10. INSTITUTIONAL AND REGULATORY MODELS FOR THERMAL ENERGY SERVICES

Sustainable Thermal Energy Service Partnerships

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STEPs
Sustainable Thermal Energy Service Partnerships

FOREWORD

Absence of safe and modern thermal energy services covering a significant share of the global population is resulting in significant levels of pre-mature deaths. This market failure needs to be addressed through a comprehensive policy and regulatory framework.

The key stakeholders in the current policy and regulatory landscape are energy, environment and consumer protection ministries as well as energy and fuel regulators. The needs, roles and responsibilities of key stakeholders of users, service providers, manufacturers, governments and regulators and financiers were analysed to identify the principles of support required and the guidelines for the required regulatory and policy framework.

A number of policy and regulatory instruments to achieve the objectives of security of supply, social justice, environmental and consumer protection and economic efficiency have also been specified. This new approach to the policy and regulatory framework is required to facilitate a transformational change in thermal energy service delivery through the use of technology, finance and business models.

- Binu Parthan, 2017.

Acronyms

5P	Pro-Poor Public-Private Partnership
BOOT	Build-Own-Operate-Transfer
CNG	Compressed Natural Gas
CO	Carbon Monoxide
GHG	Greenhouse Gas
IPP	Independent Power Producer
LPG	Liquefied Petroleum Gas
NOx	Oxides of Nitrogen
PM	Particulate Matter
SDG	Sustainable Development Goal
SO	Sulphur Oxide
SE4All	Sustainable Energy for All
TVET	Technical and Vocation Education and Training
UN-ESCAP	United Nations Economic and Social Commission for Asia Pacific
VOC	Volatile Organic Compounds

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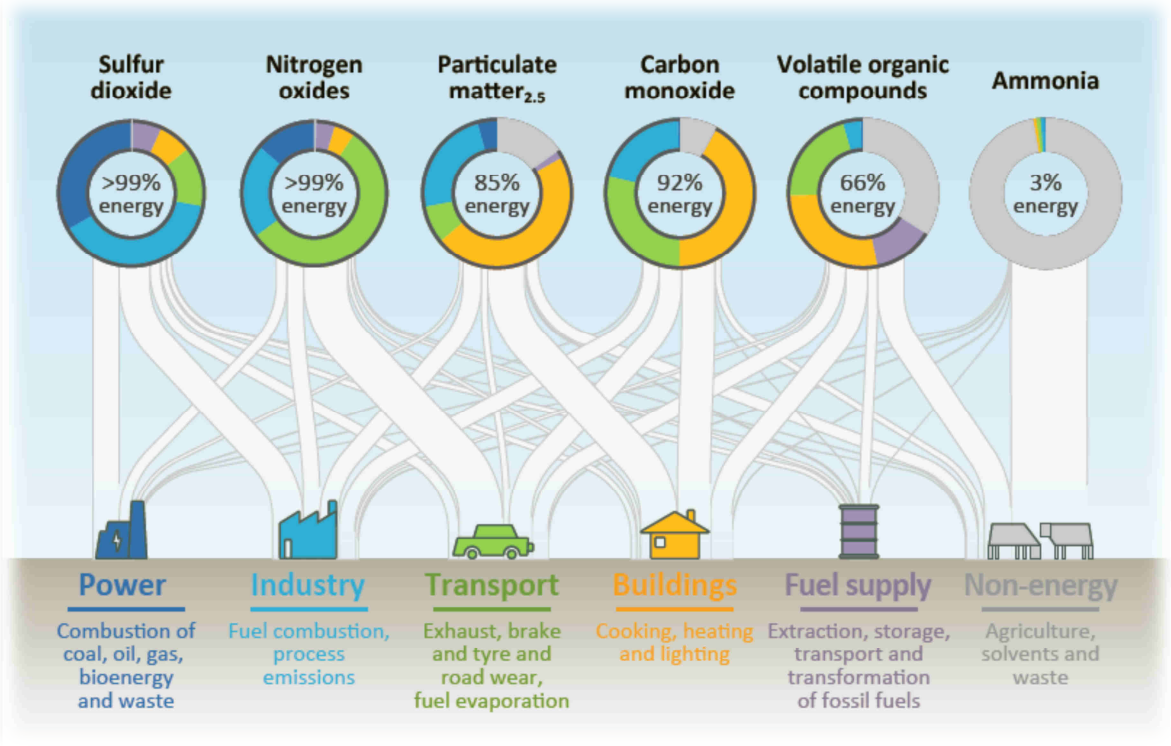
1.0 – Background

Policy and Regulation could play a very important role in ensuring the Sustainable Development Goal (SDG) 7 of 'By 2030, ensure universal access to affordable, reliable and modern energy services'[1]. This is particularly important for thermal energy that faces much more significant challenges that electrical energy access. There were about 2.9 billion people without access to modern thermal energy services[2] in developing countries, the number having increased from 2.8 billion in 2010 (IEA and World Bank, 2015). This lack of progress probably denotes a market failure in meeting one of the major energy related development challenges of our times. This market failure needs to be addressed through a combination of policies and regulation and associated instruments.

The policy and regulatory challenges facing provision safe and modern thermal energy by a service provider over the life of the system are many. The market failures with thermal energy services is because the current emphasis is on product sales than delivering services as well as the unavailability of thermal energy devices, cleaner fuels and services in rural parts of the developing world where majority of the poor live. This market failure in thermal energy services is also resulting in major adverse health impacts as explained below.

Figure 1. Primary Air Pollutants and their Sources



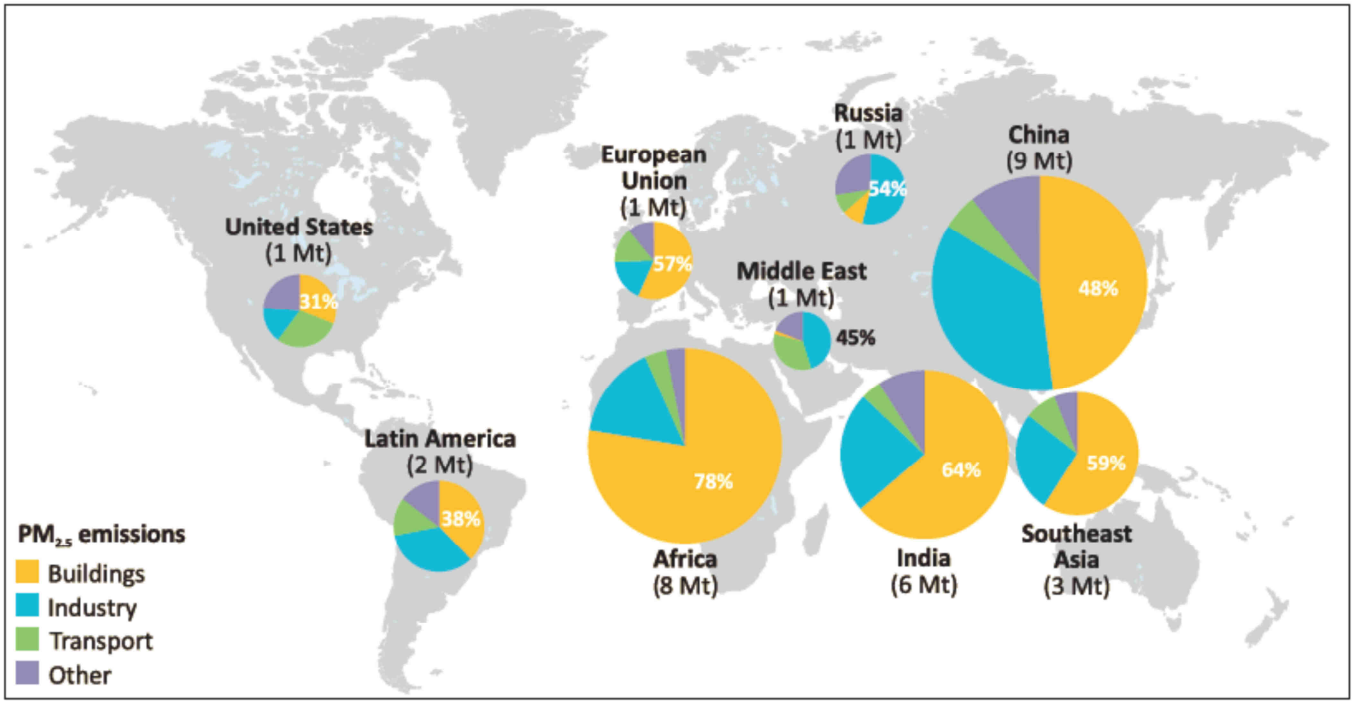
Source: IEA, 2016.

