Energy Efficiency Policy Instruments and Measures

Review, Comparison and Evaluation of France, Germany, Italy, Sweden and United Kingdom
And recommendation for Bhutan

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Abstract

This study aims at describing energy production, consumption and supply trends, review, comparison and evaluation of energy efficiency policies, policy instruments and measures in the five industrialised European countries- France, Germany, Italy, Sweden and the United Kingdom and provides recommendation to Bhutan, an Asian country. The recommendations are more generic in nature which could be implemented in most of the developing nations which are freshly boarding in the energy market. From the review analysis, it is seen that most of the recent policies are amended forms of the earlier energy efficiency policies, which are in place incorporating the climate change policies. In doing so, the energy efficiency policies not effective at times have proven more effective in coalition than in separate, with the expected result in lowering the primary energy supply and reducing the carbon dioxide (CO_2) emissions. From the evaluation, it is seen that the energy efficiency policy instruments and measures in residential sector are very mature and have huge experiences in the developed nations. Therefore, transferring these policy instruments and measures with some modification incorporating the local policies and needs in the developing nations is crucial to enhance energy efficiency and indirectly in the reduction of CO_2 emissions from developing world. The energy efficiency policy analysis is, by nature, a trade-off among careful measurement, expert opinion and self-judgement. However, an uncertainty exists in the analysis; the overall experience and estimation cannot be ruled out since it minimizes the cost and at the same time can draw acceptable conclusions.

Keywords: Energy, Energy Efficiency Policies, Policy Instruments & Measures, Evaluation, Recommendation

1. Introduction

"Larger energy savings would require an even bigger policy push" [1]. It is clear that the policy push and reform is an urgent solution to mitigate the present problems in energy crises, GHG[1] emissions reduction and dependency on the import of fossil fuels and other energy services. The industrialization and technological advancement will continue to grow and would definitely change the way of present energy production, consumption and generation of other harmful emissions. In the meantime, energy conservation and efficiency improvement would play a vital role and could provide a long-term solution if the political goals/instruments used today are reviewed and integrated in the existing energy efficiency policies and transferred to any need-felt nation.

To maintain the CO_2 emissions at the present level would require much stronger policies and enhanced instruments to encourage both the public and private sectors to take up the challenge confidentially. In doing so, the country is not only push to the reach of a much more sustainable energy future, at the same time a larger private sector participation would come up with the policy instruments as player in the commercial market. With such political goals and instruments in hand, a more competitiveness is expected to come among the stakeholders and people at large to produce more and more energy saving facilities which ultimately secure the raising energy demand and better energy future. Taking consideration of the importance of the 'energy efficiency policy instruments and measures for outlook of energy future, the detail study of the policy measures and instruments in place of France, Germany, Italy, Sweden and Great Britain from Europe have been undertaken. Bhutan has

[1] Greenhouse gas

been included in a view to see the energy consumption in the developing or least developed country and find a suitable recommendation through the shared experiences of the developed nations.

2. Objectives

The first objective of the study is to describe, explain and compare the energy supply mix, production and consumption in the selected countries at sectoral levels. The second objective is to review, describe and compare the energy efficiency policies, policy instruments and measures in the five industrialised countries selected for this study at sectoral levels and provide a short evaluation and recommendation for Bhutan. Overall, the study aims at identifying the suitable policy measures that have proven to be most effective to make recommendations for Bhutan, a developing nation, which is freshly boarding on energy market and energy management policies.

3. Methodology and Approach

In this study, consideration was given to the current energy supply, consumption and production mix. 'Energy efficiency policy instruments and measures' of the governments in the countries of interest with respect to increasing energy efficiency, their possible interactions, to the extent possible the cross-sectoral measures taken were looked in detail. Residential and commercial sector, transport sector, industry sector, electricity sector and cross-sectoral measures were taken for this study. The data collection for the above sectors and the documents related to political agenda, the policies and future target and goals were from international publications and on-going projects of the European Commission. For further assistance, broad literature surveys through internet were undertaken. Systematic comparison of the 'energy efficiency policy instruments and measures' were carried out. The evaluation was done only for the selected 'energy efficiency policy instruments and measures' in place. The main considerations, assumptions and its positive effects on the long-term future energy supply were looked.

4. Energy Consumption and Supply Mix

The total primary energy needed to supply the five giant countries of European Union France, Germany, Italy, Sweden and Great Britain was 1093.63 Mtoe[2] in 2005. The energy demand is increasing in these countries despite several measures adapted for reduction in consumption and import dependency. However, the increase in the energy supply indicates the country's push towards more advanced developmental activities, rise in the GDP[3] and increase in the comfort levels.

4.1 Energy Supply, Production and Net Import

The comparison of key energy indicators among five European countries depicted a strong dependence on imports of energy. This fact is vivid from the total primary energy supply, energy production and net import in 2000 and 2005 (fig 1) [3]. It is evident from the figure that the productions are in the decline and these countries have become more import dependent to meet the present energy supply. This entails the fact that the fuel resources are depleting, a threat to the security of primary energy supply. In addition, it illustrates a need to address the security of primary energy supply with the depleting fossil fuel resources to meet the present and future energy demand.

