Energy Efficiency and the 10YFP- Background Paper for the 10YFP Workshop

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Acronyms and Abbreviations

10 YFP	Ten Year Framework of Programmes
ACEEE	American Council for an Energy-Efficient Economy
ADB	Asian Development Bank
AgDSM	Agriculture Demand Side Management
AR	Assessment Report
BAU	Business as Usual
BEA	Building Efficiency Accelerator
C2E2	Copenhagen Centre on Energy Efficiency
CDM	Clean Development Mechanism
CER	Certified Emissions Reductions
CFL	Compact Fluorescent Lamp
CHENACT	Caribbean Hotel Energy Efficiency Action Program
CII	Confederation of Indian Industry
CIP	Consumer Information Programme
CO2	Carbon Di-oxide
COP	Conference of the Parties
DES	District Energy Systems
ECBC	Energy Conservation Building Codes
EE	Energy Efficiency
EECA	Energy Efficiency and Conservation Authority (New Zealand)
EEPS	Energy Efficient Pump Sets
EESL	Energy Efficiency Services Limited
EPC	Energy Performance Certificate
ESCO	Energy Service Company
ESCWA	(United Nations) Economic and Social Commission for Western Africa
ESMAP	Energy Sector Management Assistant Program
EU	European Union
EUR	Euro
FAO	Food and Agriculture Organisation
FEMP	Federal Energy Management Program
GCAA	Global climate Action Agenda
GCF	Green Climate Fund
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GPP	Green Public Procurement
Gt	Gigatonnes
HVAC	Heating Ventilation and Air-Conditioning
IDB	Inter-American Development Bank
IEA	International Energy Agency
INDC	Intended Nationally Determined Contributions

IPCC	Inter-Governmental Panel on Climate Change
IPEEC	International Partnership for Energy Efficiency Cooperation
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
KRW	South Korean Won
kWh	Kilo-watt hour
LBNL	Lawrence Berkeley National Laboratory
LCC	Life Cycle Costing
MOE	Ministry of Environment (Japan)
Mtoe	Million Tonnes of Oil Equivalent
MWH	Mega Watt Hours
NAMA	Nationally Appropriate Mitigation Actions
NDC	nationally Determined Contributions
NGO	Non-governmental organisation
NPV	Net Present Value
OECD	Organisation for Economic Cooperation and Development
PPP	Purchasing Power Parity
RMB	Renminbi
SBC	Sustainable Buildings and Construction
SBCI	Sustainable Buildings and Climate Initiative
SCP	Sustainable Consumption and Production
SDG	Sustainable Development Goal
SE for All	Sustainable Energy For All
SFS	Sustainable Food Systems
SLE	Sustainable Lifestyles & Education
SPP	Sustainable Public Procurement
ST	Sustainable Tourism
TJ	Tera Joules
U4E	United for Efficiency
UK	United Kingdom
UNCSD	United Nations Conference on Sustainable Development
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
USA	United States of America
USAID	United States Agency for Sustainable Development
USD	United States Dollar
USDOE	United States Department of Energy
WB	The World Bank
WBCSD	World Business Council for Sustainable Development

Executive Summary (10 YFP Background Paper)

At the United Nations Conference on Sustainable Development (Rio+20), the attending Heads of State reaffirmed that promoting sustainable patterns of consumption and production is one of the three overarching objectives of--and essential requirements for—sustainable development. As a response, the Heads of State adopted the 10-Year Framework of Programmes (10YFP) on sustainable consumption and production (SCP) patterns. Enhancing resource efficiency, which in broad terms means using less resource(s) for the same or increased output, is central objective of activities to be undertaken within the 10YFP.

Energy, in its various forms, is one resource whose demand and use has been rising and whose production and consumption is resulting in rising levels of greenhouse gas (GHG) emissions, making 'energy resource' the single largest contributor to climate change. Increasing the efficiency of 'energy resource' thus assumes profound weight in the context of shifting towards sustainable consumption and production patterns, as well as in the 10YFP.

Energy Efficiency (EE) is an important strategic option, not only for mitigating climate change effects, but also for deriving economic benefits and competitive advantage. According to International Energy Agency, if we are able to capture all the economic potential, the total primary energy demand in 2030 will be about 15 percent lower than the business as usual scenario. In terms of the benefits of energy efficiency, actors in the 10YFP are keen to integrate and strengthen EE in the six programme areas. This background paper is intended to provide an overview of how EE can be positioned in 10YFP's programme areas. This paper will form the basis for discussion during the workshop scheduled for September 2016, and for identifying designing specific projects in 10YFP programme areas, engaging actors from both the EE and SCP "communities of practice".

Sustainable public procurement

Government procurement of goods and services accounts for 12 percent of GDP on average in OECD countries, about 20 percent in the EU, and as high as 30 percent in India. Accordingly, incorporating energy efficiency as a key decision criterion in government procurement policies can drive the market towards the uptake of more energy efficient products, and be highly influential on overall energy use and the attendant GHG emissions, and thus serve the sustainable public procurement objectives.

Energy efficiency labels, catalogues of technical specifications, Life-Cycle costing (LCC), and energy efficiency preferences are some of the main approaches that are being used for integrating energy efficiency in public procurement.

Under Sustainable public procurement (SPP) or Green public procurement (GPP), a well-established set of parameters are often used for comparison of competing goods and products, and energy efficiency just becomes one of the many parameters used for comparison. In the context of SPP and GPP, therefore, approaches such as energy labels, catalogue of technical specifications or energy efficiency preferences are relatively easier to incorporate in the overall set of parameters as compared to the LCC approach. However, products such as pumps, blowers, fans, refrigerators, air-conditioners, compressors, where life time energy costs of operation are many times the initial capital investments, using LCC

makes more sense. Energy efficient procurement programmes are underway in several countries and they have achieved very good results in terms of energy savings and mitigation of greenhouse gases. For example, the mandatory green procurement policy put in place in the Mexico City in 2011 had resulted in saving of 340 gigawatt hours of energy and avoidance of 6500 tons of carbon di-oxide emissions in the initial two years.

Sustainable buildings and construction

Buildings is one of the main sectors contributing to increasing greenhouse gas emissions, accounting for more than one third of final energy use and approximately 9 $GtCO_2$ emissions per year globally. Under various scenarios, by mid-century energy demand from the sector is expected to double and CO_2 emissions to increase in the range of 50-150% without additional mitigation efforts. In order for the world to stay on the path below 2°C, CO_2 emissions from the building sector needs to reduce by almost 80% by 2050 in comparison to the current levels.

Intergovernmental Panel on Climate Change's fifth assessment report shows that, at the global level between 34% and 70% of final energy use can be saved by 2050 (in relation to the baseline) through holistic improvements in the building energy efficiency for various end-uses. There is evidence from various studies that new buildings can achieve net zero or even energy positive performance at no or low additional costs, while deep retrofits of existing buildings can result in up to 90% of energy savings in thermal energy use. Moreover, energy efficient equipment and appliances can save 5-90% of electricity, depending on the end-use.

In general terms potential energy efficiency initiative in the buildings may include:

- Promoting commercial financing of energy efficiency investments by bringing together commercial banks and energy service companies
- Providing technical assistance for implementation of building energy codes at the city level
- Supporting design and implementation of holistic 'deep' retrofits of existing buildings
- Assisting in design and implementation of adequate energy pricing and other market imperfections in order to spur energy efficiency investments
- Developing appropriate energy use measurement and verification systems and ensure their incorporation in the project design
- Ascertaining credit lines extended to support energy efficiency subprojects.

Consumer information programmes (CIP)

The lack of appropriate and targeted consumer information is recognised as one of the main barriers to accelerating the implementation of energy efficiency measures by consumers through behavioural change and targeted purchasing decisions.

Consumers, buying appliances and equipment, typically go through a process that consists of a sequence of events: need stimulation/recognition, information search, evaluation of alternatives, purchase decision and post purchase behaviour. Irrespective of whether the purchasing entity is a household, a business or government, information available at every stage of the buying process plays an important part in not only moving the consumer to the next stage along the buying process but also in shaping the ultimate buying decision. Providing appropriate energy efficiency related information to consumers, appropriate to each stage in the buying process, could direct consumer-buying decisions towards energy efficiency purchases and behaviour.

Appropriate energy efficiency information could be provided by consumer information and energy efficiency experts coming together and developing case study and best practice

guidebooks. In addition, the two sets of experts can together to undertake feasibility studies, prepare detailed project proposals, source finance and implement initiatives such as setting up of energy efficiency demonstration centres, mobile technology demonstration vans or demonstration projects. Further, the two set of experts can also come together to develop dedicated presentations, films, information flyers, tip sheets, and product & consultant directories. They could also design and execute consumer awareness campaigns and training programmes, or organize events such as 'buyer-seller' meets.

Sustainable life styles and education

Over the period 1990-2009, energy efficiency in the household sector increased by 24 percent, driven by the diffusion of more efficient buildings, space heating technologies and electrical appliances. In the 450 Scenario of the IEA, energy efficiency by end-users can contribute up to 34 percent of carbon emission decrease globally. [1] According to the Global GHG Abatement curve developed by McKinsey, around 4 GtCO2 abatement/year can be achieved through change in behaviour at a comparatively low cost. [2]

The residential sector accounted for 23 percent of the world final energy consumption in 2014. When indirect (upstream) emissions are taken into account, households are responsible for more than 70 percent of UK carbon emissions.

Governments have a key role to play by creating the appropriate frameworks and infrastructures (regulatory instruments, technological innovations, new public services) to enable citizens to change. An "energy efficient lifestyle" needs to be enabled both by efficient infrastructures, goods and services, and by individual choices and actions that minimise the use of natural resources, and generation of emissions, wastes and pollution, while supporting equitable socio-economic development and progress for all. According to the Global GHG Abatement curve developed by McKinsey, around 4 GtCO2 abatement/year can be achieved through change in behaviour at a comparatively low cost.

- Economic incentives, subsidies and taxes, making it in the consumers' economic interest to select the energy efficient ones
- Availability of alternatives (legislation, prohibiting energy inefficient options)
- Information and awareness
- Communication and behavioural nudges that make energy efficiency the easy choice, e.g. changing default settings to the most energy efficient setting.

One policy of promoting EE through sustainable lifestyle and education could be showcasing it among social groups that are most concerned with climate change. Further approaches include making use of social comparison in neighbourhoods by communicating energy use compared to ones neighbours; and/or framing energy efficiency in such a way that it connects to peoples' lives (e. g. emphasizing the durability of energy efficiency products rather than their carbon mitigation potential).

Sustainable tourism

The opportunities for energy efficiency improvements in the tourism sector are cross-cutting with opportunities in hotels (buildings), transport (air, bus and other mediums), food processing, waste reduction and procurement (large scale, by hotel chains). In the business-

[1] International Energy Agency (2010). World Energy Outlook. Paris: International Energy Agency.
[2] McKinsey. (2009). Pathways to a low-carbon economy. McKinsey and Company.

as-usual scenario, energy consumption in tourism is expected to double by 2035-2040, compared to 2010. Conversely, according to an analysis by Siemens, optimised heating, ventilation and air-conditioning (HVAC) alone can lower energy consumption by more than 40% in hotels – without negatively impacting guest satisfaction. Six Senses, a luxury hotel group, showed varying returns on investment from a number of energy-savings measures applied in resorts located in Thailand with paybacks ranging from six months to ten years. Examples include: energy monitoring system (cost: USD 4,500), enabled 10% energy savings; investment in a mini-chiller system (USD 130,000), saved USD 45,000 annually, paid off in 2.8 years; and heat-recovery system (USD 9,000), saved USD 7,500 annually, equalling 1.2 years payback time.

- Buildings
  - Hotels: A significant part of energy consumption in tourism occurs in in hotels. Energy efficiency options in such cases are covered by the commercial building sector.
  - Resorts: Many resorts offer additional facilities such as swimming pools, sports facilities, and casinos. Resorts also typically have large common areas which may require decentralised heating / cooling arrangements and lighting.
- Entertainment facilities: Amusement parks, pools, golf, skiing, surfing and other water sports.
- Transport: Tourism sector uses a range of transport e.g. air, water, automobiles, buses, trains. Energy efficiency options in transport sector cover that.

Sustainable food systems

Estimates show that, globally, the food production and supply chain accounts for about 30% of the total energy consumed and about 70% of total fresh water withdrawals. Food Systems also contribute about 20% of total GHG emissions in the world. Apart from being energy and water intensive, food systems continue to be heavily dependent on fossil fuels, and the energy use in agriculture remains completely coupled with the output from the sector, with agricultural energy intensities mostly remaining stagnant over years. Given these factors, as the demand for food increases, the demand for energy and emission of GHGs from agriculture/food systems will therefore reach unsustainable levels.

Areas for energy efficiency improvements in the food system are:

- Promotion of improved cook stoves in developing and emerging economies
- Deployment of efficient water pump sets for reducing water and energy foot-print of agri-food systems. As an example, a pilot project in India replaced 2209 old inefficient pump with star rated Energy Efficient Pump sets (EEPS) and provided free operation and maintenance for installed pump sets in the project duration. On average, the replacement leads to 37% in energy efficiency improvement)
- Promoting drip and sprinkler irrigation systems for agri-crops and horticultural products to reduce energy and water usage in agri-food systems
- Increased use of renewable energy or waste heat from farm machinery for farm operations such as drying (solar), water heating or cooling requirements

- Increased generation and use of bio gas for productive purposes like heating and electricity production or distributed generation through wind or solar for on-site electricity production and storage
- Energy efficient storage of agri-produce and food storage at homes and commercial establishments as well as energy efficient processing of agri-produce
- Energy efficient heating and cooling in areas where livestock is housed
- Removal of subsidies on energy used for agri-food systems

Energy efficiency project are being taken up in some of the areas mentioned above. For example and Asian Development Bank Supported Project in India for improving the efficiency of agricultural irrigation pumps is expected to save about 30 percent of the electricity consumption in the agriculture sector in India

Nationally Appropriate Mitigation Actions and intended Nationally Determined Contributions

Nationally Appropriate Mitigating Actions (NAMAs) were developed under the United Nations Framework Convention on Climate Change (UNFCCC) to focus mitigation planning and implementation at the country level. NAMAs are developed by governments and agencies and, when they get to a bankable stage, they seek public and private financing from domestic and international sources. Additional sources of financing include the NAMA Facility—funded by the Governments of Germany and the UK as well as the European Commission and Denmark—and the Green Climate Fund.

The UNFCC website contains a NAMA Registry[3] which provides information on NAMAs seeking support for development, finance, or implementation. Such NAMAs cover areas such as energy efficiency, residential and commercial buildings, and agriculture. NAMA Registry thus could be one possible source for identifying potential energy efficiency projects and programmes in the six programme areas of the 10YFP.

More than 185 countries have submitted Intended Nationally determined Contributions. As per Paris agreement, the parties (countries) will be closely monitored on their progress towards INDC targets. In order to meet the intended targets, countries are beginning to initiate steps to translate targets into actionable projects and programs. The six programme areas of 10YFP would benefit by associating with the countries in this early stage (of converting their respective INDCs into actionable projects), as the 10YFP programme areas would then be able to identify synergistic projects and programmes, and look for a role in their funding and implementation.

Synergies between the SE4ALL global energy efficiency platform and the 10YFP
Sustainable Energy for All's (SE4ALL) Global Energy Efficiency Platform is a multi-stakeholder, multi-sector global implementation mechanism for energy efficiency. The Platform is SE4ALL's flagship energy efficiency programme and is directly linked to the achievement of Sustainable Development Goal 7 (ensure access to affordable, reliable, sustainable and modern energy for all) and the ambitions of the COP21 Agreement on Climate Change, as SDG7 also sets out a target to achieve a global doubling of the rate of improvement in energy efficiency by 2030.

[3] http://unfccc.int/cooperation_support/nama/items/7476.php

There is a natural overlap between implementation of some 10YFP programme areas and the activities of the Accelerator Platform. The most prominent of these include:

- **Sustainable Buildings and Construction:** While its focus is more on non-residential buildings, through the work of its extensive partners the Building Efficiency Accelerator is actively involved in some of the core work of this 10YFP programme, especially on establishing and promoting enabling frameworks for SBC policy, and reducing climate impact of the building and construction sector through energy efficiency.
- **Sustainable Public Procurement:** public procurement typically encompasses many decisions that influence energy use, including procurement of buildings, appliances and equipment, motor vehicles, and potentially district energy systems. Accelerators across each of these areas are expert in best practice standards in the relevant product areas.
- **Sustainable Tourism:** A component of Sustainable Tourism relates to the buildings and equipment used for tourism facilities, which is a further connection with the Building Efficiency Accelerator (and potentially the District Energy Accelerator).
- **Consumer Information:** similar to public procurement, Accelerators are heavily involved in standards for key energy using equipment such as appliances, lighting and motor vehicles that have direct application to labelling and consumer information at point of sale.

Next steps

Apart from information about the opportunities for incorporating on energy efficiency in 10YFP, information on relevant examples is provided in the main body of the paper. The workshop on 8-9 September seeks to bring experts together to further build on this paper to identify specific and high-impact energy efficiency opportunities within 10YFP Programme areas that can support the transition to sustainable patterns of consumption and production. It is hoped that informal consortia established in this workshop may then go on to develop and implement large scale projects together, synergizing the networks and objectives of the SE4All and 10YFP initiatives, and their wider associated "communities of practice" on energy efficiency and sustainable consumption and production.

Energy Efficiency and the 10YFP

Introduction

At the United Nations Conference on Sustainable Development (Rio+20), the attending Heads of State reaffirmed that promoting sustainable patterns of consumption and production is one of the three overarching objectives of, and essential requirements for sustainable development. As a response, the Heads of State adopted the 10-year framework of programmes (10YFP) on sustainable consumption and production (SCP) patterns. The 10YFP aims at developing, replicating and scaling up SCP and resource efficiency initiatives, at national and regional levels, decoupling environmental degradation and resource use from economic growth, and thus increasing the net contribution of economic activities to poverty eradication and social development.

SCP has been defined as "*a holistic approach to minimising the negative environmental impacts from consumption and production systems while promoting* quality of life for all"[4]. It thus embodies principles of intertemporal equity with respect to environment and resources, decoupling of economic growth and development from environmental degradation, and life-cycle thinking in all our production and consumption systems and processes. Resource efficiency, which in broad terms means using less resource(s) for the same or increased output[5], is thus ingrained within SCP and is an integral part of any SCP initiative.

Energy, in its various forms,[6] is a resource for which demand and use has been rising and whose extraction, conversion, transmission, distribution, and consumption or use is resulting in rising levels of greenhouse gas (GHG) emissions[i]. Data from the Intergovernmental Panel on Climate Change's Fifth Assessment Report (Working Group III) indicates that energy as a resource (or the energy sector) contributed about 60 percent of the total anthropogenic GHG emissions of the world in the year 2010. Thus, not only are emissions from energy use increasing, but these emissions are also the largest source of greenhouse gas emissions (GHG) and consequently global warming, making the energy resource' the single largest contributor to the climate change. Increasing the efficiency of energy resource use is thus a major component of achieving sustainable consumption and production patterns which objective the 10YFP is intended to support.

Energy has the unique distinction of being at once an input (resource) as well as a form of infrastructure. As a form of infrastructure, its use is even now highly correlated to economic growth and general wellbeing (human development index being proxy) of the human kind (2)[ii]. In the context of continued economic growth and general wellbeing of the population, it

[4] "Sustainable Consumption and Production: A handbook for policymakers", United Nations Environment Programme (UNEP), 2011, Global Edition

[5] Resource efficiency can be brought about by reducing resource intensity or increasing resource productivity.

[6] Coal, water, oil, gas, electricity, biomass, biogas, wind, solar, geo-thermal, etc.

therefore becomes critical that adequate emphasis is placed on meeting the energy needs[7] of the human population, including providing energy access to 1.1 billion people who have no access to electricity and the 2.9 billion who have no access to non-solid fuels[8]. As an infrastructure, it becomes necessary to ensure adequate access to and availability of energy for all. As an input resource whose use is rising annually and which is a major contributor to GHG emissions, efficient and effective use of an energy resource across its lifecycle, i.e. from extraction to consumption becomes more necessary. In the context of Sustainable Development Goal (SDG) 7 too, efficient and effective use of energy assumes special significance for achievement of the SDG 7 targets[9] with respect to energy access and renewable because of the close synergies existing between energy efficiency and energy access as well as renewable energy[iii]

Energy Efficiency and 10YFP

The International Energy Agency (IEA) describes energy efficiency (EE) as a fuel of first choice[10]. In addition, as elaborated by IEA, EE has multiple benefits[11], including more efficient allocation of resources across the global economy, which, IEA estimates, could result in boosting cumulative global economic output through 2035 by USD 18 trillion – larger than the current size of the economies of the United States, Canada and Mexico combined. IEA has also recognised EE as the best option for bringing about reduction in GHG emissions to keep the global temperature below the 2 degree centigrade mark. IEA's "4 for 2 degree centigrade" scenario envisions that out of the total reduction in GHG required for adhering to 2 degree centigrade limit, EE alone would bring about 49% reduction[12]. Its importance is expressed in the Intended Nationally Determined Contributions (INDCs), where out of 187 countries that have submitted INDCs, 165 have mentioned EE as an option for meeting their respective climate goals.