[1] Available at https://sustainabledevelopment.un.org/sdg7 accessed June 2016.
[2] Generally accepted in energy and development community as access of non-solid fuels.

It is estimated that annually 6.5 million premature deaths occur as a result of poor air quality of which the major share of 3.5 million/year is due to use primarily of solid biomass for cooking and space heating (IEA, 2016). As is shown in Figure 1, the major share of Particulate Matter $PM_{2.5}$[3], Carbon Monoxide (CO) and Volatile Organic Compounds (VOCs) is from cooking, heating and lighting[4] (IEA, 2016) which are mainly responsible for these premature deaths. If the PM emissions are analysed geographically and sectorally as is shown in Figure 2, it is evident that these are concentrated in Africa and Asia which account for 80% of the total emissions.

The share of PM from buildings – primarily heating is also significant in Europe[5] (IEA 2016) but the absolute volumes are much lower. Biomass based cooking and biomass and coal based heating are the major cause for these $PM_{2.5}$ emissions primarily due to incomplete combustion of these solid fuels.

Figure 2. Geographic and Sectoral Analysis of PM Emissions



Source: IEA, 2016.

[3] Fine particles that are smaller than 2.5 µm that cause adverse health impacts.
[4] Lighting using Kerosene.
[5] As a result of biomass based space heating systems in buildings and coal based power generation with the largest share of premature deaths of 0.34 million/year reported from Germany, Italy, Poland, France, Romania, UK and Spain.

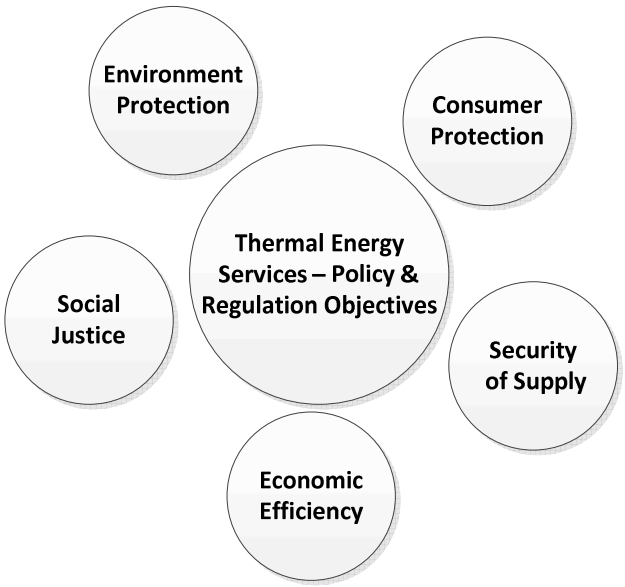
2.0 – Policy and Regulation

It is however possible to address these market failures and the resultant high levels of premature deaths through a set of targeted public policies and regulations. The key objectives of such thermal energy service related policy and regulatory frameworks would be[6]:

- **Security of supply** and continued provision of thermal energy services in a sustainable manner;
- **Social justice** to ensure that everyone who needs thermal energy services is covered – including in rural areas and the poorer sections of the society;
- **Consumer protection** through keeping the prices of thermal energy devices and systems low while ensuring the safety and well-being of the end-users through reduction of pre-mature deaths;
- **Environmental protection** through the reduction of environmental pollution including indoor and outdoor air pollution and reduction in the emissions of Greenhouse Gases (GHG) and other undesirable emissions and waste materials;
- **Economic efficiency** to ensure effective competition and to prevent market abuse and failures.

These objectives are illustrated in Figure 3.

Figure 3. Objectives of Policy and Regulatory Frameworks for Thermal Energy Services



[6] UNIDO and REEEP, 2008, REEEP/UNIDO *Sustainable Energy Regulation and Policymaking for Africa Toolkit.*

The level to which each of these objectives are relevant in different developing countries vary and some countries have much more developed policies and regulatory frameworks than others. However the key challenges that hamper the achievement of these five regulatory objectives include:

- Consumer protection through keeping the prices low for thermal energy services compared to current options is difficult in many developing countries and especially in rural areas as biomass, low grade peat and coal are available for free and can be collected by investing time;

- Costs involved in monitoring security of supply of thermal energy services through continued service provision is high compared to the cost of the systems and often investments are difficult to justify for policy makers;

- Use of clean energy for environmental protection through reduced emissions of GHGs and low levels of pollution might increase the prices for thermal energy services to customers. Similarly ensuring universal thermal energy service delivery is also likely to increase the average prices;

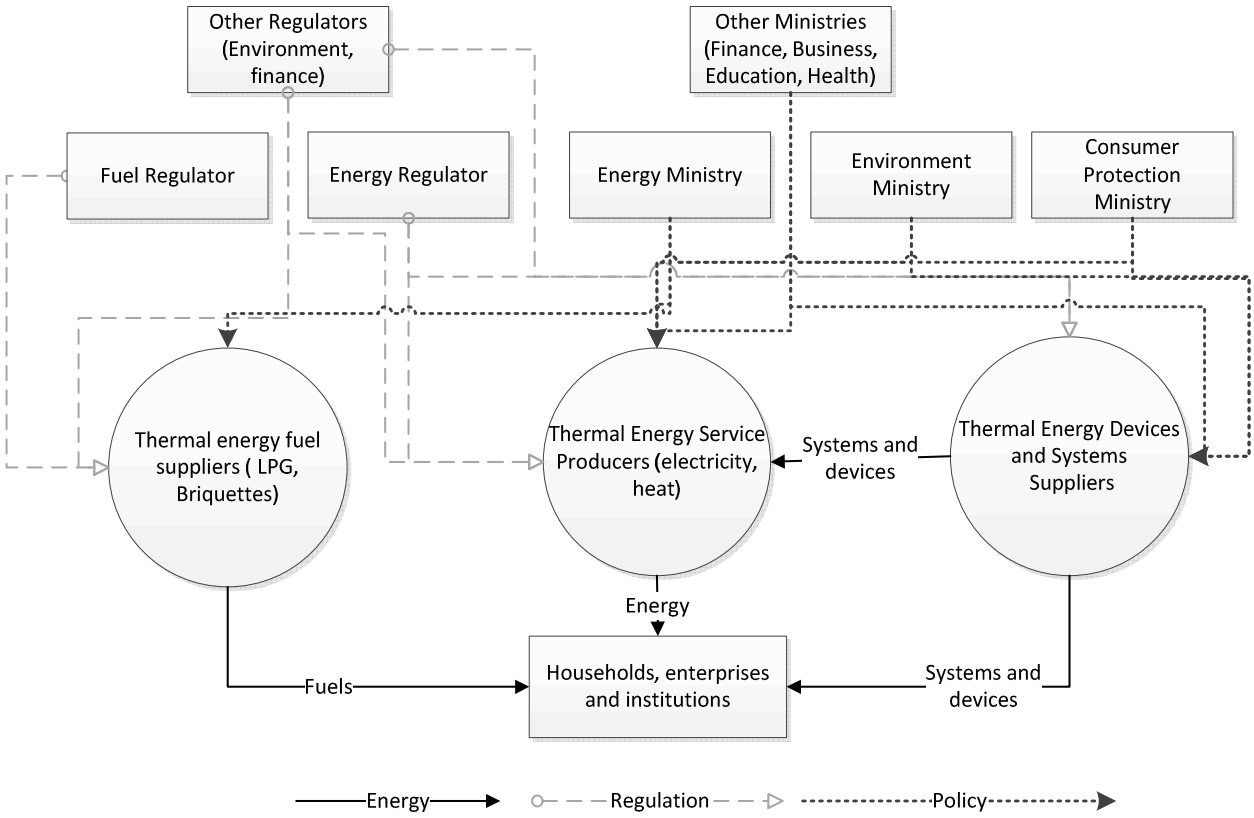
- As the market failures have resulted in the supply chains and associated support ecosystems to be concentrated in an urban and wealthier areas, it could be a lengthy and challenging prospect to extend similar quality services to rural and poorer areas;

- The human and institutional capabilities of policy making and regulatory institutions are limited in many developing countries with regulators often with electricity backgrounds with limited understanding and interest in thermal energy. Therefore there is a need to build sustainable institutional capacity and as well as toolkits consisting of appropriate policy and regulatory recommendations.

