ESMAP
Energy Sector Management Assistance Program

FEBRUARY 19, 2014

A New Multi-Tier Approach to Measuring Energy Access





Agenda

- Multi-tier measurement of energy access
- Initial results from pilot surveys
- Tablet based survey tool (GIZ)
- Technical assistance package

WHY AND HOW TO MEASURE ENERGY ACCESS

MULTI-TIER MEASUREMENT OF ACCESS TO ENERGY

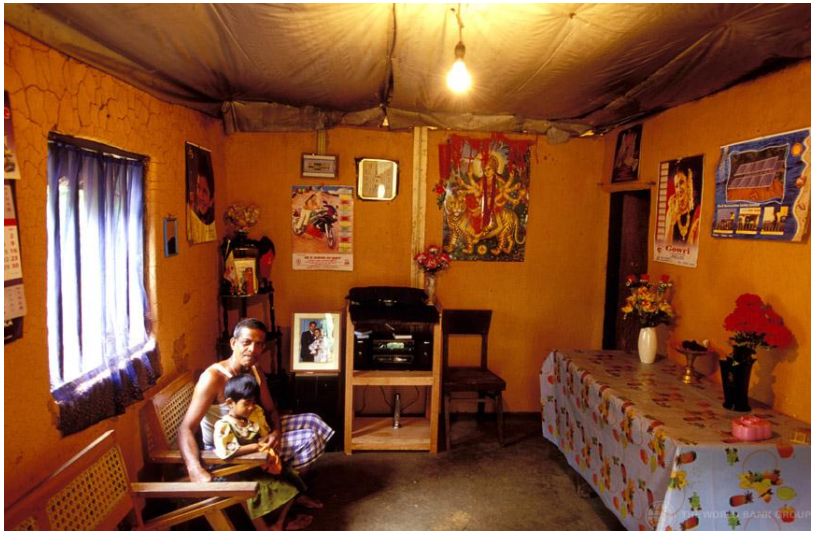
NICOLINA ANGELOU, ENERGY ECONOMIST (ESMAP)

CONTEXT

SUSTAINABLE ENERGY FOR ALL (SE4ALL) INITIATIVE

Achieve 'universal access to modern energy services by 2030'

But what does 'access to modern energy services' mean?



ESMAP Energy Sector Management Assistance Program

CURRENT APPROACH

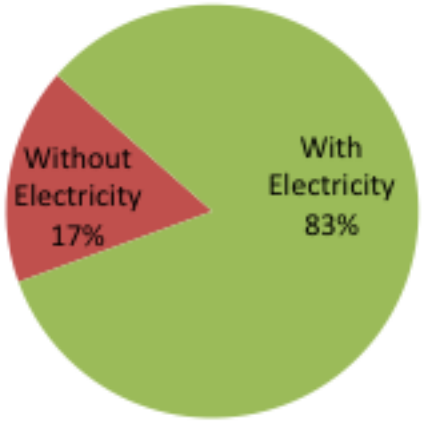
DEFINITION AND MEASUREMENT

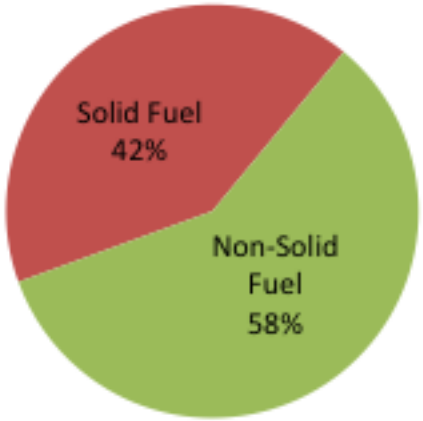
- Current definition of access

  *'having electricity **or** not having electricity'*

  *'cooking with non-solid fuels **or** cooking with solid fuels'*

- Binary metric (Access or No access)





NEW APPROACH

NEW DEFINITION

New definition of energy access based on the performance of the energy supply

Access to energy is the ability to avail energy that is adequate, available when needed, reliable, of good quality, affordable, legal, convenient, healthy & safe, for all required energy services across household, productive and community uses

Attributes of the energy supply
1. Capacity
2. Duration/ Availability
3. Reliability
4. Quality
5. Affordability
6. Legality
7. Convenience
8. Health & Safety

MEASURING ENERGY ACCESS

NEW MULTI-TIER MEASUREMENT

New multi-tier approach measuring energy access as a continuum of improvement, based on the performance of the energy supply

Binary

Multi-tier

WHY MEASURE ENERGY ACCESS

ASSESSING THE ENERGY ACCESS STATUS EX ANTE

- Detailed baseline data
  - Inform policy formulation
  - Facilitate investment planning
  - Improve project design
  - Better targeting of resources
  - Estimate the likely energy access impact of projects ex ante

