2012 INTERNATIONAL YEAR OF SUSTAINABLE ENERGY FOR ALL

SE4ALL
Global Tracking Framework

Preview of Findings

ESMAP Consultative Group

March 1st 2013

COORDINATORS

ESMAP

THE WORLD BANK

iea International Energy Agency

IIASA

peec International Partnership for Energy Efficiency Co-operation

PRACTICAL ACTION Technology challenging poverty

IRENA International Renewable Energy Agency

REN21 Renewable Energy Policy Network for the 21st Century

UNDP

UNEP

UNIDO

UN-Energy

UNITED NATIONS FOUNDATION

WORLD ENERGY COUNCIL CONSEIL MONDIAL DE L'ÉNERGIE For sustainable energy.

World Health Organization

GLOBAL ALLIANCE FOR CLEAN COOKSTOVES

INTRODUCTION

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SE4ALL Objectives for 2030

- **Energy access**
  - Ensure universal access to modern energy services
- **Renewable energy**
  - Double the share of renewable energy in the global energy mix
- **Energy efficiency**
  - Double the global rate of improvement in energy efficiency

A phased and differentiated approach

	Immediate	Medium term
Global tracking	Which indicator is ready to go for global tracking with all data needs (past, present, and future) already fully met?	Which indicator is highly desirable for global tracking, but would require a feasible incremental investment in global energy data systems over the next five years?
Country level tracking	Na.	Which indicator is ideal for tracking, and although too ambitious for global tracking, could be very suitable for country level tracking under SE4ALL?

Available data allows coverage of over 180 countries

	Data Sources	Country Coverage (% global popn.)
Electrification	Global omnibus and national household surveys plus some censuses	212 (99.8%)
Cooking	Household surveys Global omnibus and national household surveys plus some censuses	190 (99.8%)
Renewable Energy	IEA (plus UN) for Energy Balances REN 21, IRENA, BNEF for complementary indicators	181 (98%)
Energy Efficiency	IEA (plus UN) for Energy Balances WDI for GDP and sectoral value added	181 (98%)

ENERGY ACCESS

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Methodological challenges immediate resolution

Measurement of Access

- Household survey are the most common source of information on primary cooking fuel and electricity connections
- Surveys are carried out every 3-4 years
- A modeling approach has been adopted to allow data estimation for all countries annually

Definition of Access

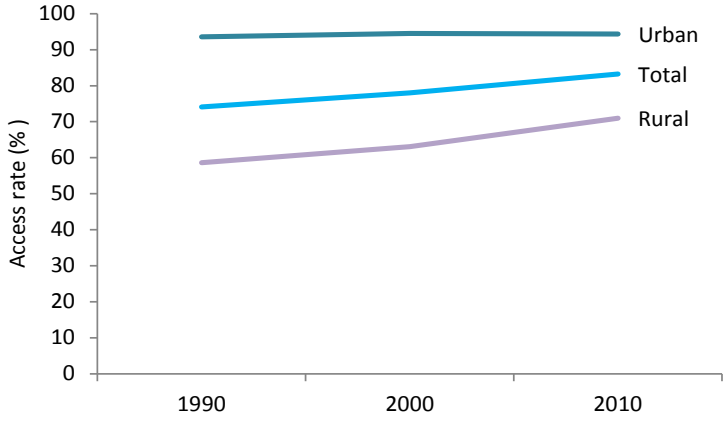
- For electricity, availability of an electricity connection at home or use of electricity as a primary energy for lighting is considered access
- For cooking, primary use of various non-solid fuels is considered as access

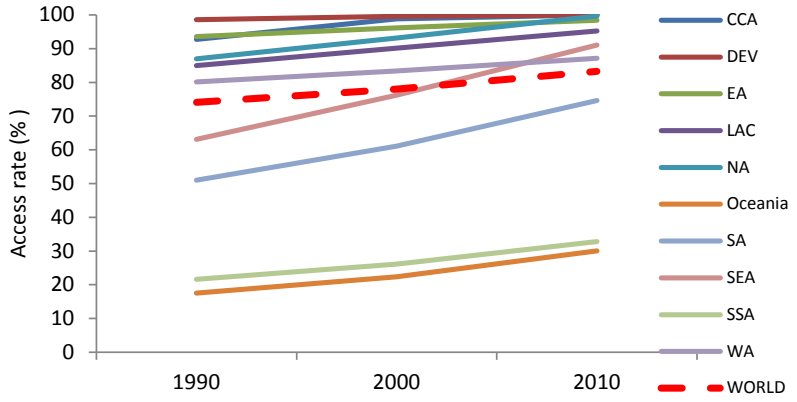
Access rate to modern energy rose driven by increase in rural access rate and growth in South Asia and East Asia regions

Global

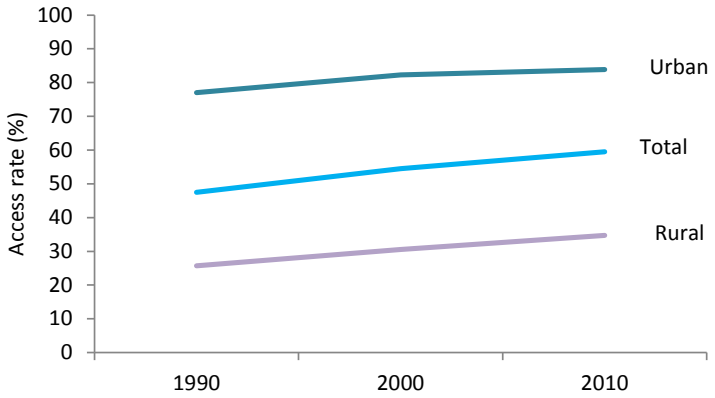
Regional

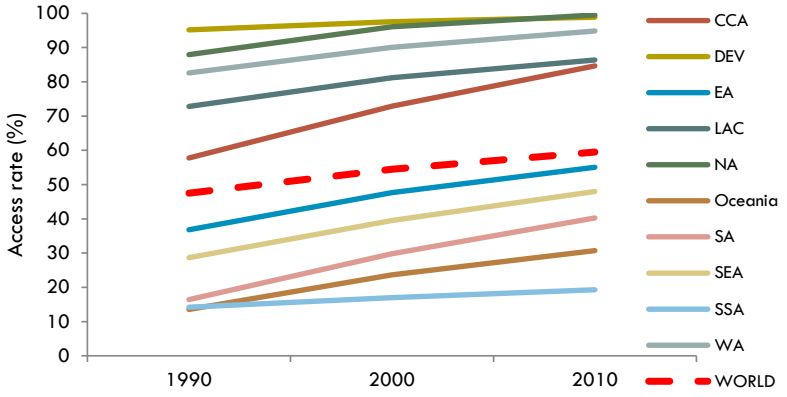
Electricity Access





Non-solid fuel Access





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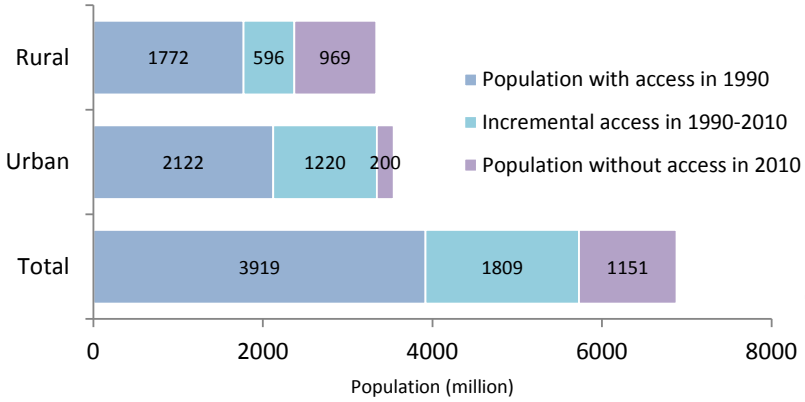
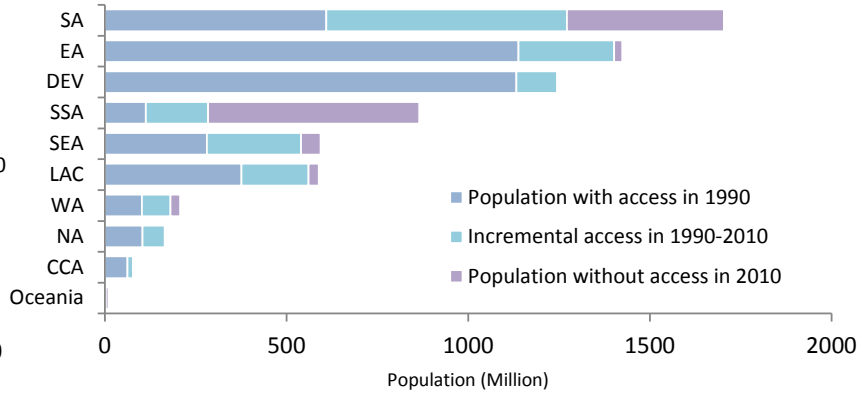
Most of the absolute growth took place in urban areas and in South Asia, East Asia, and South East Asia regions