These benefits of EE have resulted in EE being looked upon as an important strategic option, not only for mitigating climate change effects, but also for deriving economic benefits and competitive advantage. Energy efficiency's virtues are helping to initiate and attract increasing investments in EE. IEA's Energy Efficiency Market Report 2014 (EEMR 2014) estimates that investment in energy efficiency markets worldwide in 2012 was between USD 310 billion and USD 360 billion, which was larger than supply-side investment in renewable electricity or in coal, oil and gas electricity generation, and around half the size of upstream

[7] In terms of being available in right quantum, at right time, in right form, at right place, and at right and affordable price.
[8] Global Tracking Framework Report 2015, SE for All and the World Bank, 2015
[9] The SDG 7 Targets are: Target 7.1 - By 2030, ensure universal access to affordable, reliable and modern energy services, Target 7.2 - By 2030, increase substantially the share of renewable energy in the global energy mix By 2030, Target 7.3 - double the global rate of improvement in energy efficiency
[10] " Energy use avoided by International Energy Agency (IEA) member countries in 2010 (generated from investments over the preceding 1974 to 2010 period), was larger than actual demand met by any other single supply-side resource, including oil, gas, coal and electricity – making energy efficiency the largest or "first" fuel." (Capturing the Multiple Benefits of Energy Efficiency, IEA, 2014)
[11] Ibid, IEA lists fifteen such benefits, including: energy savings, lower GHG emissions, higher energy security, better energy delivery, lower energy prices, broader macro- economic impacts, higher industrial productivity, poverty alleviation, better health and well-being, higher employment, lower local air pollution, better resource management, balanced public budgets, higher disposable incomes, and enhanced asset values.
[12] IEA: Redrawing the energy climate map, IEA, June 2013

oil and gas investment. Further, as per the latest (2016) State of the Market Report on Green Bonds (prepared by Climate Bonds Initiative), out of the total of USD 130 billion of outstanding bonds under the energy theme, nearly 6 percent, or USD 7.8 billion outstanding bonds are under the energy efficiency sub-theme.

In view of the benefits and the rising interest in energy efficiency, as well as its close synergies with resource efficiency - an integral part of SCP – actors in the 10YFP are keen to integrate and strengthen EE in its six programme areas. As a first step in this direction, this background paper has been produced. It is intended to provide an overview of how EE can be integrated and strengthened in the 10YFP 6 programme areas: Consumer Information (CI), Sustainable Public Procurement (SPP), Sustainable Buildings and Construction (SBC), Sustainable Lifestyles & Education (SLE), Sustainable Tourism (ST), and Sustainable Food Systems (SFS). The paper, while elaborating on generic tools and programmes and schemes for capturing EE potential, discusses and analyses for each of the programme areas of 10YFP, the need and importance of EE, the opportunities for EE, and examples of successful projects and programmes. This paper will form the basis for discussion during the workshop scheduled for September 2016, and for identifying specific projects in six 10YFP programme areas.

Realisation of Energy Efficiency Potential

Considerable energy efficiency[iv] potential exists at every stage of the energy cycle - from extraction to final consumption. According to IEA, if we are able to capture all the economic potential (IEA 450 scenario)[13], the total primary energy demand in 2030 will be about 15 percent lower than the business as usual (BAU) scenario. In terms of sectors and regions, the estimates of energy saving or energy efficiency potential in 2030 (as a percentage of consumption under BAU scenario in 2030) is given in Table 1.

Normal market mechanisms should ordinarily be able to capture this vast energy efficiency potential. However, as noted in a series of recent blog posts by Steven Nadal of the American Council for an Energy-Efficient Economy (ACEEE), while market solutions have worked in segments such as institutional and large commercial consumers, they have had limited success in capturing energy efficiency potential in residential, small business or industrial sectors, where government and public supported and managed energy efficiency programmes have been able to successfully deploy and deliver energy efficiency[14v]. Even where market solutions have worked, the experience shows that governments have played a major role in creating conducive atmosphere through legislative or facilitative measures for uptake of energy efficiency by various consumer segments. As concluded in the ACEEE blog posts, the strategy to capture the available energy efficiency potential and to bring

[13] Based on data contained in :'World Energy Outlook 2015', IEA, 2015
[14] The blog posts in 3 parts by Steven Nadal of ACEEE: http://aceee.org/blog/2015/02/why-we-don%E2%80%99t-have-choose-between-ener (part 1) http://aceee.org/blog/2015/02/look-history-efforts-increase-relianc (part 2); http://aceee.org/blog/2015/02/looking-future-energy-efficiency-mark (Part 3)

Table 1: Energy efficiency potential in 2030 compared to business as usual scenario

Region	Savings possible in total primary energy consumption in 2030 under IEA "450 " scenario as compared BAU scenario (percent)	Savings possible in industry sector final energy consumption in 2030 under IEA "450 " scenario as compared BAU scenario (percent)	Savings possible in transport sector final energy consumption in 2030 under IEA "450 " scenario as compared BAU scenario (percent)	Savings possible in buildings sector final energy consumption in 2030 under IEA "450 " scenario as compared BAU scenario (percent)	Savings possible in other sectors' final energy consumption in 2030 under IEA "450 " scenario as compared BAU scenario (percent)
World	15	14	15	13	4
EU	13	11	18	13	3
USA	17	12	15	16	2
Peoples Republic of China	19	15	14	17	7
India	19	10	13	11	4
Russian Federation	11	13	6	12	7
Brazil	14	12	15	12	2
South Africa	14	17	15	11	0
Middle East	17	11	21	19	4
Japan	12	8	9	18	3

Figures calculated from data contained in 'World Energy Outlook 2015, IEA, 2015

acceleration and scale, the future efforts will continue to have to rely on a combination of market based solutions and energy efficiency programmes, with governments continuing to play the role of creating an atmosphere conducive to uptake of energy efficiency by boosting demand for energy efficiency and at the same time strengthening the supply side.

For energy efficiency uptake to happen, apart from having motivated consumers (of energy) who are eager to adopt energy efficiency, there is also a need to have financiers who are willing, motivated and eager to lend for or otherwise invest in energy efficiency, and also well-functioning energy efficiency delivery systems consisting of the entire supply chain entities. Those include energy auditors and managers, energy service companies (ESCOs), measurement and verification professionals, energy efficiency service providers, as well as equipment manufacturers, importers, and dealers, to energy efficiency project designers. Weakness in any one of the links (consumers, financiers or supply chain entities) will lead to less than optimal levels of success in any energy efficiency improvement effort. In their energy efficiency strategies and approaches, therefore, governments and policy makers will have to include elements that simultaneously create a conducive environment for these three stakeholders - consumers, financiers, and supply chain entities.

Hitherto the discourse on energy efficiency policy has tended to dwell more on motivating consumers to adopt energy efficiency. Governments and policy makers have generally relied on the following instruments to boost demand for energy efficiency among consumers or to motivate consumers to adopt energy efficiency:

Regulatory Instruments: These instruments could be 'normative' or 'informative' in nature. Examples of normative regulatory instruments include standards, energy conservation building codes (ECBC), and specific energy consumption norms for industries. Examples of informative regulatory instruments are labelling of appliances and certification of buildings.

Economic Instruments: These instruments help improve the economics of energy efficiency initiatives and measures or help in reducing the first cost burden of energy efficient products. Examples of these instruments include rebates, targeted subsidies, tax breaks, interest rate draw down, accelerated depreciation, rational pricing of energy, etc.

Information/education: These instruments help move the consumer through various stages of the adoption process (from creating a need for information search to evaluation behaviour to purchase decision) by creating interest in energy efficiency, converting interest into inclination towards adoption of energy efficiency and ultimately converting inclination into actual adoption. Examples of these instruments include case studies & best practices, behavioural nudges, films, information flyers, demonstration projects, awareness campaigns, training programmes, testimonials, and advisory services.

The instruments are usually given effect through synergistic policies and schemes/projects (see table 2 below).

Table 2: Instruments and synergistic policies and Schemes

Instrument	Policy	Scheme/Project
Labelling	Mandatory Labelling of appliances, equipment and products	Public procurement of highest rated appliances Tax breaks on highest rated appliances
Energy Conservation Building Codes (ECBC)	Voluntary compliance of ECBC	Tax Breaks and/or lower yearly charges for ECBC compliant buildings
Vehicle mileage norms	Voluntary compliance	Tax breaks for vehicles meeting norms, free parking for vehicles meeting norms, etc.
Specific energy consumption norms	Mandatory compliance	Trading scheme for meeting norms

Conditions prevalent (e.g. infrastructure available, institutional set-up, organizational/national capacity, resource availability, including financial resources) in the programme areas, countries, regions or cities determine what mix of instruments, policies and schemes are needed for realisation of energy efficiency potential.

Financiers, the second important element of the energy efficiency chain, face three main barriers to investing in energy efficiency: high transaction cost per loan application; risk associated with the quantum of energy savings and absence of tangible or visible cash flow streams emerging out of energy efficiency investments; and lower effort-to-reward ratio of energy efficiency projects as compared to other lending portfolios available for financiers, such as lending for housing projects, consumer durables, or passenger vehicles. Governments, policy makers, and private initiatives have started addressing some of these barriers. Thus the high transaction cost which to some extent is an 'energy saving risk' barrier is being addressed by initiatives such as the 'Investor Confidence Project'15. The Investor Confidence Project codifies and standardises efficient building (i.e. retrofits) transactions, creating transparent processes that help to create sector bankability. Similarly, bundling projects with similar properties into a package of sizeable investment is another methodology for reducing high transaction costs.16 Bundling is used to resolve the EE investment bottleneck of insufficient scale. Bundling, or securitization, of street lighting projects or housing allows projects to achieve the scale necessary to appeal to commercial investment.

Multilateral development banks such as the World Bank (WB), European Investment Bank, and the Green Climate Fund (GCF)[17] are using guarantee mechanisms and insurance to catalyse finance to energy efficiency projects by mitigating energy efficiency project performance or 'energy saving' risks. Vehicles targeting climate resilience, such as the Global Environment Facility (GEF) and Climate Investment Funds (CIF), also include substantial energy efficiency initiatives in their portfolios, aimed at bridging financing gaps. These include the CIF's partial-risk guarantees in India and the GEF's energy efficiency market support in Bulgaria. These initiatives are helping in addressing the low reward-to-effort barrier by providing dedicated incremental funds with lower costs (due to mechanisms such as guarantee and risk sharing) for onward lending to energy efficiency.

Another source of financing, green bonds, initiated in early 2007-08 by the World Bank are now providing dedicated funds for addressing climate change related funding, including for energy efficiency. This is helping to address the low reward-to-effort barrier by providing dedicated incremental funds with lower costs (due to mechanisms such as guarantee and risk sharing) for onward lending to energy efficiency. Green bond activity for financing energy efficiency has increased to a level of USD 7.2 billion (bonds outstanding basis. One good example of energy efficiency specific green bonds is the GCF approved project wherein USD 217 million have been allocated to the Inter-American Development Bank (IDB) energy efficiency green bonds issue for energy efficiency funding in Latin America and the

[15] See for example: http://www.eeperformance.org/ OR http://web.unep.org/climatechange/buildingsday/investor-confidence-project-0

[16] https://web.law.columbia.edu/sites/default/files/microsites/climate-change/files/Publications/Energy%20Efficiency%20BEER%20Financing%20Overview-Kerstetter.pdf

[17] For example the two projects providing a partial risk sharing facility to the Indian Government totalling USD 43 million for fostering energy efficiency, or the GCF USD 20 million for de-risking and scaling-up investment in energy efficient building retrofits in Armenia with UNDP and European Investment Bank (USD 100 million), or the GCF loan of 20 million and a grant of USD 1.7 million for de-risking energy efficiency loans (Inter-American Development Bank &GCF) for small and medium enterprises in El Salvador

Caribbean. These developments on the financing side are expected to considerably bring down the barriers faced by financiers in funding energy efficiency and drive increasing levels of finance to energy efficiency, paving the way for accelerated and wide-spread uptake of energy efficiency.

While having motivated consumers and financiers is necessary for energy efficiency, it is by no means sufficient to scale up energy efficiency. In recognition of this, governments and policy makers have been paying considerable attention for some time now to strengthen the supply side. Some of the important initiatives undertaken/being undertaken to strengthen the supply chain include:

- Providing institutional identity to energy efficiency within the governmental structure and giving effect to energy efficiency efforts through drafting and operationalization of appropriate legislations and policies, articulation of qualitative and quantitative objectives of energy efficiency, prioritising action areas (sectors, regions, end-uses, technology, etc.), provision of budgets, providing avenues to generate funds for energy efficiency on a sustainable basis, etc.
- Establishing necessary institutions and infrastructure, for example: correct pricing of energy, database development (to strategize, plan, design, and monitor energy efficiency progress), testing facilities creation, or creating a cadre of energy efficiency professions through the establishment of energy auditor, energy manager, and measurement and verification certification programmes.
- Promotion of ESCOs, promotion of energy efficiency appliance and equipment manufacture.

Capturing the available energy efficiency potential will require a combination of market based and government-led actions to simultaneously address and overcome barriers to energy efficiency being faced by consumers, financiers, and supply chain entities. The tools and the strategies are all there. What is required is to identify and research the target segment to arrive at an optimal mix of initiatives in terms of instruments, policies, programmes, and projects required for capturing energy efficiency in the identified target segment. The next six sections highlight how and which energy efficiency initiatives could be taken up to integrate and scale up energy efficiency in the six thematic or sectoral areas of the 10YFP programmes.

Sustainable Public Procurement

The 10YFP Programme on Sustainable Public Procurement (SPP) is a global multi-stakeholder platform that supports the implementation of SPP around the world. The Programme builds synergies between diverse partners to achieve the SDG target on SPP. It has following two main objectives:

- Build the case for SPP: improve the knowledge on SPP and its effectiveness as a tool to promote sustainable consumption and production, support a transition to greener economies and sustainable development.
- Support the implementation of SPP on the ground through increased collaboration, and better access to capacity building tools and support from SPP experts.

Energy efficiency and sustainable public procurement

Governments are a major consumer of goods and services and are often among the largest user of energy in a given country. Government procurement of goods and services accounts for 12 percent of GDP on average in OECD countries, about 20 percent of GDP in EU, and as high as 30 percent of GDP in India[18]. Accordingly, incorporating energy efficiency as a key decision criterion in government procurement policies can drive the market towards the uptake of more energy efficient products, and be highly influential regarding overall energy use and corresponding GHG emissions, as well as concerning the offer of energy consuming products in a country and thus serve the sustainable development objectives.

Integrating energy-efficiency into public procurement is a tangible and influential action with which, besides saving energy, governments can use their big contracts to support innovation and market transformation towards more energy efficient products by influencing manufacturers wishing to sell to their large and relatively stable public sector customers[19]. Governments can also use their role as a big market buyer to showcase how to integrate energy efficiency requirements in its procurement contracts, which can provide a model in both leadership and good practice for the private sector to follow. Sustainable public procurement by national and regional government bodies can help raise the profile and awareness of energy efficiency among public servants and the general public.

Integrating energy efficiency in public procurement

An ESMAP, World Bank publication[20] provides a very good account of approaches that are being used for integrating energy efficiency in public procurement. Given below is an overview of some of the main approaches discussed in the publication:

Energy Efficiency Labels[vi] *:* Here, requirement for purchased products to carry a minimum level of energy efficiency based on a comparative or endorsement energy label, when such labels are available, is advised or mandated.

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[18] Government at a Glance 2015, OECD Publishing, Paris. http://www.oecd-ilibrary.org/content/book/gov_glance-2015-en [accessed in March 2016]. It is almost 20% of EU GDP ('Sustainable Public Procurement: From rhetoric to practice - Dispelling myths and exploring effective solutions- A case Study from Sweden', Version 1.1, March 2016. In India it is estimated to be of the order of 30% of GDP (Going Green: Best Practices for Sustainable Procurement, OECD, 2015)

[19] Singh, Jas; Culver, Alicia; Bitlis, Melis. 2012. "Public Procurement of Energy Efficient Products: Lessons from Around the World". Energy Sector Management Assistance Program (ESMAP); Technical report 003/12, World Bank. The report points out that jurisdictions that mandate energy efficiency in public procurement, generally see a greater and more rapid increase in the adoption of energy efficient products and market transformation effects than those that do not

[20] *Ibid,* Chapter 4

Catalogues of Technical Specifications: Here, catalogues, books or websites are used to lay down the technical specifications and energy efficiency standards for commonly purchased products, especially those where energy labels may not be available or where energy intensity is high or the products in question consume relatively large amounts of energy. The specifications or standards are included in tender documents.

Life-Cycle Costing (LCC)/Best Value Award: The LCC analysis concept is used to identify and procure goods and products that offer best financial value over their life. Under this approach, life time ownership cost of the product or appliance is used as a parameter for comparing competing brands or products. For many of the commonly used appliances and equipment such as pumps, air-conditioners, ceiling fans, refrigerators, etc., the initial purchase price is a fraction of the energy cost incurred for operating these appliances and equipment over their life. For example, initial purchase cost of pumps is only about 7-15 percent of their life time energy cost. Similarly, for air-conditioners, initial purchase cost is about 20-25 percent of their life time energy cost. For refrigerators the percentage is about 40-50 percent, while that for ceiling fans is 15-20 percent[21]. In the procurement of such goods and products, using LCC (combining initial capital investment with energy consumption cost over life) as a procurement criteria helps identify products that offer optimal energy efficiency and the best financial value over life.

Energy Efficiency Preferences: Here, energy efficient goods and products are awarded additional points or price preferences in the bid evaluation process.

Opportunities for energy efficiency in public procurement

Energy efficiency does not always fit well with existing procurement systems that seek to deliver 'best value', due to a wide range of barriers that may be encountered by many government jurisdictions, for example:

- Assessment of energy efficiency's value relies on an assessment of whole-of-life performance, which governments may not have the capacity to compare or calculate;
- Strict and inflexible rules for procurement of energy using goods and specific items of plant, rather than taking a system-wide perspective on procurement of energy services;
- Restricted ability to enter into multi-year contracts that might be needed to recoup capital outlays for energy efficiency projects;
- Lack of incentive for managers based on an inability to retain energy savings within departmental budgets.

To overcome these barriers, holistic approaches are needed that build local capacity. While such approaches need to be tailored to local circumstances, there are strong common elements of a recommended program for energy efficiency in public procurement which could be widely replicated at city and/or national levels:

- Examining treatment of energy in budget laws and regulations
- Considering treatment of energy in public sector specification and tendering documents

[21] Source: Experience of C2E2 experts

- Adopting a two-stage assessment process so that technical value of options is assessed first, and then supplemented with financial considerations based on net present value (NPV)
- Institutionalizing and normalizing procedures for the inclusion of energy efficiency considerations
- Awareness raising and training activities

A wide-scale and replicable program could build on the good local work being undertaken by individual stakeholders in many jurisdictions and focus on major and common sectoral areas of public procurement. Candidate topics for focus of such a program could include standardised models and guidance for procurement of whole building retrofits (including through services contracts), lighting products including street-lighting, appliances such as computers, or vehicle fleets.

Examples of energy efficient public procurement

Worldwide, many national and local governments are integrating energy efficiency criteria in their public procurement. One good example of the use of energy labels in the public procurement area is the Office Memorandum issued by the Indian Finance Ministry (Box 1). Other good examples of this approach are seen in the United States and the European Union. The United States Government has adopted a broad federal sustainable acquisition policy that requires federal agencies to purchase, rent, or lease ENERGY STAR or Federal Energy Management Program (FEMP)-designated equipment and products. In 2008, the EU adopted an "Energy Star Regulation" (EC/106/2008), which "requires EU institutions and central Member State government authorities to use energy efficiency criteria no less demanding than those defined in the ENERGY STAR programme when purchasing office equipment".

Mexico City's *General Guidelines for the Procurement of Goods with Less Environmental Impact*, which are mandatory for all city agencies, is a good example of how energy efficiency standards and specifications are being incorporated in government procurement. Some of these guidelines call for products to comply with ENERGY STAR and low standby power office equipment standards as well as fuel efficient and low emission light passenger vehicles standards.

Another good example of this approach in combination with the life cycle costing (LCC) methodology is a project Indian Railways implemented in 2008[22]. This was a unique initiative to reduce the peak lighting loads in Indian Railways' residential quarters by replacing incandescent lamps with high efficiency CFLs. The project team used LCC as a tool to demonstrate the potential benefits of using CFLs over incandescent lamps for lighting needs even though the upfront purchase price of a CFL was approximately eight to ten times higher than that of an incandescent lamp at the time in India. The secondary objective of the project was to demonstrate the use of the Clean Development Mechanism (CDM) under the Kyoto Protocol to finance an energy-efficiency project in an emerging economy. It leveraged money earned through the sale of certified emission reductions (CERs) generated

[22] Going Green: Best Practices for Sustainable Procurement, OECD, 2015

during the project to distribute a maximum of 4 CFLs to 400 000 households across Indian Railways. The project resulted in direct energy savings of 112,500 MWH per annum. More than 400 000 households benefited directly from this project as they received free CFLs. One of the key lessons learnt was that the SPP is a demand-side policy intervention to reduce the consumption of resources, and that the consumer is central to any discussion on sustainable public procurement. Therefore, the implementation of SPP, in practice, requires not only laws and guidelines but also a change in consumers' attitude towards the sustainable consumption of products and services. The project success, it was surmised, was largely because consumers understood the benefits of using CFL and adopted the project wholeheartedly.