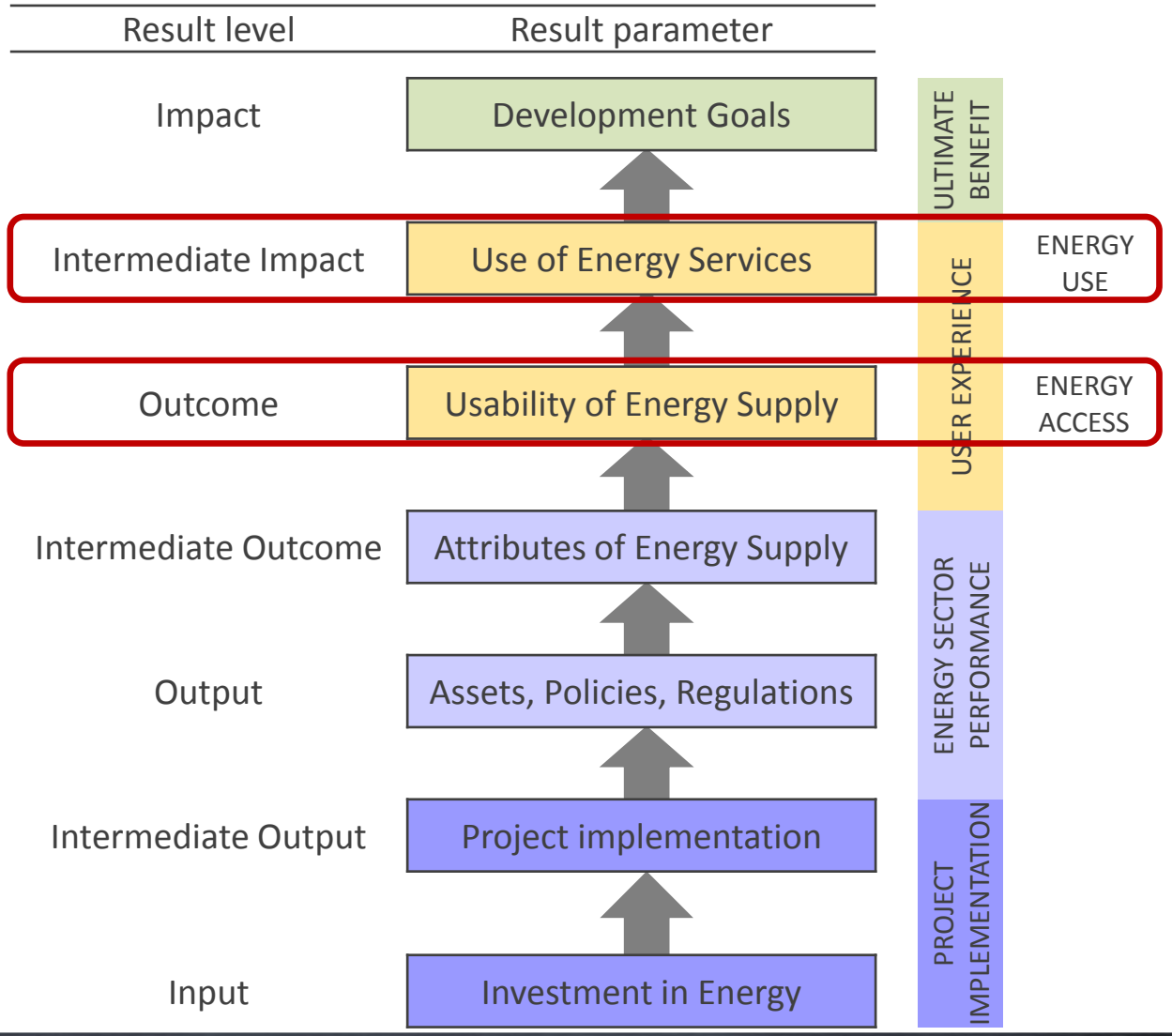
WHY MEASURE ENERGY ACCESS

ASSESSING THE ENERGY ACCESS STATUS EX POST

- Ongoing data collection
  - Evaluate the contribution of projects to improving energy access
  - Improve accountability of energy providers and policy-makers
  - Better assess the linkages between energy access and poverty
  - Track progress towards achieving the SE4All goal

HOW ENERGY INTERVENTIONS INFLUENCE ENERGY ACCESS

ENERGY ACCESS WITHIN THE ENERGY RESULT CHAIN



HOW ENERGY INTERVENTIONS INFLUENCE ENERGY ACCESS

ALL ENERGY INTERVENTIONS CAN IMPROVE ENERGY ACCESS

Project Type	Grid Connections	Legality	Peak Capacity (W)	Duration (Hrs)	Evening Supply	Quality (Voltage)	Reliability (Outages)	Affordability
Grid Electrification	↑	↑	↑	↑				↑
Mini-Grid Electrification	↑		↑	↑	↑	↑	↑	↑
Off-Grid & Solar Lanterns			↑	↑	↑		↑	↑
Generation & X-Border T/M	↑			↑	↑	↑	↑	↑
Transmission & Distribution	↑	↑				↑	↑	↑
Rural Feeder Segregation		↑		↑	↑	↑	↑	↑
Energy Efficiency			↑	↑	↑			↑
Regulations & Market Reform	↑	↑	↑	↑	↑	↑	↑	↑

HOW IS ENERGY ACCESS MEASURED

OBJECTIVE

- Develop a measuring method that:
  - Is technology and fuel neutral
  - Has energy applications at its core
  - Can be applied to household, but also productive & community uses
  - Enables calculation of an over-arching index of access to energy, as well as disaggregated analysis

HOW IS ENERGY ACCESS MEASURED

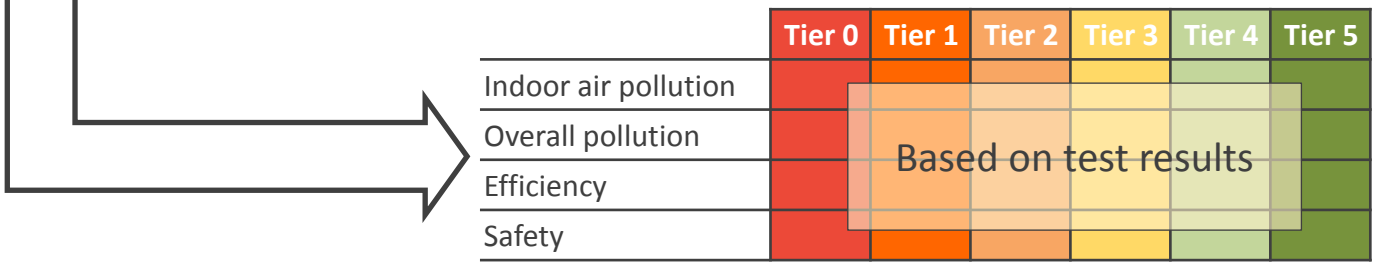
MULTI-TIER MATRIX MEASURING ACCESS TO HOUSEHOLD ELECTRICITY

	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Capacity	No electricity	1-50W	50-500W	500-2000W	>2000W	
Duration	<4hrs	4-8hrs		8-16hrs	16-22hrs	>22hrs
Reliability	Unscheduled outages				No unscheduled outages	
Quality	Low quality			Good quality		
Affordability	Not affordable			Affordable		
Legality	Not legal			Legal		
Health & Safety	Not convenient				Convenient	

HOW IS ENERGY ACCESS MEASURED

MULTI-TIER MATRIX MEASURING ACCESS TO HOUSEHOLD COOKING SOLUTIONS

	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Capacity	Primary solution not adequate*				Adequate	
Availability	Primary solution not available*				Available	
Quality	Low quality			Good quality		
Affordability	Primary solution not affordable*				Affordable	
Convenience	Not convenient				Convenient	
Health & Safety**	Self-made stove	Manufactured stove	Biogas/LPG/Electricity/Natural Gas Stoves			



*When the the primary is deficient, a secondary solution is regularly used.

**If the cook stoves have been tested, the tier is based on results for indoor air pollution, overall pollution, efficiency and safety.