Global

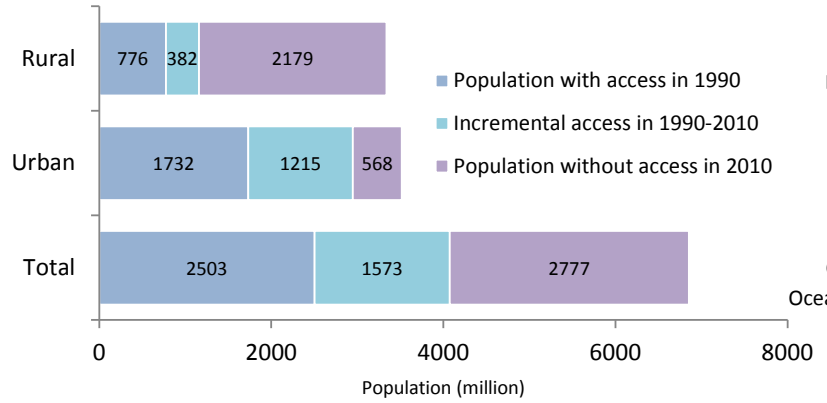
Regional

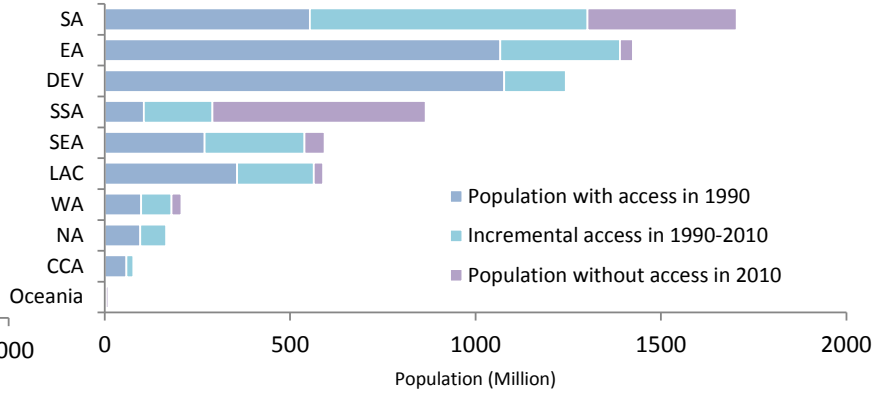
Electricity Access





Non-solid fuel Access





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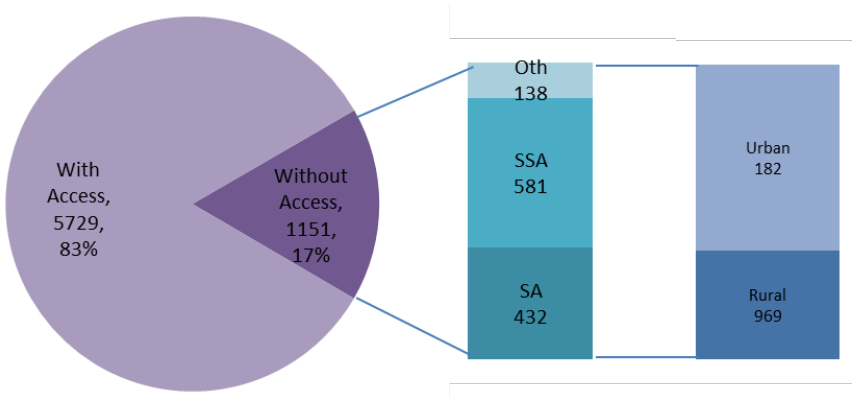
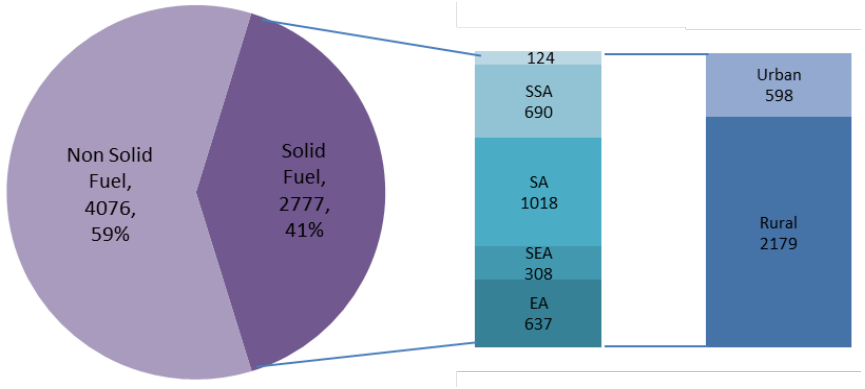
Still, 1.2 billion people live without electricity and 2.8 billion cook with solid fuels

Global

Electricity Access



Non-solid fuel Access



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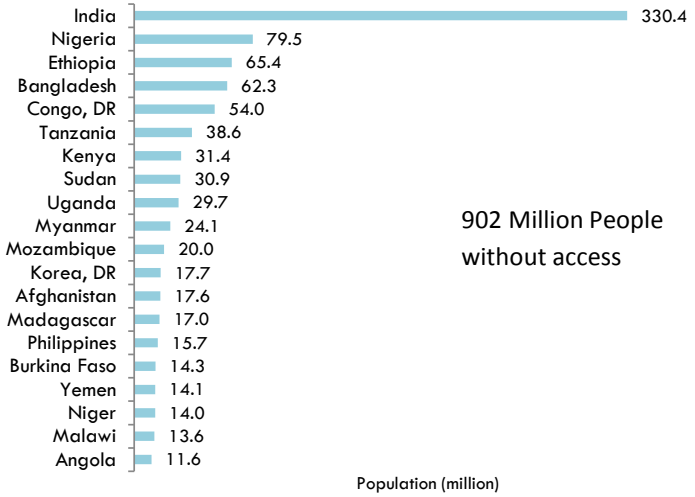
More than three quarters of global access deficit concentrated in some 20 high impact countries

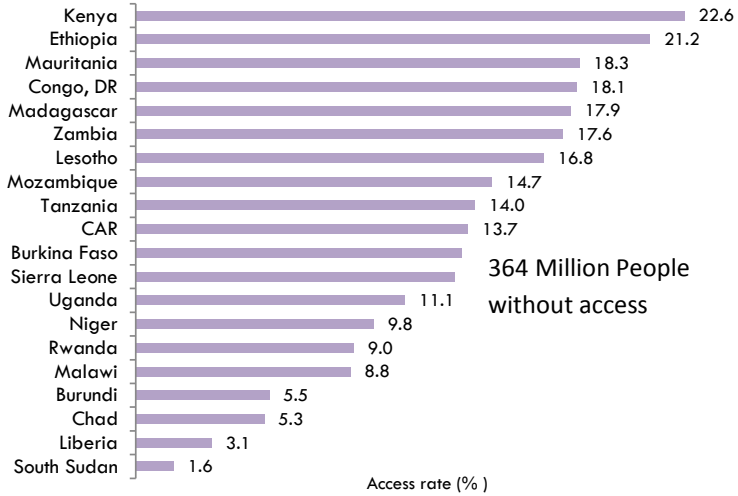
Top 20 access deficit countries

Top 20 lowest access rate countries

Electricity Access

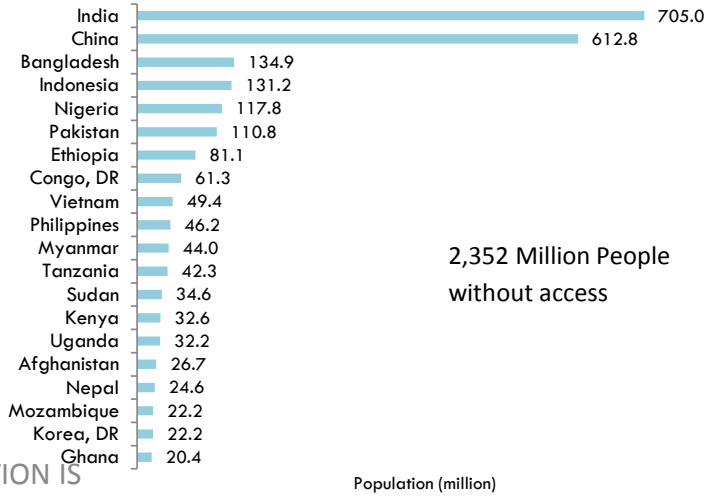


902 Million People without access

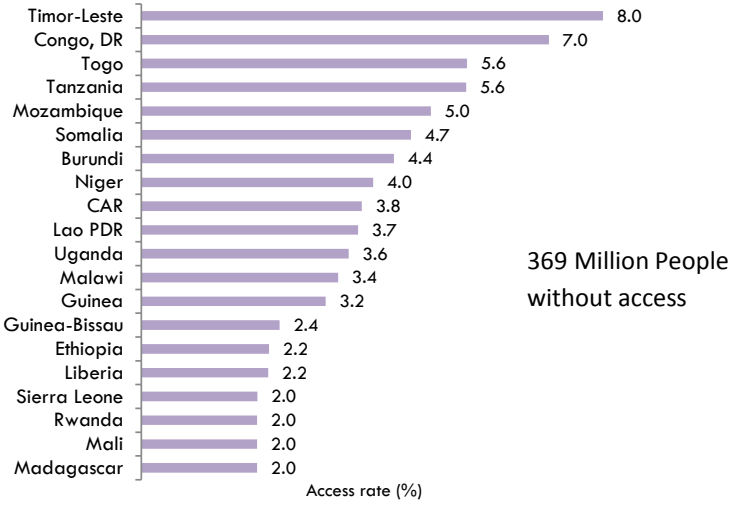


364 Million People without access

Non-solid fuel Access



2,352 Million People without access



369 Million People without access

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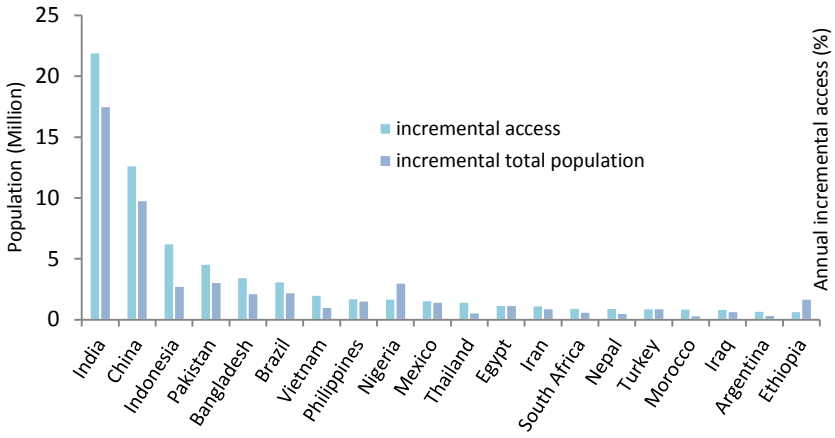
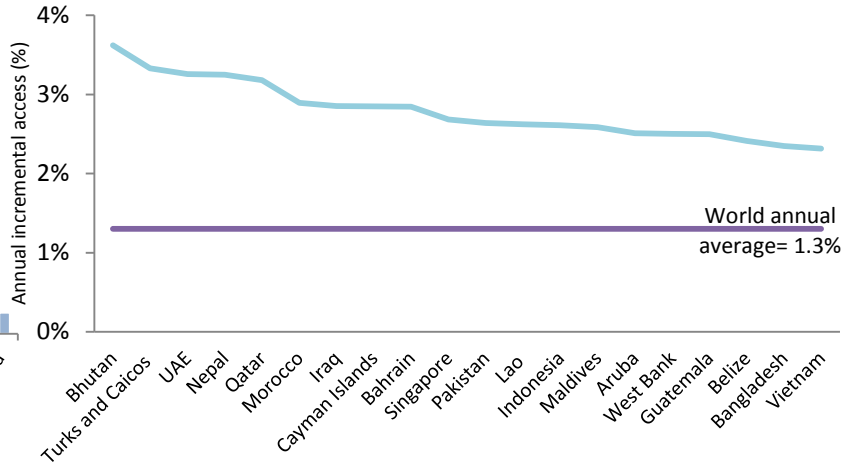
Fastest moving countries have succeeded in providing access to 3-4% of their populations annually