As pointed in a 2009 white paper[23] and ESMAP-World Bank report[24], while LCC is not very popular, a growing number of countries are using this methodology and best value assessments to help ensure the products they are purchasing are making the best use of public budgets. The USA, United Kingdom and European Union are using LCC in various forms and in various degrees. The European Union, for instance, publishes the results of a generic product-based LCC analysis to support its voluntary Green Public Procurement criteria. Furthermore, its *Directive on the Promotion of Clean and Energy-Efficient Road Transport Vehicles* encourages purchasing authorities throughout the European Union to make procurement decisions based on an LCC assessment and to consider monetizing emission reduction benefits and factoring them into a vehicle's LCC. Similarly, the United States' Federal Energy Management Program (FEMP) publishes the results of LCC assessments based on "the product's typical usage pattern" when setting recommended and best practice EE levels for federal agencies to follow when procuring "FEMP-designated" products[25]. With respect to LCC, it is worth noting the observations made under the 'lessons learnt' section of the Indian Railway project discussed earlier:

- Procurement professionals do not always have the technical knowledge to capture all costs themselves and have to depend on external sector experts.
- LCC must take into consideration all of the associated costs. However, it is often not possible to realistically establish the LCC of products and services due to non-availability of data for the use phase.
- In the case of competing products, procurement professionals depend on data provided by vendors for working out operation and maintenance costs. Accuracy of data must be closely checked.
- It is time consuming.
- It does not, *per se*, take into account the impacts of products and services on the environment and society.

[23] Oshani Perera, Barbara Morton, and Tina Perfrement, 'Life cycle costing in sustainable public procurement: A question of Value', International Institute of Sustainable Development (IISD), December 2009
[24] Opcit, 3, Chapter 4
[25] Ibid, Chapter 4

The Energy-efficient Public Procurement: Best Practice in Program[26] published by the Lawrence Berkley National Laboratory in 2013 highlighted the key issues and considerations when implementing energy-efficient public procurement. Similarly, the ESMAP, World Bank publication referenced earlier, in summarising global experiences with energy efficient purchasing on the basis of 10 case studies and multiple expert interviews, concludes that policies and programmes on energy efficiency procurement can be an effective way to promote energy efficient products by leveraging a government's purchasing power and influence.

Table 3 provides further examples of energy efficient public procurement policies in selected countries and cities along with their economic and environmental impacts.

Table 3: Success stories of energy efficient public purchase in selected countries and cities.

City or Country	Procurement Policy	Impacts
Vienna, Austria	Mandatory Green Public Procurement (GPP) policy of 1999 includes energy efficiency criteria. Guidelines cover 23 goods and services.	Annual savings of EUR 17 million. 30,000 tons of CO_2 emissions avoided.
China	Energy Efficient Procurement policy enacted in 2004 mandated to all government levels in 2006. Guidelines cover 28 product categories (2011).	Energy efficiency purchasing reached RMB 15.7 billion (USD 2.3 billion) in 2009. Covered 70% of products in target categories.
Mexico City, Mexico	Mandatory GPP policy in 2011includes energy efficiency criteria. Covers eight product categories.	Energy savings of 340 GWh/year and 6,500 tons of CO_2 emissions avoided.
South Korea	Voluntary green public procurement policy in 2004 includes energy efficiency criteria. Guidelines cover 11 product categories.	GPP reached KRW 1.12 trillion (USD 1.0 billion) in 2009.

Source: Singh, Jas; Culver, Alicia; Bitlis, Melis. 2012.[27]

Incorporating energy efficiency in SPP

Under SPP or GPP, a well-established set of parameters are often used for comparison of competing goods and products, and energy efficiency just becomes one of the many parameters used for comparison. In the context of SPP and GPP, therefore, approaches such as energy labels, catalogue of technical specifications or energy efficiency preferences are relatively easier to incorporate in the overall set of parameters as compared to LCC. However, products such as pumps, blowers, fans, refrigerators, air-conditioners,

[26] Christopher Payne, Andrew Weber, Abby Semple, 2013. 'Energy-efficient Public Procurement: Best Practice in Program Delivery'. Environmental Energy and Technologies Division, LBNL, February 2013. http://superefficient.org/Activities/~/media/Files/SEAD%20Procurement%20Best%20Practices%20Guide_final.pdf [accessed in March 2016]

[27] *Ibid*, Table 1, page 3

compressors, where life time energy costs of operation are many times the initial capital investments, using LCC will make sense. LCC itself can be purely a financial exercise using market values for prices and costs or an economic exercise using shadow prices. In either case, application of LCC would necessitate drafting of standardised guidelines for carrying out the LCC calculations as well as for various values such as for lifetime of the equipment, yearly hours of operation, future energy prices, and cost of capital to be taken for discounting future costs.

Box 1

No. 26/6/12-PPD
Government of India
Ministry of Finance
Department of Expenditure
(Procurement Policy Division)

North Block, New Delhi
Dated : 21st January, 2013.

OFFICE MEMORANDUM

Subject:- Procurement of energy efficient electrical appliances.

In order to effect energy savings in the long-term by promoting procurement of energy efficient equipment, there is a need for Ministries/Departments to procure energy efficient appliances. In this context it has been decided, in consultation with Ministry of Power and the Bureau of Energy Efficiency (BEE), that all Ministries/Department and their attached and subordinate offices would, while procuring appliances indicated in Para 2 of this OM, ensure that they carry the threshold BEE Star Rating indicated against them, or higher. The threshold ratings have been finalized based on a life cycle cost analysis carried out by BEE.

2. The appliances and the minimum threshold BEE Star rating are tabulated below:

Appliance	Threshold star rating
Split Air Conditioners	5 star (under normal conditions where annual usages are expected to be more than 1000 hrs.) 3 star (where usage of AC is limited, eg. In Conference Rooms)
Frost Free Refrigerators	4 Star
Ceiling Fans	5 Star
Water Heaters	5 Star

3. It may be noted that GFR provisions and all extant rules/guidelines of procurement would apply. Ministry of Power and BEE have confirmed that adequate number of manufacturers/models of the prescribed Star rating are available to enable competitive procurement.

(Vivek Ashish)
Under Secretary to the Government of India
Tele.No. 2309 5629

To:
i) Secretaries of all Ministries/Departments
ii) FAs of all Ministries/Departments.

Linking energy efficiency measures to SPP objectives

Regarding linking energy efficiency measures to the programme's objectives and work areas, the following connections can be thought of:

Table 4

SPP objectives	SPP Work Areas	Links to energy efficiency
Build the case for SPP	WA1: Proposing a vision for SPP and defining purchasing principles	Include energy efficiency as one purchasing principles.
	WA2: Monitoring SPP/GPP implementation and assessing impacts	Include increase in energy efficient purchases as one impact area and provide targeted policy support and cases studies on energy efficiency.
	WA 3: Addressing barriers to SPP implementation and proposing/disseminating new solutions	Include energy efficiency labels and standards and business models, e.g. ESCOs when proposing and disseminating new solutions.
Support the implementation of SPP	WA4: Promoting collaboration with the private sector	Look for collaboration with the energy sector in particular, e.g. via awareness raising on both public and private side regarding preferences for energy efficient products.
	WA5: Cooperating for SPP implementation (number of partnerships with IGOs and MDBs)	Look specifically for partners focusing on energy efficiency including donors.
Core activities	WA6: Core activities	Include specific capacity building and tool kit development on energy efficiency.

Sustainable Buildings and Construction

The 10YFP Sustainable Buildings and Construction Programme aims to foster a mutual understanding of sustainable buildings among relevant stakeholders and to identify the knowledge, resources and incentives required to build, maintain and use them; ensuring structures are healthy to live and work in; that they sustainably utilise energy, water, land and other key resources, respect environmental limits; are responsive to climate change; and contribute to the social and economic development of the communities where they stand.

Energy efficiency and sustainable buildings and construction

Buildings is one of the main sectors contributing to increasing greenhouse gas emissions, accounting for more than one third of final energy use and approximately 9 $GtCO_2$

emissions per year globally, 45 percent of which are in OECD and about. 46 percent in developing countries.[28] Under various scenarios, by mid-century energy demand from the sector is expected to double and CO_2 emissions to increase in the range of 50-150 percent without additional mitigation efforts[29]. In order for the world to stay on the path below 2°C it is required that the global CO_2 emissions from the building sector reduce by almost 80 percent by 2050 in comparison to the current levels[30]. Residential buildings consume between 50 percent to tenfold the amount compared to commercial buildings. Buildings contribute even more toward global energy consumption when considering their entire lifecycle due to material requirements of steel, cement and glass, among others.[31] At the same time a wide range of technologies for more sustainable buildings are already commercially available, including a number of cost-effective energy efficient solutions[32]. Support from integrated and comprehensive policy-making aimed at increasing energy efficiency in buildings is required in order to overcome existing barriers and further boost the transition towards more sustainable buildings and construction[33].

One of the most comprehensive overviews of energy efficiency potential in the building sector, presented in IPCC AR5[34], shows that according to different studies, at the global level between 34 percent and 70 percent of final energy use can be saved by 2050 (in relation to the baseline) through holistic improvements in the building energy efficiency for various end-uses. According to the IEA 'Energy Efficient World'[35] scenario, close to 1,000 Mtoe can be saved through energy efficiency by 2035. There is evidence from various studies that new buildings can achieve net zero or even energy positive performance at no or low additional costs[36], while deep retrofits of existing buildings can result in up to 90 percent of energy

[28] UNEP, 2012: Increasing Access to and Demand for Energy Efficiency in a Perspective to Sustainable Energy for All www.unep.org/gc/gcss-xii/docs/EE_SCPreport_160212_FF.pdf

[29] IPCC, 2014: Summary for Policymakers, In: Climate Change 2014, Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlomer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[30] IEA, 2013. Transition to Sustainable Buildings. Strategies and Opportunities to 2050.

[31] UNEP, 2012: Increasing Access to and Demand for Energy Efficiency in a Perspective to Sustainable Energy for All www.unep.org/gc/gcss-xii/docs/EE_SCPreport_160212_FF.pdf

[32] Levine, M., D. Ürge-Vorsatz, K. Blok, L. Geng, D. Harvey, S. Lang, G. Levermore, A. Mongameli Mehlwana, S. Mirasgedis, A. Novikova, J. Rilling, H. Yoshino, 2007: Residential and commercial buildings. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[33] IEA, 2013: Transition to Sustainable Buildings. Strategies and Opportunities to 2050.

[34] Lucon O., D. Urge-Vorsatz, A. Zain Ahmed, H. Akbari, P. Bertoldi, L. F. Cabeza, N. Eyre, A. Gadgil, L. D. D. Harvey, Y. Jiang, E. Liphoto, S. Mirasgedis, S. Murakami, J. Parikh, C. Pyke, and M. V. Vilarino, 2014: Buildings. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S.Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlomer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. (Figure 9.13 and Table 9.6)

[35] IEA, 2012: World Energy Outlook. International Energy Agency, p. 328, Figure 11.1

[36] Lucon O., D. Urge-Vorsatz, A. Zain Ahmed, H. Akbari, P. Bertoldi, L. F. Cabeza, N. Eyre, A. Gadgil, L. D. D. Harvey, Y. Jiang, E. Liphoto, S. Mirasgedis, S. Murakami, J. Parikh, C. Pyke, and M. V. Vilarino, 2014: Buildings. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth

savings in thermal energy use[37]. Moreover, energy efficient equipment and appliances can save 5-90 percent of electricity, depending on the end-use[38].

The largest part (up to 75 percent) of the energy saving potential can be realised in cities: urban buildings are estimated to be responsible for more than 60 percent of the total final energy use in buildings. Moreover, in developing countries urban building energy use is expected to more than double by 2050[39].

Integrating energy efficiency in sustainable buildings and construction

There are still a number of barriers, which prevents energy efficiency potential from being realised in the building sector, namely[40]:

- **Limitations of the traditional building design process and fragmented market structure:** high building energy performance requires optimisation of the building as a system and, therefore, coordination among multiple stakeholders involved in the process
- **Misplaced incentives:** intermediaries involved in decisions to make investments into energy efficiency improvements are different from those benefiting from the energy savings
- **Energy subsidies, non-payment and theft**: energy pricing that does not reflect the long-term marginal costs of energy, including direct subsidies to some customers, hinders the penetration of efficient technologies; however, radical removal of energy subsidies may result in the failure of some recipients of energy service to pay discouraging energy efficiency improvements
- **Regulatory barriers**: various policies and requirements, which discourage energy-efficient investments
- **Small project size, transaction costs and perceived risk** of energy efficiency investments
- **Imperfect information**: information about energy-efficiency options is often incomplete, unavailable, expensive and difficult to obtain or trust.
- **Culture, behaviour, lifestyle and the rebound effect**: impact of lifestyle and tradition on energy use depends on the country and personal choices; 'rebound effect' takes place when increased energy efficiency is accompanied by increased demand for energy services

In order to overcome these barriers ambitious policy efforts need to be structured around implementation of efficient policy packages.

Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S.Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlomer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA

[37] IEA, 2012: World Energy Outlook. International Energy Agency, p. 328, Figure 11.1

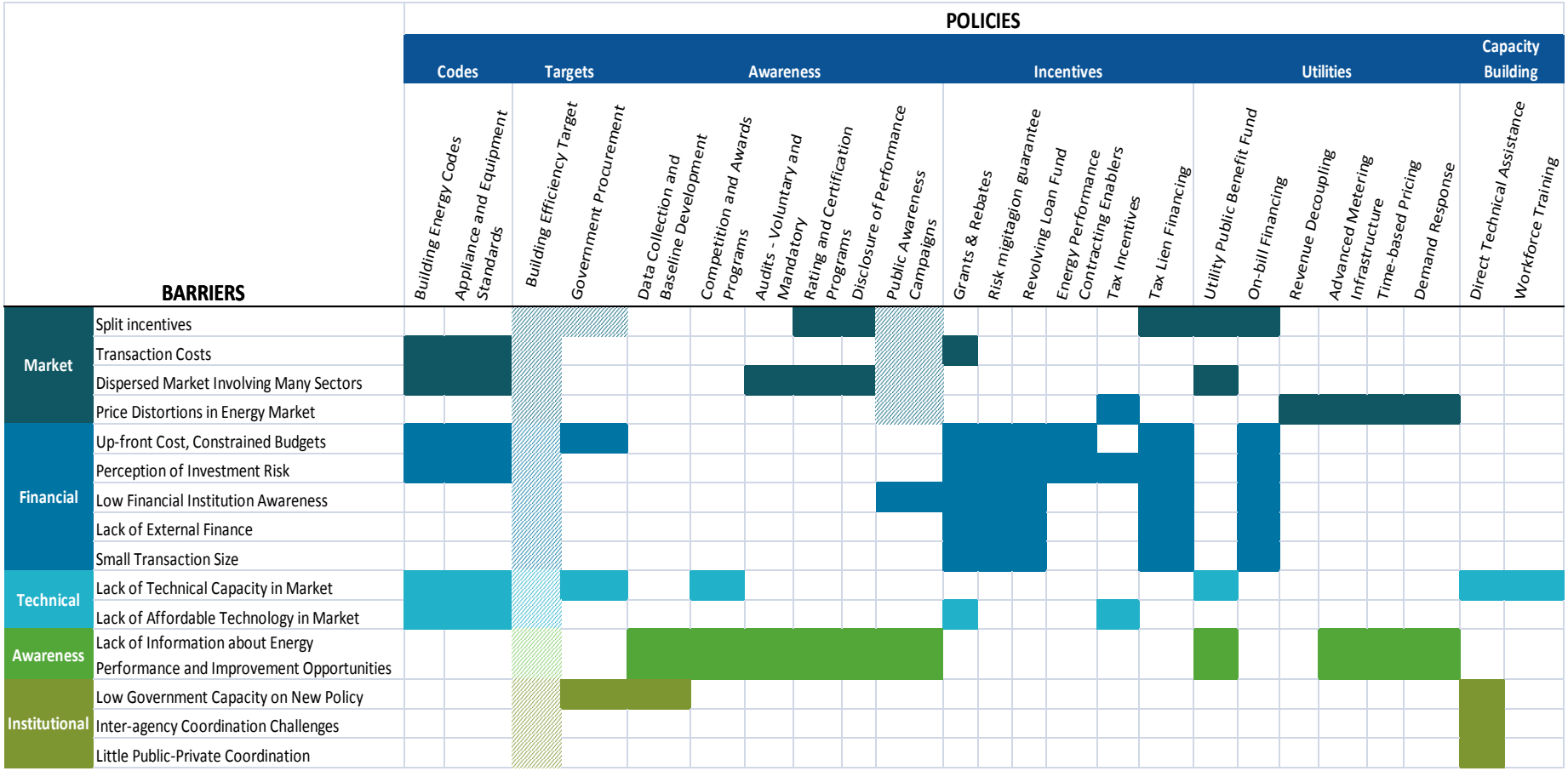
[38] ibid

[39] IEA, 2016: Energy Technology Perspective. Towards Sustainable Urban Energy Systems , p. 171

[40] Levine, M., D. Ürge-Vorsatz, K. Blok, L. Geng, D. Harvey, S. Lang, G. Levermore, A. Mongameli Mehlwana, S. Mirasgedis, A. Novikova, J. Rilling, H. Yoshino, 2007: Residential and commercial buildings. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Table 5 illustrates the key policy instruments, which can help to tackle certain barriers. The list below provides the technological measures, when applied through a holistic approach, can ensure that energy use and related CO_2 emissions are significantly reduced. Relevant policy instruments can support these measures in order to ensure their wide-scale application.

Table 5: Mapping policy instruments against barriers to energy efficiency in buildings[41].



[41] Managan, K., Layke, J., Araya, M., Nesler, C., 2012: Driving Transformation to Energy Efficient Buildings. Policies and Actions. URL: http://www.buildingefficiencyinitiative.org/sites/default/files/legacy/InstituteBE/media/Library/Resources/Energy-and-Climate-Policy/Driving-Transformation-to-EE-Buildings-Taking-Action.pdf

Table 6: Policy menu for improving energy efficiency in buildings. [42]

Policy	Definition
Building Energy Codes	Regulations that set minimum requirements for energy efficiency, including design and energy systems, for different building types.
Appliance and Equipment Standards	Minimum energy performance requirements established by a recognized public authority for a particular product class
Policy targets & roadmaps	Publicly announced commitments (quantitative or qualitative) to improve energy efficiency and a transparent strategy to achieve them.
Building performance targets	Commitments to achieve a certain level of the overall energy performance of buildings (or of a building type) typically significant lower than that of typical buildings
Energy efficiency obligations/ White Certificates	Obligations put on energy suppliers and/or retailers to achieve a defined amount of energy savings in a given period on the consumer premises, accompanied by monitoring and verification of energy savings and often by certification
Data collection & baseline development	Research and analytical efforts channelled at gathering, creating, systematizing and analysing data on building energy performance, energy efficiency policies and building sector conditions
Energy audits	Measurement of building energy performance with the aim to identify potentially cost-effective improvements, ensuring that informed decisions are made.
Building certification & rating	A rating system of energy performance of individual (new and/or existing) buildings, according to a credible set of criteria, accompanied by issuing the certificate and typically requiring its disclosure.
Disclosure of Energy Performance	Certificates issued to buildings containing the information on energy consumption and in some cases CO_2 emissions, which usually have to be presented when the dwelling is sold or rented out.
Energy taxes	Taxes levied directly on the consumption of fossil fuels and/or on energy using products, based on their energy demand.
Tax exemptions and reductions	A transfer of wealth from one group (e.g. the society at large) to another group, typically investors in energy efficiency measures, which indirectly reduces the cost of energy efficiency investments.
Grants and rebates	A form of financial assistance provided by the public administration to companies or individuals, in order to support energy efficiency investments and projects in order to mitigate the lack of access to capital or financing opportunities for energy efficiency investments.
Soft loans/ Revolving	Publicly supported loans offered by government agencies (often through a public-private partnership) or

[42] Adapted from ibid.

loan funds	banks at low interest rates to finance energy efficiency measures or to guarantee a bank's investment in energy efficiency.
Risk mitigation mechanisms	A guarantee of a certain low level of risk provided by the government to banks that lend to building energy efficiency improvement projects.
Preferential mortgages	Mortgages supported by the public authority through providing an incentive to commercial banks, which allow building owners to benefit from lower interest rates or extended credit options when the investment is related to energy efficiency.
Public building and facility energy improvement programs	Programs aimed at improving energy efficiency of public buildings with the aim to demonstrate the efforts, raise awareness and encourage energy efficiency initiatives also in other building types, through communication to relevant stakeholders.
Procurement regulations	Regulations for organized purchase by public bodies following pre-set regulations, which include provisions for energy efficiency
Public benefit charges	Charges billed to consumers as an additional percentage of the utility costs with the aim to collect funds and use them for energy efficiency improvement.
On-bill repayment	A loan made to a utility customer to pay for energy efficiency improvements to the customer's dwelling through the energy bill, administered by the utility directly or by a state energy office
Revenue decoupling	A utility pricing policy that separates a utility's profits from the amount of electricity it sells through a rate adjustment mechanism.
Time-based pricing	Energy price program, which sets different tariffs for energy use depending on the time of the day or energy demand, with higher rates applied for larger amount of energy consumed and/or during the peak hours.
Demand response	An energy saving strategy, which includes rates, incentives and other strategies to help better manage electricity used during periods of high demand and reduce the need to build new generation to cover peak demand
Smart metering	Technological devices that record energy consumption in (near) real-time and remotely communicate this information to the utility provider and users
Energy performance contracting market	A form of financing for capital improvement, normally offered by Energy Service Companies (ESCOs), which allows funding energy efficiency upgrades in buildings through cost savings from reduced energy consumption.
Workforce training & education	Programs that increase the skills of workers and job-seekers by providing education or training in energy efficiency.