HOW IS ENERGY ACCESS MEASURED

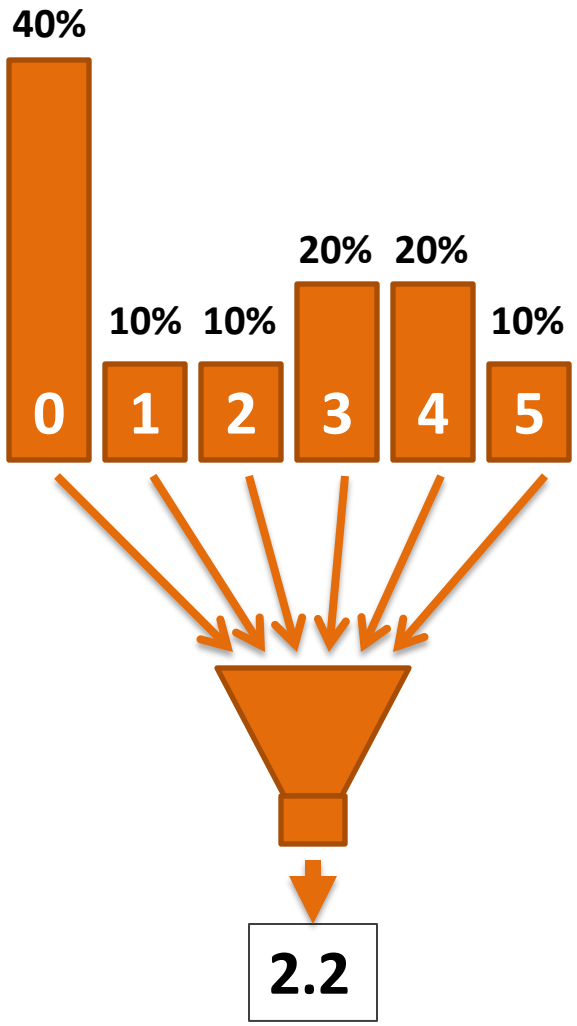
INDEX OF ENERGY ACCESS

Index of Access to Energy

$$\sum(P_i \times K)$$

P_i = Proportion of households at the k^{th} tier

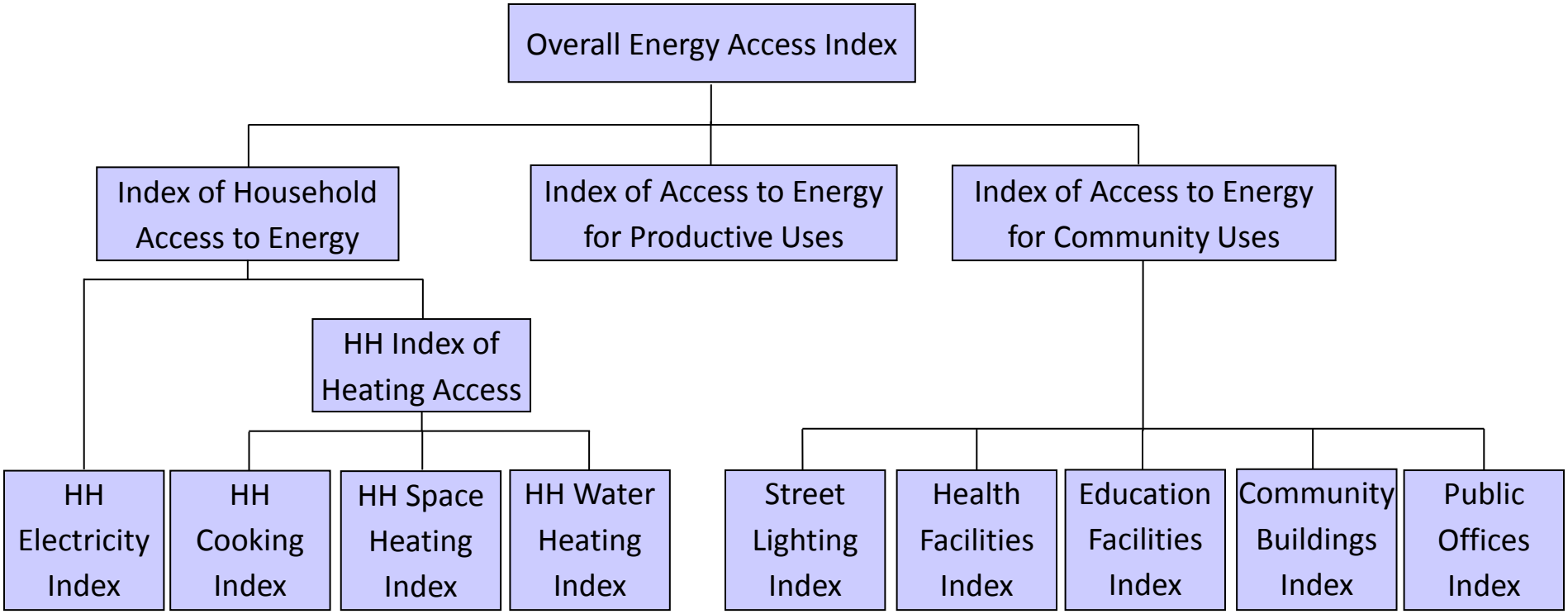
K = Tier number {0,1,2,3,4,5}



- Can be aggregated across geographies
  Village, district, province, country or region
- Can be tracked over time

HOW IS ENERGY ACCESS MEASURED

INDICES BY DIMENSIONS OF ENERGY USE



TOOLS AND RESULTS

APPLYING THE MULTI-TIER FRAMEWORK

ELISA PORTALE, ENERGY ECONOMIST (ESMAP/SEGEN)

Where and how the multi-tier can be applied

ENERGY ASSESSMENT IN THE COUNTRIES

Household Energy survey questionnaire:

- CORE questions (multi-tier assessment): 12 for electricity, 13 for cooking
- Non-Core modules

The CORE questionnaire for energy assessment can be integrated in the following survey:

- A stand-alone energy survey
- Part of an ongoing survey linked to a project
- Part of a broader scope survey (LSMS…)

Important characteristics for the survey:

- Representative sample: composition and size (national/project level, rural/urban/peri-urban).
- Transparency in sample selection: information on the geographic location and project purpose
- Information on the periodicity of the survey (on-time survey or baseline and monitoring process)

Current situation of pilots

ONGOING AND PIPELINE PILOTS

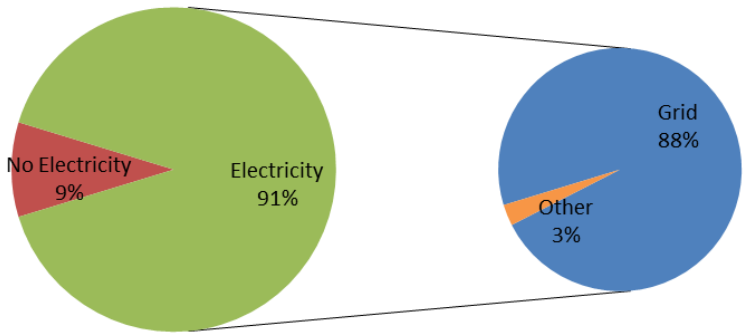
Survey Status	Country	Area	Dimensions	Survey sample size
Completed	DRC	Kinshasa area	Household cooking Household electricity	2,500 HH 2,500 HH
Completed	Uganda	National	Household Cooking	3,000 HH
Completed	Ethiopia	Amhara Region	Household cooking Household electricity	100 HH
Ongoing	Rwanda	Northern, Western and Southern provinces	Household cooking	N/A
Pipeline	India	Jharkhand Region	Household cooking Household electricity	1,800 HH

Measuring access to Electricity

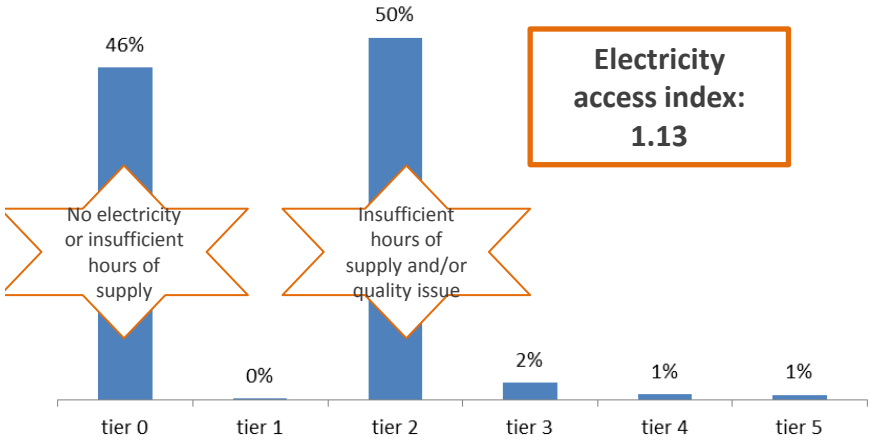
Data yet to be validated.
Not to be quoted.