Annual incremental access and population

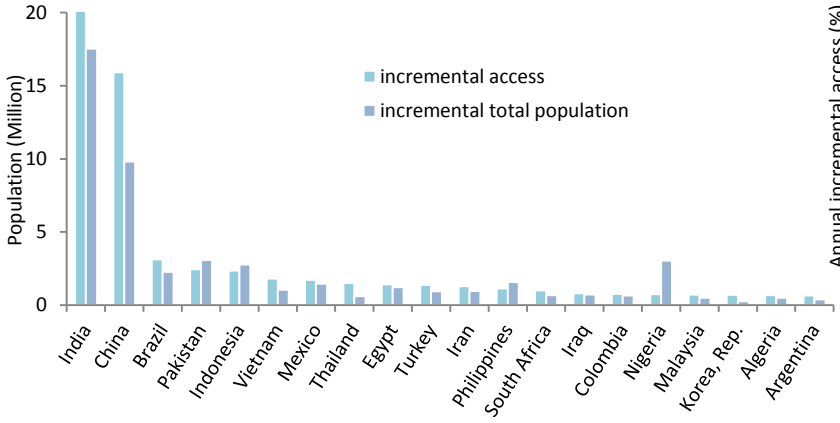
Annual change in incremental access

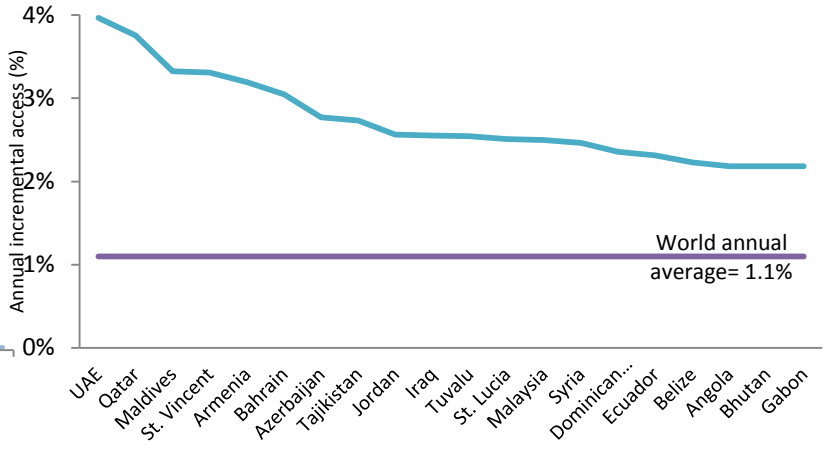
Electricity Access





Non-solid fuel Access





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Methodological challenges in medium term

Measuring Household access to electricity

- *Access to Electricity Supply* defined by increasing levels of supply attributes including quantity, duration, evening supply, affordability, legality, and quality
- *Electricity Services* defined by the use of number of key electricity services. The use is measured through ownership of appliances, which are categorized by tier following the equivalent tier of electricity supply needed for their adequate operation.

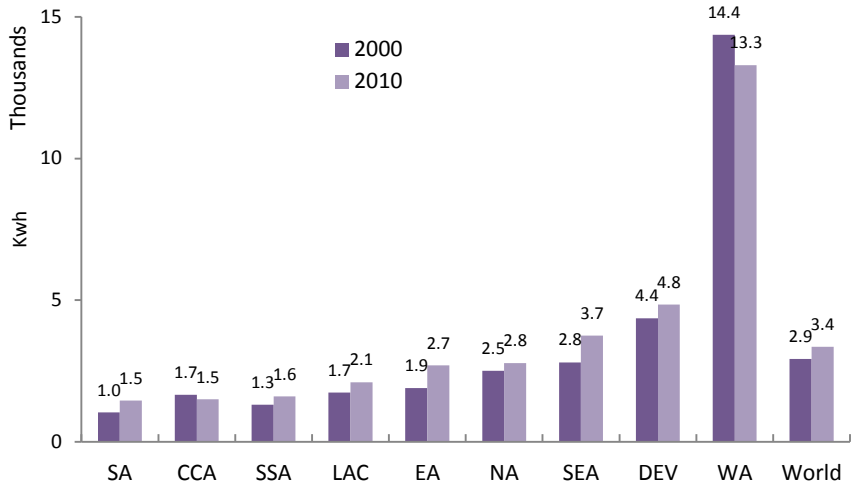
Measuring access to modern cooking solutions

- *Technical performance* is done firstly by categorizing cookstoves into low, medium or high grade, based on direct observation. Secondly, the manufactured cookstove is assessed based on whether it is certified or not
- *Conformity, convenience and adequacy (CCA)* are the three attributes that are included in addition to the technical performance of the cooking solution to obtain an integral measurement of access to cooking.

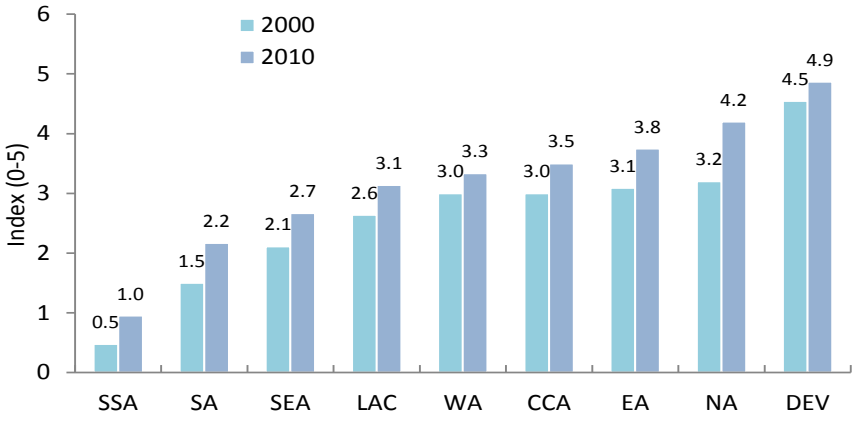
Multi-tier access index can be approximated using data on average residential electricity consumption

	Tier-0	Tier-1	Tier-2	Tier-3	Tier-4	Tier-5
Indicative Electricity Services	-	Radio, Cellphone Charging, Task Light	General Lighting AND Television AND Fan	Tier-2 AND any low-power appliances	Tier-3 AND any medium-power appliances	Tier-4 AND any high-power appliances
Consumption (kWh) per hh per year	**<3**	**3-66**	**66-321**	**321-1,317**	**1,317-2,120**	**>2,120**
Index of Access to Electricity Services = ∑(PT x T) with P_T = Proportion of households at the T^{th} tier T=Tier number {0,1,2,3,4,5}						

Average residential electricity consumption per household (1,000 Kwh) - (IEA 2010)



Simplified energy access index based on average consumption



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RENEWABLE ENERGY

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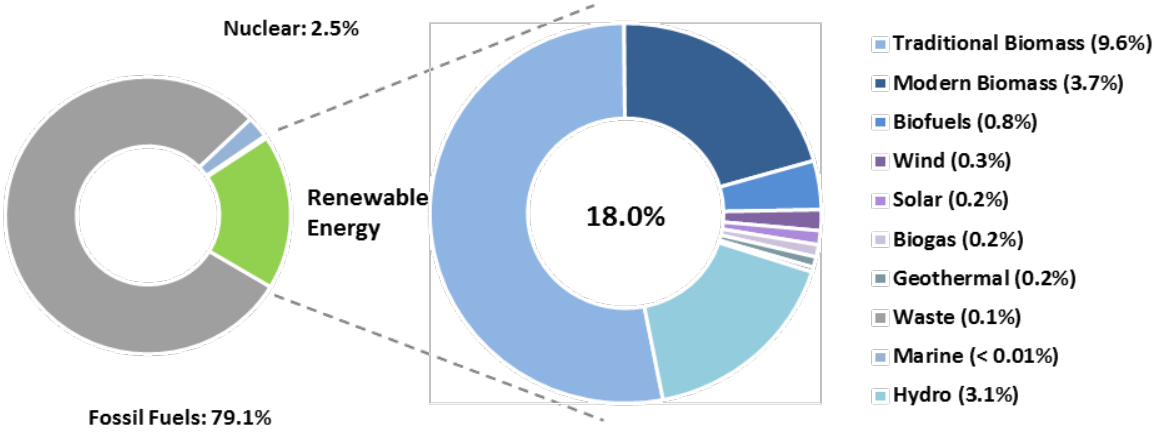
Methodological Challenges

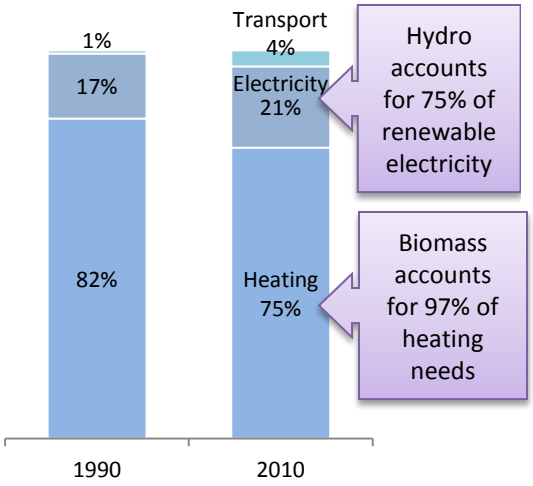
Challenge	Issues	Proposed Approach
Energy Accounting Method	Primary energy accounting under-estimates useful energy produced by renewable sources, multiple methods exist for estimating final energy consumption	Measure the share of renewable energy in total final energy consumption terms using direct equivalent method
Measuring Sustainability	Despite progress, no internationally agreed criteria and assessment methodologies for each of the renewable energy technologies	Create a framework for measuring sustainability in the medium term
Classifying Biomass	Available data repositories do not distinguish between traditional and modern uses of biomass	Improve capability to separately track different categories of bio-energy in medium term
Data Gaps	Some aspects of renewable energy not fully captured in data (small distributed grid-connected generation, direct production of heat, waste fuels, heat pumps, etc.)	Develop methods for accounting these categories and including them in data collection efforts / surveys in medium term (link to access)

Traditional biomass accounts for over half of total renewable energy used mainly for heating and cooking

Global Share of Renewable Energy in TFEC, 2010



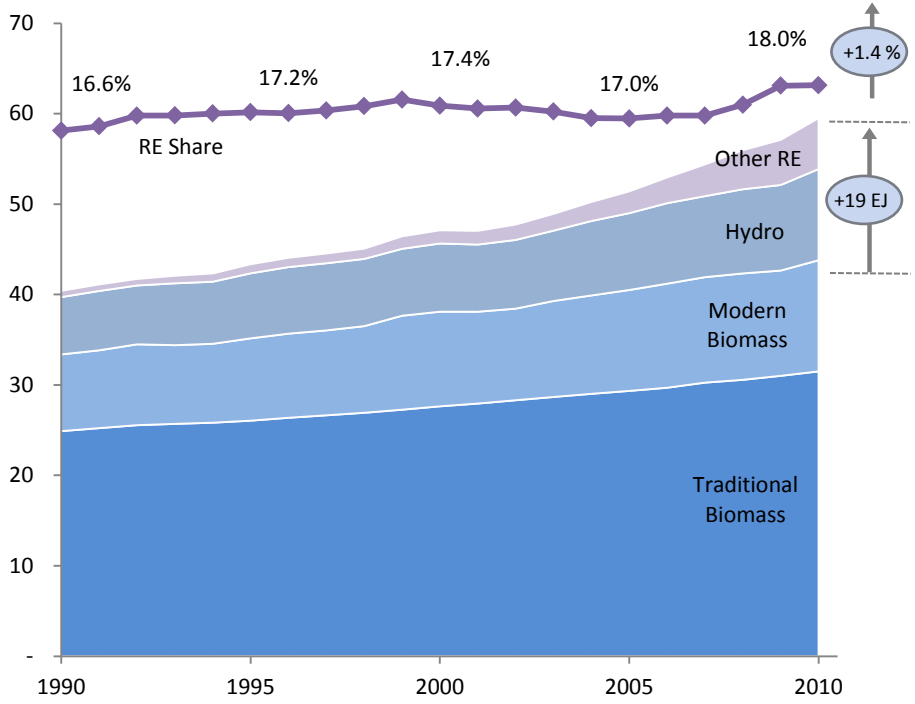
Renewable Energy Applications



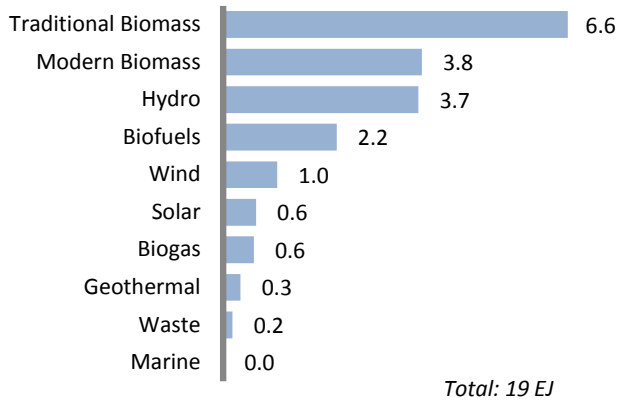
Source: IEA

Share of renewables in global energy mix hardly increased since 1990 (despite absolute growth)

