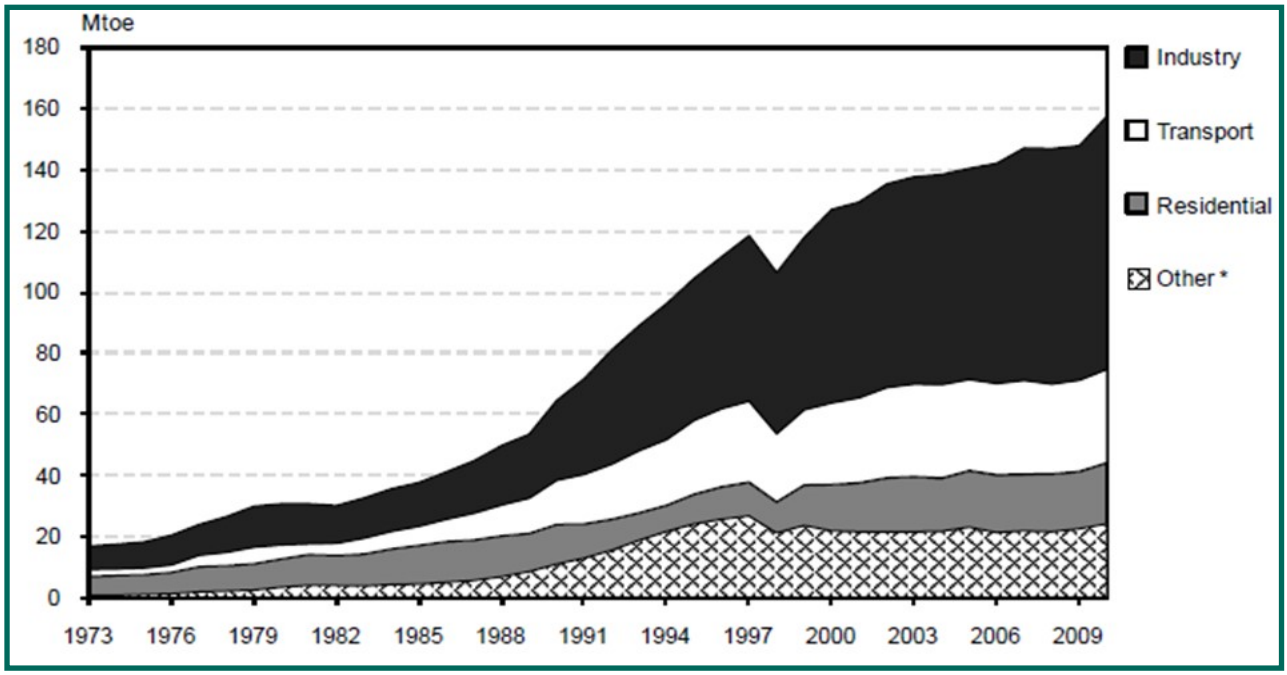
Table 2. Final Energy Consumption by Sector

(Million TOE, %)

Year	Industry		Residential & Commercial		Transport		Public & etc.		Total
		% share		% share		% share		% share	
1990	36.2	48.1%	22.0	29.3%	14.2	18.9%	2.8	3.7%	75.1
2000	83.9	56.0%	32.4	21.6%	31.0	20.7%	2.6	1.8%	149.9
2012	128.3	61.7%	37.9	18.2%	37.1	17.8%	4.8	2.3%	208.1
2013	130.9	62.3%	37.3	17.8%	37.3	17.8%	4.7	2.2%	210.3
2014	136.1	63.6%	35.5	16.6%	37.6	17.6%	4.7	2.2%	213.9
2015p	136.3	62.6%	36.3	16.7%	39.9	18.4%	5.1	2.3%	217.5
Average Annual Growth rate ('00~'15)	3.3%		0.8%		1.7%		4.5%		2.5%

* Public & etc. includes commercial, public services, agricultural, fishing and other non-specified sectors.
Source: *2016 Korea Energy Handbook,* Korea Energy Agency, May 2016.