3.0 – Institutional Framework

The policy and regulation and institutional arrangements for thermal energy will need to cover solid biomass fuels, liquid biomass fuels and electricity as well as appliances for thermal energy end use. The institutional and regulatory frameworks for electricity and electrical appliances are much more advanced in developing countries than gaseous fuels and liquid and solid biomass fuels. However many developing countries have institutional and regulatory frameworks for liquid petroleum fuels for household and transport use as well as for solid fossil fuels for industrial use.

Figure 4. Policy and Regulatory Framework for Thermal Energy



All graphs from B. Parthan, except otherwise stated

A typical institutional arrangement for promotion of thermal energy developed through the research is illustrated in Figure 4 and the general roles of the key institutions are expected to be as follows:

3.1 – Government Agencies

Ministries or organisations which have a legal mandate to promote safer, cleaner use of energy for heating, cooking, water heating in households as well as for heating and cooling applications for commercial and industrial establishments and public service institutions. These organisations are normally responsible for ensuring social justice, environmental protection and often consumer protection or economic efficiency. Normally a large number of government ministries and/or agencies discharge these responsibilities rather than a single ministry. For instance, environmental protection is often carried out by one specialised ministry and energy issues are dealt by another ministry. Typical responsibilities of government agencies in the context of thermal energy are:

Energy Ministry: ministries or agencies responsible for energy or clean energy are normally responsible for developing national policies and programmes that govern LPG, efficient cookstoves, biomass linkages and sales, SWHs, electricity, coal, biofuels etc. These ministries lead on developing technical specifications, creating fiscal and financial incentives for manufacturers and users as well as implement programmes often targeting social justice. In a number of countries the electrical utilities as well as fuel exploration, extraction, processing and supply companies are also owned by the government or is under the administrative control of the energy ministry.

Environment Ministry: ministries or agencies responsible for indoor and outdoor air pollution as well as prevention and management of wastes and by-products from the manufacturing facilities for thermal energy devices within the country. Also responsible for Environmental Impact Assessments (EIAs) of large scale programmes involving thermal energy as well as thermal energy related infrastructure such as gas fields, mines, electric power plants, transmission lines etc.

Consumer Protection Ministry: ministries or agencies responsible for safeguarding the interests and protecting the consumers from abuse by thermal energy equipment suppliers and electricity and thermal energy services. These ministries take the lead on developing technical specifications on equipment, creating a quality assurance framework consisting of requirements for testing, certification and compliance as well as arrangements for consumer grievance and redressal from thermal energy equipment and services.

Other ministries: ministries and agencies that have other mandates also directly or indirectly influence and impact thermal energy services. Finance or economy ministries have a direct impact due to allocation of financial resources for thermal energy programmes as well as setting tax rates for thermal energy equipment manufacturers and service enterprises. Finance ministries are also responsible for setting sales or service taxes that affect the cost of the product or service delivered. Finance ministries also have a role in the use of electric payment systems such as mobile money which are important to thermal energy service delivery models.

Similarly industry or business or enterprise ministries create the framework conditions for establishment and operation of the thermal energy businesses including all stages of the value chain – extraction, processing, distribution and retailing and service provision. Ministries such as education, agriculture and health ministries need to be involved to promote safe and clean thermal energy service applications in schools, agro-processing, health posts, hospitals etc. Ministries of education or human resources development also have a role in the context of Technical and Vocation Education and Training (TVET) for training technicians who will design, install and service thermal energy systems.

3.2 – Independent Regulatory Agencies

Increasingly, independent regulatory agencies have been established around the world including developing countries to create independent institutions to regulate infrastructure and service delivery. Independent regulation of the financial sector was the precursor to independent infrastructure regulation and increasingly regulation of infrastructural services such as telecommunications, internet, transportation, electricity, fuels etc. are being brought into the ambit of independent regulators. Typical regulatory agencies that are responsible for thermal energy services delivery are:

Energy Regulator: these regulatory agencies often focus on electricity sector and are responsible for regulating electricity tariffs, balance the interests of the consumers and the energy utilities, ensure technical safety and reliability, increase energy access etc. (Zinaman et al., 2014). The regulators also issue licences to operate energy systems and often empanel equipment suppliers. In a number of cases the energy regulator also regulates fuels and fuel distribution. Energy regulators play a role in enforcing quality and safety of thermal energy systems and devices, regulating electricity tariffs and could play an important role in regulation and facilitation of innovative thermal energy service models.

Fuel Regulator: these agencies often focus on regulating the commercial fuels such as coal, petroleum fuels, Compressed Natural gas (CNG), LPG etc. Some fuel regulators also regulate solid biomass fuels and densified biomass fuels such as pellets and briquettes. The fuel regulators regulate the fuel prices in some markets and ensure universal availability of fuels across all geographical regions of the country and across various segments. Since fuels need to be transported and stored these regulators also oversee the safety aspects of transport, storage and distribution. Similar to the electricity sector, the fuel regulators are also responsible for the safety and performance of the conversion and end-use equipment and cylinders/bottles in the case of LPG. Fuel regulators have a role in thermal energy services by ensuring appropriate pricing of fuels available to the poor and in rural areas. They also have a role in the technical performance and safety aspects of cooking stoves, space heaters etc.

Other regulators: other regulatory agencies also have a direct or indirect impact on the delivery of sustainable and safe thermal energy services. There are often environmental regulators which enforce indoor air quality standards which help the case of modern thermal energy services. The financial regulators like the central or reserve banks help in regulating and facilitating mobile money and other electronic payments which help in delivering thermal energy services cost effectively. The financial regulators in some countries also regulate micro-finance institutions which also help in providing end-use finance for thermal energy services where relevant.

It should be noted that the regulatory landscape varies across countries and the framework presented in Figure 4 the above descriptions are generalisations. The names and the placement of the ministries and agencies vary across countries and some countries may not have some of the ministries/agencies or the regulators mentioned here.

4.0 – Roles, Responsibilities and the Needs of Stakeholders

There are a number of key stakeholders whose roles need to be recognised and needs should be reflected in policy and regulatory frameworks. These stakeholders should also fulfil their responsibilities within the framework to ensure an orderly and sustainable growth of the market. Often policy and regulatory frameworks are designed to encourage optimal behaviour of stakeholders through the use of incentives and penalties. The key stakeholders in a thermal energy system are the users, service providers and equipment suppliers which are often private and the public sector and government. There are also direct and indirect roles for financiers, development agencies, test and certification agencies, research and educational institutions etc.

As the published materials on policies and regulations for thermal energy services were limited, a global survey was carried out by the STEPs team during the one period August 2014 to August 2015 where questionnaires were sent out to 69 organisations covering development agencies, research institutions, private organisations, practitioners, policy makers and researchers who were either involved in developing and implementing energy access programmes or carrying out research. The geographical focus of the survey was Sub-Saharan Africa followed by Asia. The questionnaires were followed up with phone interviews as well as site visits to elicit maximum responses from the targeted organisations and researchers. A total of 30 responses have been received which provide a good basis to characterise the various efforts at the international and local level in providing thermal energy on a service mode. Of these 30 respondents, 16 are direct stakeholders and practitioners in thermal energy solutions and are subject to policies and regulations in the markets that they operate. The details of organisations which responded to the survey and their roles and policy and regulatory environments are detailed in Table 1.