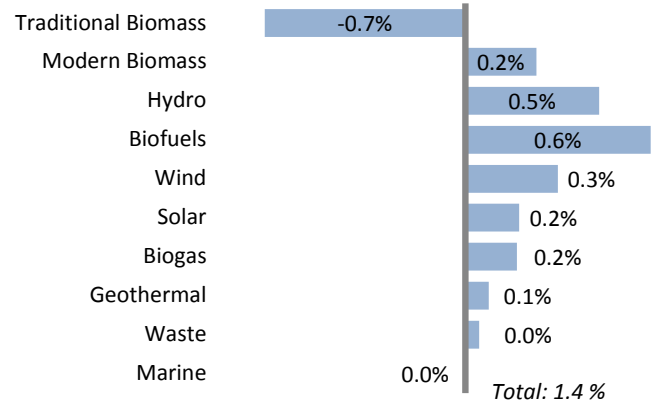
Renewable Energy Consumption (EJ) vs. Share of RE



Incremental Growth, EJ 1990-2010



Share Change in TFEC, 1990-2010

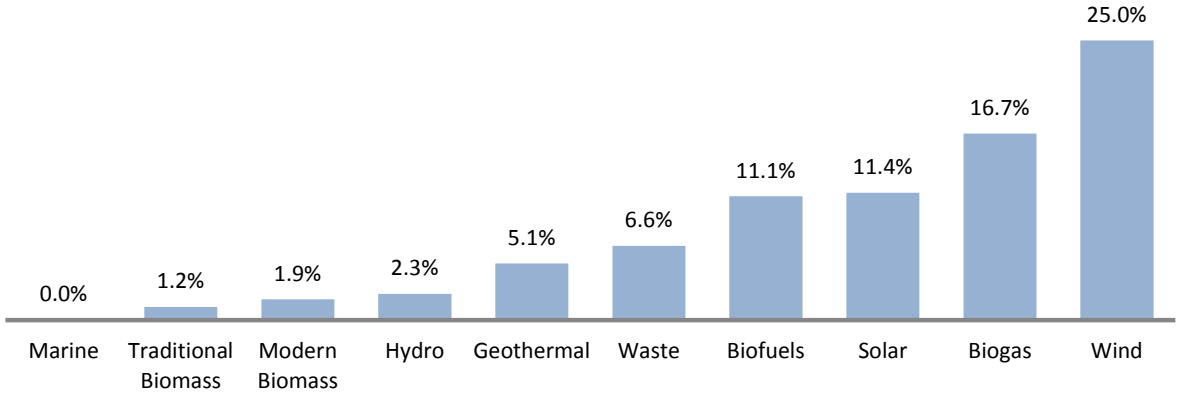


Source: IEA

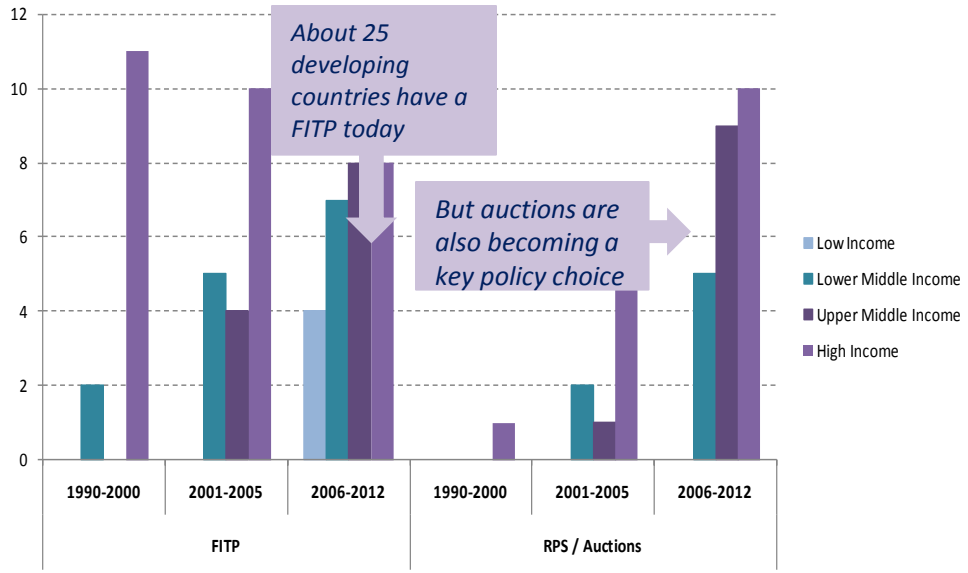
2012 INTERNATIONAL YEAR OF SUSTAINABLE ENERGY FOR ALL

Non-conventional renewables experienced double digit growth reflecting surge in policy incentives and finance

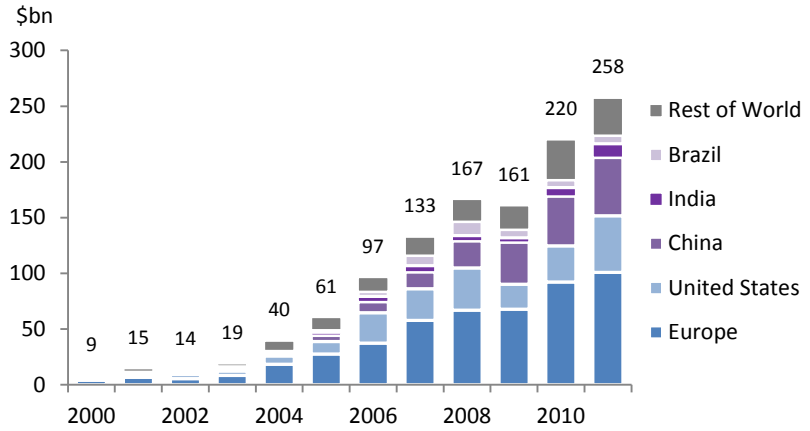
Compound Annual Growth Rate (%) of RE Consumption, 1990-2010



Number of Countries Introducing RE Policies and Targets



Investments in Renewable Energy

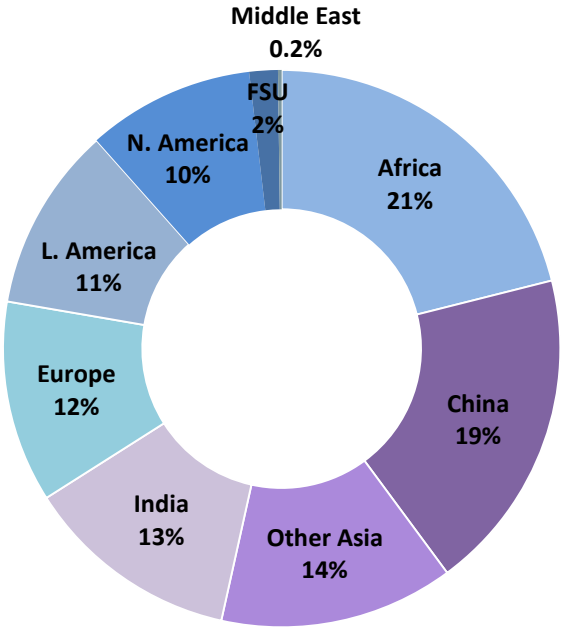


2012 INTERNATIONAL YEAR OF SUSTAINABLE ENERGY FOR ALL

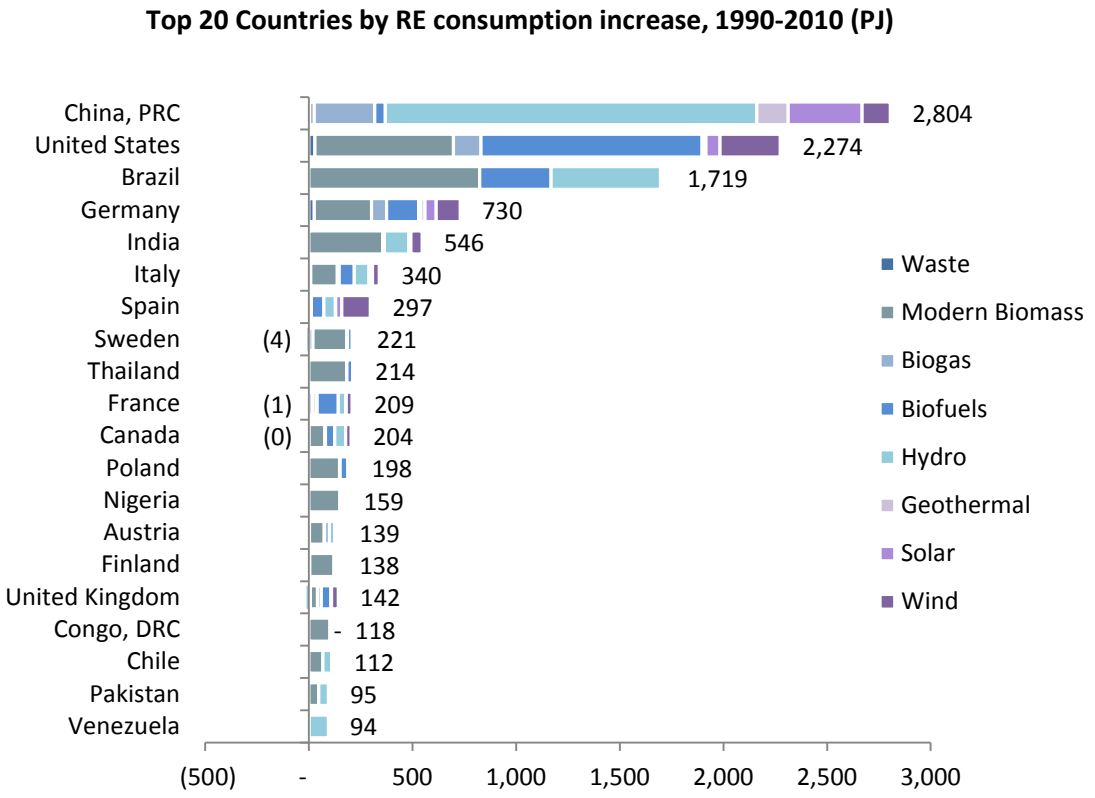
Less developed regions show higher (though declining) renewable energy shares – and vice versa