Graph 1. Final Energy Consumption by Sector, 1973-2010

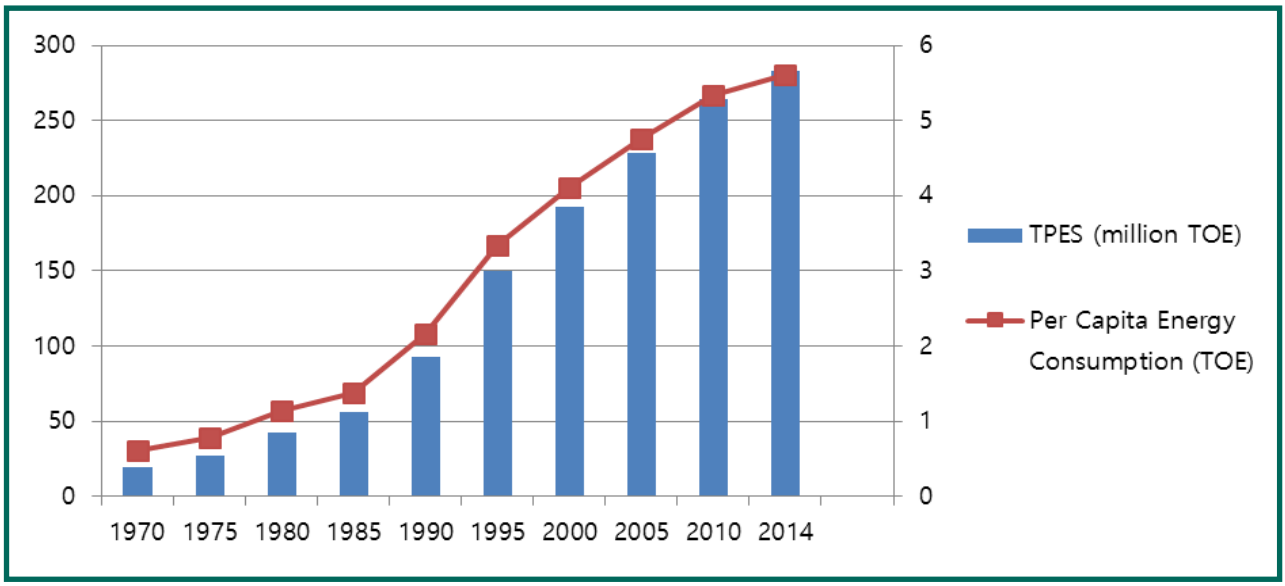


* Other includes commercial, public services, agricultural, fishing and other non-specified sectors.
Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2012.

2. Genesis and Evolution of Energy Efficiency Policy in Korea

Korea is not blessed with natural resources such as oil and gas. Therefore, most of the energy needed for its economic development has been imported from overseas. As shown in Graph 2, as the economy developed, energy consumption significantly increased in Korea. In response, as an energy poor country, Korea had to pursue energy efficiency measures to reduce the economic burden of energy imports. The two oil crises during the 1970s hit the Korean economy hard by increasing its export costs and reducing cost-competitiveness in the world market. In response, energy efficiency programmes were launched in Korea during the 1970s. These took the form of national energy saving campaigns and regulatory measures to enforce energy saving in the industrial and commercial sectors.

Graph 2. Total Primary Energy Supply (TPES) and Per Capita Energy Consumption (1970-2014)



*Left Axis: TPES (million TOE), Right Axis: Per Capita Energy Consumption (TOE)
Source: *Monthly Energy Statistics*, Korea Energy Economics Institute, Oct 2016.
Korea Energy Handbook, Korea Energy Agency, May 2016.
30 Years of Energy Management, Korea Energy Management Corporation, Dec 2004.

In 1973, to address the first oil crisis, the Korean government set up the ad-hoc Energy Saving Committee, which was in charge of implementing national energy saving campaigns. In 1974, the Thermal Energy Management Act was enacted and the Korea Thermal Energy Association was established, mandated to promote savings of heat, fuel, and electricity in the industrial sector. The association designated large thermal energy consumers and managed their thermal energy consumption. It implemented thermal energy audit on the designated business entities and helped the enterprises to get rid of their inefficient energy use practices. A public awareness programme during 1970s utilized simple approaches such as 'Turn-Off One Light per One Household.' Those efforts gradually receded as the economy recovered from the first oil crisis.