[2] Million tonnes of oil equivalent

3 Gross domestic product

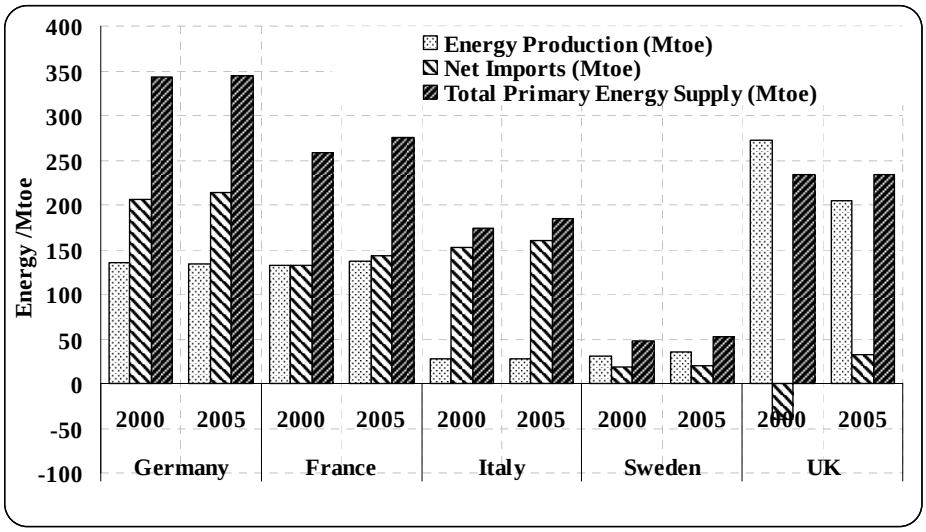

Fig 1. Total Primary Energy Supply, Production and Import

To address this issue and the issue of climate change, the governments in the countries selected for this study initiated the national energy efficiency policies, policy instruments and measures as a means of maintaining their competitiveness among energy-intensive industries, elongating supplies over a longer period for sustainable use and reduce the dependency on the import of fossil fuels. Apart from national initiatives, the other international obligations such as Kyoto Protocol objectives, the European Union (EU) mandate and European Commission (EC) directives have an impact in enhancing and prioritising the energy efficiency policies and measures. However, the energy demand and supply is increasing continuously in spite of these initiatives though effective (fig 2). From this figure, one can say that the primary energy supply has increased from 1990 by almost about 5% every five years until 2005 except for Germany. The uniqueness in the primary energy supply for Germany is due to reunification process in 1990. The main reason for the decrease in energy use was due to the fact that many economically inefficient production sites were shut down. The stabilisation of energy supply in case of UK in 2000 and 2005 indicates that the national and international obligations (Kyoto – 1995, EU, EC-2000) on energy efficiency policies have prevented the continuation of the trend of increasing energy consumption of the preceding years. Thus, the measures proved to be effective. Overall, this figure portraits that the energy efficiency policy instruments and measures proved to be effective in increasing efficiency but cannot guarantee in reducing the primary energy supply over time due to rising per capita income, increasing GDP and increasing demand for comfort level and behavioural change of the people in these countries.

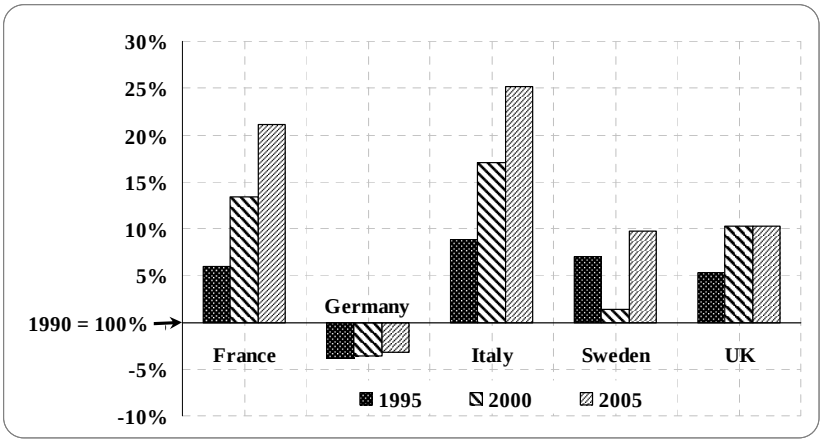

Fig 2. Percentage Increase/Decrease in Primary Energy Supply taking 1990 figures as Base Value

It is clear that the TPES[4] is the largest in Germany, near about 346 Mtoe in 2005, while the least among five European countries is Sweden with less than 55 Mtoe in the same year (fig 1). It is obvious in the gross supply of energy in terms of its population and size. However, in terms of the per capita energy supply, Sweden is the largest with per capita primary energy supply of about 6.0 toe (fig 3). The UK is not much dependent on the import, as the total primary energy supply obtained from its own production, however, the production had reduced substantially in 2005 from 2000 by about 27%, and this trend will likely to follow in future. But, the rest of the countries including Bhutan are import-dependent for the primary energy supply. The fact is that there is no known reserve of oil and natural gas in Bhutan[5]. The per capita production of primary energy for Germany (1.6), France (2.2) and Italy (0.5) is much lower than the net per capita imports while Sweden, United Kingdom and Bhutan have the per capita production (3.9, 3.4 and 0.74 respectively) larger than per capita import. It is because these countries are exporting the surplus energy enhancing their economic growth and revenue generation. Bhutan, being a developing country, the import has a much larger implication in the economy and energy security than the developed nations. It has a negative balance in the economy of the country shadowing its benefit from the export of energy at the same time.