Regional and Country Share of Renewables in TFEC (%)			
Region/Country	Share of RE in Each Region / Country		
	1990	2000	2010
Europe	7.8	9.4	13.7
North America	6.0	7.1	9.0
Former Soviet Union	3.2	3.8	4.0
Middle East	1.2	0.7	0.9
Latin America	32.3	28.2	29.0
Africa	62.1	63.0	61.6
Asia (excl. China and India)	21.8	18.9	18.8
China	33.5	29.2	19.4
India	57.5	52.6	42.4
World	16.6	17.4	18.0

Regional Contribution to the Global RE Share, 2010



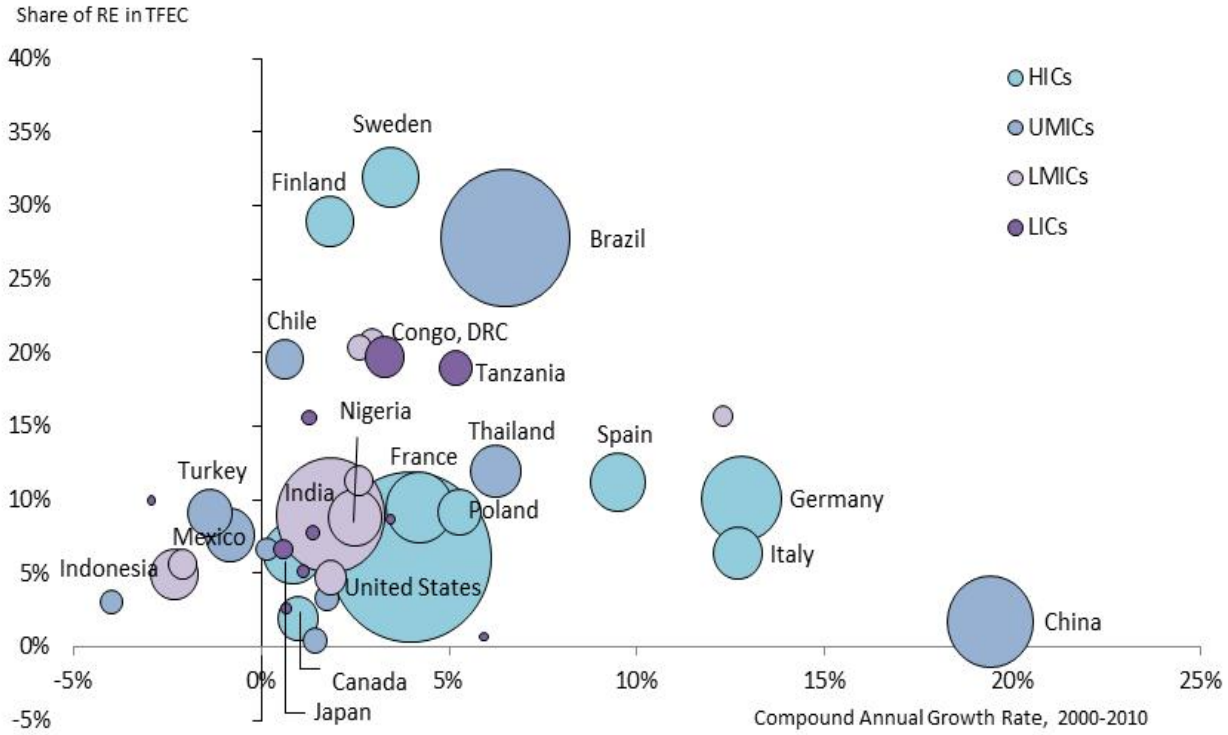
Two thirds of expansion of modern renewable energy during last 20 years concentrated in just five countries



RE excluding traditional biomass

Source: IEA

Countries most heavily dependent on renewable energy have reached penetration levels of around one third



RE excluding traditional biomass and hydro

Source: IEA

ENERGY EFFICIENCY

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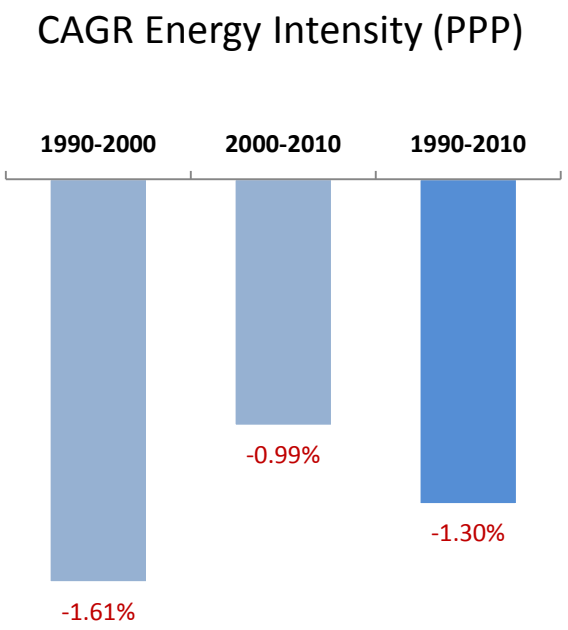
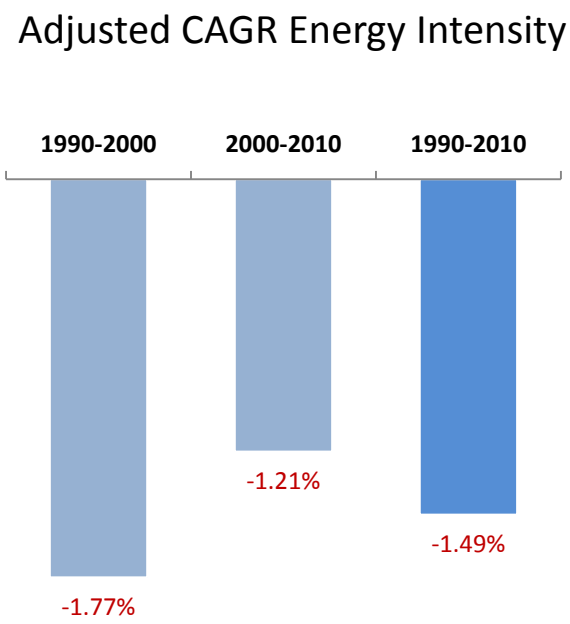
Methodological challenges

Challenge	Proposed Approach
Multi-dimensionality	Track global performance on energy intensity complemented by energy intensity of major economic sectors and efficiency of energy industry Move towards better tracking of targets, policies, institutions, investments
Intensity vs. Efficiency	Track energy intensity for countries and major regions/blocks, where feasible complement with efficiency decomposition to strip out structural effects
Market Exchange Rate vs. Purchasing Power Parity	Track purchasing power parity
Primary vs. final energy	Track global energy intensity in terms of primary energy demand Track sectoral energy intensity in terms of final energy consumption
Volatility	Track a five year moving average trend

Last decade shows slowing rates of improvement in energy intensity (higher when adjusted)

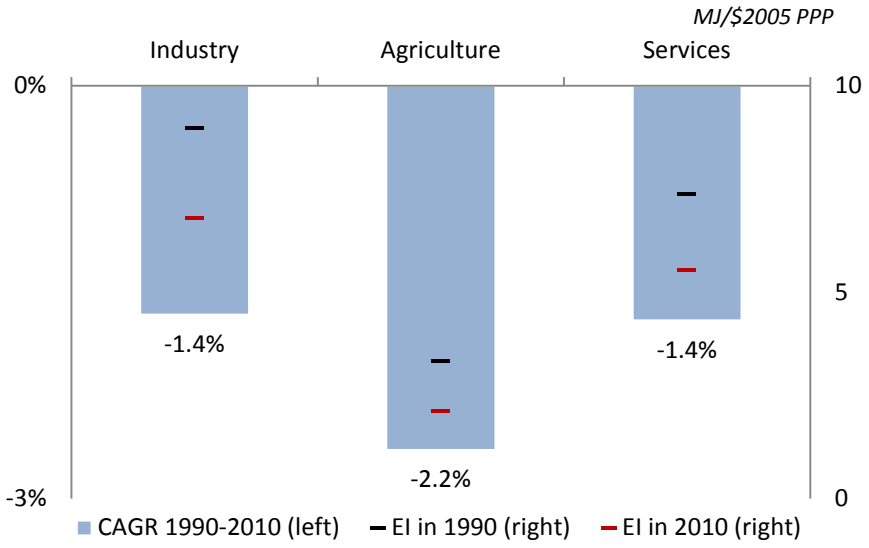




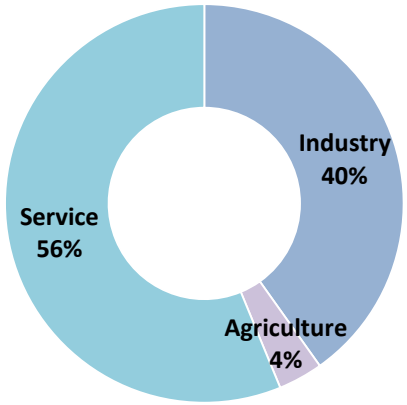
Source: IEA, WDI

Service sector contributed the most to energy savings during last 20 years

Energy Intensity Trends by Sector



Share of Cumulative Savings by Sector

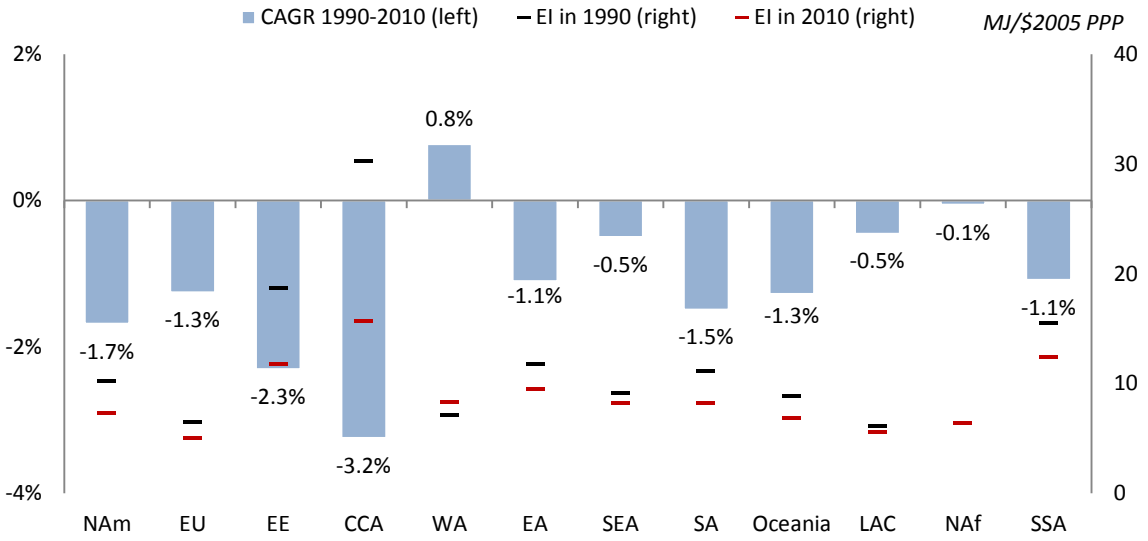


Note: Services include services, transport, and residential

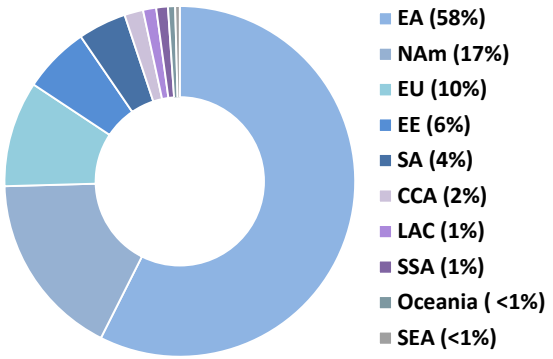
Source: IEA, WDI

East Asia accounted for the lion's share of energy saved, even as Middle Eastern energy intensity deteriorated