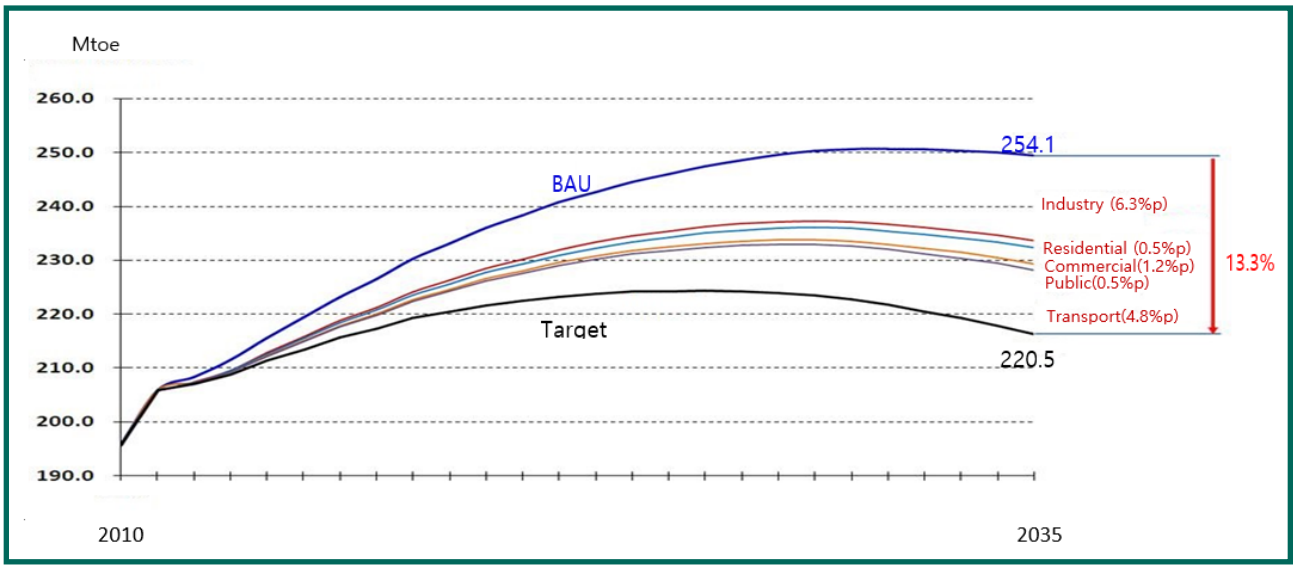
Hit hard by the second oil crisis in 1978, the Korean government realized the need for systematic improvements in energy efficiency. The Rational Energy Utilization Act was passed in 1979. As a national energy efficiency agency based on the Act, the Korea Energy Management Corporation (KEMCO) was established in 1980. In fact, KEMCO was founded by the merger of three organizations: Korea Thermal Energy Association; Korea Solar Energy Association and Korea Motor Association. KEMCO was mandated by the government to give guidance to enterprises on energy management technologies and practices, provide training and raise public awareness, as well as approve and inspect the operation of thermal energy equipments. Initially, KEMCO's activities focused mainly on the industrial sector.

As difficulties associated with the second oil crisis eased due to falling oil prices, the Korean government collected tax and levies on imported oil and other products, and established the Petroleum Fund. This fund was used for various energy projects such as setting up a strategic oil reserve and making energy efficiency investments. The hardships during the oil crises provided valuable lessons to Korea. The government was determined to avoid a repeat of the difficult experience and, thus, refocused its energy policies from short-term and partial goals to long-term and comprehensive ones. The Petroleum Fund functioned as a valuable financial resource for implementing these policies. In 1995, the Petroleum Fund and five other energy-related funds were merged into the Energy and Resources Special Account for effective management of energy policies and projects. Thanks to the stable financial flow of this Special Account, Korea has implemented energy efficiency programmes in a consistent and comprehensive manner.

In 2014, Korea launched the Second National Energy Master Plan, which marked a new milestone in the national energy policy, shifting its focus from supply management to demand management. Under the Master Plan, Korea set its national energy efficiency target to reduce final energy consumption by 13% compared with the Business As Usual (BAU) baseline by 2035 as shown in Graph 3. Industry and Transport will be responsible for achieving most of energy saving target, 6.3% and 4.8% respectively. The six core plans of the 2nd National Energy Master Plan are as follows:

1. Shift the policy focus from Supply Management to Demand Management
   Reorganize energy tax, improve power tariff and promote ICT DSM (Information and Communication Demand Side Management)
2. Promote Distributed Power Generation
   Supply 15% of power from distributed systems by 2035
3. Enhance Sustainability of Energy Policies
   Improve climate change response, strengthen nuclear safety
4. Strengthen Energy Security
   Reinforce state energy/mineral corporations, pursue wider New & Renewable Energy deployment
5. Build Stable Energy Supply Chain
   Diversify supply lines, increase domestic energy reserves
6. Pursue Citizen-Friendly Energy Policy
   Strengthen energy welfare, respond to energy-related conflicts preemptively

Graph 3. National Energy Efficiency Target by 2035



*BAU: Business as Usual
**13.3%: Cumulative Savings
Source: *Korea Second Energy Master Plan*, 2014.

3. Acts Passed by Korea Energy Agency

Since its establishment in 1980, the work scope of KEMCO continuously expanded from industry to various other sectors including the building, transport, and appliance sectors. This was a response to energy consumption increases in the residential, commercial, public, and transport sectors in line with overall economic development and individual income growth. KEMCO changed its name to Korea Energy Agency (KEA) in 2015 to clarify its identity as an overarching agency cooperating with various stakeholders.

3.1. Energy Audit

Korea's energy audit practice dates back to 1974, when the Korea Thermal Energy Association was mandated to manage thermal energy audits. At that time, Korea did not have the capacity of doing audits on its own. Therefore, the Association set up an Audit Team and invited overseas audit experts from Japan and the United States and built its own capacity by learning from them. The Audit Team made all efforts to hone its audit skills and procure proper audit equipment.

The audit work was transferred to the newly established KEMCO in 1980. During the 1980s, electric energy audit was added to the existing thermal energy audit, and the two types of audits were provided to the clients in parallel, which enhanced the audits' quality, efficiency, and usefulness. The target of energy audit was expanded from heavy energy users to Small and Medium-sized Enterprises (SMEs) who lacked technical expertise. The energy audit for SMEs was a walk-through complimentary service.