Business development for efficiency providers	Technical assistance efforts aimed at creating business opportunities related to energy efficiency improvements in buildings
Information and education campaigns	Dissemination of general information and messages on energy efficiency to the general public or to specific target groups (e.g. architects, engineers, etc.).
Competition & awards programs	Events and/or programmes aimed at gathering, evaluating and selecting the best energy efficiency practices presented through the certain application process and compiled with pre-defined and announced eligibility criteria. Governments can also design competitions and reward best performers.
Feedback programs	Organised provision of information to energy users about their energy consumption patterns through their bills, directly on their appliances, or through communication, which can include recommendations on how to reduce consumption.

Today many countries have established energy efficiency codes for buildings and put in place various incentives for households and businesses to invest in energy efficient houses and buildings. One example covers the stringent energy efficiency requirements in Denmark. This policy successfully drives energy efficiency innovations in the construction sector, reducing energy consumption in new buildings while improving comfort levels (See Box 2)[43].

[43] Søren Aggerholm, 2013. Cost-optimal levels of minimum energy performance requirements in the Danish Building Regulations. Danish Building Research Institute, Aalborg University 2013

A good example of an integrated policy package can be the building efficiency policy in Singapore, which recognises energy efficiency in buildings as one of the national policy priorities and includes instruments such as the Green Mark Certification Scheme. In addition it also includes, a set of governmental incentives for high building energy performance, minimum environmental sustainability standards for new and existing buildings, and comprehensive training framework for the industry (including formal training and certification for green building specialists and energy managers) [44].

Box 2: Tightening energy efficiency standards for new buildings - example of Denmark

In Denmark, the energy rating scheme are in existence since 1981. Denmark is the first country in the EU to begin issuing Energy Performance Certificates (EPCs). The EPCs are mandatory for all types of buildings.

A 150 m² single family house is used in order to compare the level with the new requirements. The energy supply for heating, cooling, ventilation and domestic hot water must not exceed:

- Building Regulation 1995: 105 kWh/m² per year.
- The energy requirement 2006: 85 kWh/m² per year.
- Building Regulation 2010: 63.5 kWh/m² per year.
  Two voluntary low energy classes have been introduced in the Building Regulation 2010:
  Energy class 2015: ≤37 kWh/m² per year.
  Energy class 2020: ≤20 kWh/m² per year.

Opportunities for energy efficiency in sustainable buildings and construction

In order to realise energy efficiency potential in the most effective way, it is critical to take into account the local context and priorities. A survey conducted by C40[45] of a number of cities taking actions in the field of building energy efficiency showed that the following interventions were reported by cities, as the top 10 most important ones: improvements in building insulation, audits and advice, benchmarking, energy performance certification, improvement of heating/cooling efficiency, smart meters, building energy management systems, solar heating/hot water, energy efficient appliances, and energy efficient lighting systems.

In general terms potential energy efficiency interventions in buildings may include:

- Promoting commercial financing of energy efficiency investments by bringing together commercial banks and energy service companies
- Providing technical assistance for implementation of building energy codes at the city level
- Supporting design and implementation of holistic 'deep' retrofits of existing buildings
- Assisting in design and implementation of adequate energy pricing and other market imperfections in order to spur energy efficiency investments

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44 http://www.buildingefficiencyinitiative.org/sites/default/files/legacy/InstituteBE/media/Library/Resources/Energy-and-Climate-Policy/Driving-Transformation-to-EE-Buildings-Policy-Options.pdf

45 C40, 2014: Urban Efficiency. A global survey of building energy efficiency policies in cities. URL: http://www.kankyo.metro.tokyo.jp/en/int/attachement/Full_Report.pdf

- Developing appropriate energy use measurement and verification systems and ensure their incorporation in the project design
- Ascertaining credit lines extended to support energy efficiency subprojects.

Examples of energy efficiency in buildings and construction

A number of initiatives are supporting energy efficiency in buildings at the global, national and sub-national levels:

- Sustainable Energy for All Building Efficiency Accelerator
- Global Alliance for Buildings and Construction
- UNEP's Sustainable Buildings and Climate Initiative (SBCI)
- IEA's Sustainable Buildings
- IPEEC's Buildings Energy Efficiency Task Group (BEET)
- UNECE's Housing and Land Management
- Architecture 2030
- WBCSD's Energy Efficiency in Buildings (EEB2.0) project
- Energy Efficient Buildings Association
- C40's Private Building Efficiency network
- US DOE Better Buildings Accelerators

Linking energy efficiency measures to SBC objectives

Regarding linkages of energy efficiency measures to the programme's objectives and work areas, the following table indicates various possibilities:

Table 7

SBC objectives	SBC Work Areas	Links to energy efficiency
To foster a mutual understanding of sustainable buildings among relevant stakeholders	WA1: Establish, promote, and enable conditions for sustainable building and construction policies	Include energy efficiency as one the key principles in the construction policies; consider and promote multiple benefits of energy efficiency (e.g. improved health and well-being, reduced local air pollution, job creation, poverty alleviation, etc.)
To identify the knowledge, resources and incentives required to build, maintain and use buildings	WA2: Support and promote sustainable housing	Disseminate knowledge about energy efficient measures in buildings' design and renovation, share related best-practices, case studies and lessons learnt from existing projects, promote standards and labelling schemes with disclosing information on buildings' energy performance, support higher levels of energy efficiency with relevant incentives

To ensure buildings are healthy to live and work in, responsive to climate change; they utilise resources sustainably, and contribute to the social and economic development	WA 3: Enhance sustainability in the building supply chain	Consider the whole life cycle when designing and/or renovating a building, include energy efficiency requirements into every stage of building supply chain, aim at minimizing embodied energy through sustainable construction materials, more energy efficient manufacturing processes and transportation, etc.
	WA4: Reduce climate impact and strengthen climate resilience of the building and construction sector	Increase energy efficiency of buildings in order to reduce their GHG emissions and, therefore, climate impacts; align energy efficiency strategies with resilient building design via including respectful requirements into the building codes and minimum performance standards

Consumer Information

The 10YFP Consumer Information Programme (CIP) has three objectives: 1) improve availability, accessibility and quality of consumer information; 2) drive change in business and government; and 3) enhance communication to drive behavioural change. While there are strong links to all of the 10YFP programmes as consumers form a key constituency in each, the CIP is particularly aligned with the 10YFP SLE programme in terms of energy efficiency, as the provision of reliable information relates not only to the purchasing of energy efficient products and services, but to their usage as part of a sustainable lifestyle

Energy efficiency and consumer information

The provision of energy efficiency information to consumers aims to influence purchasing decisions, geared towards preference of energy efficient goods over less efficient ones, and consumers' behaviour in using energy appliances and systems. Such decisions often have upstream effects on the production and supply chain of goods and services. The lack of information about the benefits of efficiency for consumers is recognised as one of the main barriers to the effectiveness of standards and labelling Programmes[46]. The provision of targeted information in the design and implementation phase are critical to the success of policies and programs.

A multi-dimensional approach to information provision is important to cater for the different ways consumers absorb information. The development of baseline data is important to ensure that the benefits and changes in behaviour from consumer information programmes can be measured, modified and appropriately shaped to maximise impact. Government agencies, consumer groups, schools, electricity suppliers, NGOs, and the private sector (e.g. via labelling practices) can all help to increase the change in consumer

[46] CLASP 2005 see page 180 http://clasp.ngo/en/Resources/Resources/PublicationLibrary/2005/SL-Guidebook-English

behaviour. The provision and evaluation of consumer information needs to be considered at the design stage and consider many factors including budgetary, impact, mix, duration and evaluation. In many cases consumer information programmes can play an important role in monitoring, verification and enforcement of energy efficiency programmes. Monitoring and evaluating consumer information programmes through activities such as consumer surveys can help to further improve programmes and can also provide a sound basis for further investment by government and stakeholders in consumer information programmes.

Opportunities for better energy efficiency through consumer information

Consumers can be encouraged to purchase energy efficient products and services and to use appliances and energy efficiently in the home, school, and the workplace via actions such as:

- Government mandates concerning labelling of appliances, buildings and transport to provide information to consumers at the point of sale or lease.
- Communication channel such as television, newspapers, radio, websites, comparison tools and various other options can directly communicate information to consumers.
- Training of, retailers, real estate agents and car salespeople.
- Energy bills that help consumers to identify how energy and money can be saved. The provision of additional comparative information such as how ones energy bill compare's to other households can be an effective tool for households to change their behaviour towards more energy efficiency. For example, energy retailers in Australia provide electricity consumption benchmarks on a residential customer's bill to allow end-users to compare their household electricity usage with similar households in their area. This assists consumers to make more informed choices about how they use energy.
- Establishing energy efficiency centres in some cities has demonstrated to the general public the energy and financial benefits arising from consumer actions such as selecting more efficient technologies or changing energy using behaviours. Mobile demonstration vans travelling to various locations have also been used to educate consumers on energy efficiency.
- Energy efficiency tips, case studies and best practices for consumers – distributed by governments, energy providers or civil society organisations - to provide simple actions that households can undertake to save energy and money.
- Developing curriculum for school education programmes that focus on practical tips for households to save energy and money.
- Directories of consultancies, manufacturers and product suppliers can be made available for consumers to allow easy access to relevant information on technical aspects including energy efficiency.
- Award schemes for industrial, commercial and SME's for the most energy efficient products can help promote efficiency to consumers.
- 'Buyer-seller' meets - providing a platform or forum for consumers to meet with manufacturers to discuss and share opinions and views on technologies and opportunities to improve energy efficiency can provide an important dialogue. Confederation of Indian Industry (CII), in India holds several such events, which

generally have a product (soft starters for motors) or technology (variable speed drives) focus

- Promoting the participation of consumers in events such as Earth Hour, as a symbol of their commitment to the planet.

Using the correct means to target consumer information

Consumer information plays a significant role in bringing energy efficiency consideration in the purchase decisions. Consumers, buying appliances and equipment, typically go through a process that consists of a sequence of events: need stimulation/recognition, information search, evaluation of alternatives, purchase decision and post purchase behaviour[47]. Irrespective of whether the purchasing entity is a household, a business or government, information available at every stage of the buying process plays an important part in not only moving the consumer to the next stage along the buying process but also in shaping the ultimate buying decision. Providing appropriate energy efficiency related information to consumers (appropriate to each stage in the buying process) therefore has the potential in shaping the consumer buying decision towards adopting energy efficiency and/or adopting efficient appliances and equipment.

As noted in the preceding section, appropriate information to consumers could be provided through variety of means such as product energy labelling, energy efficiency demonstration centres, mobile technology demonstration vans, dedicated presentations, case studies, best practices, films, information flyers, demonstration projects, energy bill inserts, tip sheets, product & consultant directories, handbooks/ guidebooks, awareness campaigns, training programmes, advisory services, testimonials, study tours, and 'buyer-seller' meets. In addition, in the context of energy efficiency, two important means of providing information are energy audits and energy accounting systems.

However, the choice of means to be used depends upon the consumer segment being addressed, product, equipment or appliance characteristics, and the stage in the buying process[48]. Correct targeting and choice of means therefore is important for energy efficiency information initiatives to be effective. Table 8, Table 9, and Table 10 below provide an overview of preferred means of providing information with respect to different buying stages, consumer types and product/equipment types[49].

Table 8: Indicative list of preferred means of providing information with respect to the stages in the buying process.

Need stimulation / Recognition	Information search	Evaluation of alternatives	Purchase decision	Post purchase behaviour
• Awareness Campaigns	• Case studies	• Product labelling	• Advisory services	• Testimonials • Energy

[47] Kotler, Philip, and Keller Kevin Lane, "Marketing Management", 12 edition, Chapter 6, pp 203. Chapter 7, pp 234 further states that businesses and governments, while purchasing equipment, machinery, appliances, etc. typically go through a buying process that consists of sequence events such as: need recognition, general need description, product specification, supplier search, proposal solicitation, supplier selection, order placement, and performance review.

[48] Consumer segment also has bearing on the nature of information (information content) and the medium as well as the mode used to convey the information.

[49] Based on the experience of C2E2 experts

• Case Studies • Demonstration projects • Energy efficiency Centres • Films • Tip sheets • Training Programmes • Energy audits • Energy accounting systems	• Best practices • Directories • Training programmes • Energy Efficiency Centres • Films • Hand or guide books	• Case Studies • Advisory services • Testimonials	• Product labelling	audits • Energy accounting systems

Table 9: Indicative list of preferred means of providing information with respect to type of consumer.

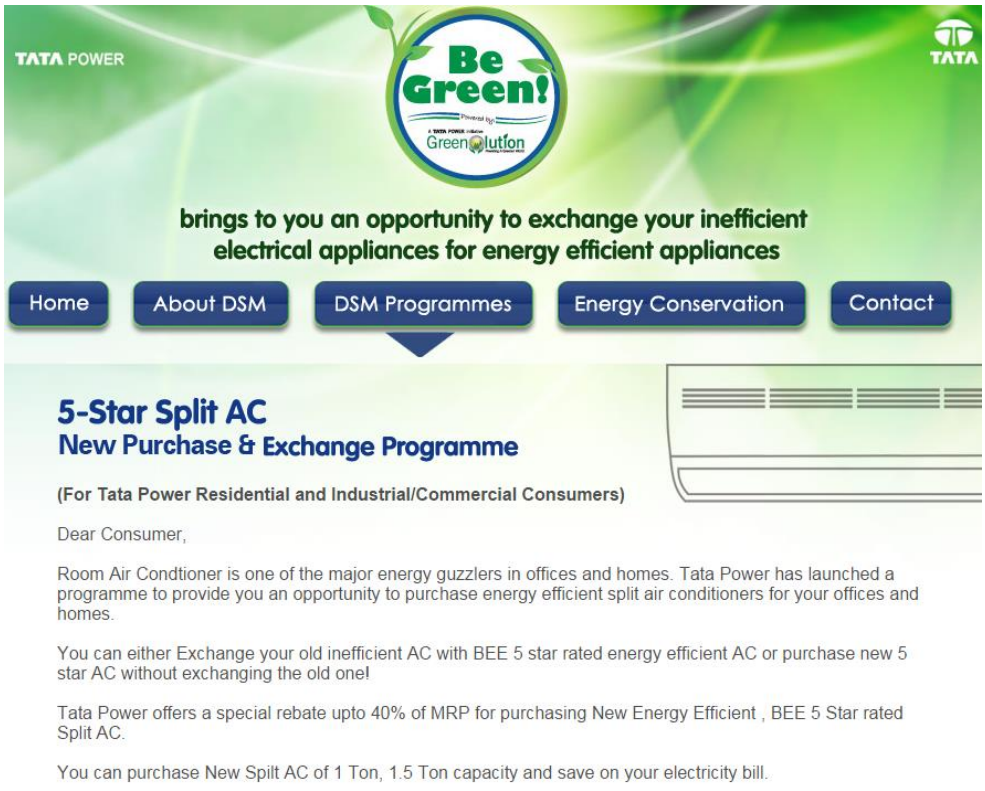
Residential consumer	Small and medium enterprises	Large commercial and industrial consumers (Municipal and public sector included)	Policy makers
• Awareness campaigns • Tip sheets • Energy efficiency centres • Energy bill inserts • Films • Energy Labels • Mobile demonstration vans	• Awareness campaigns • Training programmes • Case studies • Product and consultant directories • Demonstration projects • Advisory services • Case studies • Energy audits • Energy Labels	• Demonstration projects • Testimonials • Training programmes • Energy audits • Case studies • Handbooks/guidebooks • Energy labels • Dedicated presentations • 'buyer-seller' meets	• Training programmes • Study tours • Best practices • Case studies • Demonstration projects

Table 10: Indicative list of preferred means of providing information with respect to type of the product/energy efficiency adoption situation.

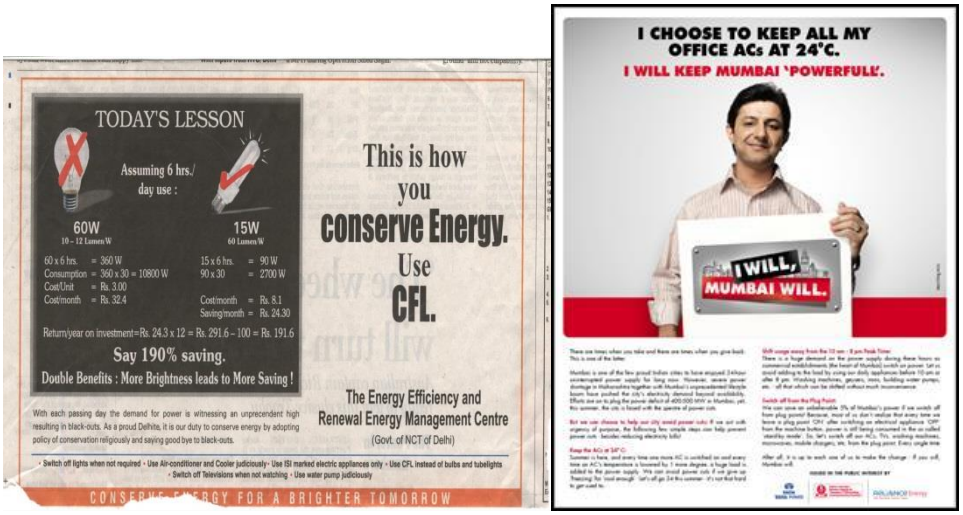
Household appliances, lighting products	Simple industrial or commercial equipment	Complex equipment and systems
• Energy Labels • Awareness campaigns	• Information flyers • Guidebooks • Case studies	• Demonstration projects • Testimonials • Case studies • Dedicated presentations

Examples of energy efficiency through consumer information

- US, Department of Energy (DOE) tip sheets on saving energy in home cooling systems http://energy.gov/energysaver/home-cooling-systems
- ACEEE consumer guide for home energy saving: http://aceee.org/consumer-guide-home-energy-savings-online
- US DOE Tip sheet for Pumps & cooling systems: http://energy.gov/sites/prod/files/2014/05/f16/adjust_speed_pumping.pdf
- The Human Factor in Energy Efficiency. Lessons from Developing Countries: http://www.die-gdi.de/en/books/article/the-human-factor-in-energy-efficiency-lessons-from-developing-countries/
- Example of combining information and incentive to spur action is the campaign by Indian power utility wherein incentives are being provided to consumers for early retirement of old inefficient appliances or purchasing high efficiency appliances under new buying situations:



- Awareness campaign for energy saving CFLs and energy efficiency in air conditioning (India, New Delhi & Mumbai)



Box 3 provides an example of the consumer information campaign Energy- wise in the New Zealand.

Box 3: Energy Spot – A part of New Zealand's Energy-wise

The Energy Spot is a television segment that brings the energy efficiency message to New Zealanders. It has been on air since 2009 and viewed by around 2.4 million people, The Energy Spot television series is EECA's most effective awareness-raising tool. The series covers a range of consumer topics including power saving, water heating, appliances, vehicles, efficient driving and tyre pressure.
In 2013/14, the Energy Spot reached 62% of New Zealanders, and 39% of viewers said they took action as a result, with actions taken ranging from turning off appliances and lights when not in use, to installing energy efficient light bulbs or draught stopping in winter.

Linking energy efficiency measures to CI objectives

Regarding linkages of energy efficiency measures to the programme's objectives and work areas, the following table indicates various possibilities:

Table 11

CIP Objectives	CIP Work Areas	Links to Energy Efficiency
Improve availability, accessibility and quality of consumer information	Improve availability, accessibility and credibility of consumer information through principles and guidelines	Introduce energy labelling programmes wherever they do not exists and strengthen them by bringing in more appliances and equipment under energy labelling regime wherever they exist
	Address data gaps and quality	Include energy efficiency database development and load research programmes of utilities
	Improve methodology of key sustainability impact indicators	Include 'market energy efficiency' of appliances and equipment as an indicator to

		be tracked
Drive Change in business and government	Support retailers and brand owners to promote sustainability	Build formal partnerships with brand owners in Standards and Labelling programmes and training of retailers on energy labelling and its place in consumer interface
	Encourage the uptake of new business models and the design of products that make the sustainability the easy choice	Introduce or strengthen mandatory minimum efficiency standard regimes
	Encourage the uptake policies which enable more sustainable practices	Include energy efficiency as an important purchase criterion
Enhance communication to drive behavioural change	Stimulate comparability of consumer information tools	
	Identify and scale up effective practices of consumer information	Design and implement energy efficiency awareness campaigns, bring out and disseminate case studies, best practices, etc.
	From information to action: understanding the impact of sustainability information on consumer behaviour	Track yearly changes in market energy efficiency for key appliances and equipment

Sustainable Lifestyle and Education

According to the Business Dictionary, lifestyle is a way of living of individuals, families (households), and societies, which they manifest in coping with their physical, psychological, social, and economic environments on a day-to-day basis. It is expressed in both work and leisure behaviour patterns and in activities, attitudes, interests, opinions, values, and allocation of income. Lifestyles also reflect people's self-image or self- concept; the way they see themselves and believe they are seen by the others.[50]

Education is an important way of raising consumer awareness about the environmental and social impacts of their behaviours and stimulating the change toward more sustainable lifestyles. Consumer education is practical, touching the daily lives of people near and far away.[51] Education can inform consumers the environmental impacts of their economic

[50] Read more: http://www.businessdictionary.com/definition/lifestyle.html

[51] Together with UNEP, UNESCO has been active in raising awareness and providing educational resources in relation to sustainable consumption via its YouthXchange Project.

choices, spreading practice information about how to live in a responsible way with less environmental impacts.