Table 1. Policy and Regulatory Frameworks for Institutions Responding to STEPs Global Survey on Thermal Energy Services

Organisation[7] and role	Geographic Focus	Regulatory Framework	Policy Environment
Africa Clean Energy (Manufacturer)	Lesotho, Sub-saharan Africa	Empanelled by regulator for Lesotho – Lesotho Electricity Authority (LEA)	National and international programmes supporting equipment purchases and service delivery models
Bright Green Energy Foundation, (Energy Service Provider)	Bangladesh	Oversight of operations by regulator – Bangladesh Energy Regulatory Commission (BERC). Technical quality control framework for equipment	National and international programmes that offer financing and incentives
Emerging Cooking Solutions (Energy Service Provider)	Zambia	Overseen by regulator Energy Regulation Board (ERB)	Limited national and international programmes to support market

[7] In Alphabetical Order.

Organisation[7] and role	Geographic Focus	Regulatory Framework	Policy Environment
International Lifeline Fund (NGO/Project developer)	United States, Uganda, Kenya, Haiti	Varies across countries. Local entities which end up as operators under regulatory purview	Varies across countries. Local entities which end up as operators under policy ambit
Inyenyeri (Thermal energy service provider)	Rwanda	Overseen by regulator Rwanda Energy Management Authority (REMA)	Limited national and international programmes to support market.
M-Kopa (Thermal and lighting service provider)	East Africa – Kenya, Tanzania, Rwanda	With regulatory oversight by Energy Regulatory Commission (ERC)	Positive national energy and financial services environment
NuRa Energy (Lighting and thermal energy service provider)	South Africa	Operates under area based regulatory framework by Department of Energy (DoE) and National Energy Regulator South Africa (NERSA)	Largely clear and positive policy environment. Policy implementation challenges
Practical Action (NGO/Project Developer)	United Kingdom, global	Varies across countries. Local entities which end up as operators under regulatory purview	Varies across countries. Local entities which end up as operators under policy ambit.
Prime Cookstoves AS (Project Developer)	Norway, Indonesia, South Africa, Russia, Zambia, Senegal, Cambodia	Varies across countries. Local entities which end up as operators under regulatory purview	Varies across countries. Local entities which end up as operators under policy ambit
SELCO (Lighting and Thermal energy service provider)	India	Overseen by state regulator Karnataka Electricity Regulator Commission (KERC) and Ministry of New and Renewable Energy	Policy environment positive in some markets. Others not conducive
SESI International (Project Developer)	New Zealand, Afghanistan etc.	Regulatory framework emerging	Policy framework being developed
Simpa Networks (Lighting service provider)	India	Under regulatory purview of Ministry of New and Renewable Energy	Policy environment positive in some markets. Others not conducive
Small Scale Sustainable Infrastructure Development Fund (Thermal energy Project financier)	United States, India	Under regulatory purview of Ministry of New and Renewable Energy	Policy environment positive in some markets. Others not conducive
SNV (NGO/Project Developer)	Netherlands, Sub-Saharan Africa, South-east and South Asia and South America	Varies across countries. Local entities which end up as operators under regulatory purview	Varies across countries. Local entities which end up as operators under policy ambit
The Energy and Resources Institute (NGO/Project Developer)	India, global	Under regulatory oversight of Ministry of New and Renewable Energy	Policy environment positive in some markets. Others not conducive
Vuthisa Technologies cc (Thermal Energy Equipment and Fuel supplier)	South Africa	Under regulatory purview Department of Energy (DoE) and National Energy Regulator South Africa (NERSA)	Limited policy and programmatic support

The feedback from the survey provides a good overview of the policy and regulatory environment in which the thermal energy service practitioners operate. The feedback questionnaire also provides details of the major challenges faced by the practitioners and the market factors that are driving the thermal energy services market. Based on the feedback, site visits and additional research the needs as well as the roles and responsibilities of the key stakeholders in policy and regulatory frameworks for thermal energy services is explained below and indicated in Table 2.

Users: the need for the users of thermal energy services is to have access to safe, clean and continuous thermal energy services offered at the lowest cost. The specific needs for the households are cleaner indoor air, savings in time spent on biomass collection and efficient technical performance and personal safety of the thermal energy devices. Also needed are quick and efficient access to maintenance and repair services in the event of a malfunction or breakdown in services.

Poorer households would also need services offered at low price points due to limited financial resources and affordability. For the institutional users in commercial and industrial enterprises and public service institutions, the need is for reliable thermal energy services that are available when needed at the quantity demanded and preferably at a price point that this competitive with current alternatives. The institutional users also demand safety of own personnel and efficient performance as well as access to maintenance and repair services. The role and responsibility for the users would be to use the thermal energy services responsibly and to make payments for services in a pre-agreed manner based on the terms of service.

Private Service Providers and Equipment Suppliers: it is assumed that the service providers and the thermal energy equipment manufacturers and suppliers are predominantly privately owned. It is also assumed that the service providers and equipment manufacturers/suppliers do have a for-profit orientation. The main need of the private service providers and equipment suppliers are to make a return on their investments. However the revenue model for the equipment supply or manufacturing operation differs fundamentally from the service provider.

The business of thermal energy systems and devices manufacture and supply is oriented towards obtaining a profit margin on the sale price of a system. Therefore there is an incentive to close the sale quickly and make a profit. However for the service provider, the business model is linked to the payments associated with service as the profit share is included in the service payments. As the service period increases and the number of customers increase, the thermal energy service provider business model is more profitable.

Therefore there is a synergy between the needs of the users and that of a thermal energy service provider which does not exist with that of manufacturers and equipment suppliers. Within the policy and regulatory framework this translates to remunerative service payments. Another need for the service providers and manufacturers/suppliers is the low risk to the business model through stable and long-term policy and regulatory framework.

Also important is a facilitation/enforcement framework for ensuring timely service payments, access to long-term low cost resources and technical quality assurance of the systems and devices. The roles and responsibilities of the thermal energy service providers and the manufacturers and suppliers of thermal energy equipment are to provide reliable, clean and safe energy services or systems to users at a fair price, which may often be regulated.

Government and Public Sector: some of the service providers such as electricity utilities and fuel companies are often publicly owned and might exhibit similar needs, roles and responsibilities of the private sector service providers. Generally profit expectations of the public sector are lower than private businesses as they receive large grants or low-cost debt from the governments for capital investments.

It is possible that the cost of service or fuel delivery may also be higher for the public sector due to inherent inefficiency, limited use of technology and lower levels of productivity compared to the private sector. So the needs of the public sector thermal energy service providers are similar to the private sector service providers. However the government needs to ensure social justice through providing energy services in rural and unserved areas as well as to all its population especially people who are poor.

The government also have a need to protect the environment, especially through limits on indoor and outdoor pollution as well as limits on GHGs and other Persistent Organic Pollutants (POPs) etc. as well as limit any possible damage to the local and global environment through thermal energy manufacturing, supply and service value chain in the country. Governments and regulators also try to protect the consumers and also ensure economic efficiency of the thermal energy services and projects.

The role of the public sector service providers is similar to the private sector counterparts in terms of thermal energy service delivery but is often able to provide services in a socially beneficial manner due to the lack of inherent profit motive. The government policy makers and regulatory agencies can also use their legal position to ensure that the societal needs are met through policy and regulatory instruments.

Financiers: a mention must also be made of the needs and role of the financiers – both private and public. The needs of the financiers in general are to minimise their risks and to maximise their returns on interest. Financiers also prefer a stable policy and regulatory framework to keep their risks low and manageable. While not essentially a key stakeholder group that is part of the thermal energy services the expected role of the financiers is to provide financing instruments that are tailored to the thermal energy service business model that has a large customer base and longer term payments. The financiers also have a role to offer higher risk tolerance for thermal energy service investments and business models to be established and scaled up. Normally longer tenure debt instruments and higher risk tolerance are exhibited by public sector financiers – both national as well as international. The role of financiers in thermal energy services is further analysed in chapter 9.