During 1990s, KEMCO's energy audit team started using a computer-based system to meet the complex needs of clients. The audit organization was expanded with specialized teams in areas such as petrochemical, steel, and buildings.

During 2000s, KEMCO had the opportunity to conduct overseas energy audits in China, Thailand, Mexico, Bolivia and other developing countries. These overseas audits were done on a case-by-case basis. Some audits were funded by international organizations. For example, the Inter-American Investment Corporation (IIC) funded the audit in Bolivia. The Chinese audit was conducted in Chinese factories owned by Korean companies while the Thai audit was conducted as part of Korean climate change ODA. Finally, the Mexican audit was done as a complimentary walk-through audit as part of bilateral cooperation. The KEA audit team started using high-end software during the 2000s in an effort to enhance the clients' understanding and trust in the outcome of the audit.

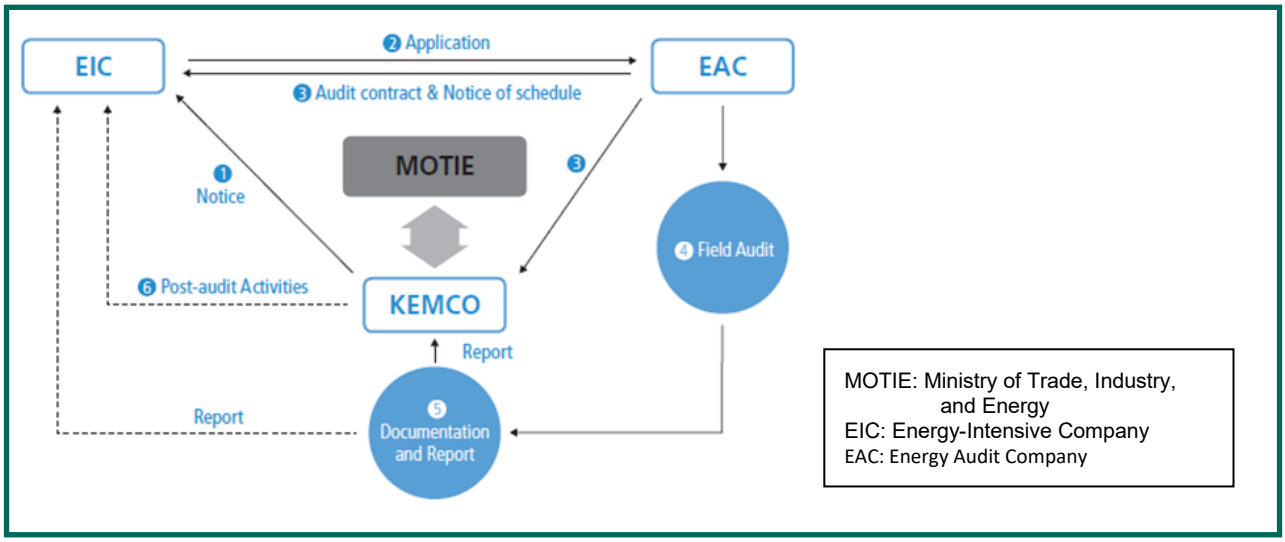
In 2004, the government decided to make energy audit mandatory on heavy energy users. The decision was incorporated into Article 32 of the Rational Energy Utilization Act in 2005 and came into effect in 2007. Now, there is an Energy Audit Regulation which specifies the details of the mandatory energy audit programme. Energy audits are stipulated in Article 57, Item 5 (Energy Audit and Energy Management Guidance) of the Act.

Since 2007, the government has mandated Energy-Intensive Companies (EIC)s to undertake energy audits on a regular basis in order to respond to high oil prices and climate change. Every five years, companies using over 2,000 TOE must undergo energy audits to identify energy savings potential and take optimal measures to raise energy efficiency.

KEMCO is authorized to operate mandatory energy audit programmes and provide technical assistance to private audit companies and financial assistance (partial subsidy on audit fee) to energy-intensive SMEs subject to the energy audit requirement. With the introduction of mandatory energy audits, the energy audit market, which was dominated by KEMCO, was opened to private EACs (Energy Audit Companies). As of the end of 2014, 91 energy audit companies with expertise and experience were registered, having implemented audits on 4,111 companies since 2007.

The procedure of mandatory energy audit in Korea is shown in Diagram 1. Energy-Intensive Companies (EIC)s are required to submit energy audit reports to KEA, pursuant to Article 32 of the Rational Energy Utilization Act. Small businesses consuming less than 10,000 TOE of energy annually are eligible for a subsidy of 70% of audit fees. The energy audit is an essential tool in the effective control of energy costs. The audit includes detailed evaluations of a firm's energy efficiency, technical and economic analyses of its energy facilities, and recommendations for energy saving measures, which include changes in operating practices or equipment, to reduce energy costs.

Diagram 1. Energy Audit Procedure (applied domestically in ROK)



Source: *Annual Report 2013*, KEMCO, 2014.