The mission of the Sustainable Lifestyles and Education (SLE) programme is to foster the uptake of sustainable lifestyles as the common norm. The five objectives of the Programme are: 1) Build a shared vision of sustainable lifestyles; 2) Integrate sustainable lifestyles principles and practices across all sectors of society; 3) Develop tools and incentives, provide capacity-building for achieving sustainable lifestyles and disseminating good practices; 4) Empower individuals to adopt sustainable lifestyles through education, awareness-raising and participation, engaging all forms of education; and 5) Measure and track the benefits of action targeting sustainable lifestyles.

Sustainable lifestyles are considered as ways of living, social behaviours and choices, that minimise environmental degradation while supporting equitable socio-economic development and better quality of life for all (UNEP, 2010)[52].

Energy efficiency and sustainable lifestyle and education

Energy efficiency improvement and energy conservation, key solutions for climate change mitigation and decoupling global economic growth and environmental pollution and degradation, are an inherent component of the SLE Programme.

Energy efficiency is an important parameter for judging and measuring the sustainability of different lifestyles. Energy use, as a fundamental input, is chosen by the United Nations Conference on Sustainable Development UNCSD as one of the key indicators for measuring and comparing Sustainable Consumption and Production.[53] Opting for a lifestyle that uses energy in a more efficient way and avoids wasteful and unnecessary energy use can contribute to reducing the various environmental impacts and resource requirements for energy resource extraction, processing, and energy production and transmission.

Technology innovation alone is insufficient to address the problem of unsustainability. Therefore it is necessary to address the problem of sustainability from demand side - especially consumer behaviour change. SLE has an important role to play in improving energy efficiency and mitigating climate change. The global environmental and resource conditions call for responsible living and sustainable lifestyle - respecting the limits of various natural resources. From the equity perspective, priority should be given to meet people's basic needs, while luxury and wasteful uses of resources should be discouraged and reduced.

The residential sector accounts for 23 percent of the world final energy consumption in 2014.[54] Private cars are directly responsible for a large part of the energy use of the transport

[52] UNEP, 2010. ABC OF SCP - Clarifying Concepts on Sustainable Consumption and Production. Available at: https://sustainabledevelopment.un.org/content/documents/945ABC_ENGLISH.pdf [accessed in March 2016]
[53] UNEP (2008) 'SCP Indicators for developing countries. A guidance Framework', UNEP. Paris, available at http://www.unep.fr/shared/publications/pdf/DTIx1085xPA-SCPindicatorsEN.pdf.
[54] IEA 2016, Key World Energy Trends - EXCERPT FROM WORLD ENERGY BALANCES (2016 edition)

sector, which accounts for 28 percent of the world final energy consumption. Apart from direct energy use at homes and in their cars, consumers also cause indirect energy consumption that is used to produce and deliver the products and services they use. For example, when indirect (upstream) emissions are taken into account, households are responsible for more than 70 percent of UK carbon emissions (Druckman and Jackson, 2009).[55]

Many of people's daily choices and behaviours at home, at work, on the road, and in other social and economic contexts can lead to different levels of energy use. There exist many opportunities for reducing people's energy use through reducing wasteful consumption and switching to a more sustainable alternatives.

Over the period 1990-2009, energy efficiency in the household sector increased by 24 percent, driven by the diffusion of more efficient buildings, space heating technologies and electrical appliances. In the 450 Scenario of the IEA, energy efficiency by end-users can contribute up to 34 percent of carbon emission decrease globally.[56] According to the Global GHG Abatement curve developed by McKinsey, around 4 GtCO2 abatement/year can be achieved through change in behaviour at a comparatively low cost.[57]

Apart from environmental benefits, reducing energy use reduces energy costs and may result in a financial cost saving to consumers if the energy savings offset any additional costs of implementing an energy efficient technology.

Energy efficiency through sustainable lifestyle and education

Many transitions toward energy efficient consumer lifestyles require change of habit. Recycling, turning off the lights, lowering the thermostat in winter, using recyclable bags for shopping—all require changing behaviour. Consumer lifestyles are difficult to alter. Not only are there many structural (e.g. economical, infrastructural, institutional, social–practical) barriers, but also consumer behaviours and lifestyles tend to be deeply embedded in worldviews, values, and cultural associations and habits.[58] Modern society perceives the acquisition of wealth and material possessions as important life goals. People are motivated by environmental concern and cost saving to reduce their consumption of energy and materials, they also have material concerns that motivate them to purchase new products and increase their environmental impact. Consumer behaviours and lifestyles are also affected by the constraints of their available time and budget.

Southerton, Warde, and Hand (2004) identify three types of constraints to sustainable lifestyles: 1) lack of resources for sustainable living; 2) materialistic social norms; 3) lack of the supportive material and infrastructural arrangements.[59] The up-taking of energy efficient

[55] Values and sustainable lifestyles.pdf
[56] International Energy Agency (2010). World Energy Outlook. Paris: International Energy Agency.
[57] McKinsey. (2009). Pathways to a low-carbon economy. McKinsey and Company.
[58] Worldviews and their relationship with Sustainable lifestyles.pdf
[59] Southerton, D., A. Warde, and M. Hand. 2004. The limited autonomy of the consumer: implications for sustainable consumption. In *Sustainable consumption: The implications of changing infrastructures of provision*, ed. D. Southerton, H. Chappells and B. van Vliet, 32–48. Cheltenham, UK: Edward Elgar.

options among consumers face similar barriers - lack of resources, especially upfront investment and readily available and reliable information; the materialistic values of modern society; as well as the absence of a conducive choice architecture including infrastructure and options for energy efficient consumer behaviour and lifestyle.

Sorrell et al. (2011) list the following categories to explain the energy efficiency gap from a behavioural perspective: bounded rationality (limited ability to process information correctly such as using faulty rules-of-thumb), risk (technical or financial), split incentives imperfect information, hidden costs, and access to capital.[60] Beyond this, a range of other behaviours impact energy consumption: humans tend to follow default settings even if this is not beneficial, engage in social comparison rather than following monetary incentives, hold on to things they already know or own (endowment effect) and procrastinate, all of which can lead to inertia vis-a-vis energy efficiency options.[61]

Initiatives and lessons learned

In economics, a fundamental assumption about human behaviour is the 'homo economicus' or 'economic man'. People are assumed to act rationally and with complete knowledge, responding only to self-interest and the quest to maximize personal utility. It assumes that if other aspects are the same, people will opt to buy the cheapest product so as to maximise their satisfaction for each unit of money they spend. Under rational choice theory, government policies which relax budget constraints, increases income, provide information disclosure or alter relative prices and thus changes consumer preferences will be effective in changing consumer behaviour.

Governments implement policies to influence consumer behaviours following this theory: Worldwide, many countries stimulate the purchase and use of energy conservation and the purchase of energy efficient products through providing banning or limiting inefficient choices; offering financial incentives to inefficient alternatives; and/or requiring the disclosure of certain information.[62]

Table 12: Existing initiatives to promote energy efficient lifestyle.

Category	Explanation	Examples
Command and control	mandatory minimum energy efficiency standards for consumer products, banning the sales, purchase, and use of energy inefficient appliances, bulbs, cars	Banning the sales of inefficient incandescent bulbs in UK, Philippines, Malaysia, Australia Minimum energy efficient standards for new houses, cars, and various electrical appliances in the EU
Economic instruments	Make it relatively cheaper and more financially attractive to purchase and	Energy tax in all OECD countries Carbon tax in Denmark, Germany, UK

[60] Sorrell, S., Mallett, A. & Nye, S. (2011): Barriers to industrial energy efficiency: A literature review, Working Paper No. 10/2011. Vienna: UNIDO.

[61] Pegels et al (2015): The Human Factor in Energy Efficiency. DIE.

[62] The Power of Community: How Community-Based Organizations Stimulate Sustainable Lifestyles Among Participants

	use energy efficient products or reduce energy use Energy tax/carbon tax on various vehicles, credit, subsidies for the purchase of energy efficient products, energy efficient renovation	Subsidies for the purchase and use of energy efficient products, energy efficient renovation in Ghana, China, India
Information	Standards and labelling, energy audit, tips and guidance	The US DOE website contains lots of tips and practical guidance on how to save energy and choose energy efficient products
Legislation and Institution	Laws on energy efficiency Setting up government agencies that specialises in energy efficiency promotion	Energy Conservation Laws in China, Singapore Energy Efficiency Bureau in India, ambitus long-term energy efficiency plans

Source: prepared by the authors

Yet the barriers given above show that human behaviour often deviates from the rational model. Policies and interventions should account for this wherever possible and include behavioural nudges when designing policy programmes or financial incentives for energy efficiency. These can include encouraging social comparison concerning energy consumption, and communication of energy inefficiency as a loss rather than a prospective gain to adhere to the principle of loss aversion which is stronger than expectancy of gains. Furthermore, randomised controlled experiments indicate that the combination of monetary and behavioural incentives is more potent than sum of each individual intervention [63], indicating that a focus purely on financial incentives may be missing potential for increase in energy efficiency.

Examples of energy efficiency through sustainable lifestyle and education

Generally, more emphasis is given on energy efficiency through technology innovation than energy conservation through social innovation. The reasons behind this include the emphasis on materialism and consumerism in modern society, the difficulty in changing people's lifestyles, as well as the established value that government shall refrain from intruding into a person's private and family life and lifestyle is part of a person's personal liberty. There are various campaigns, consumer guides and tips on energy conservation and energy efficiency improvement, provided by various government agencies, environmental organisations, as well as community working groups. There exist some success stories of energy conservation through lifestyle changes; however, they are often at a local scale and among certain small social groups.

[63] Figueroa et al (2015): Show me (more than) the money! Durability driven CFL uptake in a context of informality

Box 4: Cool Biz Campaign

Cool Biz Campaign by the Japanese Ministry of the Environment (MOE) for saving cooling energy use in government buildings during the summer season. It first started in summer 2005 and has become an annual practice among Japanese government agencies. The campaign asks government office workers to dress down, ditching their suits and ties for open-necked, short-sleeved shirts. It also encourages offices to turn down air conditioners to set office temperatures at 28 degrees Celsius. This initiative has been picked up by companies and spread across the Japanese business sector and has been in practice since 2005 and has expanded its reach considerably. It has been estimated that the avoided carbon emissions due to this practice was about 2.2 million tonnes in 2012, more than double the avoided carbon emissions in the year 2005. Inspired by the Japanese success story, the South Korean Ministry of Environment and the British Trades Union Congress have promoted their own Cool Biz campaigns since summer 2006. The United Nations launched the "Cool UN" initiative in 2008. It also inspires the 'Warm Biz' campaign which aims at lowering office heating temperature settings during winter in order to save the energy use of localised space heating.

Examples of success stories with sustainable lifestyle and education include: the Cool Biz campaign to air conditioning energy use in government buildings during hot summer in Japan (see Box 4);[64,6566] and Copenhagen's successful effort of turning itself into the world's most bicycle-friendly city (Box 5). [67]

Box 5: Copenhagen city's efforts to reduce its reliance on fossil fuel and promoting biking.

In big cities, the heavy reliance on cars for transportation causes traffic congestion, air pollution, and make cities less liveable. To tackle this problem, Copenhagen has committed itself to be carbon neutral by 2025. One of its main efforts is promoting public transport and bicycle use, including extending bicycle lanes, improving bike parking facilities, allowing cyclists to carry their bikes in local trains for free, as well as making it easy and convenient to rent a bicycle. As a result, in the Danish capital, people use bikes for over 50% of their trips within the city centre.

The transition towards sustainable lifestyles cannot be realised by a single actor or by merely 'top-down' processes. The EU policy increasingly recognises the need for more participatory policies and strategies. Also it is necessary to take a life-cycle perspective when assessing the energy efficiency performance of different products.[68]

[64] QUARTZ, 19 July 2015. "Ditch the tie and reduce the AC—Japan's Cool Biz gets summer hell just about right", by Robert Smart. http://qz.com/465327/ditch-the-tie-and-reduce-the-ac-japans-cool-biz-gets-summer-hell-just-about-right/,

[65] Cool Biz campaign, Wikipedia. https://en.wikipedia.org/wiki/Cool_Biz_campaign [accessed in March 2016].

[66] NHK World, 1 May 2015, "Cool Biz Campaign Heats Up", by Jun Yotsumoto

[67] The Guardian, 6 Jan 2016. "Where is the most cycle-friendly city in the world?" By Athlyn Cathcart-Keays. http://www.theguardian.com/cities/2016/jan/05/where-world-most-cycle-friendly-city-amsterdam-copenhagen, [accessed in March 2016]

[68] Sustainable lifestyles 2050: stakeholder visions, emerging practices and future research

Capturing energy efficiency through SLE

An "energy efficient lifestyle" needs to be enabled by an effective choice architecture that focuses on a presentation of choices to consumers such that the opting for the energy efficiency product or service is easiest. This includes an energy-efficient physical infrastructure, readily available efficient goods and services, and energy efficient default settings for optimal efficiency during the use-phase of a product. Individual choices and actions can thus minimise the use of natural resources, and generation of emissions, wastes and pollution, while supporting equitable socio-economic development and progress for all.

Governments have a key role to play by creating the appropriate frameworks and infrastructures (regulatory instruments, technological innovations, new public services) to enable citizens to change. Information and education are essential, as well as the full participation of civil society in the movement and the involvement of the business sector that can develop innovative solutions for sustainable lifestyles.

- Economic incentives, subsidies and taxes, making it in the consumers' economic interest to select the energy efficient ones
- Availability of alternatives (legislation, prohibiting energy inefficient options)
- Information and awareness
- An effective choice architecture enabling energy efficient choices – e. g. through upgrade or change in physical infrastructure (e.g. bikes in Copenhagen)

Lifestyle is a vague concept and needs to be demonstrated through concrete examples and actions. One policy of promoting EE through sustainable lifestyle and education could be showcasing it among social groups that are most concerned with climate change. As people are mostly influenced by those around them, community level initiatives could effectively overcome some group behaviour code barrier.[69]

To capture the EE potential through consumer lifestyle change and education, the measures to be taken include both:

- The societal "software" including the non-material values and norms, institutions and cultures that govern our society in an informal way, and
- The societal "hardware", including the material basis of society: the infrastructure, technology, products and services, as well as regulatory and economic frameworks that enable or constrain consumer choice).

The creativity and leadership of many is needed to achieve the widespread changes that will shift current unsustainable lifestyle trends and provide sound policies, innovative business models and resilient support systems to make difficult changes easier. Individual and collective choices will have to be supported by infrastructure that enables, maintains and sustains more sustainable ways of living. Lifestyles that support future sustainable societies will need to accommodate human diversity and reflect different approaches to work-life

[69] Leading a Sustainable Lifestyle in a 'Non-Sustainable World'

balance and personal well-being. Future sustainable lifestyles will have to be based on equity, efficiency and sufficiency and fit within the global resource and ecological limits.[70]

The transfer towards energy efficient lifestyles requires:

- enabling policy frameworks and supportive political leadership;
- provision of stimulating and supportive infrastructure;
- support to alternative business models;
- increased focus on and support to local community empowerment, and finally
- deeper understanding of people's behaviour and the thoughtful design of living contexts to embed and normalise sustainable options in everyday life. [71]

Applied research, pilot projects and socio-technical demonstrations can be a very useful way to try out, test, validate and evaluate new, sustainable concepts and translate research outcomes into policy roadmaps. Examples for intervention range from social comparison, to changing default settings, to exploring loss aversion rather than expected gains from energy efficiency technologies and closing energy efficiency gaps by addressing implementation intentions.[72]

Linking energy efficiency measures to SLE objectives

Regarding linkages of energy efficiency measures to the programme's objectives and work areas, the following table indicates various possibilities:

Table 13

SLE objectives	SLE working areas	Links to energy efficiency
Develop and replicate SLs, including low-carbon lifestyles	• Promoting innovative models and traditional practices of SLs	• Promoting innovative models and traditional practices of energy efficiency
	• Supporting conducive policies, infrastructures and economic instruments	• Supporting conducive policies, infrastructure and economic instruments
	• Building the business case and encouraging responsible market innovation for SLs	• Building the business case and encouraging responsible market innovation for energy efficiency
Educate for SLs	• Mainstreaming SLs into formal education	• Mainstreaming energy efficiency into formal education
	• Making SLs a focus in every learning environment	• Making energy efficiency a focus in every learning environment
	• Mobilising and empowering youth for SLs	• Mobilising and empowering youth for energy efficiency
Transform current and shaping future generation's lifestyles	• Scenarios for sustainable and low-carbon lifestyles	• Scenarios for energy efficient lifestyles
	• Developing frameworks and tools to assess and track lifestyle	• Developing frameworks and tools to assess and track lifestyle

[70] Sustainable lifestyles 2050: stakeholder visions, emerging practices and future research
[71] Sustainable lifestyles 2050: stakeholder visions, emerging practices and future research
[72] Alcott et al (2010): Behavioural Science and Energy Policy.

	impacts	impacts
	• Ensuring and measuring the programme contribution to global priority challenges	• Ensuring and measuring the programme contribution to global energy efficiency improvement

Sustainable Tourism

The 10YFP Sustainable Tourism Programme (STP) catalyses changes in tourism operations promoting transformation to sustainability through efficiency, innovation and adaptability.

The Programme has following main objectives:

- Integrating sustainable consumption and production (SCP) patterns in tourism related policies and frameworks
- Collaboration among stakeholders for the improvement of the tourism sector´s SCP performance
- Fostering the application of guidelines, instruments and technical solutions to prevent and mitigate tourism impacts and to mainstream SCP patterns among tourism stakeholders
- Enhancing sustainable tourism investment and financing

Energy efficiency and sustainable tourism? [73]

The tourism sector comprises of the value chains and infrastructure which deliver all the goods and services used by tourists. Focus, from energy efficiency perspective, could be on hotels, resorts, leisure travel and restaurants, which provide an array of opportunities to reduce energy waste, often through simple upgrades and adjustments, but also through customer or tourist engagement. The opportunities for energy efficiency improvements in the tourism sector are cross-cutting with opportunities in hotels (buildings), transport (air, bus and other mediums), food processing, waste reduction and procurement (large scale, by hotel chains) etc. . In 2014, travel and tourism accounted for about 10% of global GDP which translated to USD 7.6 trillion and 277 million jobs. The potential for tourism can be gauged from the study by DEMUNTER Christophe, Krista and DIMITRAKOPOULOU (2013)[74] report that in 2010, more than one in seven enterprises in the European non-financial business economy belonged to the tourism industries with 3.4 million enterprises employing an estimated 15.2 million persons. Energy consumption at the global level in the tourism sector, in 2010, amounted to 16,697 PJ, equivalent to the total annual energy use of Japan and Russia combined (US Energy Information Administration, 2014). In the business-as-usual scenario, energy consumption in tourism is expected to double by 2035-2040, compared to 2010.

[73] Lucas Nigel, Increasing access to and demand for energy efficiency in a perspective of Sustainable Energy for All, UNEP, 2012

[74] DEMUNTE Christophe, R, Krista DIMITRAKOPOULOU, One in seven businesses belong to the tourism industries, Eurostat, 2013.

Energy represents the single fastest-growing operating cost in the hospitality industry, accounting for between 3% and 6% of total running costs.[75] According to an analysis by Siemens, optimised heating, ventilation and air-conditioning (HVAC) alone can lower energy consumption by more than 40% in hotels – without negatively impacting guest satisfaction.[76]

A large proportion of tourism's energy consumption occurs in the following areas:

- Buildings
  - Hotels: A significant part of energy consumption in tourism occurs in in hotels. Energy efficiency options in such cases are covered by the commercial building sector.
  - Resorts: Many resorts offer additional facilities such as swimming pools, sports facilities, casinos etc. Resorts also typically have large common areas which may require decentralised heating / cooling arrangements and lighting.
- Entertainment facilities: Amusement parks, pools, golf, skiing, surfing and other water sports etc.
- Transport: Tourism sector uses a range of transport e.g. air, water, automobiles, buses, trains. Energy efficiency options in transport sector cover that.