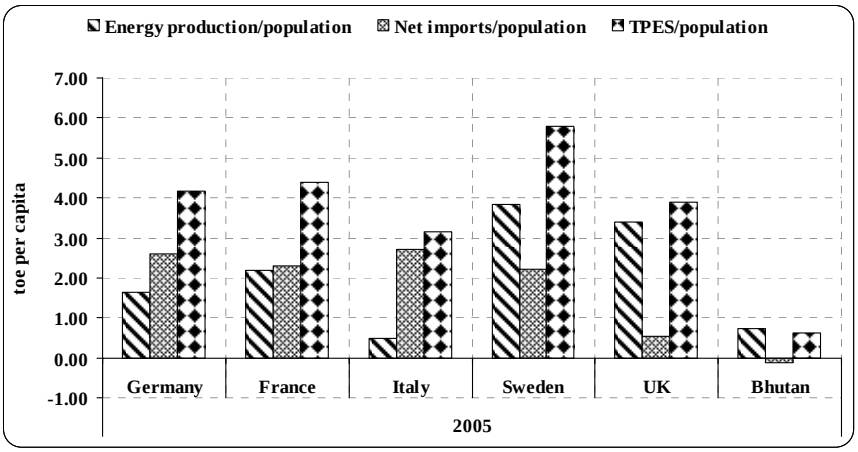

Fig 3. Per capita total primary energy supply, production and net import

4.2 Final Energy Consumption

No doubt, Germany (260.96 Mtoe) has the largest consumption of energy followed by France, UK, Italy (176.81 Mtoe, 162.15 Mtoe, 148.04 Mtoe respectively); and Sweden has least (35.23 Mtoe) among all five. Table 1, summarizes the percentage share of energy consumption in various sectors [Source Data: Energy Balances of OECD Countries, IEA, 2007, www.bmwi.de and Bhutan Energy Directory 2005]. (Does this sentence has any meaning?). The percentage shares of energy consumption on various sectors are almost identical among the countries studied. Though Bhutan (0.39 Mtoe) is very small in terms of area, population and very far in economy from developed nations, yet the percentage share of energy consumption on sectors studied are much larger.

Table 1. Comparison of Final Energy Consumption in different Sectors

SECTORS	France	Germany	Italy	Sweden	UK	Bhutan
	[%]	[%]	[%]	[%]	[%]	[%]
Industry	19.96	22.18	26.22	33.95	19.32	24.94
Transport	29.23	24.28	30.16	24.61	34.89	14.27
Other (residential, Commercial, Agriculture, etc.)	42.59	43.84	36.81	35.31	38.58	60.14
Non-energy use	8.23	9.71	6.80	6.13	7.21	0.65

[4] Total Primary Energy Supply

[5] Fossil fuel for transport sector and LPG for domestic sector- used for cooking in urban areas

Fig 4 shows comparison of the energy consumption in Other Sectors (residential, commercial & public services, agriculture/forestry, fishing and non-specified). From the figure, it is seen that the percentage share of energy consumption in Residential sector is the highest. France consumed about 26%, Germany about 24%, Italy 22%, Sweden about 21%, UK about 27% and Bhutan about 49% of the total final energy consumption in 2005. The percentage shares of consumption are identical for all most all countries except for UK, in which Residential consumption is the largest not considering the developing nation, Bhutan. Though Germany is large in terms of area and economic activities in Europe, the percentage share of energy consumptions are far lower than the other countries. However, there are various strong measures undertaken by the respective countries to reduce energy consumption in residential sector, still a lot more work left undone. Therefore, to integrate effective energy efficiency policies and measures targeting to reduce GHG emissions meeting the EU mandate, this sector is crucial in all the countries studied for effective policy push.