Energy Intensity Trends by Region

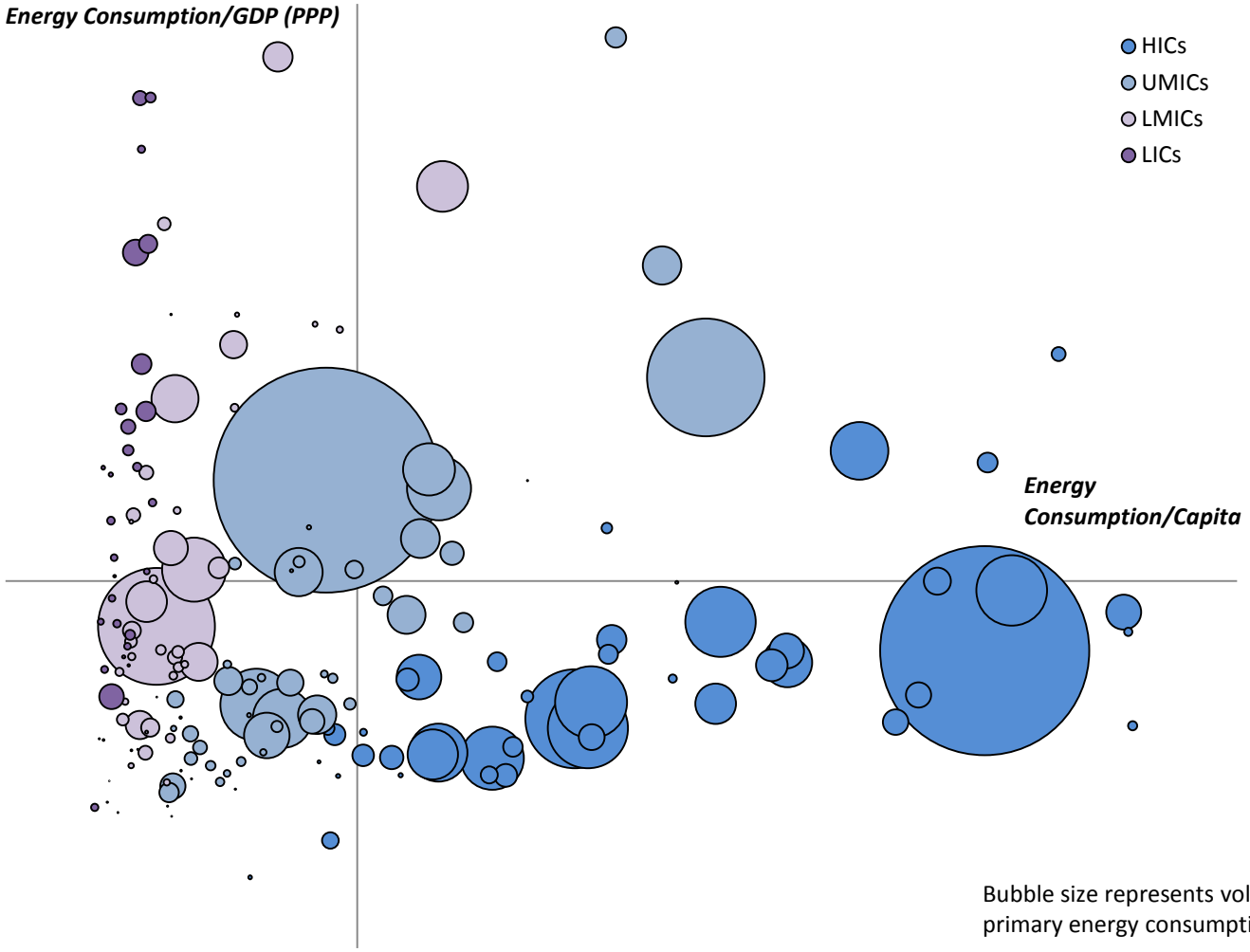


Share of Cumulative Savings by Region, 1990-2010



Source: IEA, WDI

Energy consumption patterns differ by income group

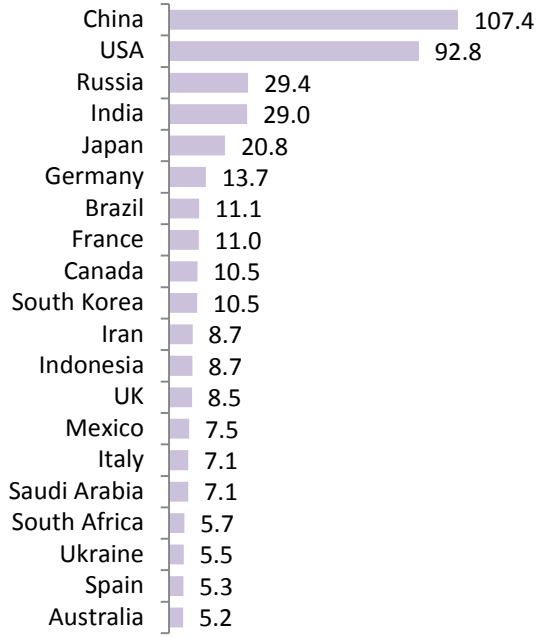


Source: IEA, WDI

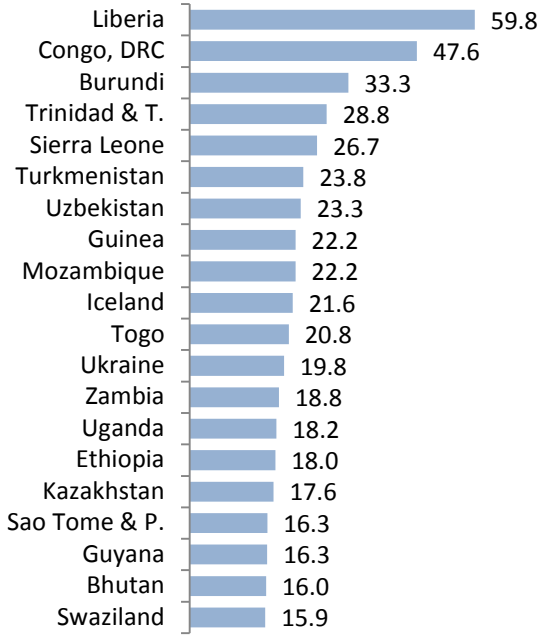
Bubble size represents volume of primary energy consumption in 2010

Top 20 (2) consumers accounting for 80% (40%) of global energy demand

Largest Primary Energy Consumers, 2010 (EJ)



Most Energy Intensive Countries, 2010 (MJ/$2005 PPP)



Countries with Highest Level of Energy Intensity Among 20 Largest Energy Consumers, 2010

	All Sectors	Industry	Services	Agriculture
1	Ukraine	Ukraine	Iran	Canada
2	Russia	Russia	Ukraine	South Africa
3	Saudi Arabia	Canada	Saudi Arabia	Russia
4	South Africa	Brazil	Indonesia	United States
5	China	South Africa	Russia	Brazil

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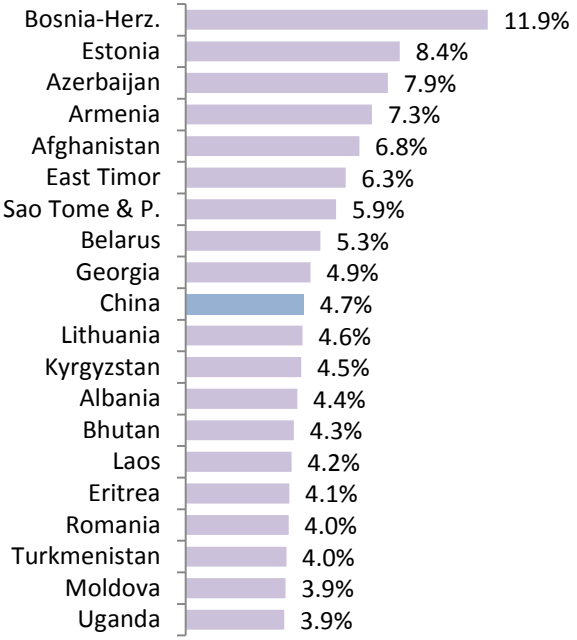
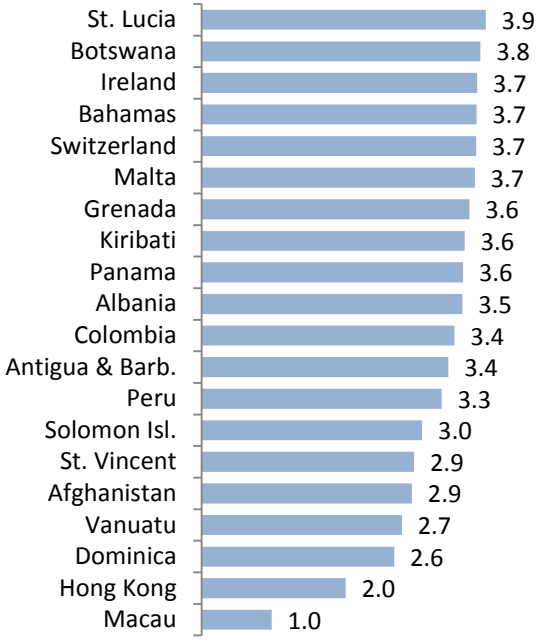
Source: IEA, WDI

Fast moving countries typically register improvements in the range of 4-8% annually

CAGR Energy Intensity, 1990-2010



Countries with Lowest Level of Energy Intensity (MJ/$2005 PPP)



Countries with Lowest Level of Energy Intensity Among 20 Largest Energy Consumers, 2010