Waste Generation: Tourism is a high energy and water resources demanding activity, and generating significant amounts of solid wastes from lodgings and recreational areas. Based on various sources, UNEP (2003) estimated that in 2001 the world's 692.5 million international tourists may have generated more than 4.8 million tons of solid waste, and according to Edmundo Muñoz and Rodrigo Navia (http://wmr.sagepub.com/content/33/7/593.full), this representing about 14 percent of the total municipal solid wastes generated during this year

Energy efficiency in tourism

Resorts/Hotels and Restaurants: Guest rooms, public area (lobby, bars meeting rooms, swimming pools) and service areas (kitchens, offices, store rooms) are three prime zones with different energy consumption profiles in hotels and electricity is the primary source of energy.[77] Energy costs are 3-6 percent of the total operational costs in a large part of the world, a reason efficiency part has been neglected despite huge potential for savings. Geographical location and quality of hotel are important and in typical higher rating hotels, heating and air conditioning accounts for highest energy consumption, followed by catering, water heating, and lighting in that order. Efficient heating, ventilation, air conditioning and cooling (HVAC) systems and climate control systems (including occupancy sensors), efficient water heaters (including solar water heaters), efficient kitchen and other appliances, and renovation of building envelope are therefore major options to

[75] http://w3.siemens.com/market-specific/global/en/hospitality/hotels-resorts-casinos/hotel-energy-efficiency/pages/hotel-energy-efficiency.aspx
[76] http://w3.siemens.com/market-specific/global/en/hospitality/hotels-resorts-casinos/hotel-energy-efficiency/pages/hotel-energy-efficiency.aspx
[77] Paulina Bohdanowicz et. al, Energy Efficiency and Conservation in, Hotels- Towards Sustainable Tourism, 4th International Forum on Asia Pacific Architecture, Hawaii, 2001.

reduce energy consumption. Customer awareness and engagement in limiting the waste of power in use of lights and air-conditioning (in lieu of sensors) is also practiced by many hotels, and in many cases, it includes reuse of towels to save both water and power. Barriers and drivers to energy efficiency in hotels are important considerations while planning implementation measures[78]. A step by step approach has been given by ESCWA[79] (2009) and USAID[80]. A number of case studies have been illustrated by "The Green Hospitality Programme"[81].

In the case of transport, one of the most important modes in tourism is air travel where the decision to switch to efficient aircraft depends on many factors, including cost of fuel. Automobiles (buses and cars), sea transport (cruise travel, boat travel, yachting, and ferry travel) and rail transport are other mediums used by tourists. A range of initiatives includes improving energy efficiency in vehicles through fuel economy standards, regulations for cleaner fuels, and incentivizing alternate vehicles. Global Fuel Economy Initiative (GEFI), which is one of the SE4ALL Accelerators, and operating in several countries, can help in formulating regulations to meet efficiency standards. Electric vehicles are another option, which besides improving energy efficiency, also help reduce air pollution from transport and contribute to development. A good public transport infrastructure can also help shift to it from other inefficient modes. Tourists can also be provided with biking and similar options.

Small Island States (SIDs), though small, are particularly resource incentive and may need special consideration, as indicated in the Box

Box 9

The resource-intense character of tourism in SIDS has been illustrated on the basis of various studies into energy use and emissions. For instance, a study comparing the USA, Spain, China, Malaysia, Turkey, Maldives, Seychelles, South Africa, Singapore, New Zealand and the Bahamas found that the average weighted distance covered by each international tourist to these destinations varied between 1602 and 8712 km, entailing emissions of between 0.37 and 1.83 t CO_2 per tourist arrival, with the highest value found for arrivals from Switzerland to New Zealand (3.93 t CO_2 per arrival, transport only; Gössling et al 2014). Destinations depending on more peripheral markets are thus generally more resource intensive; for a sample of SIDS in the study, average weighted emissions varied between 635 kg CO_2 (Jamaica) to 1873 kg CO_2 (Seychelles) per tourist arrival (Gössling et al. 2008).'

[78] Hotel Energy Solutions (2011), Factors and Initiatives Affecting Energy Efficiency use in the Hotel Industry, Hotel Energy Solutions project publications

[79] ESCWA, 2009; Guidelines for Energy Efficiency in the Tourism Sector: Strategy, Design, Systems and Operations Approach

[80] "Powering Tourism" (https://www.usaid.gov/sites/default/files/documents/1865/Powering%20Tourism_2.pdf).

[81] (http://www.ghaward.ie/ghaward/userfiles/file/Case%20Studies/GHP%202012%20Case%20Study%20Booklet%20v1.pdf)

Examples of energy efficiency in tourism

There are many examples of promoting energy efficiency among tourist and hotel facilities. These include promoting public transport use in Geneva and Berlin (Box 10)[82].

Box 10: Promoting public transport use among tourists in Geneva and Berlin

Some European cities provide free or discount tickets for public transport to tourists. Geneva, Switzerland has a successful programme of promoting public transport use among tourists. Hotels in the city provide guests a "transport card" and a map of the city when they check in. The 'transport cards' are available at all hotels in the city and give tourists free rides on all buses, trams, boats and even to the airport for the duration of their stay. The Berlin WelcomeCard also encourages tourists to use public transport by offering unlimited travel on public transport (S-Bahn, U-Bahn, bus, and trams) for periods of up to 6 days. Tourists can choose the duration of and the zones of their ticket. By choosing the Berlin WelcomeCard, tourists can get ticket discounts of between 25% and 50% at some 200 sights and other offerings of interest to tourists in Berlin and Potsdam, including some of the city's most popular attractions.

Another example is the Caribbean Hotel Energy Efficiency Action Program (CHENACT), an energy and climate change project supported by the Inter-American Development Bank[83] (see Box 11). [84]

Box 11: The CHENACT for Hotel Energy Efficiency Improvement.

CHENACT aims to improve the competitiveness of small- and medium-sized hotels by helping them to assess their energy use and improve their energy efficiency practices and profile. This is accomplished through energy audits for hotels which can lead to bankable projects supported through innovative financial mechanisms. Hotels in the Caribbean have discovered that readily achievable upgrades, e.g. switching to energy efficient light bulbs, can dramatically lower energy costs. For example, incandescent light bulbs in the region cost around USD 1.50 and last 1,200 hours. Although LED light bulbs require a greater initial investment of USD 7, they can last 50,000 hours, delivering large energy and financial savings, making hotels become more competitive over the long-term.

To complement CHENACT, the Government of Barbados, with IDB support, developed the Energy Smart Fund, a financial instrument that allows Small and Medium Enterprises (SMEs), including hotels, to apply for affordable loans at discounted rates to implement renewable energy and energy efficiency projects. Together, these initiatives have driven energy efficiency activities in the tourism sector. In addition, SME hotels can sell any excess electricity back to the utility company, paying off their investment over an accelerated timeline.

Box shows energy efficiency measures taken by a luxury hotel, Six Senses, in Thailand and the short payback period of these measures.[85]

[82] http://www.berlin.de/en/tourism/1895467-2975548-berlin-welcomecard.en.html [Accessed in March 2016]
[83] http://blogs.iadb.org/desarrolloefectivo_en/2015/05/14/energy-efficiency-caribbean-hotels/
[84] http://www.responsibletravel.org/events/documents/Final%20Presentations/Workshop%2013%20-%20Boutique%20Beach%20Resorts%20-%20Innovations%20&%20Eco-Certifications/Loreto%20Duffy-Mayers%20-%20CHENACT/Loreto%20Duffy-Mayers%20-%20CHENACT%20-%20Workshop%2013%20Presentation.pdf

Box 12: Six Senses Hotel's measures for better energy efficiency and their effects.

Six Senses, a luxury hotel group, showed varying returns on investment from a number of energy-savings measures applied in resorts located in Thailand with paybacks ranging from six months to ten years:

- Energy monitoring system (cost: USD 4,500), enabled 10% energy savings;
- Investment in a mini-chiller system (USD 130,000), saved USD 45,000 annually, paid off in 2.8 years;
- Heat-recovery system (USD 9,000), saved USD 7,500 annually, equalling 1.2 years payback time;
- Laundry hot-water system (USD 27,000), saving USD 17,000 annually (1.6 year payback time);
- Efficient lighting (USD 8,500), resulting in USD 16,000 savings per year, (six months payback);
- Investment in a water reservoir (USD 36,000), leading to annual savings of USD 330,000 (less than one month payback time);
- Biomass absorption chillers (USD 120,000) resulting in USD 43,000 saving annually (2.8 years payback);

An additional and emerging component in financing energy efficiency upgrades in the tourism sector is green bonds which are debt products aligned with climate-neutral investments. In 2014, DusitD2 Hotels and Resorts, in partnership with Structured Finance Associates and Los Angeles County in the U.S., issued a $6.9m PACE (Property Assessed Clean Energy) bond with its proceeds financing energy efficient improvements to a DusitD2 property. This included financing for the installation of LED lighting, window treatments, water systems, insulation, and a new HVAC control system.

Linking energy efficiency measures to ST objectives

Regarding linkages of energy efficiency measures to the programme's objectives and work areas, the following table indicates various possibilities:

Table 14

STP objectives	STP Areas	Links to energy efficiency
Integrating sustainable consumption and production (SCP) patterns in tourism related policies and frameworks	• Integrating SCP principles and objectives for sustainable development • Monitoring policy implementation	• Include energy efficiency as one of the elements of tourism policies • Select best practice examples and modify to suit specific circumstances of the country. • Provide targeted support • Develop monitoring framework for EE implementation and monitor

[85] http://www.unep.org/resourceefficiency/Portals/24147/scp/business/tourism/greeneconomy_tourism.pdf

Collaboration among stakeholders for the improvement of the tourism sector´s SCP performance	• Data sharing and exchange of information • Fostering stakeholder collaboration and joint action • Capacity building for stakeholders • Establishing monitoring frameworks	• Identify and include data gathering for monitoring energy efficiency • Collaborate with partners who can support energy • Include elements of EE in capacity building • Include EE as one of the parameters in monitoring framework
Fostering the application of guidelines, tools and technical solutions to improve, prevent and mitigate tourism impacts and to mainstream SCP patterns among tourism stakeholders	• Developing integrated tools for use at destinations and in tourism enterprises • Research and action on priority issues of the tourism value chain • Influencing consumer choice and behaviour	• Develop EE tools and guidelines for use by hotels, resorts, tourist transport and other such areas related to tourism • Identify priority actions on EE for various actors / areas • Design awareness materials and campaigns for customers • Organise experience sharing on EE measures
Enhancing sustainable tourism investment and financing	• Promoting use of sustainable tourism investment and financing tools • Enabling and mainstreaming sustainable tourism investment and finance	• Integrate energy efficiency in the investment and financing tools • Integrate energy efficiency in the investment and financing decision making

Sustainable Food Systems

With a goal to accelerate the shift towards more sustainable food systems, the Sustainable Food Systems programme has following objectives:

- Raise awareness of the need to shift to sustainable food systems
- Build enabling conditions for the uptake of sustainable practices across food systems
- Increase access to actionable information and tools to make food systems more sustainable
- Build synergies and cooperation to enhance and facilitate the shift to sustainable food systems

Energy efficiency and sustainable food systems

Feeding the world is not only resource intensive, but is also carbon intensive. Estimates show that, globally, the food production and supply chain accounts for about 30 percent of the total energy consumed and about 70 percent of total fresh water withdrawals. Food Systems also contribute about 20 percent of total GHG emissions in the world[86]. Apart from being energy and water intensive, food systems continue to be heavily dependent on fossil fuels largely as a legacy of the "green revolution" of the 1970s and 1980s, which was heavily

[86] From: "Energy Smart Food for People and Climate - Issue Paper", FAO, 2011

reliant on inputs of fossil fuels[87]. Further, as can be seen from Figure 1 below, the energy use in agriculture remains completely coupled with the output from the sector[88]. Similarly, Figure 2 shows that agricultural energy intensities, by and large, have either remained stagnant or are increasing.

Together, the high energy and water intensiveness, the high share of fossil fuels in total energy use, stagnant or rising energy intensities, and highly coupled nature of energy use and output indicate that in years to come, as the demand for food increases[89], the demand for energy and emission of GHGs from agriculture/food systems could reach unsustainable levels. Efforts are required to not only decouple

[87] Policy Brief: The case for energy-smart food systems, FAO: http://www.fao.org/docrep/014/i2456e/i2456e00.pdf

[88] In 18 of the 20 largest energy consuming countries of the world. The countries are: Australia, Brazil, Canada, China, India, Indonesia, France, Japan, Korea, Italy, Iran, South Africa, Saudi Arabia, Thailand, Mexico, UK, USA, and Russian FederationThe Figure shows that there exists a strong positive co-relationship between energy use and value added in agriculture sector in these 18 countries value added being measured in constant 2011 US $ in PPP terms and energy use being measured in tera joules).

[89] Estimated to increase by 60% of the 2010 level by 2050; World Water Development Report, Vol. I, Chapter 6, 2014.

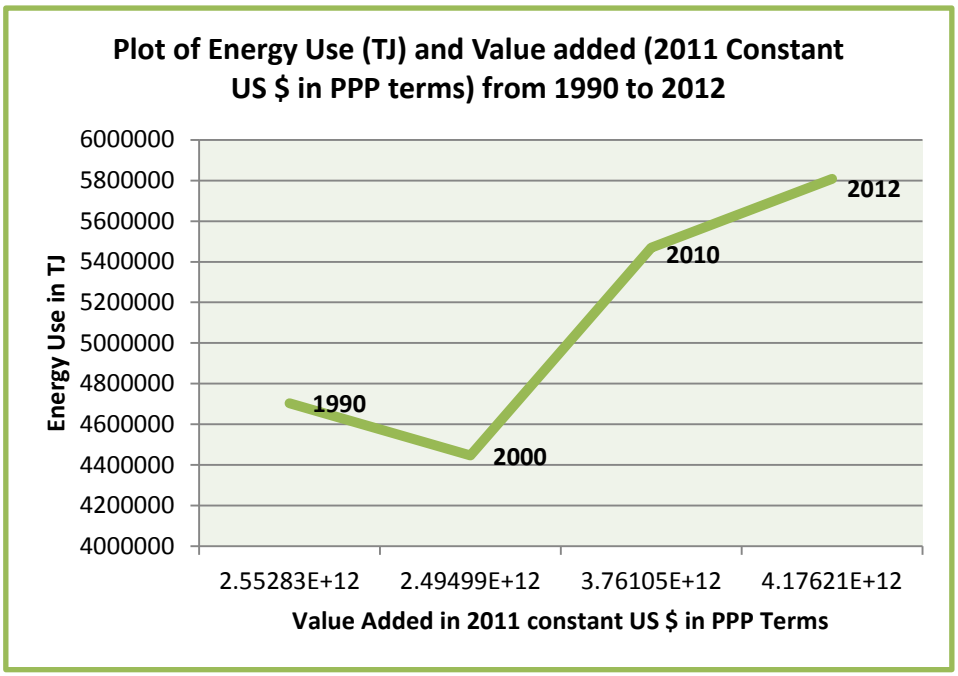


Figure 1: plot of Value Added in Agriculture to Energy Use in Agriculture for years 1990, 2000, 2010 and 2012 (Source: C2E2).

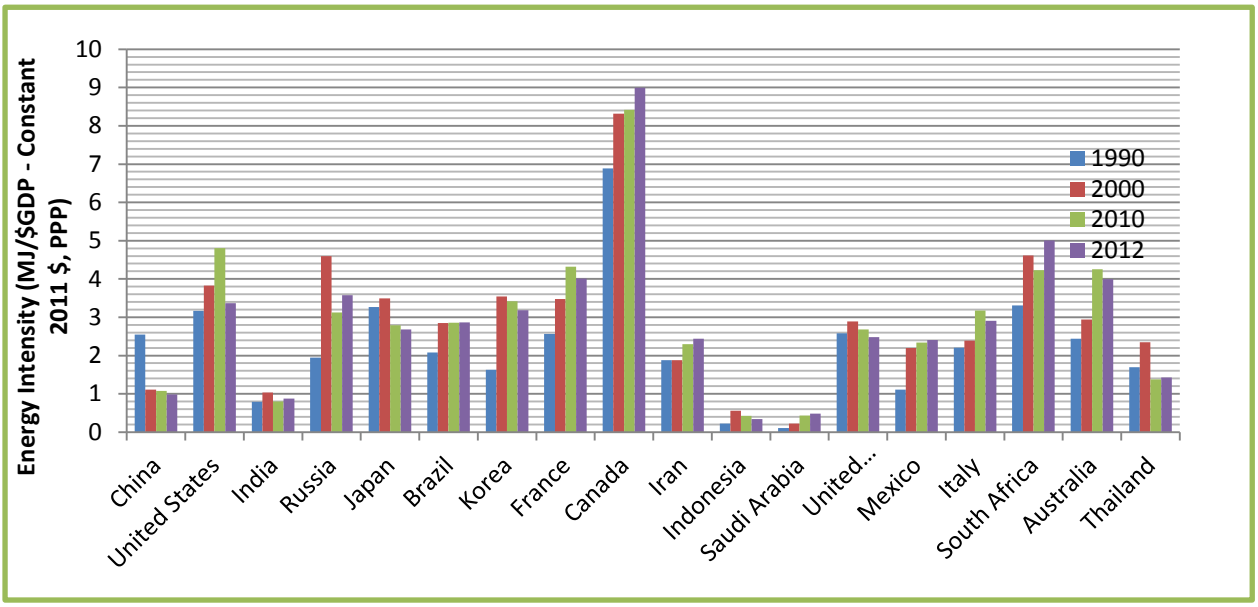


Figure 2: Energy Intensity for 18 of the 20 Largest Energy consuming Countries for Different Years: Agriculture Sector (Source: C2E2).

energy inputs from food system's outputs, but also to reduce dependence on fossil fuels.

The need for decoupling becomes more urgent when the fact is taken into account that with rising incomes and modernizing life styles in the developing countries, the energy needs for food, which is only about 8 gigajoules per capita per year in these countries as of now, will start climbing towards the developed country average of 35 gigajoules per capita per year[90].

[90] From: Energy -Smart Food at FAO: An Overview, 2012

Similarly, in addition to climate change related reasons, the need for reducing dependence on fossil fuel also becomes important because dependence on fossil fuels has meant that food prices have been linked to fossil fuel prices and thus have been vulnerable to the volatility associated with fossil fuel prices as can be seen from Figure 3 below.[91]

Efficient use of energy and water, and substitution of fossil fuels with renewable energy in the entire agri-food chain[92], and adoption of less energy intensive agricultural practices (e.g. organic and other integrated farming systems), provide options for decoupling food system energy use from its output. They also offer options to reduce the carbon foot print of the food systems and reduce their vulnerability to fossil fuel price volatility. Energy efficiency thus can play an important role in ensuring sustainability of food systems.

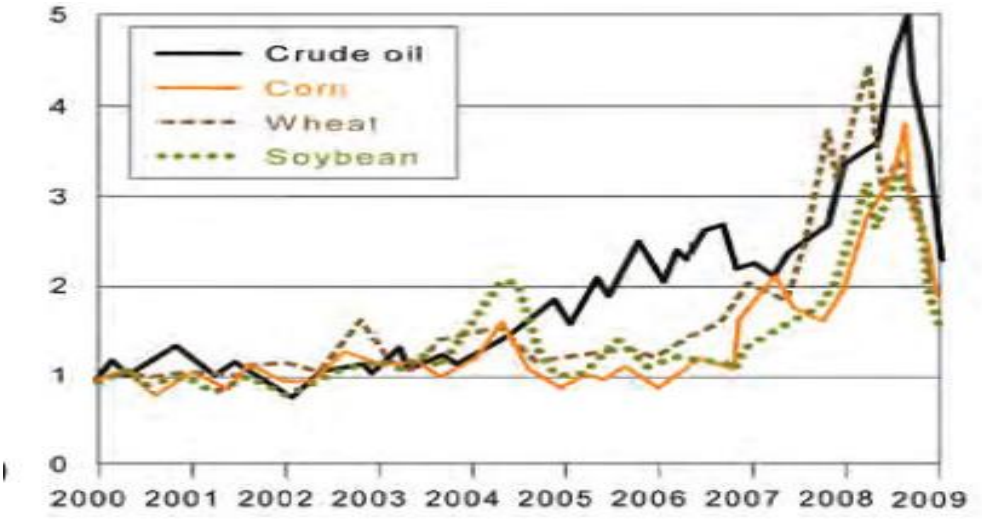


Figure 3: Coupling of Food and Fossil Fuel prices.

Energy efficiency in food systems

Several opportunities exists to improve energy efficiency and to substitute fossil fuels in the food systems. The table below presents examples of some of the energy efficiency measures across the food chain.

Table 15: Examples of energy efficiency improvements at farm level. [93]

	Direct Energy Efficiency	Indirect Energy Efficiency
Behind farm gate	• Fuel efficient engines • Precise water application & Precision farming for fertilizers[vii] • Adopting no-till practices • Controlled building environments	• Less input-demanding crop varieties and animal breeds • Agro-ecological farming practices • Reducing water demand and losses • Energy efficient fertilizer and

[91] Extracted from: : "Energy Smart Food for People and Climate - Issue Paper", FAO, 2011
[92] Production of crops, fish, livestock, forestry, and horticulture products; post-harvest operations; food storage and processing; food transport and distribution; food preparation; and food disposal.
[93] "Energy Smart Food for People and Climate - Issue Paper", FAO, 2011, Table 5.

	• Heat management of greenhouses • Propeller designs of fishing vessels	machinery manufacture • Biological nitrogen fixation • Electronic identification of fish stock locations and markets
Beyond Farm gate	• Truck design and operation • Modal switch in food transport • Variable speed electric motors • Better lighting and heat processes • Insulation and cool stores • Minimising packaging of food • Technology transfer and education • Improving efficiency of cooking devices	• Improving road infrastructure • Reducing food losses at each stage[94] • Matching food supply with demand • Changing diets away from animal products[viii] • Labelling of food products • Lowering obesity levels

Based on the specific measures mentioned in the Table above, the following specific opportunities are suggested:

- Energy used in various parts of the food chain varies considerably between developed and developing countries as is evident from the figure below. While the processing and distribution part of the food system account for majority of energy consumption in developed countries, in developing countries, retail, preparation, and cooking account for the majority of the total energy consumption in the food systems[95]. *Inter alia,* one high impact and high potential energy efficiency opportunity in developing countries is the promotion of improved cook stoves to not only provide benefits of reduced fuel use, reduced time for fuel collection and preparation, but also benefits of better health.