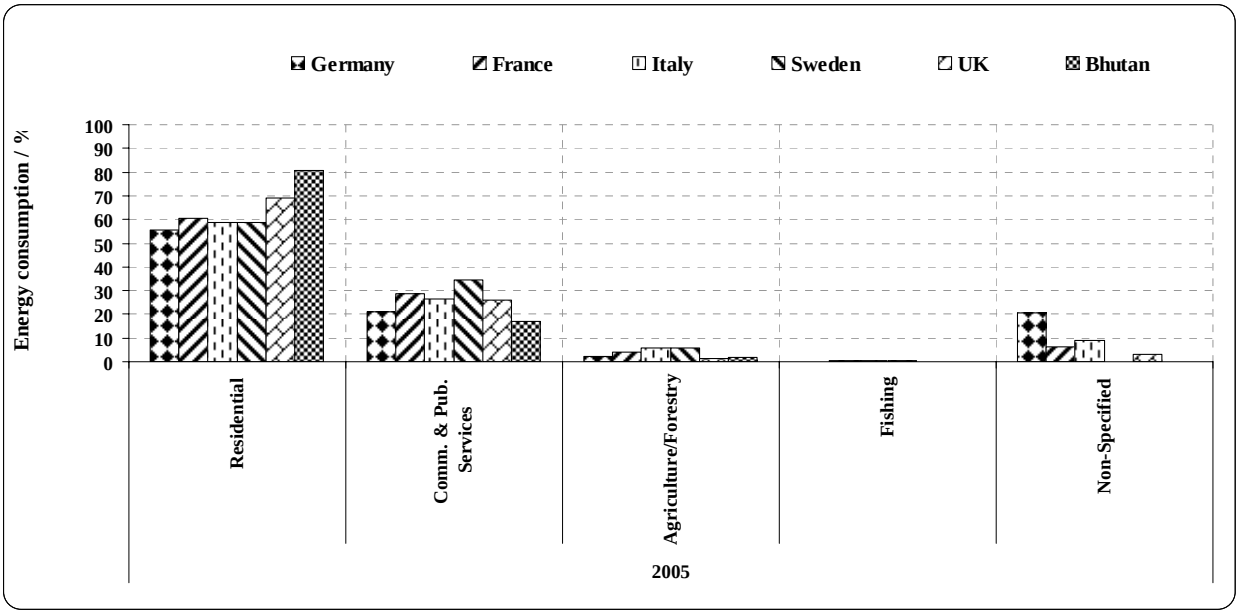

Fig 4. Per capita total primary consumption in other sectors

4.3 Comparison of Energy Intensity

Energy intensity is one of the key indicators assessing economic activities in any nation. The higher the energy intensity the lower is the economic growth. It provides an indication of purchasing power of a nation to purchase any goods and services including energy, an essential commodity in the today's living habits and standards. The energy intensity of Bhutan, the least developed country among the countries selected for this study, is the highest, both the TPES per GDP and electricity consumption per GDP and is very noticeable the same trend for most of the least developed and developing nations (fig 5). Among European countries taken, Sweden has the highest electricity consumption per GDP while TPES per GDP is significantly low. The variation of trend in the energy consumption per GDP in the developed nation is not much significant, almost equal and identical. It clearly gives an indication that the economic activities among five European countries studied are very stiff and neck-to-neck, as they can effort easily to purchase energy requirement based on their GDP growth and purchasing power. However, the fact of the scarcity of fossil fuels and risk of market disruption on the oil prices at present moment, the Kyoto obligations and EU mandate of carbon taxation will have a much larger implication in future. Therefore, well developed and careful policy push directed towards the reduction in primary energy supply and consumption is essential. In addition, it will provide an immense opportunity to look through the achievement and shortcoming of the existing policy instruments and efficiency measures, which are in place mandatory or voluntary.

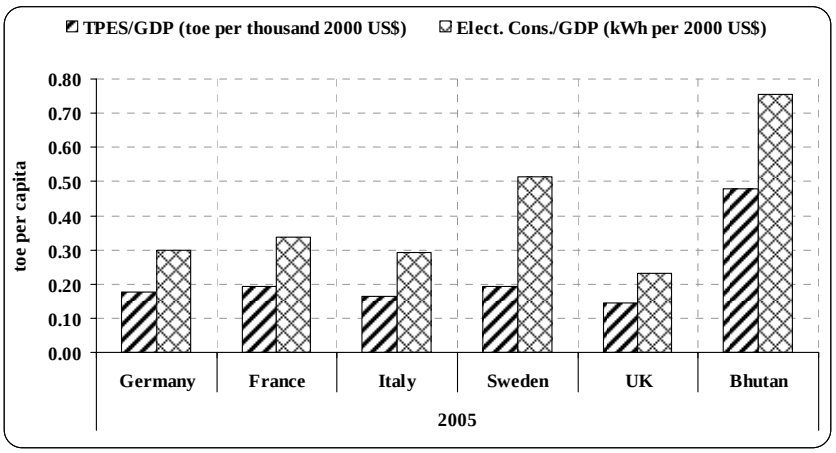

Fig 5. Per TPES per GDP and electricity consumption per GDP

5. Evaluation of Selected Energy Efficiency Policy Instruments

There is no single tool to evaluate the impact of all policies concerning all the sectors with the highest degree of sensitivity analysis. It is because the existing models such as MURE impact study tools have shortcomings to assess properly the effect of energy use as the policy instruments are departing from monetary value. The introduction of voluntary program, the step subsidy issues, health of human being and the environment cannot have translation into a reasonable accurate model. Therefore, a basis of subjective judgement based on qualitative analysis is chosen to show the effectiveness of the policy instruments in place for the selected policy instruments.