KINSHASA AREA (DRC)

Binary measure

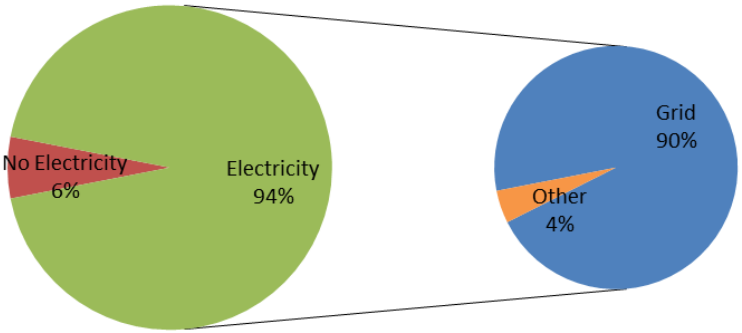


Multi-tier measure

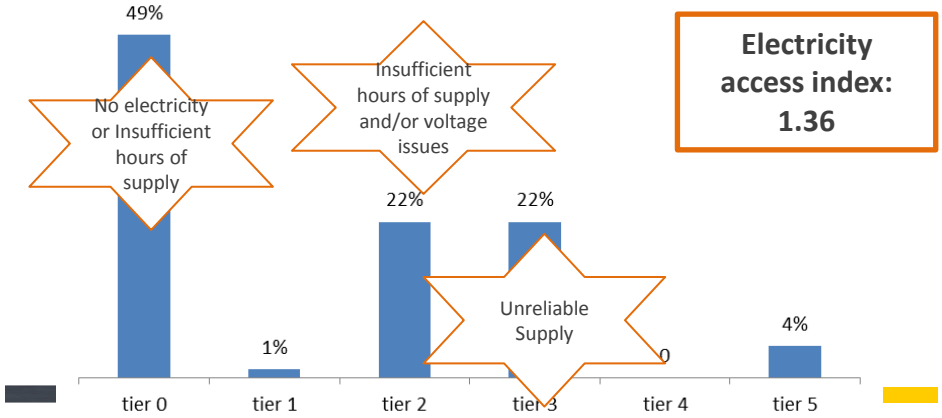


AMHARA REGION (ETHIOPIA)

Binary measure



Multi-tier measure



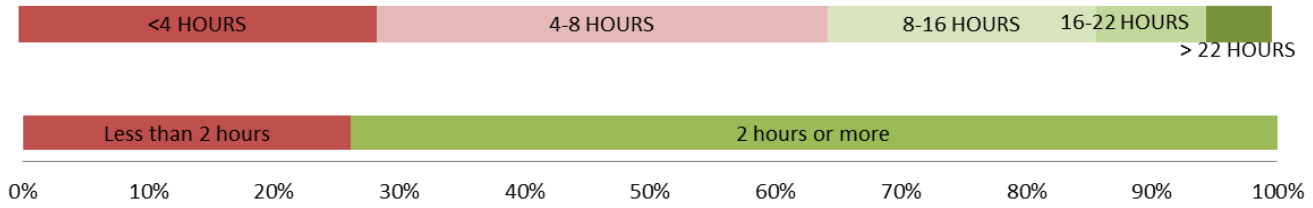
Data yet to be validated.
Not to be quoted.

Disaggregated analysis: access to Electricity

KINSHASA AREA (DRC)

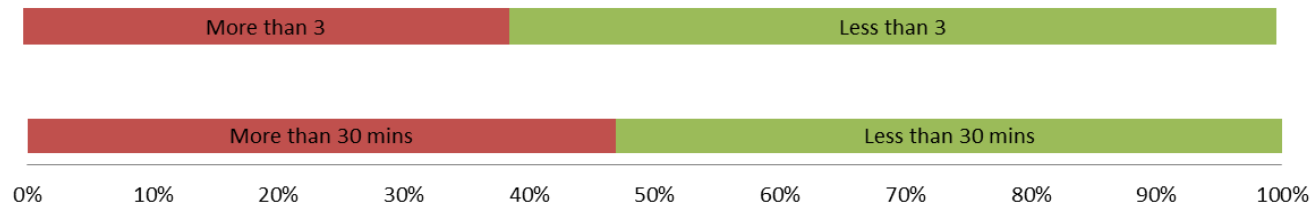
Duration:

- Hours of electricity per day
- Hours of electricity during the evening



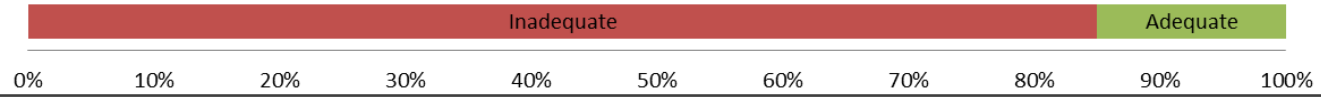
Reliability:

- Number of unscheduled interruptions per week
- Duration of each interruption



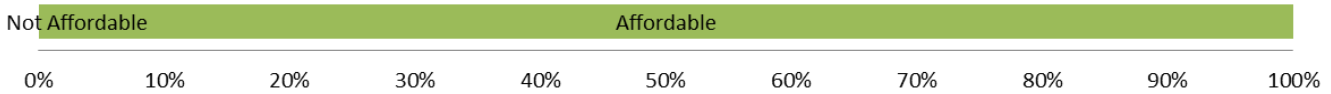
Quality:

- Voltage problems



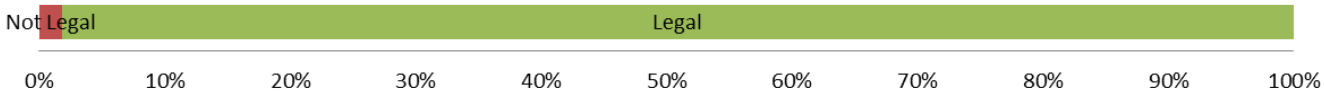
Affordability:

HH income >= 10*365kWh*tariff



Legality/Formality:

Legality of grid connection



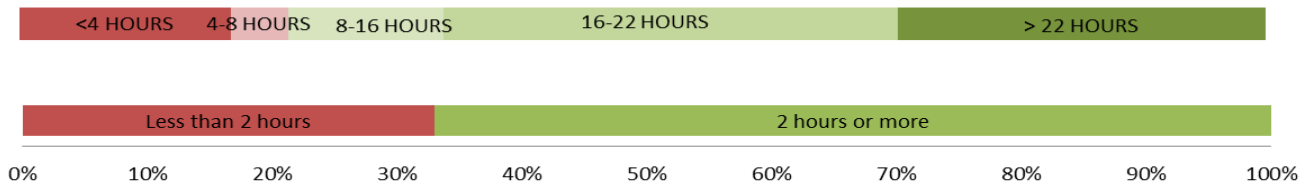
Data yet to be validated.
Not to be quoted.