[94] As per FAO, more than one-third of the food we produce is lost or wasted, and with it about 38 percent of energy consumed in the agri-food chain. 'Energy smart food at FAO: An Overview', FAO, 2011
[95] From: "Energy Smart Food for People and Climate - Issue Paper", FAO, 2011

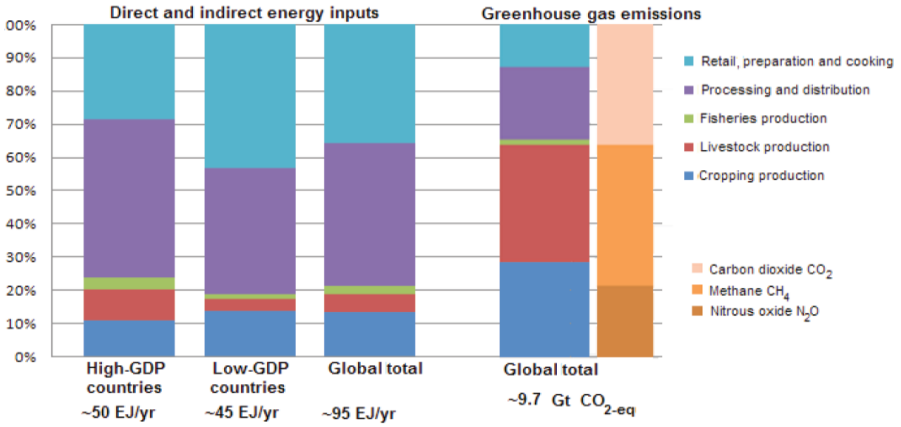


Figure 4: Indicative share of Final Energy Consumption in LOW and High GDP Countries. [96]

- Food production is water intensive, and considerable amount of energy is used for pumping water for irrigation. Studies in countries such as India have shown that there is a potential to save 30-40% energy used for water pumping in the agriculture sector by replacing existing in-efficient pump sets by modern energy efficient pump sets. Therefore, the deployment of efficient water pump sets provides another opportunity for reducing water and energy foot-print of agri-food systems.
- Sprinkler and Drip irrigation systems use about 30 to 65 percent less water for irrigation, respectively, as compared to flow irrigation systems that are employed in most developing counties. Commensurate with less water use, these systems also consume less energy for pumping water. Promoting drip and sprinkler irrigation systems, for agri-crops and horticultural products for which they are suitable, could be another opportunity for reducing energy and water usage in agri-food systems.
- Other high impact opportunities for energy efficiency and energy substitution in the agri-food systems include:
  - Increased use of renewable energy for farm operations such as drying (solar), water and other heating requirements
  - Increased generation and use of bio gas for productive purposes like heating and electricity production
  - Use of waste heat from farm machinery for drying or cooling through heat pumps
  - Distributed generation through wind or solar for on-site electricity production and storage
  - Training and capacity building for efficient farm operations
  - Energy efficient storage of agriculture products (cold storage chiller energy efficiency improvement projects)
  - Energy efficient agriculture processing : introduction of ISO 50001 energy management standards in agro-processing industries

[96] Extracted from: "Energy Smart Food for People and Climate - Issue Paper", FAO, 2011, Figure ES 1.

- Energy labelling and minimum efficiency standards for cooking appliances and promotion of modern efficient cook stoves - cooking ranges, gas stoves, induction cooking
- Energy efficient food storage at homes and commercial establishments through establishment and strengthening of Standards and Labelling programs for appliances such as - freezers and refrigerators
- Energy efficient heating and cooling in areas where livestock is housed
- Minimum fuel efficiency standards for tractors
- Removal of subsidies on energy used for agri-food systems: for example, in many States in India, electricity used for pumping water for irrigation is given free of any charge. This stops farmers from employing high efficiency pumping equipment in their farms.

Examples of energy efficiency in the agri-food systems

A report by European Commission[97] provides case studies on energy efficiency measures implemented in major food companies such as Cogeca, PepsiCo, Kellog's, Mars, Nestle, and the Danish Agriculture and Food Council. The report also provides a summary of energy flows and GHG emissions in the food systems of 27 European Union (EU) countries. The report also discusses the 'behind' and 'beyond' the farm gate energy related challenges and solutions. In addition, the report discusses the relevant policy tools and initiatives currently in place in the EU and presents and examples of R&D projects and actual practical implementations of the measures listed. Similarly, the issue paper by Food and Agriculture Organisation (FAO)[98], provides information on energy inputs for food supply chains and GHG emissions. It also elaborates how food systems can be made energy efficient by becoming energy-smart. Further, the report discusses policy options for promoting energy efficiency and provides recommendations on the roles for energy efficiency and renewable energy in the agri-food system.

- Deployment of energy efficient cook stoves:
  - Cook stoves alliance program (http://cleancookstoves.org/)
  - Indian improved cook stoves program (http://mnre.gov.in/schemes/decentralized-systems/national-biomass-cookstoves-initiative/)
- Agriculture pumping efficiency improvement program in India

One example of international initiatives for energy efficiency in the food sector is the Global Alliance for Clean Cook stoves (see Box).[99]

[97] European Commission, Joint Research Centre, " Energy use in the EU food sector: State of play and opportunities for improvement", 2015
[98] Energy Smart Food for People and Climate - Issue Paper", FAO, 2011
[99] http://cleancookstoves.org/about/our-mission/

Box 13: The Global Alliance for Clean Cook Stoves.

Hosted by the UN Foundation, the Alliance is a public-private partnership that seeks to save lives, improve livelihoods, empower women, and protect the environment by creating a thriving global market for clean and efficient household cooking solutions. It is at the forefront of efforts to promote the adoption of clean cooking solutions and spur universal adoption of clean cook stoves and fuels. Launched in September 2010 by former U.S. Secretary of State Hillary Clinton at the Clinton Global Initiative, the Alliance has an ambitious 10-year goal to foster the adoption of clean cook stoves and fuels in 100 million households by 2020. The Alliance and its partners are working to establish a thriving global market for clean cooking solutions by addressing the market barriers that impede the production, deployment, and use of clean and efficient cook stoves and fuels in developing countries. Significant progress was made during Phase I (2010-2014) in achieving the Alliance's original goals and objectives. To date, more than 20 million clean cook stoves are in use and global awareness has grown significantly regarding the serious health, environmental, and livelihoods issues posed by household air pollution.

Another example is the agriculture pumping efficiency improvement programme in India (see Box). [100,101]

Box 14: The AgDSM program of replacing inefficient pumps with efficient ones in India.

There are about 20 million motorised pump sets for agriculture in India, with an annual addition of 0.25 to 0.5 million pump sets. Low or free electricity contributes to the adoption of local made inefficient & unreliable pump sets, resulting in massive water wastage and higher energy consumption. The Indian Bureau of Energy Efficiency has facilitated and initiated the implementation of first Agricultural Demand Side Management (AgDSM) pilot project in Solapur circle of Maharashtra. The pilot project replaced 2209 old inefficient pump with star rated Energy Efficient Pump sets (EEPS) and provided free operation and maintenance for installed pump sets in the project duration. On average, the replacement leads to 37% in energy efficiency improvement. It generates benefits for the government in the form of less energy subsidy, to the utility in less peak load, and to the farmers in the form of free and more reliable pumps. Based on the successful experiences, there are now plans to expand the implementation in all over India.

The Asian Development Bank (ADB) has agreed to provide a loan to Energy Efficiency Services Limited (EESL), to be guaranteed by the Government of India, to support demand-side energy efficiency investments in several Indian states. Part of the loan will be used for more energy efficient agricultural water pumps. EESL estimates that energy savings of 30% can be achieved with more efficient pumps.

[100] http://www.eeslindia.org/User_Panel/UserView.aspx?TypeID=1088&p=Agriculture%20(AGDSM)
[101] http://www.eeslindia.org/writereaddata/Agricultural%20Demand%20Side%20Management.pdf

Box 15

The World Bank funded Climate Smart Staple Crop Production project (project ID P 144531) in China (USD 30.1 million): The development and global environmental objective of the Climate Smart Staple Crop Production Project for China is to demonstrate climate smart and sustainable staple crop production in Huaiyuan County of Anhui province and Yexian County of Henan province. One of the components of the project - climate smart agriculture (CSA) demonstration will support demonstration of greenhouse gas (GHG) emission reduction and efficient irrigation techniques

Linking energy efficiency measures to SFS objectives

Regarding linkages of energy efficiency measures to the programme's objectives and work areas, the following table indicates various possibilities

Table 16

SFSP Objectives	SFSP Work Areas	Links to Energy Efficiency
Raising awareness on the need to adopt SCP patterns in food systems	Promote reliable communication of product information about food sustainability throughout the supply chain	Disseminate energy use and GHG emission figures for 'behind and beyond' farm gate activities
	Raise awareness about the need to adopt more sustainable diets	Disseminate data on carbon and energy intensity of various diet forms
Building enabling environments for sustainable food systems	Encourage, facilitate and support inclusive, multi-stakeholder dialogue to help inform policy-making towards sustainable food systems at local, national, regional and international levels	Include energy use, carbon emissions, and energy efficiency potential in the dialogue
	Enhance the development of skills and capacities to promote SCP in food systems among all relevant stakeholder groups	Identifying opportunities and solutions for improving energy efficiency in food systems
	Promote investments and financing in sustainable food systems	Disseminating economic and carbon benefits of energy efficiency measures and solutions in food systems
Increasing the access to and fostering the application of actionable knowledge, information	Strengthen, develop and promote information platforms on sustainable agri-food	Include information on energy efficiency opportunities, solutions, and case studies or best practices

and tools to mainstream SCP in food systems	products and systems for extension services and knowledge sharing amongst producers	in information platform on sustainable agri-food products and systems
	Make available knowledge on the drivers of sustainable food consumption and production	Disseminating knowledge about drivers of energy efficiency in various stages of the food system cycle
	Promote the use and development of methodologies, information and tools for more sustainable food systems, including the reduction of food losses and waste	Include energy efficiency tools

Energy efficiency collaboration opportunities in climate mitigation: Nationally Appropriate Mitigation Actions and intended Nationally Determined Contributions

Nationally Appropriate Mitigation Actions

Nationally Appropriate Mitigating Actions (NAMAs) were developed under the United Nations Framework Convention on Climate Change (UNFCCC) to focus mitigation planning and implementation at the country level. "Transformational NAMAs are projects, policies, or programmes that shift a technology or sector in a country onto a low-carbon development trajectory."[102] NAMAs are developed by governments and agencies and, when they achieve a bankable stage, they seek public and private financing from domestic and international sources. Additional sources of financing include the NAMA Facility—funded by the Governments of Germany (the International Climate Initiative (IKI)) and the UK as well as the European Commission and Denmark—and the Green Climate Fund. A snapshot of criteria and projects supported by NAMA Facility is given in Box 16.

[102] https://www.international-climate-initiative.com/fileadmin/Dokumente/20121129-Fact_sheet-NAMA-Facility-EN-final_1163.pdf

Through technical advisory interventions, UNEP DTU works with governments and agencies to develop effective transformational initiatives that can be developed into

Box 16

NAMA Facility - NAMA Support Projects

The NAMA Facility recently issued its 4th Call for Proposals - the experience from the first three calls has been encouraging with funding provided to 14 projects covering an array of sectors and resources including transport, renewable energy, agriculture and forestry. These projects come from a range of countries including Mexico, Costa Rica, Chile, Peru, Thailand, Burkina Faso, Tajikistan, China, Kenya, South Africa, Guatemala and Colombia. Examples include sustainable urban transport programmes in Indonesia and Peru, a new housing NAMA project to promote cost effective energy-efficient building concepts in Mexico, refrigeration and air conditioning in Thailand, forestry in Tajikistan, Integrated Waste Management in China and renewable energy in Chile.

The most important criterion considered by the NAMA Facility is a project's potential to catalyse transformational change towards a low-carbon development path.

bankable projects within NAMAs. In addition, UNEP DTU is working with Indonesia, the Philippines, Thailand and Vietnam to identify actions in their respective buildings sectors

NAMA Facility- NAMA Support Projects

NAMA Facility recently made 4th Call for Ptroposals- the experience from first three calls has been encouraging with support to 14 NAMA Support Projects, as the selected projects represent quite advanced and ambitious NAMAs worldwide. They cover different sectors such as transport, renewable energy, agriculture and forestry, and come from a range of countries including from Mexico, Costa Rica, Chile, Peru, Thailand, Burkina Faso, Tajikistan, China, Kenya, South Africa, Guatemala and Colombia. Some examples include sustainable urban transport programme in Indonesia and Peru, New Housing NAMA to promote cost effective energy-efficient building concepts in Mexico, refrigeration and air conditioning in Thailand, forestry in Tajikistan, Integrated Waste Management in China, and renewable energy in Chile.

The most important criteria that the NAMA Facility considers is potential to catalyse transformational change in the country towards a low-carbon development path.

Specifically, mitigation activities from countries' Intended Nationally Determined Contributions (INDCs) can be developed into projects constituting NAMAs. As the projects within these NAMAs are further advanced into bankable initiatives, they are shared with financial institutions, banks and donors for potential investment. One of the key factors to consider in this process is that private finance is not interested in investing in NAMAs *per se* (which contain policies) but rather the projects that make up those NAMAs that generate viable returns.

[103] http://www.unep.org/energy/Projects/Project/tabid/131381/language/en-US/Default.aspx?p=b7b92d27-83ee-4e77-a51c-7fd837b32f28

[104] http://unfccc.int/cooperation_support/nama/items/7476.php

Intended Nationally Determined Contributions

In simple terms, Intended Nationally Determined Contributions (INDCs) are the pledges countries have made with respect to reduction of GHGs and initiatives countries plan to undertake to reduce the GHGs to the pledged levels. INDCs often also address adaptation plans, and the support the countries need for meeting mitigation targets as well as for rolling out adaptation plans.More than 185 countries have submitted INDCs and the same now are being converted to NDCs. As per Paris agreement, the parties (countries) will be closely monitored on their progress towards NDC targets. Most NDCs/INDCs are in the nature of broad statements of intent and targets, which are gross, and in the nature of reduction of carbon intensity or carbon levelix.

In order to meet the intended targets, countries are beginning to initiate steps to translate targets into actionable projects and programs, and in the process, are planning to undertake following actions:

- Status determination - assessing how far will existing initiatives and resources take each country towards committed INDC targets
- Additionality determination - assessing what additionality in terms of target segments, technologies, projects/programs, instruments, policies, legislations/regulations, infrastructure, resources, capacity, institutional set-up, stakeholder collaboration, etc. will be needed by countries to achieve existing and future (ramped-up) mitigation targets.
- Project and programme design - Once target segments, technologies, projects and programs have been identified; preparing detailed design to aid in their implementation
- Actual implementation of identified projects and programmes, including monitoring, verification and reporting
- Finding money for implementation of the identified projects and programmes hence preparing NAMAs or bankable project proposals and canvassing these NAMAs through private and public funding sources or through GCF

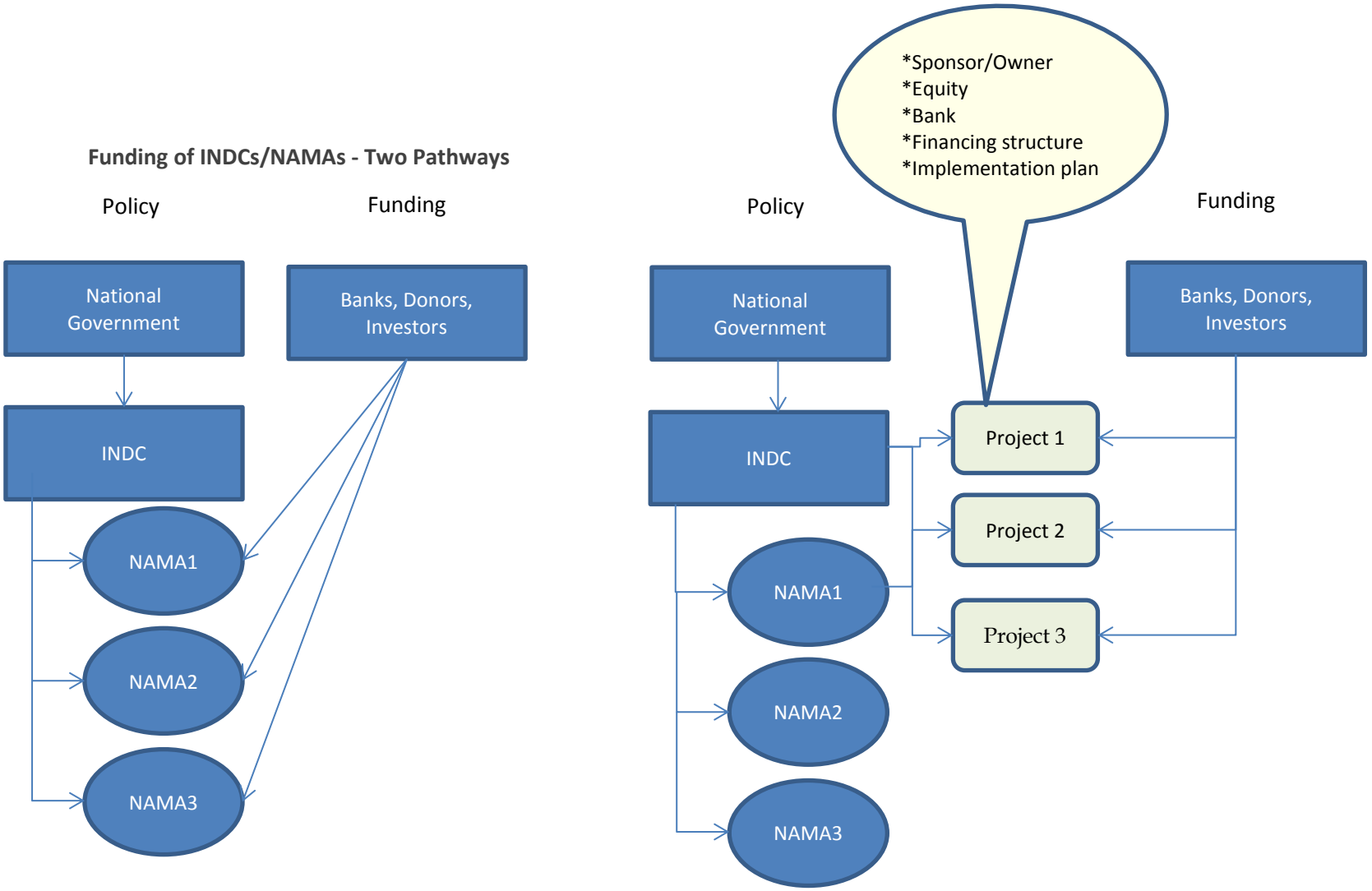
The six programme areas of 10YFP would benefit by associating with the countries in this early stage (of converting their respective INDCs into actionable projects), as the 10YFP programme areas would then be able to identify synergistic projects and programmes, and look for a role in their funding and implementation.

The current situation with respect to funding of INDCs and NAMAs is depicted in Figurexxx. In pursuit of the energy efficiency potential, a consistent message from funders is that NAMAs or INDCs need to be converted into projects that:

- Are Feasible - commercially viable,
- Have embeddedness - country backing
- Have clearly identifiable ownership (individuals, private or public)
- Have ambition - reasonable greenhouse gas mitigation impacts
- Are transformative - lead to paradigm shift in the greenhouse gas mitigation efforts of the country

- Have co-benefits such as resource efficiency improvement, sustainable life styles, employment generation

Figure 5: Funding of INDCs/NAMAs: The situation



Synergies between EE in 10YFP program areas, EE Accelerators, SE4ALL EE goals and SDG-7

Sustainable Energy for All's (SE for All) Global Energy Efficiency Platform is a multi-stakeholder, multi-sector global implementation mechanism for energy efficiency. The Platform is SE for All's flagship energy efficiency programme and is directly linked to the achievement of Sustainable Development Goal 7 and the ambitions of the COP21 Agreement on Climate Change, through the fact that SDG7 sets out a target to achieve a global doubling of the rate of improvement in energy efficiency by 2030, thereby directly adopting the objective of the Sustainable Energy for All.

Among international efforts and initiatives to implement energy efficiency, the Accelerator Platform is well developed in terms of geographical reach, sectoral diversity, length of experience, range of partners, capability to deliver genuine technical assistance, and track record of results. Platform activities are broken into key sectors, and conducted by sectoral partnerships termed 'Accelerators' that are structured around known high impact opportunities, many of them fundamentally underpinned by UNEP initiatives. These Accelerators have similar formulation and aims for energy efficiency as the 10YFP programmes have for sustainable production and consumption, in the sense that they are multi-stakeholder partnerships, incorporating public and private sector actors and expertise, and oriented towards implementation at scale on the ground. Current activities and plans include:

Industrial Energy Efficiency – industrial energy use makes up an estimated 29% of global energy consumption and large opportunities exist for efficiency in key energy using sectors. The Accelerator has been active in promoting energy management systems for more than 300 organizations in 20 countries. Through the lead agency UNIDO's convening power, on-ground presence and the expertise of its partners, the Accelerator has a superior reach to energy intensive industries in emerging economies. It also has active links with corporate commitment campaigns such as We Commit and EP100, to ensure goodwill can be tapped and best practices disseminated particularly in non-OECD countries.