5.1 Rationale of Subjective Judgement based on Qualitative Analysis

Creating a base for analysis is a huge challenge as each policy instrument has a different level and nature of activity in the target groups. There are various schemes often combined with tax exemption rules or more precisely designed as 'hybrids', opening a range of possibilities for the policies to interact among the sectors as well as with the other schemes such as renewable energy and climate change policies. In addition, there are series of policy instruments including the changed philosophy of social and cultural behaviour towards policy intervention, which has no measuring tool to supplement the study. Many of the voluntary schemes include supporting public policies such as financial assistance, audits and information dissemination, in which quantifying impact or effectiveness is very complex. There are increasing public-partnerships and different voluntary approaches emerging due to the open trade and common policies of the unified Europe triggering the policy intervention on national and international market. Today, policy instruments applied are not alone but combined within a mix aimed at increased benefits from individual policy instruments in which the study through a single input-output model is not sufficient to deliver complete results of all the sectors. Therefore, studying the effectiveness of these interventions is preferred to be done more elaborately through subjective judgement based on qualitative analysis

5.2 Defining Subjective Rating (Levels)

Three category levels assigned for understanding the different policy instruments that were implemented in the countries of interest. Only the selected energy efficiency policy measures, which are in place, are taken. The symbol '++', '+' and 'o' signs were assigned to respective policy instruments based on the weight factor assigned subjectively. The overall rating was derived for that particular sector based on the rating obtained on the subsequent selected energy efficiency policy instruments, '++' for the highest level, 'effective' followed by '+', 'moderate' and 'o', for the lowest level or 'indistinct'. The '++' symbol represents that the policy instrument is in place which is considered having a direct contribution for energy efficiency gains. These instruments can interact with other energy policies and are considered complementary to other energy efficiency measures. Moreover, these policy instruments and the energy indicator are considered complementary, though the energy supply and consumption is looked at a broad horizon - at the sectoral level except industry sector in which some of the most energy consuming industries are segregated. The '+' symbol

represents that the policy instrument is in place which is considered having a potential contribution for energy efficiency gains, but do not interact with other energy policies. Certain deviation is expected, however, the overall gain is considered positive. The 'o' symbol represents that the policy instrument is in place, but more general in nature. It can have positive contribution, negative impact or not at all. Even if the policy instruments are not available or not reflected, the information is missing or not complete, then this level is assigned.

5.3 Evaluation Results of Selected Energy Efficiency Policy Instruments

The evaluated ratings both the qualitative and quantitative of the policy instruments scattered throughout the tableare not so uniform, except for residential sector. It indicates that the residential sector has upper hand in terms of implemented energy efficiency policy instruments and measures, very strong and effective in all the countries studied. On the other hand, the energy efficiency policies are weak in transport and industry sectors, except for Germany, as these sectors are immature, started late in implementing energy efficiency policies. Nevertheless, with the integration of 'climate and energy' considering as a single issue and not separately as done recently by Germany and gathering experiences over time, it is expected that these sectors could take a much stronger progressive move in near future.

From table 2, it can be stated that the residential sector has the energy efficiency policies and measures in place, implemented by the selected countries, which are most effective in achieving the goals. It is because, the residential energy efficiency improvement started as early as 1970s in France, Germany and Sweden, and in late 80s to early 90s in UK and Italy.

Table 2. Summary result of evaluated selected energy efficiency policy instruments and measures

Particular	France	Germany	Italy	Sweden	UK
1 INDUSTRY SECTOR	+	++	+	+	+
a. Voluntary Agreements	+	++	++	++	+
b. Subsidies and Grants	+	++	+	+	+
c. Public information and advice	+	+	o	++	o
d. Greenhouse gas emission trading	+	++	++	o	++
2 RESIDENTIAL AND COMMERCIAL SECTOR	++	++	+	++	++
a. Building sector policies	++	++	++	++	++
i. Energy performance standards of building	++	++	++	++	++
ii. Public information and consultation	++	++	+	++	++
iii. Building rehabilitation programme	++	++	+	+	++
b. Appliances standards and labelling	+	+	o	++	o
3 TRANSPORT SECTOR	+	++	+	+	++
a. Fuel economy standards and labelling	++	++	+	+	++
b. Demand Side Management	+	++	+	+	++
4 ELECTRICITY SECTOR	+	+	-	+	+
a. Combine Heat and Power (CHP)	+	++	+	+	++
b. Support for old existing plants	+	+	o	+	+
c. Modernization of existing plants	+	+	o	o	o
5 CROSS-SECTORAL MEASURES	+	o	++	o	o
a. White Certificate	+	o	+	o	+
b. Green Certificate	+	o	++	+	o
c. Eco-taxation	o	+	o	o	o

Note: ++ symbolizes 'effective'; + symbolizes 'moderate'; o symbolizes 'indistinct'

The policies in place in industry sector in Germany are very effective, though Sweden is not far behind. It is because the most energy intensive industries are located in Sweden and energy efficiency is a critical issue in increasing the production efficiency and effectiveness. Some of the policies in industry sector in Italy are very effective though majorities are moderate. However, UKs' focus is less in the industry sector as seen from the table. Even in France, the policies are good and effective. The divergence of most of the energy efficiency policies from industry sector is due to the limited availability of data, the complexity of industrial production process, type of industry and due to the fact that all the energy intensive industries are efficient. In addition, industry consumes substantial amount of energy, and from the start, energy efficiency is always given the first priority.