Disaggregated analysis: access to Electricity

AMHARA REGION (ETHIOPIA)

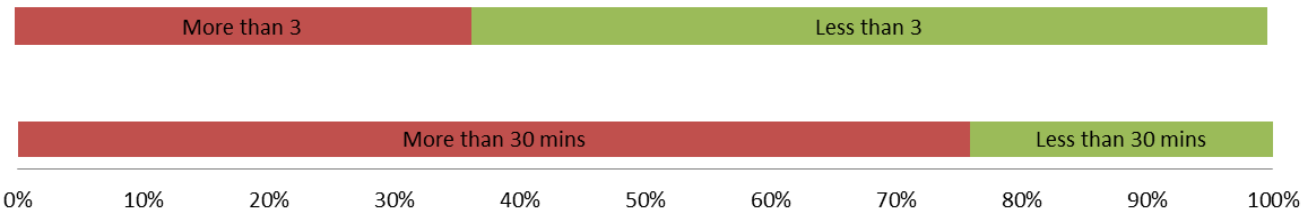
Duration:

- Hours of electricity per day
- Hours of electricity during the evening



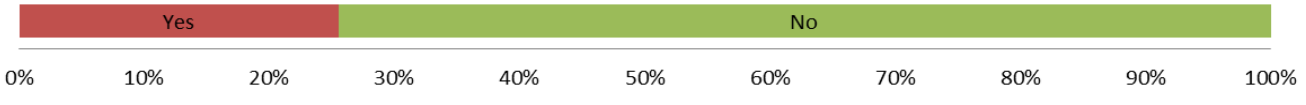
Reliability:

- Number of unscheduled interruptions per week
- Duration of each interruption



Quality:

- Voltage problems



Legality/Formality:

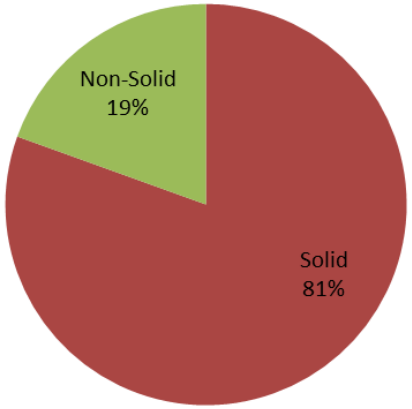
Legality of grid connection

Measuring access to Modern Cooking

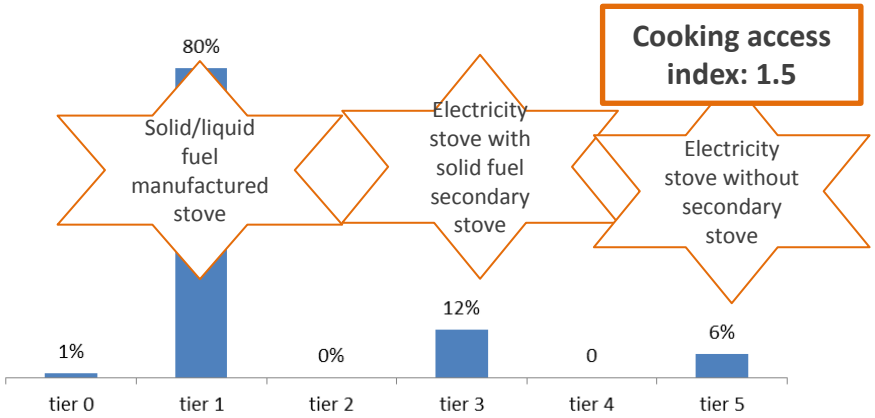
Data yet to be validated.
Not to be quoted.

KINSHASA AREA (DRC)

Binary measure

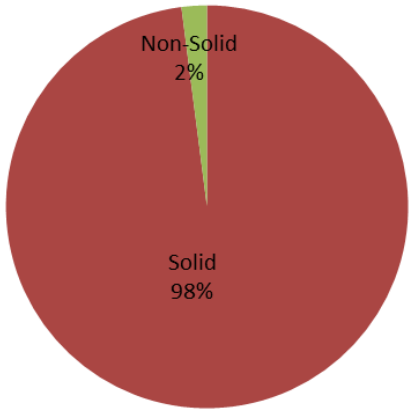


Multi-tier measure

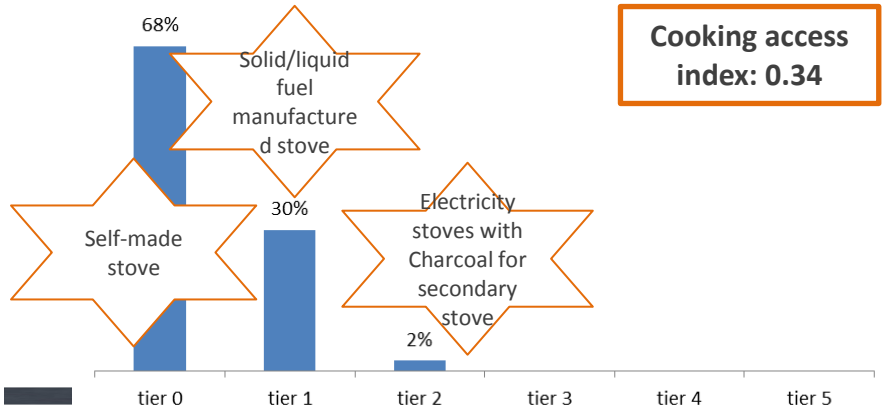


AMHARA REGION (ETHIOPIA)

Binary measure



Multi-tier measure

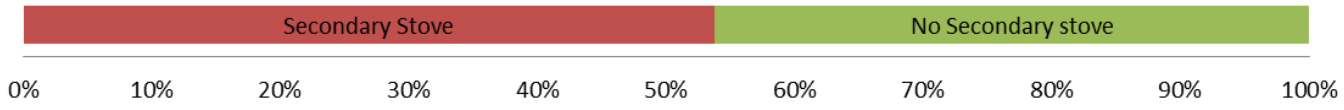


Disaggregated analysis: access to Modern Cooking

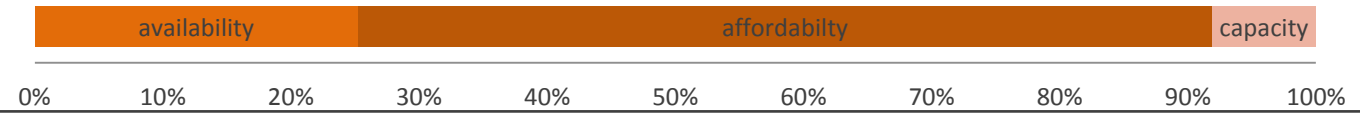
KINSHASA AREA (DRC)

Data yet to be validated.
Not to be quoted.