Table 2. Needs, Roles and Responsibilities of Key Stakeholders within Policy and Regulatory Frameworks for Thermal Energy Services

Stakeholder	Needs	Roles and Responsibilities
Household Users	Clean indoor air, time savings, personal safety, access to maintenance and repair services. Low pricing of services, especially for poor households	Responsible use. Timely payments
Institutional users	Reliability, availability, competitive pricing	Responsible use. Timely payments
Equipment manufacturers and retailers (Private)	Profit margins on sales, lower risks through stable policy and regulation, low-cost, long term finance	Safe, clean and efficient equipment and systems at a fair price
Service Providers (Private)	Profit margins on service payments, longer service periods, larger customer base, regular service payments	Safe, reliable and clean service and support. Fair service pricing
Service Providers (Public)	Relatively lower profit margins on service payments, longer service periods, larger customer base, and regular service payments	Safe, reliable and clean service and support. Fair service pricing. Coverage of rural and poorer consumers
Government and Regulators	Universal coverage – especially poor and rural population, environmental defence, balanced prices, safety, reliability, public health	Social Justice, Consumer Protection, Environmental Protection, Economic Efficiency, Security and safety of thermal energy supply
Financiers	Stable policy and regulatory framework, regular payments. Reliability and safety, Higher returns	Longer term financing, higher risk tolerance

5.0 – The Pro-Poor Public-Private Partnership (5P)

The role of Public-Private Partnership (PPP) models has been steadily increasing in the infrastructure sectors particularly in Water and Sanitation, Transport, Communications and energy. In the energy sector a number of countries have used PPP models such as Build-Own-Operate-Transfer (BOOT), Build-Own-Operate (BOO) and Build-Operate-Transfer (BOT) for energy access initiatives as well.

There is a case for PPPs to combine the business and financial efficiency of the private sector with the social and environmental objectives of the public sector to create an energy service enterprise model that will meet the needs of the thermal energy users. For the energy sector PPP projects, the major shares of the investments have come from the private sector partners with the government providing a relatively small financial contribution.

In the PPP energy projects, the private sector partners are able to bring their efficiency in the construction and operation ensuring better performance of assets and the public sector partnership ensures limited risks arising out of policy and regulation. Often PPPs are able to provide better energy service and the government also benefits from the taxes, royalties as well as dividends from the PPP. There have been PPP models in energy access which are pro-poor adding a dimension in social justice. One such interesting model is the 5P model in Cinta Mekar in Indonesia.

5.1 – 5P Model in Indonesia

In Indonesia an interesting model of a PPP has been supported by United Nations Economic and Social Commission for Asia Pacific (UN-ESCAP). A cooperative named Mekar Sari consisting of 450 members were established in 2003 in the village of Cinta Mekar to implement a hydro power based mini-grid. The STEPs team paid a visit to the hydro project and cooperative in Indonesia in 2015. The financial investments in the hydro-mechanical and electro-mechanical equipment and civil structures were from UN-ESCAP and a private company - Hidropiranti on a 50:50 financing split. The members of the cooperative also contributed labour and local materials for the construction of civil structures and the power plant.

An Indonesian NGO Inisiatif Bisnis dan Ekonomi Kerakyatan (IBEKA) coordinated and managed the initiative. Once the Indonesian electricity utility Perusahaan Listrik Negara (PLN) extended the electricity network to Cinta Mekar, the hydro power plant was converted to run as an Independent Power Producer (IPP) selling electricity to PLN. The members of the cooperative that were existing electricity consumers were taken over and serviced by PLN. The thermal energy needs of the households, the commercial enterprises, schools and hospitals are either met through electricity or LPG. Electricity is primarily used in electric rice cookers for cooking rice and LPG is used for other cooking needs and is supported by the large scale LPG transformation initiative in Indonesia which was discussed in Chapter 6.

Figure 5 shows one of the households in Cinta Mekar using electricity for cooking rice. There are a few retailers of small sized LPG cylinders in Cinta Mekar. Some of the few poorer households cook with biomass in addition to electricity and LPG as biomass is available for free in the nearby forests around Cinta Mekar.

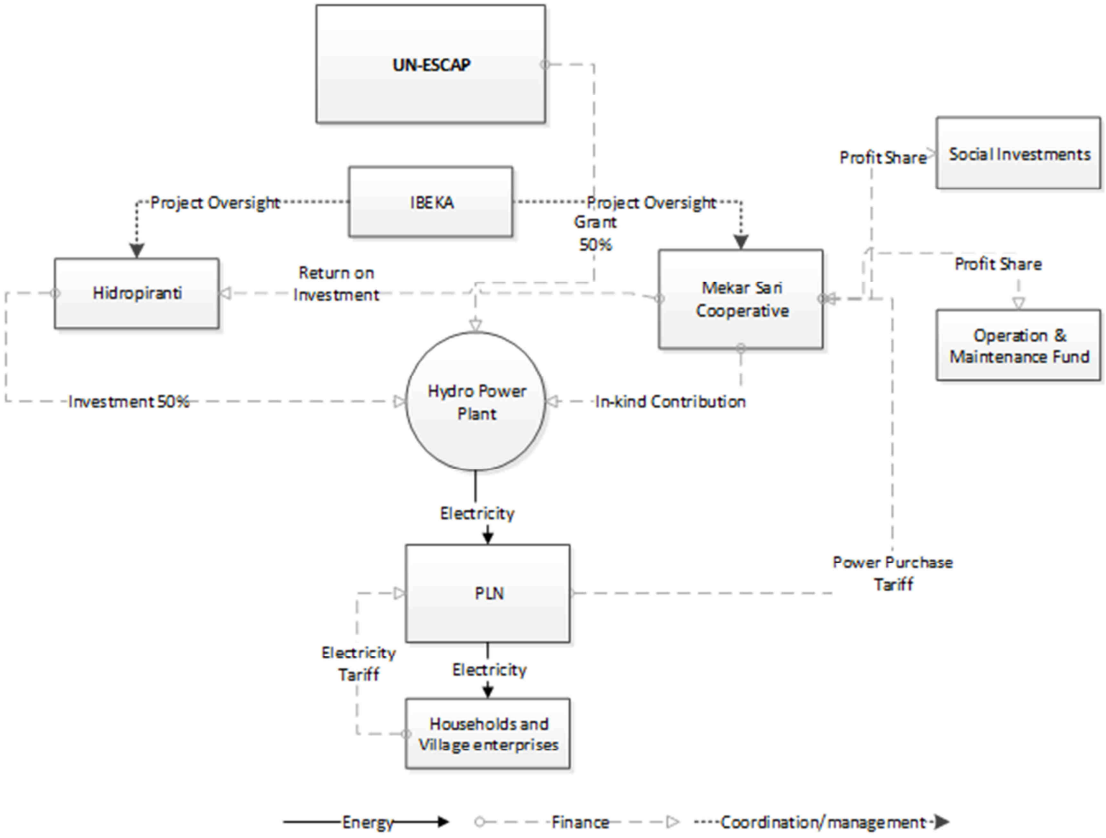
Figure 5: Electric Rice Cooking in the Cinta Mekar 5P

Credits: Sustainable Energy Associates.

The model has now evolved into a Pro-Poor-Public-Private-Partnership (5P) where the revenues from selling electricity to PLN are shared between Mekar Sari cooperative and Hidropiranti. 20% of the revenues are set aside for financing operation, maintenance and replacements and 40% is paid to Hidropiranti as a return on its investment. 40% share that is received by the Mekar Sari cooperative is spent on 'Pro-Poor' initiatives. The funds have so far been used to support electricity access by poorest households in the community and also provide land to households which did not have landholdings. Mekar Sari cooperative also provides scholarships to 360 school-going children, pays allowances to old people in the community and also to women during pregnancy and childbirth. Mekar Sari also plans to finance construction of toilets and drinking water supply points in future.

While there are community based electrification initiatives using the cooperative model in other parts of the world, there are not many examples like Cinta Mekar of a cooperative and private sector collaborating for rural electrification investments with revenue sharing and the cooperative making significant pro-poor investments. UN-ESCAP is now replicating this model in other countries in Asia and also in Sub-Saharan Africa. The financing for the initial investments of Cinta Mekar 5P project was from UN-ESCAP and Hidropiranti on a 50:50 share with Mekar Sari cooperative members contributing in-kind labour and local materials. The operation & maintenance is financed by a 20% share of the profits for electricity sales to PLN. The business model and the financial flows of the Cinta Mekar hydro project are shown in Figure 6.