The table tworeveals that France, Germany and UK are doing very well in transport sector as they have already started fuel economy standard and labelling. The EU directive on the fuel standard and labelling in transport sector has pushed other countries to work for the policy framework in this area. The demand side management is important in increasing the efficiency, reducing traffic and at the same time reducing CO_2 emissions. From table 2, it is also clear that the transport sector is gaining momentum in the effective implementation of energy efficiency instruments and measures.

5.3.1 Residential/Households Sector

There are strong building codes implemented in Germany since 1977 in household sector to enhance energy efficiency of buildings. Sweden and France had started about the same time for the building regulations, but UK and Italy started much later. The impact of the policy measures in UK seems increasing, though the UK Government started the regulation much later than Germany, France and Sweden through climate change policy to reduce CO_2 emissions and to meet the obligation of Kyoto Protocol and EU Directives. The "Tradable White Certificate" is gaining popularity in UK, Italy and France. Overall, the countries have very strong energy efficiency policy instruments and measures in household sector. However, the household energy consumption is raising in spite of several effective policy measures implemented due to the increase use of lighting and other household appliances and electronic equipment. Despite enormous efforts made in improving the energy efficiency in household sector, there is still a significant difference in the energy efficiency achieved and the saving potential. According to the study conducted by IEA, the OECD countries could save electricity of about 88 Mtoe by 2030 through deployment of more energy efficient appliances [...]. Therefore, it is clear that there is a significant technical potential for energy savings in the domestic appliances, more research and review of existing energy efficiency improvement policy instruments is essential.

5.3.2 Transport Sector

The traffic volume in EU is increasing (>650 vehicles per 1000 population in Europe [...] and therefore, the energy consumption is expected to rise continuously in transport sector. Although the transport sector falls more likely together in the theme of environment and conservation of ecosystems through its hazardous impact on the natural environment through carbon dioxide emissions, the security of supply of the transport fuel and fuel poverty are other concerns. There are various measures which comprise of technical, regulatory policy, price policy and investment measures along with public awareness and information which the governments are pursuing in more broad and elaborate packages. The impact of these policy measures are low as these policies in this sector have started much later than the residential and industrial sectors and it is gaining maturity over time. Increasing efficiency in road transport demands exploitation of advanced technical solution in reducing fuel consumption in cars and heavy vehicles. The study on fuel economy of vehicles by IEA shows that the efficiency of diesel engines can be improved from 16% to 34% and possibility of efficiency gains for spark-ignition engines could be achieved round about 13% to 26% [Energy Policies of IEA Countries, IEA, 2007]. Since there is a clear possibility in increasing the efficiency through innovative measures, the policy directives in this area need a study for energy efficiency (determination of saving potential) and setting future targets in emission reduction and sharing the burden in achieving the mandate of EU and Kyoto Protocol.

5.3.3 Industry Sector

Though the energy consumption in the industry sector is substantial, estimating the overall impact and effectiveness of energy efficiency policies on the industrial energy use is more complicated. It is due to the fact that the availability of data is limited on one hand and on the other hand the industrial process is complicated which differs from industry to industry to accurately determine the energy consumption and losses in the entire chain. The effectiveness of the policy on energy efficiency as seen from the table is remarkable in Germany followed by UK, France, Italy and Sweden. The reasons being the industries are energy intensive and therefore, energy saving measures are implemented from the beginning by themselves. Consequently, the governments are not taking strict energy efficiency policy measures in this sector and at the same time, one policy aspect might not apply to all kinds of industries. The motors and motor driven systems consume a substantial amount of energy, about two-thirds of electricity demand in industry sector. Therefore, there is a huge potential of energy savings in motors, about 20% to 25% with the existing technology in the market [World Energy Outlook 2006, IEA]. However, the direction is clear that there is a need to investigate more detail in industry sector and come up with suitable policy instruments and measures to improve energy efficiency and to lower energy consumption in this sector.

5.3.4 Electricity Sector

The climate change policy is driving most of the electricity generation in Europe to reduce the emissions. However, the CO_2 emissions from this sector were estimated to be 25% higher compared to the levels in 2004 in 2030 in the OECD [World Energy Outlook 2006, IEA.....]. Moreover, the power plants in the countries of interest are ageing which operate at much lower efficiency and rated capacity. Therefore, now it is essential to look at the policy aspect, which addresses the means for the retirements of old coal-fired, or gas and oil fired plants so that the energy efficiency in this sector is not distorted, at the same time achieving the security of supply and demand. Moreover, the environmental restrictions of EU will force these old power plants to phase out from generation, about 75 GW[6] of nuclear power plants to be permanently retired [World Energy Outlook 2006, IEA.....]. Lighting is the major source of electricity demand, which accounts for about 19% of the global electricity demand resulting in 1.9 Gt[7] of CO_2 emissions, of which three-quarters is consumed in residential and services sectors. There are various energy efficient technologies already in the market for 'smart' lighting. However, there is still a huge gap for this technology widely to penetrate due to affordability and awareness. The efficiencies of the different lighting appliances used vary greatly and depend largely on the application. Even the 'day-lighting' could solve most of our daily lighting needs if designed and used appropriately. The stronger innovative energy efficiency policy instruments looking these aspects are very crucial in lowering the electricity consumption in meeting the lighting demand and enhancing energy efficiency of electricity sector.