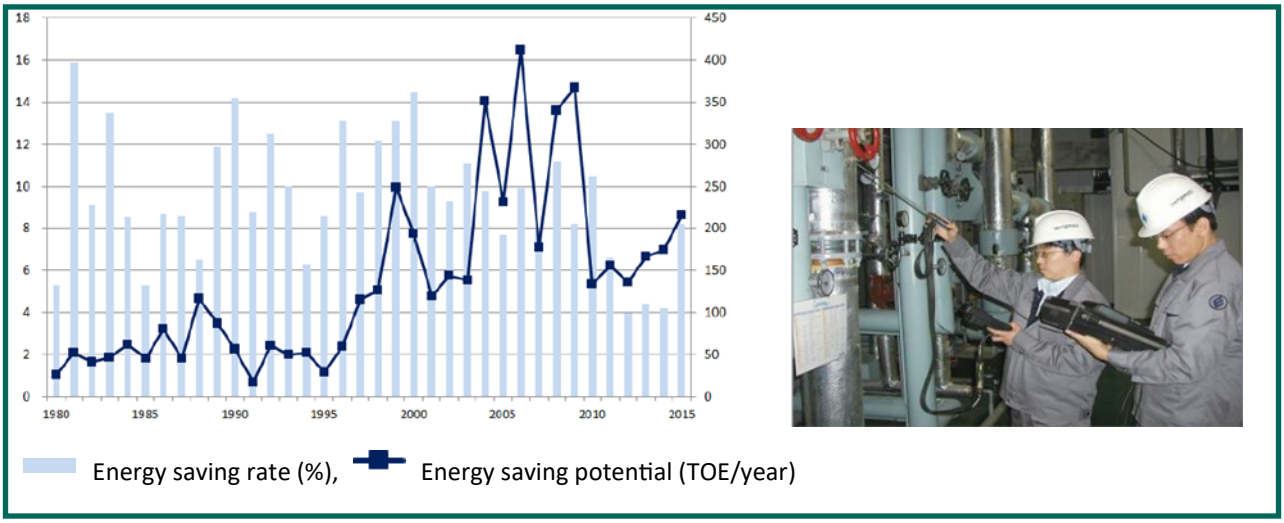
Since 2007, mandatory energy audit was executed in 4,935 workplaces, leading to identifying 4,463 thousand TOE of energy saving potential and 10,841 thousand tCO2 of GHG reduction potential. (see Table 3) The identified energy-saving projects are eligible for KEA's soft loan. Through energy audits, KEA could accumulate on-site understanding of industrial facilities and practices and EICs could build trust in KEA's audit capacity and cement the trust through realized energy efficiency measures financed by KEA's soft loans.

Table 3. Energy Audit Results on Saving Potential (2007 to 2015)

	No. of audited EICs	Saving Potential * (TOE/yr)	Average saving** (%)	GHG reduction potential (tCO2/yr)
2007	383	429,013	4.6	1,086,377
2008	420	549,333	8.0	1,463,397
2009	559	710,412	6.4	1,754,496
2010	545	479,840	5.9	1,184,438
2011	469	438,800	4.7	1,080,153
2012	546	440,622	3.5	1,004,434
2013	563	435,600	3.7	1,054,179
2014	625	458,893	3.9	1,061,890
2015	825	520,893	3.9	1,151,754
Total Audits	4,935	4,463,406	4.7	10.841,118

*Saving potential in this table refers to combination of power, steam and oil savings. These energy sources have different energy factors, and the general range of CO_2 emission factor of energy consumption is between 2.147 tCO2/TOE (primary energy) and 2.862 tCO2/TOE (final energy).
**Average energy saving potential has been on downward slope starting from 2008. The overall industrial energy efficiency has improved with EICs implementing energy efficiency measures in accordance with audit recommendations. This resulted in lower energy saving potential in every five-year cycle audits.
Source: *Korea Energy Handbook*, Korea Energy Agency, May 2016. (For more details, please refer to *National Greenhouse Gas Inventory Report of Korea (GIR)*, 2015, and http://co2.kemco.or.kr/directory/toe.asp)

Graph 4. Energy Audits by KEA



Source: *Korea Energy Handbook*, Korea Energy Agency, May 2016.

3.2. Building Energy GHG Target Management Scheme

The GHG Energy Target Management scheme (GETM) is a new programme, started in 2010. Its introduction was decided at the 6th Green Growth Committee meeting in 2009 as a specific response measure to high oil prices and climate change. The scheme was specified in Articles 26 - 34 of the Low Carbon Green Growth Act. Article 26 is about its principle and role, and Article 29 is about the designation of subject entities. Article 30 is about modalities and procedures for managing designated entities while Article 32 is about verifying agents. Lastly, Article 34 is about procedures for reporting and management of energy consumption and GHG emission specification.