Figure 6. 5P Model for Community Energy Access in Indonesia



5.2 – Supporting Thermal Energy Service Companies

Based on an analysis of the global survey results as well as the needs of the users, governments and private sector and based on the lessons drawn from the 5P experience by UN-ESCAP, the following principles and guidelines were drawn for supporting thermal energy service providers:

- Thermal energy service companies have a distinctly different business model and approach than equipment manufacturers and suppliers, with different needs and orientations. It would be difficult to convert retailers and manufacturers of systems and equipment into thermal energy service companies;

- Feedback from the thermal energy manufacturers and suppliers indicate that the marketing and selling efficient thermal energy systems and devices in the normal purchasing context is challenging without governmental support and incentives. Even if the sale is concluded it is likely that the usage rate declines over time and that the clean and safe thermal energy system is not replaced on completion of useful life;

- Policy framework supported by regulation is required to ensure that thermal energy is provided on a service mode rather than system and device sales. The policy and regulatory framework should encourage the service business model which is aligned with the government's social justice, environmental protection and consumer protection objectives;

- Regulatory frameworks need to ensure high levels of reliability and safety of service to ensure active engagement of the institutional users from the commercial, industrial and public service segments who often have the financial ability to invest in owing alternative systems;

- Policies and regulations need to be created to encourage manufacturers and suppliers to sell thermal energy systems and devices whole sale to service providers who then offer these on a service to end-users. Policies should avoid capital subsidies for system purchase and turn them into subsidies for service acquisition and service delivery;

- There is a need to offer competitive prices for thermal energy services to larger institutional users and there is a need to offer service at low prices to poor customers. This could be achieved through a regulated tariff that is economically efficient;

- Policies and regulation should include technical specifications for thermal energy systems such as SWHS, Space heaters, efficient cookstoves, LPG stoves, crop dryers etc. and an associated testing and quality control system to ensure that only high quality systems and components may be used by thermal energy service providers;

- Similar to offering high quality and reliable services, the regulations should ensure regular and full payment of service charges through a system of penalties and incentives targeting both household and institutional customers and ensure prompt payment as per service contract terms;

- Financing policies need to encourage financiers to provide long term finance to thermal energy service providers. These policies should also incentivise higher levels of risk tolerance by financiers to support innovation in thermal energy access such as thermal energy service models;

5.3 – Implementation of a Policy and Regulatory Framework

Based on the global survey feedback on policy and regulatory needs and the roles for the government, the UN-ESCAP 5P experience and research the following guidelines and recommendations have been drawn up for implementation of a policy and regulatory framework:

- The policy framework should be neutral in terms of conversion technologies and possibly energy resources. The thermal energy service provider should be able to offer a variety of choices of sources and thermal energy systems to users;

- There needs to be an integrated policy and regulatory framework for thermal energy which combines the energy regulation, fuel regulation and possibly environment protection and consumer protection elements into a single regulatory framework;

- The determination of the tariffs could be on a market led competitive basis to ensure economic efficiency and to offer least cost thermal energy services. It should be possible to establish differential tariffs for institutional and household segments;

- There may need to be a need to offer public funding to compensate provision of thermal energy services at lower tariffs to poor households as well as delivery of thermal energy services in rural areas. These funding and incentives should be performance based incentives paid over the service period and should not be based on capital investment and paid out upfront;

- A finance facility may need to be established either funded through tariff-cross subsidy or funded by a cess or a tax on fuels or energy in urban areas or consumers with higher levels of energy consumption;

- Policy and regulatory frameworks should encourage the use of technology such as mobile money and electronic payments as well as remote electronic monitoring and smart meters to reduce the costs of delivery of thermal energy services;

- The policy and regulatory framework should have a long term outlook and provide a predictable and continuous set of conditions to create favourable conditions for thermal energy business investors and financiers. Such a stable framework will also reduce the business and investment risks in thermal energy services;

- Establish regulatory frameworks that facilitate PPPs and 5Ps where the public sector and government could contribute to the initial investment capital of thermal energy service operations in a competitive manner with the responsibilities of operation, management and service delivery will be with the private sector partner.

6.0 – Policy and Regulatory Principles and Instruments for Thermal Energy Services

A number of policy and regulatory instruments are required to enable the sustained operation of thermal energy services on a 5P mode. The details of these regulatory instruments are indicated against the objectives of the policy and regulatory framework for thermal energy services shown earlier in Table 3.

6.1 – Security of Supply

The regulatory instruments need to ensure that there is continuous and sustainable supply of thermal energy for all customers. Some of the relevant policy and regulatory instruments to ensure security of supply are:

- Adoption of the multi-tier matrices for energy access from Sustainable Energy for All (SE4All) relating to cooking and heating solutions into the relevant national policy. These are given in annexes I and II and may need to be customised to national circumstances by the relevant policy making body. The policy should mandate that all thermal energy service providers use these matrices to define their thermal energy services. These can be integrated into relevant policies and could also be included as part of relevant regulations;
- Establish regulations that specify the duration of the thermal energy service to be provided and establish limits on the number of permissible disruptions over a specified time period. Stiff penalties should be established to ensure that the thermal energy service provider is compelled to comply with the regulation;
- The policies and the regulations for thermal energy services should be made technology neutral and the thermal energy service providers should have the choice of selecting the most appropriate energy source, systems and devices to offer the thermal energy services that are relevant to the location. Choices should be open to electricity, LPG, biomass, solar, geothermal, hydro etc. using efficient cooking and heating devices that convert the energy source.

6.2 – Social Justice

The policy and regulatory framework should ensure that there is universal access to thermal energy services in the jurisdiction of the policy and/or regulation. One policy and regulatory instruments to ensure this social justice is:

- Make the thermal energy service a universal service obligation. Any household or institution covered by a thermal energy service provider will have a right to request and get thermal energy services from the service provider, irrespective of their location within the service area or the quantum of their demand.

6.3 – Consumer Protection

The policy and regulatory framework should lay down technical quality standards and other service standards which ensure safe and efficient delivery of thermal energy services. Policy and regulatory instruments to ensure consumer protection are:

- Specify the limits to indoor air pollution due to thermal energy services in terms of PM 2.5 and CO that the thermal energy service provider will have to meet. The minimum limit could correspond to the limits tier/level 4[8] of the multi-tier matrix for cooking and space heating (Refer to Annex I);
- Develop, specify and enforce technical standards for all the relevant thermal energy devices and systems. A set of recommended indicative parameters for technical standards for thermal energy devices is available at Annex III. Also specify the associated testing and certification or importation requirements for these systems and devices;
- During the licensing process adopt a reverse bidding process to allow for innovation to find the lowest price at which thermal energy can be supplied and services in a geographic area. Allow for cross-subsidy arrangements to offer differentiated tariffs within the service area to offer lower service tariffs to households that are poor. Service tariffs could be stepped up for households based on consumption volumes so as to offer lower tariffs to the poorer households;
- Developing standards and labels for thermal energy systems and devices such as biomass cookstoves, biomass room heaters, LPG stoves, LPG room heaters, Electric cookers, electric room heaters, SHWS etc. with easy to understand labels with visual symbols such as stars or colour codes to encourage choice of efficient systems by the service providers and users.

6.4 – Environmental Protection

The policy and regulatory instruments could be used to ensure minim possible environmental impact of the thermal energy service including energy generation and end-use. Some of the policy and regulatory instruments that could be used are:

- In addition to the limits on PM 2.5 and CO for indoor air, limits must be specified for PM 2.5, CO, VOC, SOx, NOx for air pollution from thermal energy generation as well as end-use conversion. These limits could be placed through regulations;
- Limits should be placed on each of the thermal energy service providers for GHG emissions to encourage the use of clean sources and efficient energy conversion technologies on the supply and demand side;

[8] < 35 $\mu g/m^3$ for PM 2.5 and < 7 mg/m^3 for CO.

- Similarly appropriate pollution control and waste management regulations may be considered and specified for manufacture, transportation, storage and supply of thermal energy generation, systems and devices. These regulations could cover air pollution, GHG gases as well as management solid and liquid wastes from the manufacture.