5.3.5 Cross-Sectoral Measures

There are energy efficiency measures such as innovative measures and other cross-cutting measures like eco-taxation. Though the effectiveness is low on the selected policy instruments, however, -the measures such as eco-taxation in transport sector are gaining popularity in European countries. The energy efficient technology procurement and Green Certificates are other instruments coming in the market. Innovativeness is an essential tool that can penetrate in the market early on providing a huge benefit.

5.4 Study of Overall Assessment

The variation in the effectiveness of the overall policy instruments is not large. It is because most of the policy instruments are cross-sectoral in which the impact of one falls on the other and therefore, the overall impact is spread uniformly and is far better than the impact due to the measures in an individual sector. The highest effectiveness in Germany is expected owing to the very strong regulations in place and started very early on about late 70s in formulation of energy efficiency policies. The Sweden and France followed the same trend while UK and Italy are gaining momentum

[6] Giga Watts
[7] Giga tonnes

now in which they have started the regulations in mid 80s or early 90s. Moreover, the overall impact of the energy efficiency policies is seen quite uniform, but more potential exist for those countries which initiated such schemes recently. For instance, UK has a huge potential in increasing energy efficiency in residential sector alone, in which there are already plans to extend the energy efficiency policy implemented in 2002 up to 2011 and beyond. Similar potential exists in Italy as it has started the white certificate scheme further to enhance the energy efficiency programmes.

6. Recommendation to Bhutan

Overall, the study aims at identifying the suitable policy measures that have proven to be most effective to make recommendations for Bhutan, which is freshly boarding on energy market and energy management policies. The key recommendations are summarized below:

1. Energy efficiency policies, information, education, and awareness for efficient utilisation of energy & lifestyle change and the capacity building of the institutions are essential to address the benefit of energy efficiency and diversity of energy resources which will provide a positive impact on the energy security with rising prices of oil and gas in the market.
2. Looking at the experiences of the selected countries for this study from the developed world, though the energy efficiency policy instruments and measures are effective, it cannot be directly transferred to Bhutan. It is because Bhutan is freshly boarding into the energy market, which is far behind than developed nations in these activities and the driving element or the only source for energy production is hydro. Therefore, careful consideration of the inputs from the experienced nations in the locally designed policies would be effective.
3. Bhutan is small in-terms of area, but very large in-terms of geographical variation and topography. Therefore, regulatory reforms such as thermal building codes and performance certification could bring a substantial improvement in improving energy efficiency in the residential sector through community participation and individual mobilisation.
4. Suitable policies designed for 'Demand Side Management' of the transport sector will be highly beneficial. This will address the present problems of 'fuel poverty', security of supply, reduction of CO_2 emissions and traffic management and control of transport sector.
5. For the reduction in the energy consumption in industry sector, policy on the energy efficient technology procurement is essential. Policies targeting the small-scale industries are important too, as these industries will grow over time with the current developmental pace and collectively demand a huge amount of energy.
6. Energy efficiency policy instruments, measures and programmes promoting education and awareness are important for Bhutan looking at the experiences of the selected countries for this study. These aspects can be addressed while pursuing the goals of climate change and long-term environmental protection.
7. The long-term commitments are needed from the developed nations and development partners to balance energy investments, transfer of knowledge and set-up financing instruments which will influence private capital particularly in developing country like Bhutan where there are largely scattered population living in energy-poverty with limited accessibility due to mountainous terrain.
8. The following energy efficiency policy instruments and measures could be considered to transfer to developing nations from the selected developed countries from this study:
   a. Information, education and awareness programmes
   b. Thermal insulation of buildings
   c. Promotion of efficient windows and doors
   d. Public information and consultation
   e. Voluntary agreements for the promotion of energy efficient products in the market
   f. Encouragement in the increased use of energy efficient appliances
   g. Technology procurement for the industry sector
   h. Policies encouraging the DSM in all sectors
   i. Increased use of renewable energy resources

7. Barriers in Implementing Energy Efficiency Policy Instruments and Measures in Developing Nations

7.1 Lack of Reliable Data

Developing the suitable energy efficiency policy instruments and measures requires an accurate analysis of energy efficiencies and CO_2 emissions, empirical relations, facts and figures using good quality data and physical indicators. Lack of comprehensive data management is a critical barrier to come up with sound policy instruments and measures. Therefore, there is a clear need for the improvement of data situation, reporting of annual energy indicators assuming adequate resources if detailed and sound energy efficiency policy and measures need to be designed and implemented. Moreover, data issues become more prudent when comes to industry sector where data are confidential because of anti-trust regulations. Therefore, there is a need to develop management information system to bridge this gap and bring sound and reliable data, which will help and ease the formulation of sound policies.