Capacity
- Use of secondary cookstove

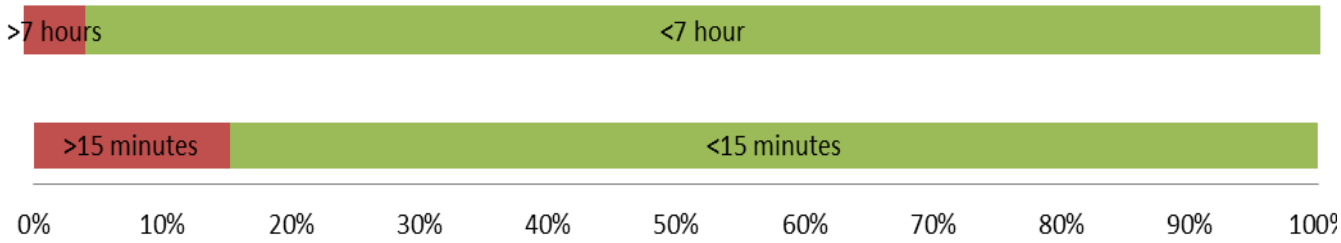


Availability/Affordability/Capacity:



Quality:
- Poor fuel combustion

Convenience:
- Fuel collection: less than 7 hours per week
- Stove preparation: less than 15 minutes per meal
- Adequacy in the cooking time speed



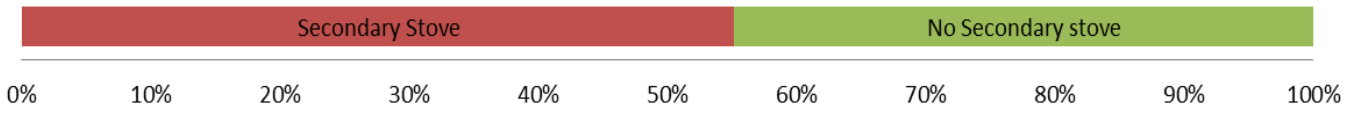
Disaggregated analysis: access to Modern Cooking

Amhara Region (Ethiopia)

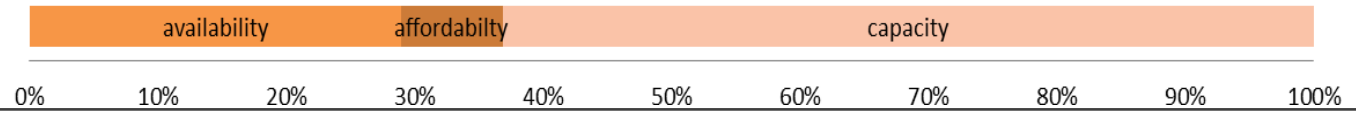
Data yet to be validated.
Not to be quoted.

Capacity

- Use of secondary cookstove

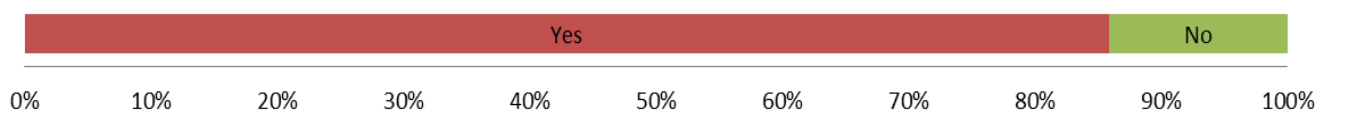


Availability/Affordability/Capacity:



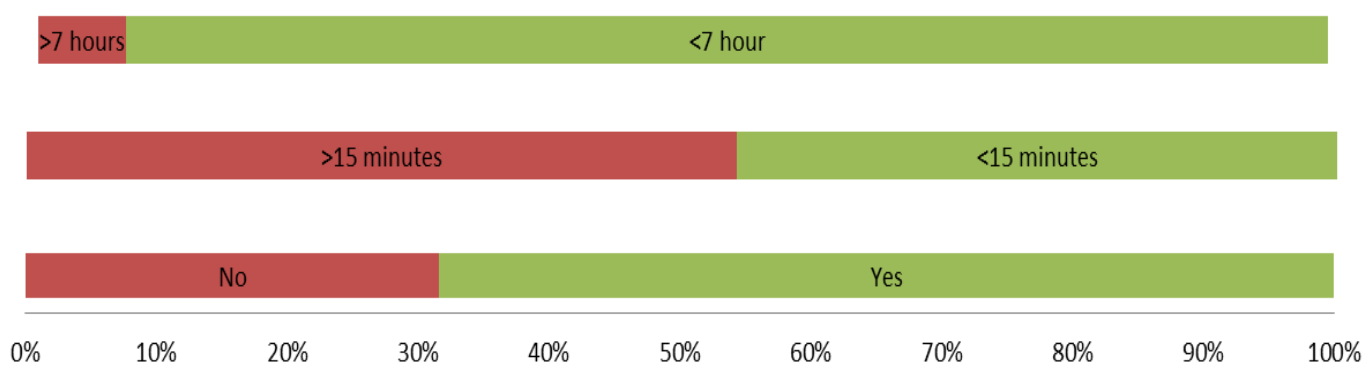
Quality:

- Poor fuel combustion



Convenience:

- Fuel collection: less than 7 hours per week
- Stove preparation: less than 15 minutes per meal
- Adequacy in the cooking time speed



Take home messages

Going beyond the binary measure and using a new definition of access with multi-tier measurement :

1. is the way ahead to track energy access status across country and over time => will be used under SE4ALL, SREP, Lighting Africa and many other programs
2. provides more nuances information on different dimension of energy supply => better informed policy formulation/investment planning/project design
3. shows how any energy intervention can be an access project => to evaluate the contribution of any energy project in improving attributes of energy
4. Under Multi-tier, countries can set their own targets => by specific attributes, minimum tier of access or improvement in index

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Pilot household energy survey Ethiopia