6.5 – Economic Efficiency

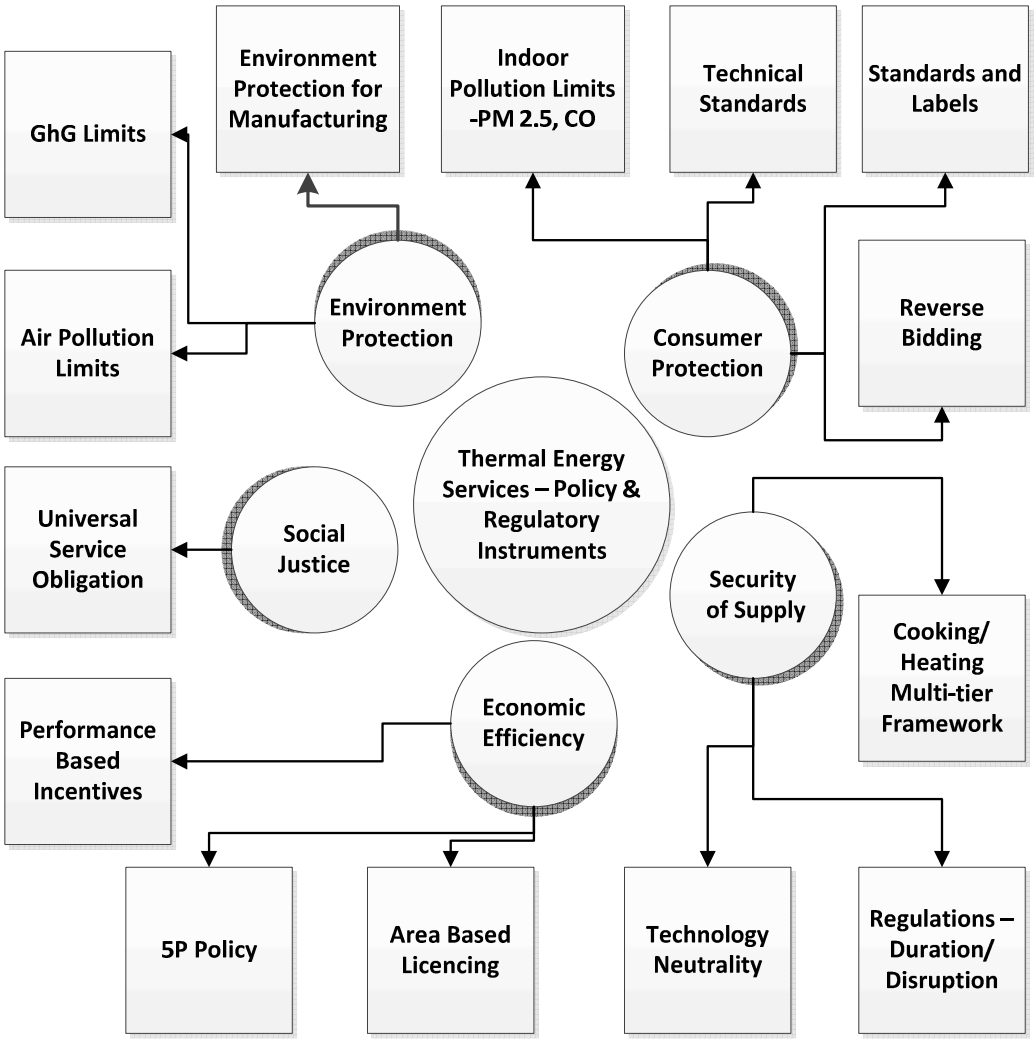
The policy and regulatory frameworks may be used to ensure competition in the markets and to prevent restrictive practices as well as failures. Some of the policy and regulatory instruments that can be used to achieve these economic efficiency objectives are:

- Area based licences be given to thermal energy service providers and the basis of the licensing be the average price of thermal energy that can be supplied at a location over a longer time period[9]. The process should involve reverse bidding and there should be a technical pre-qualification for bidders. The winning bidders must be given a long term license for either 20 or 30 years to provide universal thermal energy access in the area;
- As there is not likely to be high levels of interest in bidding for rural areas or areas with high levels of incidence of poverty[10], there may not be interest from prospective thermal energy Service Company. Governments may drive such markets through a 5P policy where a share of the capital investments may be supported by the government and a performance based incentive will be provided by the government for servicing poor sections and rural areas;
- The government may have a policy to limit to performance based incentives for use of thermal energy systems and devices and stop providing capital subsidies for purchase of thermal systems and devices. This will help gravitate the market towards services and help eliminate current market failures.

The thermal energy policy and regulatory framework with details of regulatory instruments developed through this research is illustrated at Figure 7.

[9] 20-30 year timeframe.
[10] Such as agricultural areas, urban slums etc.

Figure 7. Policy and Regulatory Instruments for Thermal Energy Services



7.0 – Conclusions

From this research, survey and analysis of the policy and regulatory dimensions of thermal energy services and the findings the following conclusions can be drawn:

- Globally, we are facing a major set-back in providing safe, clean and modern thermal energy services where the gains are being offset by population growth. The associated indoor air pollution is resulting in large scale premature deaths globally and in particular in Sub-Saharan Africa and Asia;

- There has been a market failure in providing thermal energy services which could be addressed by a policy and regulatory framework that has a five-fold objective of security of supply, social justice, consumer protection, environmental protection and economic efficiency;

- The current policy and regulatory landscape consists of policy making by government agencies such as energy ministries, environment, ministries and consumer protection ministries that have a direct role as well as other ministries. On the regulatory side we see energy and fuel regulators playing a key role followed by other regulatory agencies;

- Responses to a global survey from over 16 thermal energy practitioners were analysed to identify the key stakeholders in thermal energy services which include household users, institutional users, manufacturers and retailer, service providers – both private and public, government and regulators and financiers. The needs as well as the roles and responsibilities for these key stakeholders within a policy and regulatory framework were identified;

- Based on the analysis of the current policy and regulatory landscape, needs and roles of key stakeholders and existing experience with 5P energy access models principles and guidelines for supporting thermal energy services and establishing a policy and regulatory framework were identified;

- On the basis of this analysis, 14 policy and regulatory instruments were defined to achieve the five policy and regulatory objectives of sustainable thermal energy service partnerships. It is envisaged that implementation of such a 5P based framework will significantly help in addressing the market failures that have led to thermal energy underachievement;

- We need a concerted effort at the policy and regulatory frameworks to introduce new regulatory instruments and to promote a paradigm shift to address the absence of safe and modern thermal energy services to more than 2.8 billion people around the word. This policy and regulatory change is imperative to enable the use of technology, finance and business models to address this major energy challenge.

Questions and Answers

What objectives should policy and regulation meet regarding thermal energy services?

Policy and regulatory oversight for thermal energy services should focus on five specific factors: security of supply, social justice, consumer protection, environmental protection and energy efficiency. The level to which each of these objectives are relevant in different developing countries vary and some countries have much more developed policies and regulatory frameworks than others.

However, there are a number of barriers to implementing these factors in a policy and regulatory framework for thermal energy services. Freely- or cheaply-available traditional biomass fuels make consumer protection through reducing thermal energy service prices a difficult proposition, and the competitiveness of sustainable thermal energy sources is difficult to ensure because of this. Other barriers to enacting these key factors in a policy and regulatory framework include the current momentum of thermal energy supply chains being concentrated in urban and/or wealthier areas, and limited capacity in regulatory bodies in developing countries for thermal energy considerations, having traditionally focused solely on electricity regulation.

What institutional frameworks are appropriate for thermal energy services?

Ensuring that a strong institutional framework exists in a developing country for thermal energy needs is a key step to ensuring a strong regulatory presence in the sector. There are a number of different potential actors in the thermal energy services institutional space. Government ministries such as the Energy Ministry or Environment Ministry are often the most directly involved in energy policy, whilst other government agencies such as the Finance or Economy industries can have an indirect role in energy services more generally. However, thermal energy services are cross-cutting, and a wide variety of government agencies can be involved in directly or indirectly promoting equitable thermal energy access and promotion, including education, business development and entrepreneurship departments.