It has a detailed regulation named Guidance on operating GHG Energy Target Management (GETM). It was a key tool in achieving the national target of a 30% reduction compared to the 2020 Business as Usual (BAU) level before the introduction of the Emission Trading Scheme (ETS) in 2015. In a way, GETM paved the way for the ETS since ETS benchmarked GETM in its detailed design, and many stakeholders could accumulate experience and knowhow in preparing for the ETS by participating in GETM. Now ETS is dealing with the largest GHG emitters of over 25,000tCO_2/year and GETM is dealing with non-ETS large emitters of between 15,000 and 25,000tCO_2. The Ministry of Environment is in charge of managing the overall GETM scheme and related Ministries are in charge of managing sectoral schemes.

In the building sector, the Ministry of Land, Infrastructure and Transport (MOLIT) is in charge of Building GHG Energy Target Management (BETM). MOLIT mandated the Green Architecture Center of KEA to operate the related programmes. The purpose of BETM is to reduce energy consumption and mitigate greenhouse gas emissions. Buildings that emit GHG or consume energy above a certain level as in Table 5 are mandated to participate, and they must submit their specific plans to meet energy-conservation and GHG emissions reduction targets. Table 5 reflects that in 2015, the government set the target of a 15.4% reduction on 37 designated entities in the building sector. The subject entities are decided on the joint criteria of annual energy consumption and GHG emissions. Simply put, the subject entity needs to meet both criteria on a three-year moving-average basis. When an entity has several business units, the criteria are applied first at the entity level, and then at the business unit level. For example, when entity A emits 40,000tCO_2 and consumes 150 TJ, and its business unit 1 emits 16,000tCO_2 and consumes energy of 90 TJ, business unit 1 will be designated as the GETM entity.

Table 4. Criteria for Designating Subject Entities (within ROK)

	by Dec 31, 2011		from Jan 1, 2012		from Jan 1, 2014	
	Entity	Business Unit	Entity	Business Unit	Entity	Business Unit
GHG (tCO_2)	125,000	25,000	87,500	20,000	50,000	15,000
Energy (TJ)	500	100	350	90	200	80
Energy (TOE)	11,900	2,400	8,400	2,100	4,800	1,900

Source: *Korea Energy Handbook*, Korea Energy Agency, May 2016.

Under this programme, building owners set their own targets negotiated with KEA and aim to achieve them. The government assists the entities' efforts to achieve targets by providing incentives such as assistance in making GHG inventory and GHG emissions reports, and capacity building for on-site practitioners in the entities. The scheme proceeds as follows:

①Designate subject entities (April the preceding year)→ ②Announce the designation (June the preceding year) → ③Entities submit the specification on their energy consumption and GHG emissions (March of audit year) → ④Target is set by negotiation between KEA and entities (September of audit year)→ ⑤Entities submit implementing plans (December of audit year) → ⑥Entities implement the plans (post-audit year) → ⑦Entities submit the performance and specification on energy consumption and GHG emissions (2 years after audit) → ⑧KEA evaluates the performance, issues improvement order in case of failure.

Table 5. Number of Building GHG Energy Target Management (BETM) Subject Entities

Year	Number of Subject Entities	
	Entity	Business Unit
2010	6	28
2011	10	30
2012	16	35
2013	17	36
2014	27	41
2015	7	30

Source: *2016 Korea Energy Handbook*, Korea Energy Agency, May 2016.

By reviewing submitted specifications and on-site visits to BETM entities, KEA has the opportunity to listen to the voice of the building sector practitioners and know the state of energy-using facilities and their operating practices, leading to a better understanding of the building sector. Along the BETM process, the BETM entities have a chance to explain their difficulties and barriers in exercising energy efficiency. This communication leads to fine-tuned improvements of the BETM and other building sector programmes. The entities get assistance such as consulting on making GHG emissions inventory and specifications. The buildings sector is intertwined with various interests across many stakeholders such as Ministry of Trade, Investment and Energy (MOTIE), Ministry of Land, Infrastructure and Transport (MOLIT), and local governments. The coordination of various interests is crucial for building effective energy efficiency programmes. KEA's Green Architecture Center has been functioning as an overarching organization to implement building energy efficiency programmes and has gained trust in the market for its smooth operation of new programmes including BETM. However, BETM is a domestic programme and has not been applied in other countries.

3.3. Labeling in the Transport Sector

3.3.1. Fuel Efficiency Labeling

The total number of registered vehicles in Korea exceeded 1 million in 1985, and reached 10 million by 1997. Witnessing the sharp increase of energy consumption in the transport sector due predominantly to the increasing number of vehicles, Korea introduced a Fuel Efficiency Labeling programme in 1988. Since then, Korea has continuously strengthened transport energy efficiency measures. The notable developments in the transport energy efficiency programme are as follows:

Table 6. Sample of Fuel Efficiency Labels in ROK

	Passenger, Van	Light-duty	Hybrid	PHEV (Plug-in Hybrid)	EV (Electric Vehicle)
Old					
New					

Source: *Korea Energy Handbook*, Korea Energy Agency, May 2016.