7.2 Lack of Education and Information

Lack of awareness regarding the potential for cost-effective energy-savings will mislead to flaws or partial information regarding the energy performance of end-use equipment on energy-using systems. Moreover, the decision-makers for the energy-efficiency investments are not always the final users who have to pay the energy bill. Thus, the market and hence sound information sharing do not reveal the overall cost of energy services and education is very crucial. The financial benefit on making investment on efficient energy consuming equipment will bring a net financial benefit with over time to the consumers and not instantly. These aspects are not known and creating awareness with social consideration and habitual changes are very important in the formulation of a sound policy.

7.3 Difficulty in Decision Making

The end use efficiency improvement in the residential and commercial, transport and industry sectors involves more individuals in decision-making and much greater number of individual decisions. It is because the financing comes from the consumers themselves or from some private investors. Therefore, the precisely designed and well-enforced regulations on energy efficiency standards coupled with the existing appropriate energy pricing policies will encourage consumers and investors in making investment in energy efficiency improvements.

7.4 Lack of Incentive on Making Investment

The property owners in the city have less incentive in making building more energy efficient, as the tenants and future owners are liable for the running costs and this factor is not fully reflected in the value of the property. Despite numerous efforts in the improvement of ‘energy efficiency policy instruments and measures’ in the developed nations, the energy performance of most of the energy-using systems is either invisible or suspicious to end-users. Providing incentives for making investment on energy efficiency is necessary even if the investment in such scheme is though considered non-profitable but crucial to meet energy-security and environmental goals.

7.5 Unregulated Market

It is known that the unregulated market will deliver least-cost end-use energy services. The market barriers and imperfections derive from various aspects such as individual decisions in making a purchase, consumer choices, commercial discount rates, etc. Energy efficiency is often a minor factor in making decisions in purchasing the appliances and equipment. It is because the financial constraint is a dominating factor on individual consumers, which are far more severe than implied by long-term interest rates or rate of return. The effective operation of market requires the value of the goods and services to be clear. Therefore, precise and clear market regulation is essential.

8. Conclusion

The adoption and implementation of the best energy efficiency policy instruments and measures of the developed nations would be a major step for any developing nations on the road to a more sustainable energy future. It would begin to guide the country onto a profound different energy path

aiding the one that is followed today, environmentally unfriendly to a more sustainable energy future in which the energy supplies are secured, the emissions are reduced and import of fossil fuels are minimized. However, careful study for the best policy framework, adoption and implementation of matured policy instruments and measures from the experienced nations would be helpful if it is to achieve the maximum benefit out of it immediately. It is pertinent to investigate more on programmes on development, demonstration and deployment, additional economic incentives to encourage energy users and producers to switch to available energy efficient technologies eliminating the subsidies that encourage the wasteful use of energy.

To accelerate the energy efficiency gains for a secured energy future, the government needs to enforce standards and implement new regulatory and legislative measures to improve demand-side management, building codes, industrial energy efficiency and reduce vehicle fuel poverty. It is because on one hand, the petroleum and fossil fuel reserves are declining and on the other hand, the developing nations are likely to be highly venerable becoming the 'dumping yard' of energy inefficient appliances and equipments coming through imports. Delaying in the implementation of any legislation in this regard would compound the problems related with rising energy use by extending the path for inefficient energy systems pouring in from trade partners and neighbourhood. More strong actions and interventions are necessary particularly to spread information and knowledge as well as the specific sector measures in order to support actively, the success of energy efficiency programmes in developing nations. The most important measures include support for testing, labelling and certification of energy consuming equipment, support for technology procurement, education and information sharing and market introduction of energy efficient technology.

Modern life style and the developmental activities demand more and more use of energy in any form and hence, judicious and efficient use of energy resources is of paramount importance for sustainable development and conservation of ecology. Understanding the approach and energy efficient policy shift would provide a benchmark for any nation in combating the challenge of ever-rising energy demand and ecological imbalance caused while starving for energy and exploiting it indiscriminately. Increasing use of efficient technologies will not automatically guarantee in reducing primary energy supply but consumer behaviour in the sense of efficient use of energy plays an important role. Hence, study of "rebound effect" and 'behavioural change and habit of the people' is crucial to integrate its impact in the existing energy efficiency policies and measures if it is to obtain maximum sustainable benefit out of it. The needs for more cooperation between all the nations developing and developed are essential and urgent to tackle the issue of global climate change caused through manmade activities. "*We live in an interconnected world, we need connected solutions. It is our responsibility to lead and to create regional mechanisms to address environmental challenges. While we are far off on a global agreement, which, in any case would be hardly workable in practical terms, we are steps away from putting in place regional mechanisms for reducing and monitoring emissions and providing solid guidelines for the future*" [.....]. Therefore, it is important to act unanimously as one and work together to solve the common issue of climate change through energy efficiency improvements and CO_2 emissions reduction, making the globe a place for our future generations to see the footprint of our times.

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