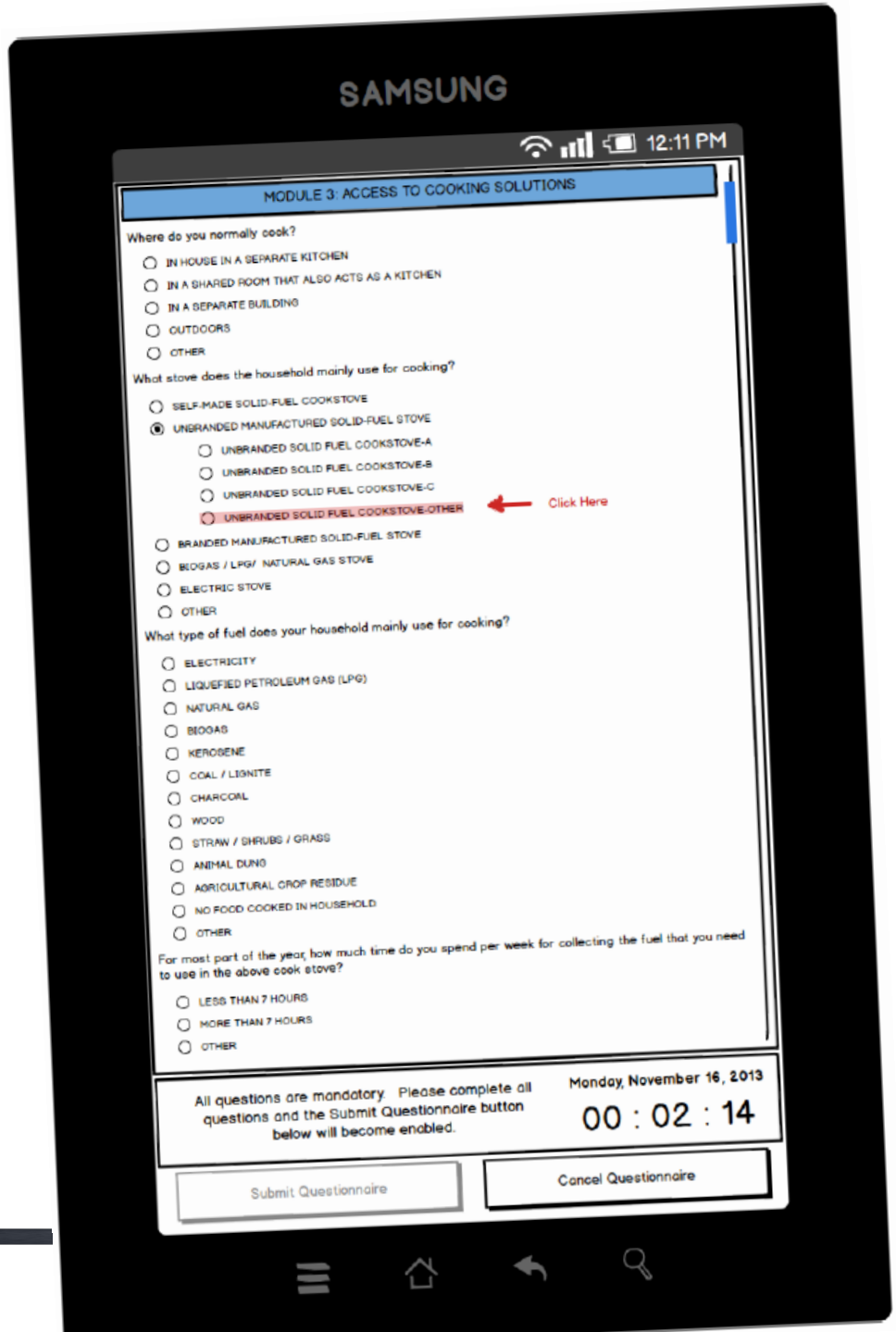
- using a tablet based survey tool -

Tim Raabe

Energising Development (EnDev)

ESMAP

General Information

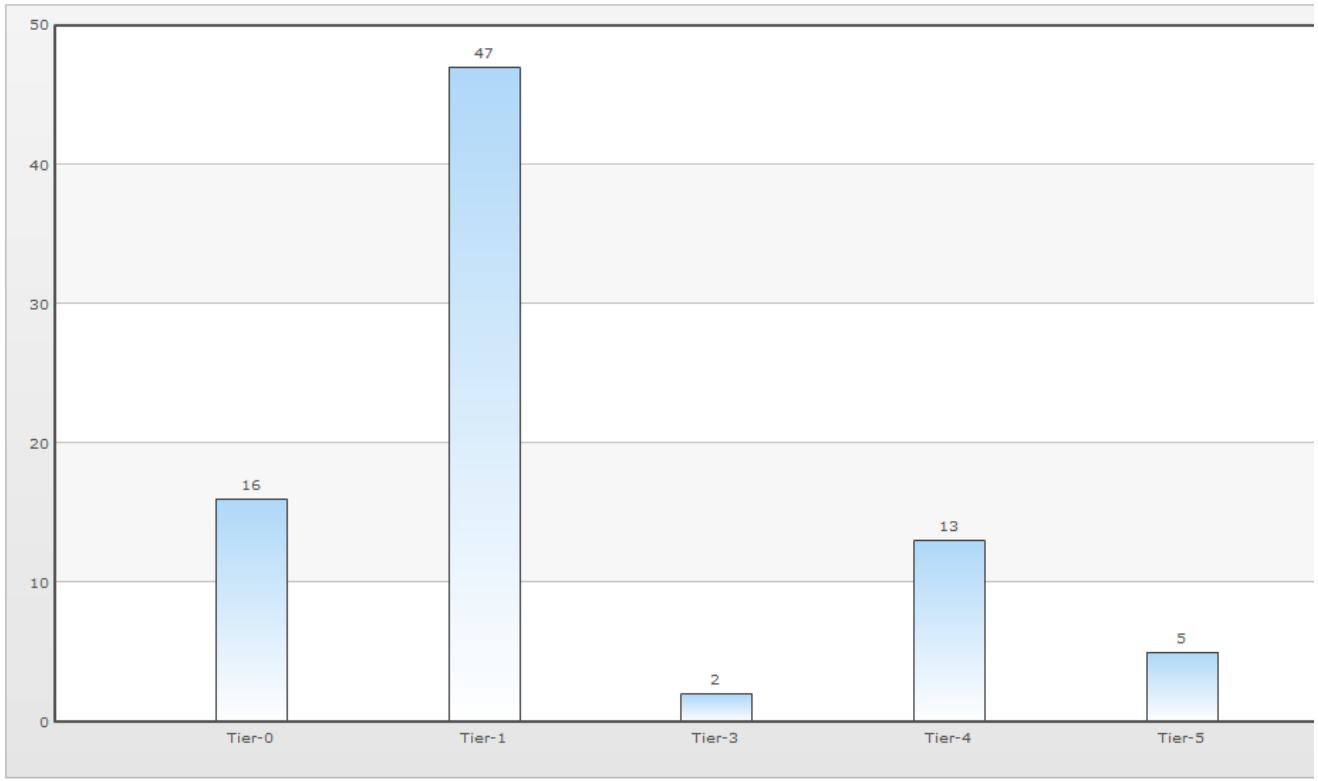

SAMSUNG
12:11 PM
MODULE 3: ACCESS TO COOKING SOLUTIONS
Where do you normally cook?
IN HOUSE IN A SEPARATE KITCHEN
IN A SHARED ROOM THAT ALSO ACTS AS A KITCHEN
IN A SEPARATE BUILDING
OUTDOORS
OTHER
What stove does the household mainly use for cooking?
SELF-MADE SOLID-FUEL COOKSTOVE
UNBRANDED MANUFACTURED SOLID-FUEL STOVE
UNBRANDED SOLID FUEL COOKSTOVE-A
UNBRANDED SOLID FUEL COOKSTOVE-B
UNBRANDED SOLID FUEL COOKSTOVE-C
UNBRANDED SOLID FUEL COOKSTOVE-OTHER
Click Here
BRANDED MANUFACTURED SOLID-FUEL STOVE
BIOGAS / LPG/ NATURAL GAS STOVE
ELECTRIC STOVE
OTHER
What type of fuel does your household mainly use for cooking?
ELECTRICITY
LIQUEFIED PETROLEUM GAS (LPG)
NATURAL GAS
BIOGAS
KEROSENE
COAL / LIGNITE
CHARCOAL
WOOD
STRAW / SHRUBS / GRASS
ANIMAL DUNG
AGRICULTURAL CROP RESIDUE
NO FOOD COOKED IN HOUSEHOLD
OTHER
For most part of the year, how much time do you spend per week for collecting the fuel that you need to use in the above cook stove?
LESS THAN 7 HOURS
MORE THAN 7 HOURS
OTHER
All questions are mandatory. Please complete all questions and the Submit Questionnaire button below will become enabled.
Monday, November 16, 2013
00 : 02 : 14
Submit Questionnaire
Cancel Questionnaire

Tablet-App

Analysis: SE4ALL Ethiopia 2013

Survey Dashboard | Histogram | Pie Chart | Bar Chart | Bubble Chart | Heatmap | Geographic View | Change to View Mode

In this page you get to analyze all the results gathered from the questionnaires. Analysis does not include the questions with answers that are not numeric or a list of values.
You can select to analyze the number of results with a histogram chart, specific values of variables with a pie chart; show a variable against another in a bar chart or more variables in a bubble chart.