The legal base of the programme is in Article 15 (Designation of Efficient Appliances) and Article 16 (Post Management of Efficient Appliances) of the Rational Energy Utilization Act. It has a Regulation on Vehicle Energy Efficiency and Labeling, and a joint Public Notice on the Testing Procedure for Vehicle Energy Efficiency, GHG emissions, and Fuel Consumption.

The Fuel Efficiency Labeling system promotes development of fuel efficient vehicles and encourages consumers to purchase them by providing information on fuel efficiency. The programme covers light-duty vehicles, vans with a capacity of 15 passengers or less, and small trucks with a total weight of less than 3.5 tons. Vehicle manufacturers or importers are required to attach labels to vehicles with information on fuel efficiency and rating (1st to 5th grade) on the back or side windows, to ensure that consumers are better informed about the fuel efficiency of their vehicles. And they are also required to indicate the vehicle's fuel efficiency and grade when they advertise the vehicles in newspapers, magazines, and on websites.

Since 2012, fuel efficiency values for both city driving and highway driving have been indicated with combined fuel efficiency. The most efficient vehicles are labeled 1st Grade and the least efficient vehicles are rated 5th Grade. CO_2 emissions (g/km) are also displayed so that consumers can take into account environmental integrity when purchasing vehicles.

Table 7. Notable Developments in Fuel Efficiency Labeling

Year	Developments
1988	Introduced Fuel Efficiency Display programme for passenger vehicles
1992	Introduced Fuel Efficiency Standard and Labeling for passenger vehicles
1993	Expanded to vans and multi-purpose vehicles
1996	Expanded to diesel vehicles
1998	Expanded to light duty vehicles, small vans and trucks
2002	Changed fuel efficiency test method: change of test run distance (6,400 km→160 km)
2006	Introduced Corporate Average Fuel Economy programme. Announced test method for hybrid vehicles
2008	Different Fuel Efficiency rating standards according to vehicle size (displacement volume) were simplified into single rating standard. CO_2 emission was added to Label
2011	Fuel Efficiency calculation was improved to customer-friendly 5-cycle method*
2014	Regulation on Fuel Efficiency Test Procedures was announced as a joint notice by three ministries (Ministry of Trade, Industry and Energy, Ministry of Environment, Ministry of Land, Infrastructure and Transport)
2015	Changed Fuel Efficiency display items for plug-in hybrid vehicles. New label was introduced according to new fuel efficiency calculation.

*5-cycle testing method is more representative of a vehicle's on-road fuel consumption, compared to previous 2-cycle method. It includes cold temperature, air conditioning, high speed/quick acceleration tests in addition to standard 2-cycle (city and highway) test.
Source: Korea Energy Agency, 2017.

Table 8. Vehicle Sales by Label and Type, 2015

		1st	2nd	3rd	4th	5th	PHEV
Passenger	**Subtotal**	127,953	363,509	413,686	293,269	121,864	252
	Bi-fuel*						
	PHEV**						252
	ICE***	90,644	363,509	412,419	293,166	121,861	
	EV						
	Hybrid	37,309	0	1,267	103	3	
Van				285	30,551	4,587	
Truck				3,532	106,748	60,568	
Total		127,953	363,509	417,503	430,568	187,019	252
Percentage		7.5%	21.2%	24.4%	25.1%	10.9%	0.0%

*Bi-fuel: Bi-fuel vehicle can run on two types of fuels (e.g. gasoline or diesel and CNG or hydrogen)
**PHEV: Plug-in Hybrid Electric Vehicle, ***ICE: Internal Combustion Engine
Source: *Korea Energy Handbook*, Korea Energy Agency, May 2016.

3.3.2. Tire Efficiency Labeling

Tires account for 4% to 7% of automotive fuel consumption. Therefore, energy efficiency standards and measures for tires are necessary to effectively reduce energy consumption in the transport sector. Tire Efficiency Labeling is a brand new programme, introduced in 2011. The legal basis for the initiative is in Article 15, titled 'Designation of Efficient Appliances' and Article 16, titled 'Post Management of Efficient Appliances'. It has a Regulation on Measurement, Rating Standard and Display of Vehicle Tire Efficiency, a Public Notice by Ministry of Trade, Industry, and Energy.

KEA is implementing the Tire Efficiency Standards and Labeling to promote the development, sale, and purchase of low-rolling resistance tires. Under this programme, tire manufacturers and importers are required to display the efficiency of their tires. The efficiency rating is determined by rolling resistance and wet grip. KEA is also conducting market research and providing consumers with information on tire efficiency.

When this programme was introduced in 2011 for passenger vehicles, displaying the tire efficiency used to be voluntary action by tire manufacturers and importers. Since December 2012, however, this programme has become mandatory. From June 2014, the programme expanded to cover tires on small trucks as well. To the best of the knowledge of the authors of this report, such initiatives on fuel and tire efficiency have not been implemented in other countries.