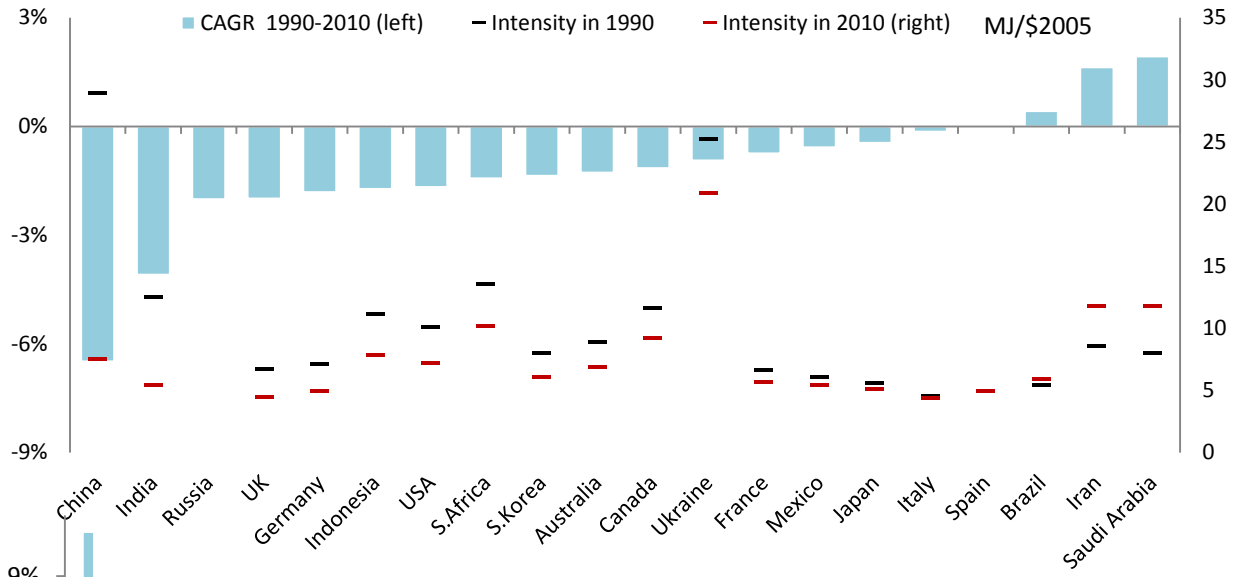
	All Sectors	Industry	Services	Agriculture
1	UK	Japan	Japan	Saudi Arabia
2	Spain	Germany	UK	Indonesia
3	Italy	UK	Spain	India
4	Germany	Spain	Italy	Germany
5	Japan	Italy	Germany	China

2012 INTERNATIONAL YEAR OF SUSTAINABLE ENERGY FOR ALL

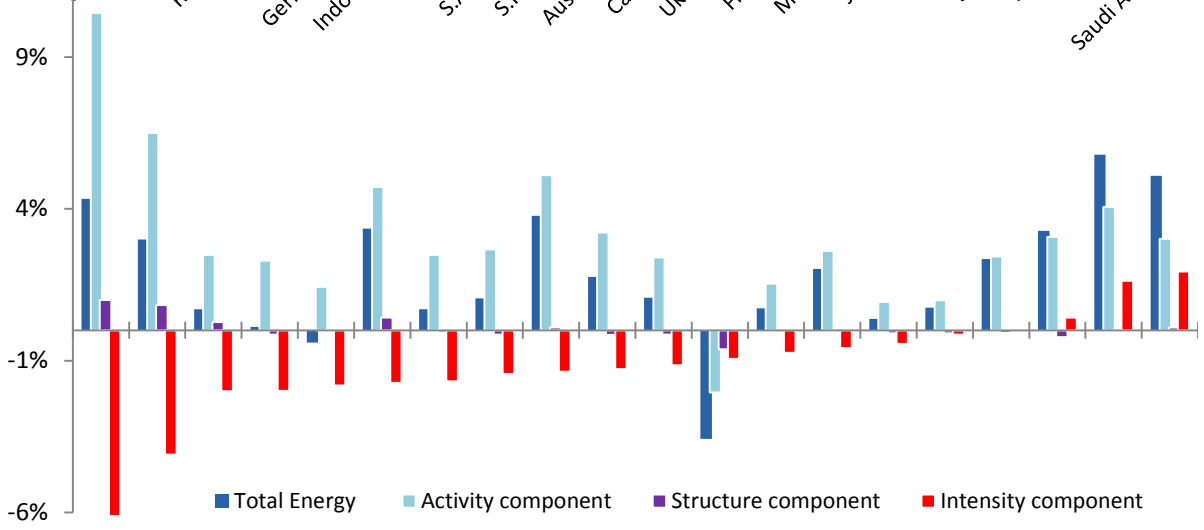
Source: IEA, WDI

Structural and activity effects partially mask extent of energy efficiency efforts among top 20 energy consumers

CAGR for Intensity Components, 1990-2010

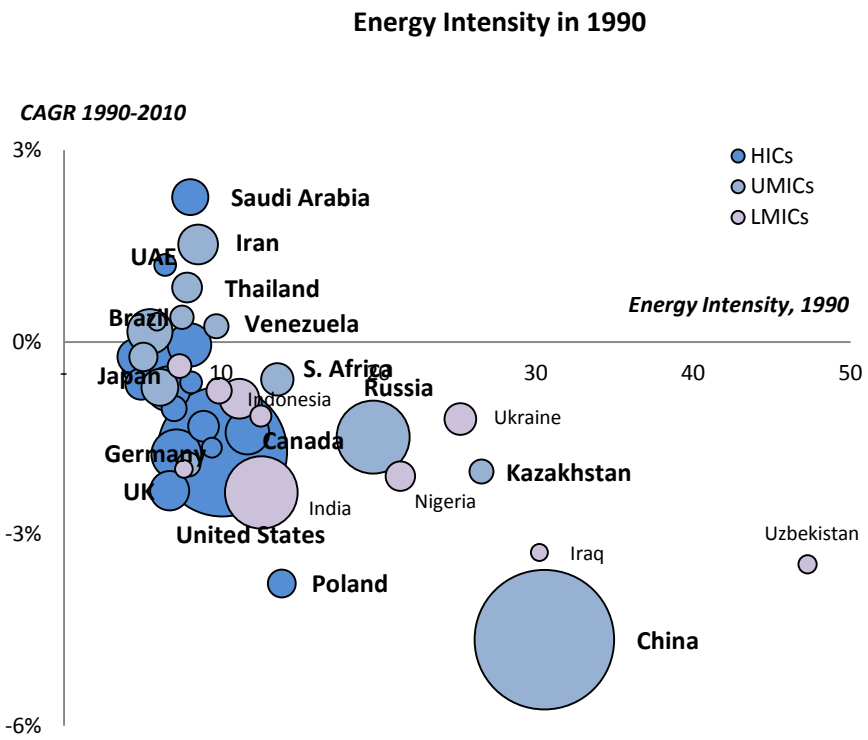


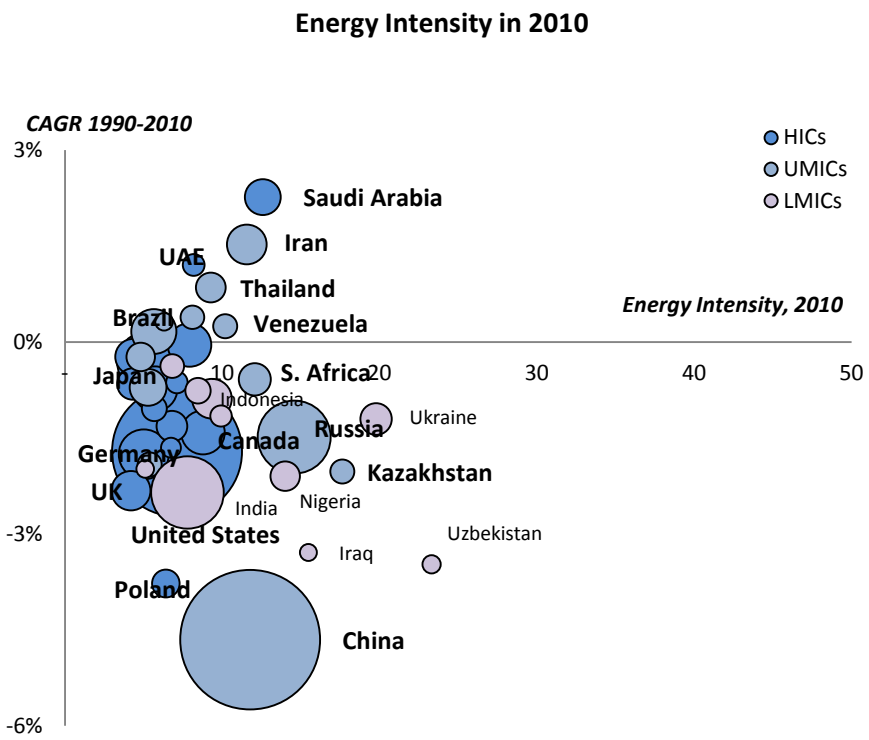
CAGR for Activity, Structure and Intensity Components, 1990-2010



2012 INTERNATIONAL YEAR OF SUSTAINABLE ENERGY FOR ALL

China stands out in terms of greatest improvement seen among top energy consuming nations





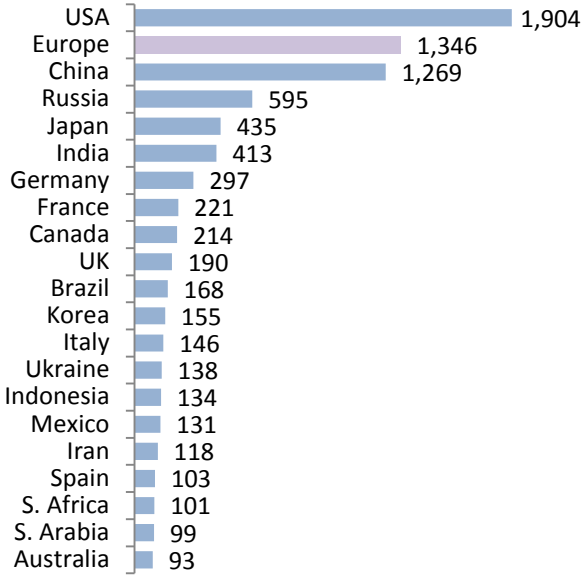
Source: IEA, WDI

Bubble size represents volume of primary energy consumption in 2010

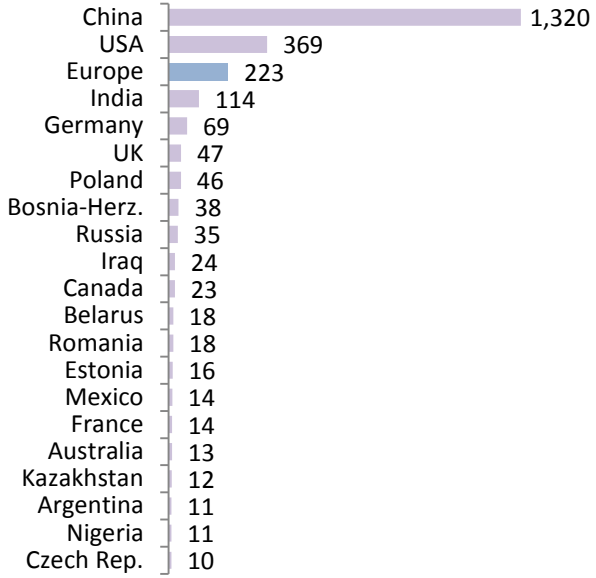
2012 INTERNATIONAL YEAR OF SUSTAINABLE ENERGY FOR ALL

Through energy intensity improvements China saved about as much energy as it consumed over last 20 years

Largest Energy Consumers, Cumulative 1990-2010 (EJ)



Largest Energy Savers, Cumulative 1990-2010 (EJ)



Source: IEA, WDI

SCALE OF CHALLENGE

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SE4ALL starting point in perspective