Non-governmental or independent quasi-governmental organisations are also important in the thermal energy policy and regulatory space. These include the national energy regulatory body, commonly an independent regulator for the electricity service space which can apply their expertise to thermal energy. Other organisations such as consumer protection bodies can also have a role, as well as fuel regulators, environmental regulatory and financial regulators. Financial regulators can be particularly important to thermal energy services, as they commonly regulate the micro-credit industries in countries with a strong micro-credit organisational presence, a sector commonly involved in thermal energy service provision and financing.

What is a public-private partnership, and how can they become more pro-poor (5P)?

Public-private partnerships involve a private entity, for example an energy service company, entering into a partnership with a public entity, usually a government ministry or department, for the delivery of a service. In the energy industry, a number of PPP (public-private partnership) models have been used in the past to deliver energy infrastructure projects. These include build-own-operate-transfer (BOOT) models, as well as build-own-operate and build-operate-transfer (BOO/BOT) models, where the private organisation constructs and operates an energy project (most commonly for electricity generation), then either transfers ownership to the public body after a specified contract length, or retains ownership and continues to receive payments for services from the public body. Pro-poor public-private partnership (5P) models differ from traditional models in that some return on investment is re-invested in pro-poor schemes for the communities involved in the project. For example, in the Cinta Mekar case detailed in section 5, 20% of the revenues are set aside for financing operation, maintenance and replacements and 40% is paid to the private operator, Hidropiranti, as a return on its investment. The 40% share that is received by the Mekar Sari cooperative is spent on 'Pro-Poor' initiatives, such as electricity access by poorest households in the community, and providing land to households which did not have a landholding previously.

How can policy and regulatory measures, as well as institutional measures, promote thermal energy services?

There are a wide variety of ways in which policy and regulatory frameworks can enable thermal energy service growth. These are detailed in full in 14 measures in section 6 above. Some key points include:

- Adopting the multi-tier matrices for energy access from Sustainable Energy for All (SE4All) relating to cooking and heating solutions into the national policy,
- Ensuring policy and regulation for thermal energy access is technology neutral, allowing providers to choose the most appropriate technology option for their service targets,
- Mandating thermal energy services as a universal service right, giving consumers the right to request services from a service provider, irrespective of location or scale of service required.
- Specifying limits for PM2.5, SO, NOx emissions etc. in order to improve indoor environments and public health,
- Develop and enforce technical standards and labelling as well as performance testing for thermal energy products to develop consumer awareness and confidence,
- Implement reverse-bidding processes for area-based concessions for thermal energy service providers, to allow for least-cost effective energy service provision. Winning bidders must be given a long term license, for either 20 or 30 years, to provide universal thermal energy access in the area.

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Annex I: Multi-Level Matrix for Cooking Energy Services

		LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5
1.Indoor Air Quality	PM 2.5 (µg/m^3)	(to be specified by a competent agency such as WHO based on health risks)	(to be specified by a competent agency such as WHO based on health risks)	(to be specified by a competent agency such as WHO based on health risks)	< 35	< 10
	CO (mg/m^3)				< 7	< 7
2.Cookstove efficiency (Not to be applied if cooking solution is also used for space heating)		Primary solution meets Tier 1 efficiency requirements (to be specified by a competent agency consistent with local cooking conditions)	Primary solution meets Tier 2 efficiency requirements (to be specified by a competent agency consistent with local cooking conditions)	Primary solution meets Tier 3 efficiency requirements (to be specified by a competent agency consistent with local cooking conditions)	Primary solution meets Tier 4 efficiency requirements (to be specified by a competent agency consistent with local cooking conditions)	
3.Convenience	Stove Preparation time (min/meal)		<7	<3	<1.5	<0.5
	Fuel acquisition and preparation time (Hrs/week)		<15	<10	<5	<2
4.Safety of primary option	IWA Safety tiers		Primary solution meets (provisional) ISO Tier 2	Primary solution meets (provisional) ISO Tier 3	Primary solution meets (provisional) ISO Tier 4	
	OR Past accidents (Burns and unintended fires)				No accidents over the past one year that required professional medical attention	

5. Affordability				Levelised cost of cooking solution (including Cookstove and fuel) <5% of household income	
6. Quality of primary Fuel: variations in heat rate due to fuel quality that affects ease of cooking				No Major effect	
7. Availability of primary fuel				Primary fuel is readily available for at least 80% of the year	Primary fuel is readily available for throughout the year

Annex II: Multi-Tier Framework for Space Heating Services

		LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5
1.Capacity		Personal Space around individuals is heated	At least one room has heating		All rooms in the household have heating	
2.Duration				At least half the time when needed (>50% of the time)	Most hours when needed (>75% of the time)	Almost all hours when needed (>95% of the time)
3.Quality				Comfortable temperature at least 50% of the time	Comfortable temperature at least 75% of the time	Comfortable temperature all the time
4.Convenience (Fuel collection time)			Max 7 hr/wk	Max 3 Hr/wk	Max 1.5 Hr/wk	Max 0.5 Hr/wk
5.Affordability				Max 2 times grid tariff		Max grid tariff
6.Reliability				Max 3 disruptions/day	Max 7 disruptions/week	Max 3 disruptions/week of total duration < 2 hrs
7.Indoor Air Quality (Health)	PM 2.5 ($\mu g/m^3$)	(To be specified by a competent agency such as WHO based on health risks)	(To be specified by a competent agency such as WHO based on health risks)	(To be specified by a competent agency such as WHO based on health risks)	<35	<10
	CO (mg/m^3)				<7	<7
8.Safety					No accidents over the past one year (burns or unintended fires) that required professional medical attention	

Annex III: Indicative Technical Specifications for Selected Thermal Energy Systems

Efficient Biomass Cookstoves and Space Heaters

Parameter	Specification
Body	Metal with metal or ceramic combustion chamber
Estimated life	Minimum 5 years
Fuel	Woody and densified (pellets, briquettes) biomass
Finishing	Waterproof and fire resistant body paint
Suitability	Cooking and space heating
Indoor Air Quality	PM 2.5 < 35 µg/m^3 and CO <7 mg/m^3
High Power Thermal Efficiency	> 35%
Safety	Meets (provisional) ISO Tier 4

Solar Water Heating Systems

Parameter	Specification
Collector	Flat Plate with • Cover of toughened glass of 4.0 mm with minimum 80% solar transmittance; • Aluminium Collector Box of minimum 1.2 mm thickness; • Back and side insulation with rock, glass or mineral wool0.96 m square degree c/w for back insulation and minimum 0.48 m square degree c/w for side insulation
Absorber Material	Both sheet of 34 SWG thickness copper and tube of copper
Absorber Coating	Selective coating with absorptivity of >0.92 and emissivity of l >0.2
Riser	Diameter of 12.7 + /-0.5 mm and thickness 0.56mm. The distance between the risers from Center to Center shall be 120mm.
Header	The diameter of header shall be 25.4 + /-0.5mm and thickness 0.71mm
Working Pressure	Riser and header assembly designed for working pressure up 24.5 k pa (2.5 kg/ cm^2) shall be tested for leakage at a minimum hydraulic pressure of 490 k pa (5 kg/ cm^2)
Hot water storage tank	200 lpd with stainless steel of min 20 gauge thickness. 100 mm thick insulation of 48 kg/cu.m. density having approx. k value_0.03 W/mk and R value 3.34 sq. m deg.C/W to withstand a temp. of 250deg.c.
Pipes	Galvanised Iron with insulation of 25mm thick with 48kg/cu.m. density and K value+0.03 W/MK R value+1.67 sq. m. C/W to withstand and temp. of 250 deg. C
Cold Water storage tank	200 lpd High or Low Density Poly Ethelyne material with Gun metal float valve equal to the capacity of Hot water storage tank.
Electrical Back-up	Min 2 KW with associated thermostat

Electric Cookers

Parameter	Specification
Technology	Electromagnetic Induction Heating
Thermal Efficiency	> 85%

Electric Rice Cookers or Steamers

Parameter	Specification
Technology	Electromagnetic Induction Heating
Thermal Efficiency	> 88%

LPG Stoves and Space Heaters

Parameter	Specification
Fuel	LPG Gas
Thermal efficiency	> 78%

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