Picture 1. Sample of Tire Efficiency Label in ROK

Source: *Korea Energy Handbook*, Korea Energy Agency, May 2016.

KEA is mandated by the government to set standards including the test method, monitor compliance with the standards, and provide customer information.

Korea Transport Energy Efficiency Laboratory

A laboratory of 3,300m^2 total floor area was completed in Jincheon, Chungcheongbuk Province in 2016, and will perform research and development in vehicle energy use efficiency. The main role of the laboratory is to develop methods to test fuel efficiency and performance of green cars (SEV, HEV, PHEV) using 5 -cycle test equipment satisfying EPA standards, and to perform a study and run a pilot program to introduce fuel efficiency programmes for large and medium-sized commercial cars. The laboratory is expected to be a critical research institute to raise the credibility of Korea's energy saving policy in the transport sector, reinforce the fuel efficiency initiatives and advance the vehicle industry.

However, labeling in transport, especially fuel efficiency labeling is a controversial issue among producers, importers, consumers and test institutes. Consumer groups may raise the reliability issue of the labeling test methods and their results. The Korean government has continuously modified the regulations to incorporate market feedback. These efforts include the change of test run distance in 2002, change of calculation method to the 5-cycle method in 2011, and introduction of new calculations in 2015. With constant effort to raise fuel efficiency and consumer reliability at the same time, KEA has managed to build trust step-by-step despite controversies and other difficulties. The Transport Energy Efficiency Laboratory is a milestone in KEA's ongoing efforts to cement its hard-won market trust.

3.4. UNDP Programmes on Energy Efficiency in Korea

At the initial stage of setting up energy efficiency programmes, Korea received assistance from international agencies such as the UNDP. During 1982 to 1986, the Korean government received the third cycle of UNDP aid, among which USD 570,482 was allocated to energy conservation. Energy conservation projects invited overseas energy efficiency experts, facilitated training of Korean officials overseas and the introduction of the Boiler Simulator. The invited experts trained Korean counterparts on energy audit in the transport sector, implemented feasibility studies on the Combined Heat and Power (CHP) project in Incheon, and designed a comprehensive district heating plan in Seoul. Korean officials were sent to the UK to learn about the Industrial Energy Audit, to Canada to learn about Waste Heat Recycle technology and Boiler Simulators, and to Canada, Sweden, and Germany to learn about District Heating technology. This UNDP assistance contributed to enhancing energy efficiency in Korea by assisting the Korean government implement transport energy management, and introduce a District Heating system in Korea.

4. Conclusions

In the Korean experience of implementing energy efficiency programmes for over 40 years, trust building stands out as the key word for Korean success. Listening to the voice of customers thorough close networks with designated energy managers and other stakeholders, the Korean government has continuously expanded its programmes to cover all relevant sectors and modified regulations to reflect changing market circumstances. The government has succeeded in acquiring trust among the stakeholders in the market, and in reaching higher compliance and successful implementation. To help replicate Korea's case in other countries, four recommendations are made below:

1. An **overarching agency** is needed to implement systematic and comprehensive energy efficiency programmes across sectors. Additionally, capacity building might be needed to an existing energy efficiency agency for strengthening its coordinating capacity and technical knowledge to cooperate with various stakeholders across all sectors.

2. A **dedicated fund** such as the Korean Energy and Resources Special Account will be useful in implementing consistent and effective programmes with meaningful results in energy efficiency investment. Possible sources may include increased taxes on fossil fuels, reallocation of existing taxes, or a certain portion of the power tariff. In the initial stage, assistance from Multilateral Development Banks such as European Bank of Reconstruction and Development (EBRD)'s Sustainable Energy Financing Facility (SEFF) could be useful.

3. All the programmes should firmly be based on a transparent, predictable **legal framework**. To secure better compliance and implementation, the government needs to set up laws and detailed regulations. A combination of carrots (incentives) and sticks (regulations) will be ideal for better and more lasting results.

4. **Coordinated efforts** encompassing **all relevant sectors** and inducing every stakeholder to get involved are needed. Energy efficiency is difficult to measure, but that cannot be an excuse for neglecting small tasks. Policy makers can also consider utilizing the tools that are available, including getting rid of 4th and 5th grade vehicles. Starting with a simple programme and achieving small but tangible success is important in the initial stage. An initial small success can encourage all stakeholders, and lead to greater successes down the road.

   It is also necessary to pick pivotal aspects that jointly hold the promise of making a substantial difference in raising energy efficiency. And to formulate policies that strike the right balance between incentivizing energy efficient practices and regulating activities to be energy efficient.

   In the initial stage of implementing or strengthening energy efficiency programmes, developing countries might select and focus on one or two flagship initiatives in priority sectors such as Energy Audit in the industrial sector, BETM in the building sector or Fuel Efficiency Labeling, taking into account their development priorities and energy consumption structures. Additionally, energy audit can be a helpful tool for many developing countries in identifying energy loss factors and, thus finding energy efficiency improvement measures in industry and building sectors.

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