Percentages	Universal access to modern energy		Renewable energy share in global energy mix (%)	Rate of improvement of energy intensity CAGR 1990-2010 (%)
	Electrification	Cooking		
Historic reference 1990	74	47	16.6	-1.3
Starting point 2010	83	59	18.0	
Objective for 2030	100	100	36.0	-2.6

2012 INTERNATIONAL YEAR OF SUSTAINABLE ENERGY FOR ALL

Large absolute achievements of last 20 years diluted by surging population and energy demand

Absolute achievements

- 1.8 bn. connected to electricity
- 1.6 bn. gained access to primary non-solid fuel use

- 20 EJ of energy provided through renewable sources
- 2,216 EJ of energy saved through reductions in energy intensity

Relative achievements

- Electrification increases at 1.3% pa
- Non-solid fuel use increases at 1.1% pa

- Compound growth rate of renewable energy consumption of 2% pa
- Compound growth rate of energy intensity only -1.3% pa

Global population grew at 1.3% per year
Global primary energy demand grew at 2.0% per year
Global GDP grew at 3.2% per year

Projections from IEA and IIASA illustrate scale of challenge entailed by SE4ALL objectives

Percentage in 2030	Universal access to modern energy		Renewable energy share in global mix	20 year rate of improvement of energy efficiency
	Electrification	Cooking		
IEA SCENARIOS				
• Current Policies	-	-	18	-2.0
• New Policies	88	69	20	-2.3
• Efficient World	88	69	22	-2.8
• 450 PPM (2^0C)	-	-	27	-2.9
GEA SCENARIOS				
• Baseline	Na.	Na.	9	-1.3
• Six GEA Pathways	-	-	31/37	-2.6/-2.8
• 2^0C	-	-	21/37	-1.6/-2.9

NEXT STEPS

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Launch and dissemination calendar

- Consultation
  - First round methodological consultation, November 2012
  - Second round full consultation, February 2013
- Previews
  - ESMAP CG, Washington DC, March 1st
  - SE4ALL EXCOM, Washington DC, March 11th
  - Energy Thematic Consultation, Oslo, April 9th
  - SE4ALL Advisory Board, Washington DC, April 19th
- Launch
  - Vienna Energy Forum, Vienna, May 28th-30th
  - Briefing to EU Development Ministers, Brussels
  - Briefing to UN Ambassadors, New York
  - Other opportunities?

Plans for future global tracking

- Details are still being discussed and funding unclear

- Individual partners commit to on-going tracking work
  - Electrification: WB/ESMAP via STEAR?
  - Cooking: WHO?
  - Renewable energy: various possibilities?
  - Energy efficiency: IEA and WB/ESMAP?

- Bi-annual unified report timed around Vienna Energy Forum

Global energy data improvement agenda

	Recommended targeting of effort over next five years
Energy access	a) Work to improve energy questionnaires for Global Omnibus Surveys b) Pilot country level surveys for multi-tier framework
Renewable energy	a) Improve data and definitions for bio-energy and sustainability b) Capture renewable energy in distributed generation c) Capture renewable energy in off-grid (including micro-grids) d) Promote a more harmonized approach to target-setting
Energy efficiency	a) Integrate data systems on energy consumption and associated output measures b) Strengthen country systems and capability to collect data on sectoral intensities (and ideally sub-sectoral process efficiency) c) Improve data on physical activity drivers (traffic volumes, number of households and floor space, etc.) d) Improve data on energy efficiency targets, policies and investments

ANNEX

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Definition of renewable energy

Energy from natural sources that are replenished at a faster rate than they are consumed, including the following

- *Hydro*
- *Bio-energy*
- *Geothermal*
- *Aero-thermal*
- *Solar*
- *Wind*
- *Ocean*

Estimation model

Mixed model to estimate values for countries with at least one data point: Mixed model includes fixed effects for the time variable and the regional aggregation and it defines hierarchical random effects by regions and country and for time at country level

FEATURES OF THE MODEL:

- Natural cubic spline transformation cantered in 2000, the median date of the surveys data collected, and 5 knots over the entire time period.
- Data has been converted in logit function
- A fitted option has been used to predict the fixed portion plus contributions based on predicted random effects in countries with at least one data point.
- Values in countries without any data point are estimated by using the linear predictor for the fixed portion of the model based on the regional average value.

Candidate Multi-tier frameworks

Measuring Household access to electricity

Supply side: Tiers based on six attributes of electricity supply

ATTRIBUTES	Tier-0	Tier-1	Tier-2	Tier-3	Tier-4	Tier-5
Peak Available Capacity (W_{eq})	-	>1	>20	>200	>2000	>2000
Duration (Hrs)	-	≥4	≥4	≥8	≥16	≥22
Evening Supply (Hrs)	-	≥2	≥2	≥2	≥4	≥4
Affordability	-	-	√	√	√	√
Formality	-	-	-	√	√	√
Quality (Voltage)	-	-	-	√	√	√

Service side: Tiers based on regular use of appliances

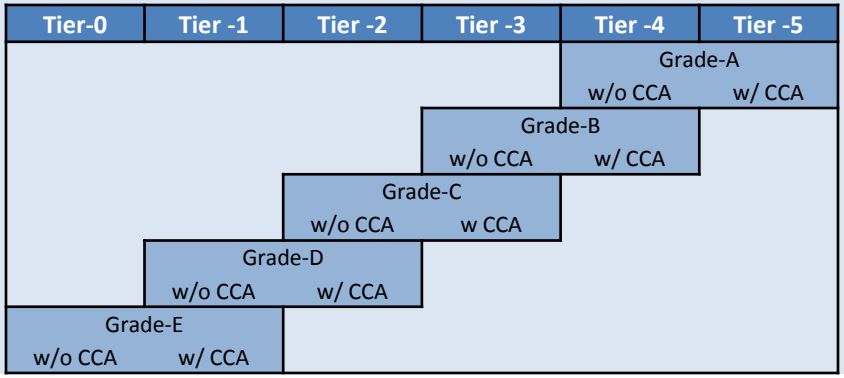
Tier-0	Tier-1	Tier-2	Tier-3	Tier-4	Tier-5
-	Task Lighting AND Phone Charging	General Lighting AND Television AND Fan	Tier-2 AND any low-power appliances	Tier-3 AND any medium-power appliances	Tier-4 AND any high-power appliances

Measuring access to modern cooking solutions

Technical Performance: Grades based on type of cookstove, fuel used and certification

	Low Grade	Medium Grade			High Grade
Attributes	Grade-E	Grade-D	Grade-C	Grade-B	Grade-A
Efficiency					
Indoor Pollution	Self-made cookstove	Non-BLEN certified cookstoves			
Overall Pollution		Uncertified non BLEN cookstove			BLEN cookstove
Safety					

Practicality: Tiers based on CCA attributes (conformity, convenience and adequacy)



Index of Access = $\sum(P_T \times T)$

P_T = Proportion of households at the T^{th} tier

T = Tier number {0,1,2,3,4,5}

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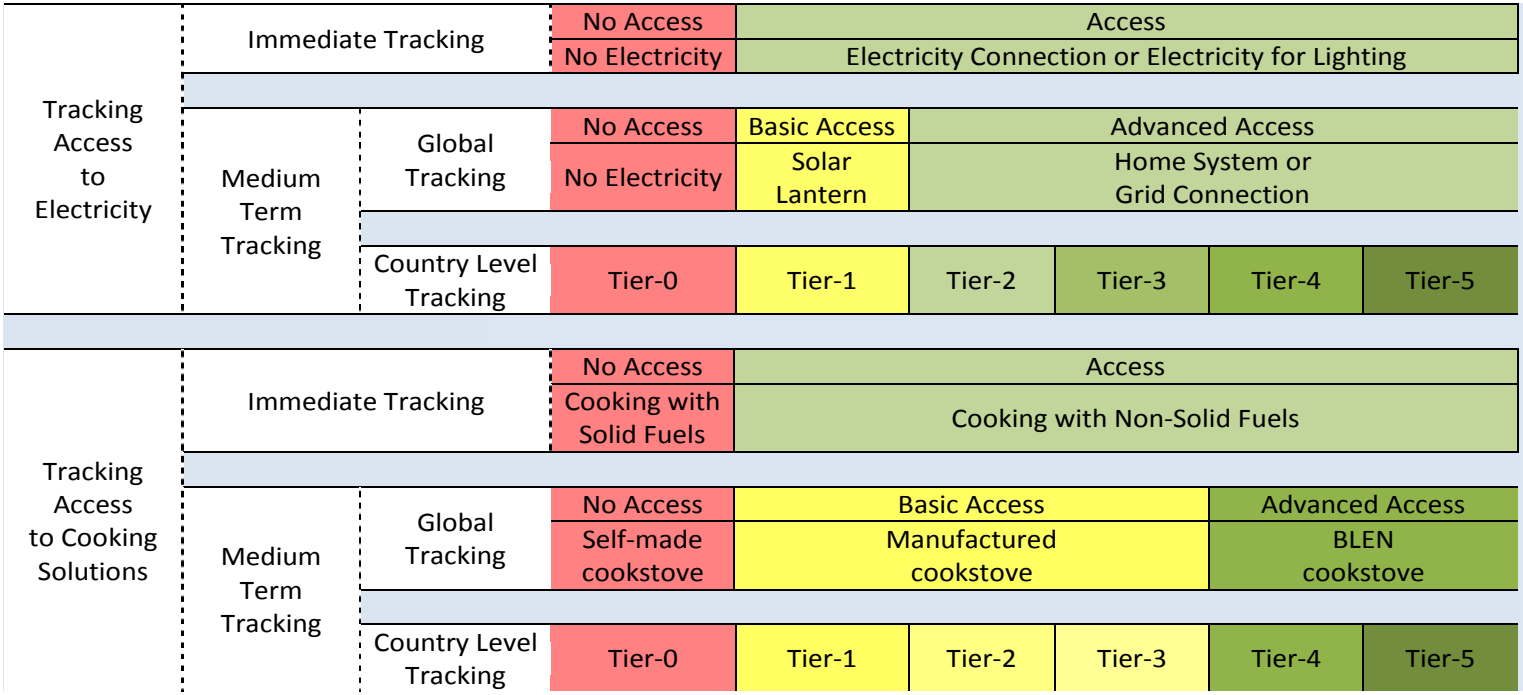
Tracking Access to Energy

Opt-in countries: The further development of the multi-tier metric can be substantially strengthened by rigorous piloting of questionnaires, certification, and consensus building

Global Tracking: a simplified three-tier measurement condensing the six-tiers in the multi-tier candidate proposal is suggested, requiring only marginal improvement in data collection

The metric is flexible and allows for country specific targets to be set to adequately account for varying energy challenges among countries.



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Achieving objectives calls for substantial financing as well as major policy commitments

Average annual US$ billion 2010-2030	Universal access		Renewable energy share in global mix	20 year rate of improvement of energy efficiency	Total
	Electricity	Cooking			
Actual for 2010	9.0	0.1	220	180	409.1
Additional from WEO	45.0	4.4	>>174	393	>>616.4
Additional from GEA	60.0	19.0	158	207	1,081.6

Both WEO and GEA coincide on need for phasing out fossil fuel subsidies and providing carbon pricing measures in order to meet objectives