Motor Vehicles – through the UNEP 'Global Fuel Efficiency Initiative', the Accelerator is focused on country commitments to fuel efficiency goals and targets, and offering in-country policy support, research and global outreach. It is working towards a 30% fuel efficiency improvement (measured in L/100km) for all new cars in OECD countries by 2020; a 50% improvement in all new cars globally by 2030, and a similar 50% improvement in all cars globally by 2050. The Accelerator is already supporting 65 countries in 2016 and in the lead up to COP21 secured commitments from 100 countries to achievement of its goals. Meeting these targets would lead to estimated savings of 33Gt of CO2 and as much as $2 trillion in fuel savings by 2025, $500bn of which would fund the costs of initiating a transition to electric vehicles.

Buildings - the Building Efficiency Accelerator (BEA) is a broad partnership that assists cities seeking to scale up their building efficiency efforts. The Accelerator brings together more than 30 globally active building efficiency organizations to develop implementation plans and is working with 23 subnational governments have with commitments to take policy and project actions to improve their building stock, and establish systems to measure and track progress. A further 130 cities have already expressed interest in tapping the Accelerator's support and future focus is on replication of the successful existing model and recruitment of local delivery partners.

Lighting, Appliances and Equipment – based on its analysis of key energy using lighting and appliances technologies, the Accelerator draws on the work of the 'en.lighten' and 'United for Efficiency' (U4E) Initiatives of UNEP to target those countries without standards (or with ineffective standards) in the key areas of air conditioners, lighting, refrigeration, motors, information technology and transformers, to create the enabling environment for energy savings. The Accelerator provides technical support for the establishment of MEPS, policies, monitoring, verification and enforcement, and environmentally sound life-cycle management. Task Forces for all major appliance groupings have been convened and country assessments for appliances are completed for 100 countries, with 50 more in process. Broadly based country appliance and lighting programs are funded in eight countries with a further 15 funding applications in the pipeline and a growing number of local private sector partners.

District Energy Systems - the Accelerator is implemented through the UNEP District Energy in Cities (DES) initiative. DES is an international public-private partnership that promotes low-carbon and climate-resilient district energy systems as often the most energy- and cost- efficient way of heating and cooling dense urban areas, with wide-ranging multiple benefits and the ability to integrate renewables. Through its flagship publication 'District Energy in Cities: Unlocking the potential of energy efficiency and renewable energy', it has positioned district energy as a key option for cities aiming at carbon neutrality in the context of climate and development goals. The Accelerator has engaged 98 cities through its regional training and outreach events and is undertaking rapid assessments in 31 cities, from which 3-5 cities will be supported to produce city wide plans and take bankable pilot projects up to tender by 2019. Demand for support is growing and future focus will be in Asia, Latin America, and Eastern Europe, and other regions of high district heating and cooling potential.

There is a natural overlap between implementation of some 10YFP programme areas and the activities of the Accelerator Platform. The most prominent of these include:

- **Sustainable Buildings and Construction:** While its focus is more on non-residential buildings, through the work of its extensive partners the Building Efficiency Accelerator is actively involved in some of the core work of this 10YFP programme, especially on establishing and promoting enabling frameworks for SBC policy, and reducing climate impact of the building and construction sector through energy efficiency.

- **Sustainable Public Procurement:** public procurement typically encompasses many decisions that influence energy use, including procurement of buildings, appliances and equipment, motor vehicles, and potentially district energy systems. The promotion of SPP can benefit from knowledge about best practices related to product standards and codes that can be translated into prescribed procurement standards for energy using equipment. Accelerators across each of these areas are expert in best practice standards in the relevant product areas.
- **Sustainable Tourism:** A component of Sustainable Tourism relates to the buildings and equipment used for tourism facilities, which is a further connection with the Building Efficiency Accelerator (and potentially the District Energy Accelerator).
- **Consumer Information:** similar to public procurement, Accelerators are heavily involved in standards for key energy using equipment such as appliances, lighting and motor vehicles that have direct application to labelling and consumer information at point of sale.

The linkage between 10YFP and the Accelerators is further underscored through the role that SE4ALL plays in the non-state actor process of the UNFCCC, known as the Global Climate Action Agenda (GCAA). SE4ALL is a key convenor of the energy segment of the GCAA and most of the Accelerator activity and the Platform overall are recognised initiatives. This will become increasingly important with concerted work now underway to develop linkages between the GCAA and delivery of INDCs for countries, for the purpose of targeting future climate financing flows towards activities that address both Sustainable Development Goal 7 and the objectives of the Paris Agreement.

Next Steps

To date, nearly 500 stakeholder institutions, including governments and large scale implementing partners (UN bodies, civil society, academic and research organisations and private sector bodies) are engaged in the 10YFP and its programmes. 10YFP can use its existing partnership networks and platforms to promote energy efficiency and integrate energy efficiency in its capacity building and technical and financial assistance to developing countries as it helps to shift towards sustainable patterns of consumption and production.

This background paper provides information about the opportunities and relevant examples of the types of energy efficiency measures that could be considered within the six Programmes of 10YFP. The workshop on 8-9 September seeks to bring experts together to further build on this paper to identify specific and high-impact energy efficiency opportunities within 10YFP Programme areas that can support the transition to sustainable patterns of consumption and production. The next steps for the 10YFP for example could include:

- Designing 10YFP strategies for energy efficiency improvement

- Identifying energy efficiency action areas for each programme
- Producing a list of potential energy efficiency project ideas for each 10YFP programme
- Establishing a set of 10YFP criteria for energy efficiency project prioritisation and selection
- Identifying 10YFP project proposals for further development, fund-raising and implementation

These issues can be discussed during the workshop and among the stakeholders of each 10YFP programme areas.

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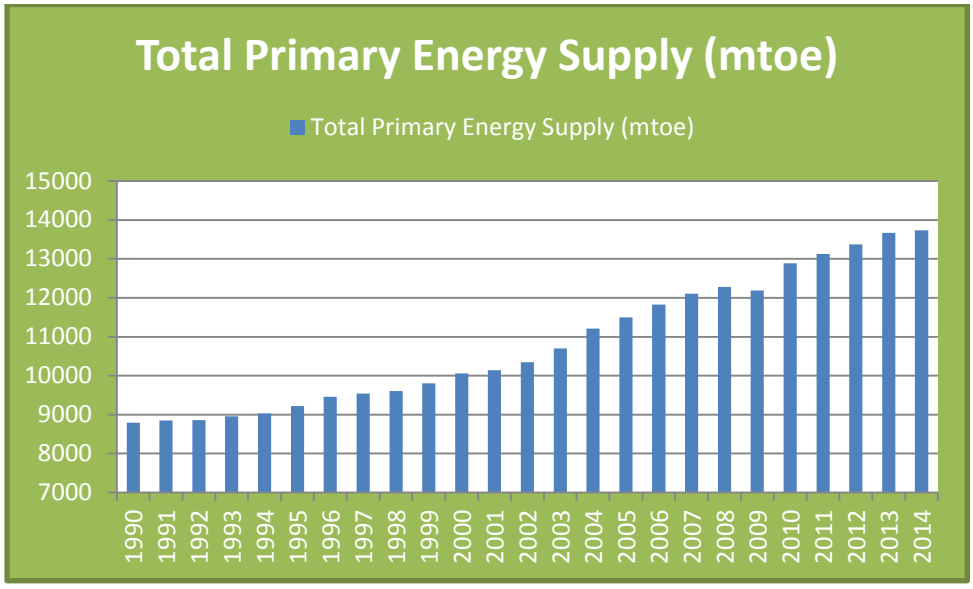
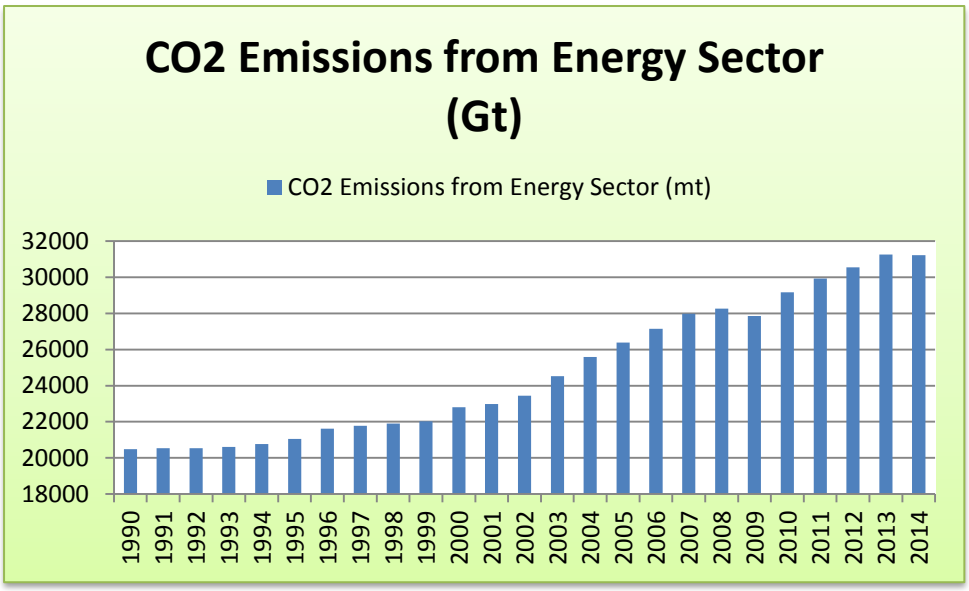
End Notes

[i] The Demand for primary energy has been rising over the years as seen in the figure below. The compounded annual growth rate (CAGR) for the period 1990-2014 is 1.77%.



(Data source: Enerdata: Global Energy Statistical Yearbook 201, June 2015): https://yearbook.enerdata.net/

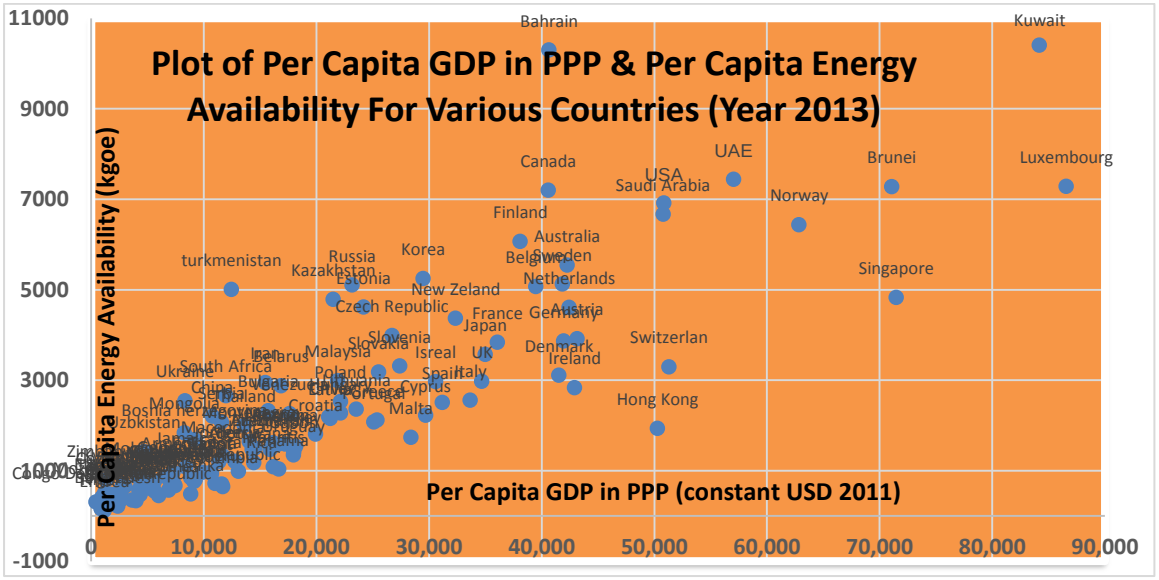
In line with rising primary energy use, we have also been witnessing rising levels of greenhouse gas emissions from the energy use or energy sector as depicted in figure below. The CAGR for the period 19090 to 2014 has been 1.85%.



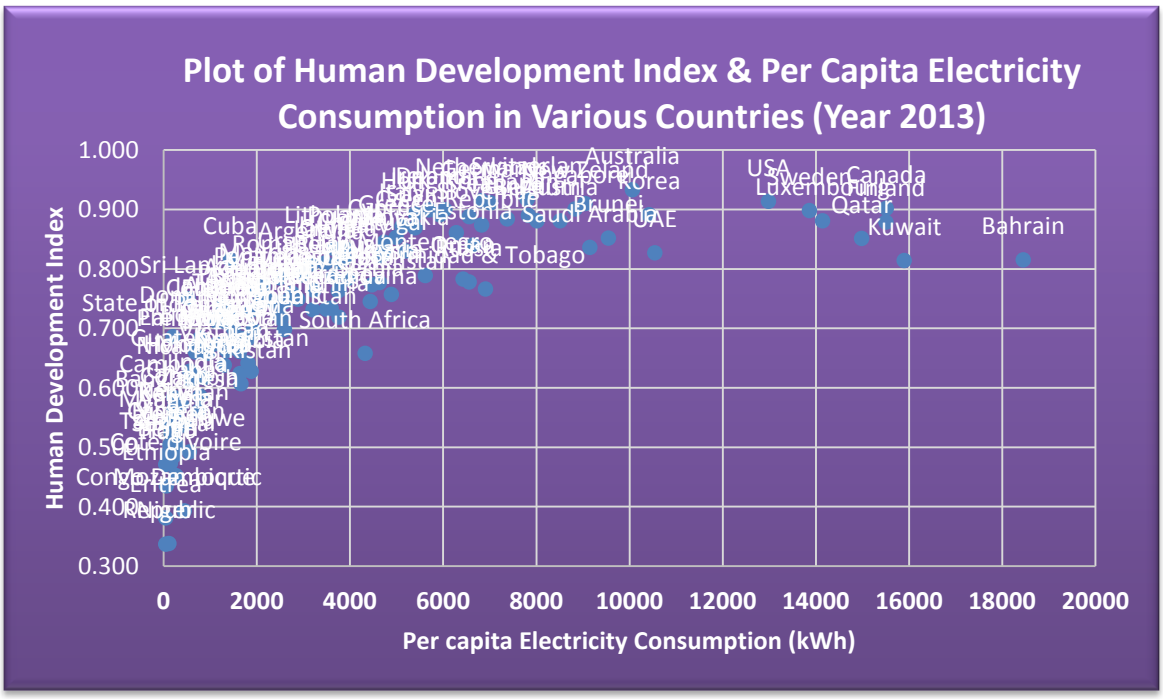
(Data source: Enerdata: Global Energy Statistical Yearbook 201, June 2015): https://yearbook.enerdata.net/

[ii] Although at the global level we have seen energy productivity improving over years (or energy intensity declining), the energy use and economic growth or electricity use and human development index are still highly correlated as can be seen from the two graphs below. The two graphs show that

the correlation that exists between energy consumption and economic growth as well as between electricity consumption and human development index for the year 2013.



Data from IEA Key World Energy Statistics, 2015



Data for Human Development from Human Development report, 2013, United Nations; and for Per Capita Electricity Consumption from IEA Key World Energy Statistics, 2015

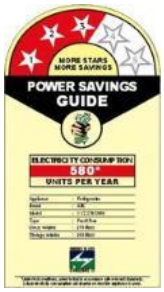
iii Use of energy efficient products and appliances can reduce the energy demand and thus help in providing access at lower investments and also lower running costs. For example, an electrification of 100 households in an area, each household requiring 2 light bulbs with light output equal to 60 watt incandescent lamp and a ceiling fan, if done with energy efficient LED lamps and ceiling fan (consuming about 40 watts) would require a solar photovoltaic system of just 6-7 kW size, against a system size of 20kW if electrification is done with

incandescent lamps and inefficient ceiling fans (consuming about 70 watts). This brings down the upfront investment cost and running cost by roughly one-third. Inter alia, with the same investment budget, access to more number of households can be provided by using energy efficient lighting and fans. Similarly, studies undertaken by Copenhagen Centre on Energy efficiency and the International Renewable Energy Agency point out that the Se for All goal of doubling the share of renewable energy in total primary energy consumption by 2030 will only be possible if reduction in total primary energy demand is brought about through energy efficiency.

[iv] In the current background paper, a broader definition of energy efficiency has been adopted. Energy efficiency is equated with primary energy savings and thus not only includes energy efficiency per se, but also energy substitution (e.g. electricity substituting petrol or diesel in transportation sector or solar energy substituting conventional fuels or electricity heating water for thermal energy use) and energy conservation (e.g. adjusting thermostat settings in heating or cooling systems or use of sensors to switch off lights when space is empty).

[v] In the absence of well-functioning energy efficiency market, governmental interventions have been necessary to capture the available energy efficiency potential. Utility rate payer funded or public funded energy efficiency programmes targeting specific consumer segments have been the main instrumentality of the governments to capture energy efficiency. Even today, one of the most successful energy efficiency programme in the world - that of deployment of more than 100 million LED lamps in India is fully conceived and manged and implemented by a host of government entities, including Energy Efficiency Services Limited (EESL), Bureau of Energy Efficiency and electricity distribution companies, 90% of whom are government owned.

[vi] Energy Label is essentially a sticker pasted or displayed prominently on an appliance or equipment. It provides information about energy consumption, energy performance or energy efficiency of an appliance or device. Labels are of two types: endorsement labels or comparison labels. Comparison labels provide consumers with information to compare different brands of a product category (e.g. air-conditioners, refrigerators) with respect to energy efficiency performance. Endorsement labels identify and endorse a limited number of brands within a product category that meet a specified level of energy efficiency performance standards. Given below are examples of endorsement and comparison labels.



Comparison Label

Endorsement Label

[vii] "*Precision agriculture* is a technology-enabled approach to farming management that observes, measures, and analyses the needs of individual fields and crops. By allowing farmers to apply tailored care and manage water more effectively, it boosts production, improves economic efficiency, and minimizes waste and environmental impact. Its development is being shaped by

two technological trends: big-data and advanced-analytics capabilities on the one hand, and robotics—aerial imagery, sensors, sophisticated local weather forecasts—on the other. According to 2014 estimates, the global market for agricultural robotics is expected to grow from its current $1 billion to $14–18 billion by 2020.

New entrants and large companies alike are developing products and services for precision agriculture. The start-up CropX offers sensors to help farmers adjust irrigation to the needs of their soil, while Blue River uses computer vision and robotics to determine the needs of individual plants. At the opposite end of the scale, IBM has developed a highly precise weather-forecast technology, Deep Thunder, and an agriculture-specific cloud technology.

Recommendations can be adjusted in real time to reflect changing weather conditions. Soil sensors and aerial images help farmers manage crop growth centrally, with automated detection systems providing early warnings of deviations from expected growth rates or quality".
(Extracted from: Magnin Clarisse, 'How big data will revolutionalize the global food chain', McKinsey & Company, August 2016, http://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/how-big-data-will-revolutionize-the-global-food-chain?cid=digistrat-eml-alt-mip-mck-oth-1608)

viii Beef production requires 20 times more land and emits 20 times more greenhouse gas emissions per unit of edible protein than common plant-based protein sources such as beans, peas and lentils. Chicken and pork are more resource-efficient than beef, but still require three times more land and emit three times more greenhouse gas emissions than beans. When it comes to resource use and environmental impacts, the type of food eaten matters as much, if not more, than how that food is produced (World Resources Institute, http://www.wri.org/blog/2016/04/sustainable-diets-what-you-need-know-12-charts)

ix 187 countries (including the European Union member states), covering around 95% of global emissions in 2010 (excluding LULUCF) and 98% of global population had submitted INDCs (total160 INDC submissions reflecting 187 countries). On the GHG side, most of the INDCs have specified GHG mitigation targets in one of the following forms:

- Economy-wide target to reduce emissions by specific percentage points below business-as-usual (BAU) scenario in the year 2030 (e.g. Morocco put forward an economy-wide target to reduce emissions by 13% below business-as-usual (BAU) in 2030).
- Economy-wide target to reduce emissions by specific value or range of value (in Mt CO2e terms) in the year 2025/2030 (e.g. Gambia is offering to reduce emissions excl. LULUCF by 0.079 MtCO2e in 2025).
- Limiting net/gross emissions to a certain specified value or within a specified range by 2030, including (or without) emissions or removals from land-use, land-use change and forestry (LULUCF) (e.g. Ethiopia has put forward the goal to limit greenhouse net gas emissions including emissions or removals from land-use, land-use change and forestry (LULUCF) to 145 MtCO2e by 2030 OR South Africa proposes to reduce its GHG emissions levels to between 398–614 MtCO2e over 2025–2030).
- Reducing emissions by a specified percentage level (or within specified range) by the year 2025/2030 as compared to base year (e.g. Japan proposes to reduce emissions by 26% below

2013 emission levels by 2030 OR Brazil has proposed an emissions reduction target of 37% for 2025 below 2005).

- Reducing carbon intensity (emissions per unit of GDP) by specified figure or range by the year 2030 as compared to the base year (e.g. China has put forward a target to reduce carbon intensity by 60% to 65% by 2030 below 2005 levels OR India has put forward the targets to lower the emissions intensity of GDP by 33% to 35% by 2030 below 2005 levels).