Electricity Services Tier

Series Selector (Reset)

Select a Variable

Add More Filters:

Select a Variable

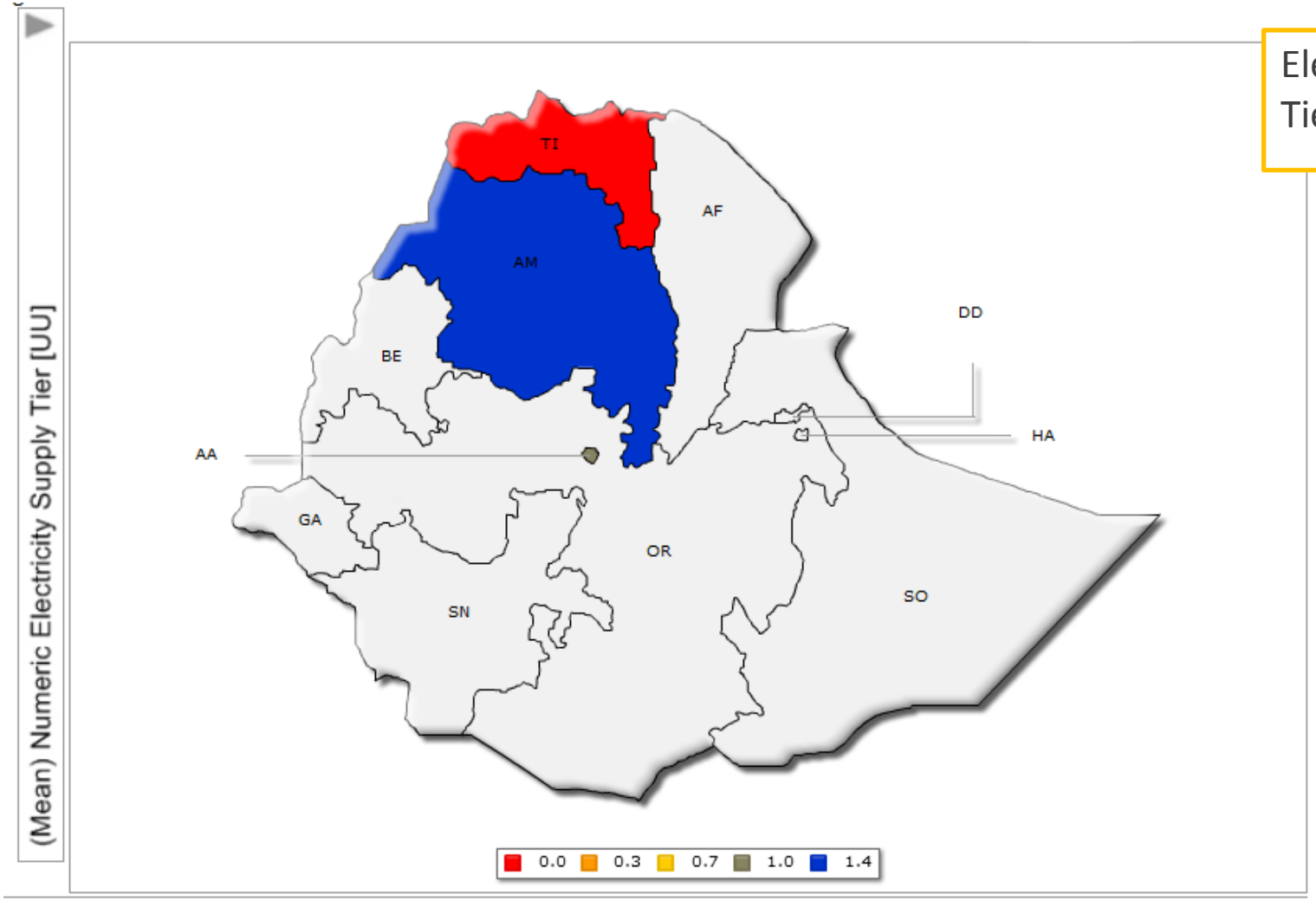
Selected Filters (Reset)

No filters applied

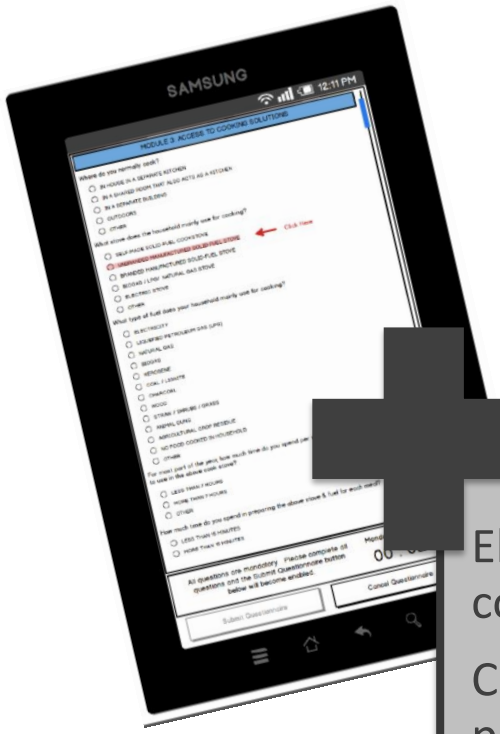
Distribution Electricity Service Tier

ESMAP Energy Sector Management Assistance Program

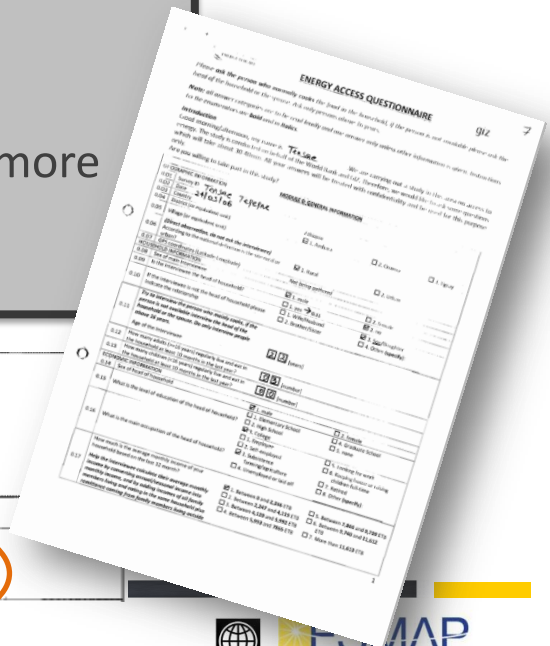
Electricity Supply Tier



Paper vs. Tablet



Eliminates error-prone, costly data entry	Questionnaire design takes more time
Computer-assisted process ensures higher quality of data	Charging in the field challenging
Saves time and money	Typing "open questions" takes more time
Captures GPS & Photos	



C. 09	How much fuel for your primary cooking solution do you use per week for cooking? *(Ask the interviewee to indicate the amount and the unit of measure, i.e. Cylinder of 5 or 12 Kg, Sack of 50 or 100 Kg)*	1 Sack [amount] _____ [unit]
C. 06	What is the one-way distance for collecting fuel for your primary cooking solution?	☐☐☐☐ [km] MB: I don't know

TECHNICAL ASSISTANCE PACKAGE

ESMAP WILL PROVIDE SUPPORT FOR:

1. **The implementation of household energy surveys** by providing standardized household energy questionnaires, and assistance with survey administration
2. **Diagnostic assessment of the energy situation of selected areas** by applying the multi-tier measurement of energy access for household, productive and community uses of energy. The report will include disaggregated analysis, highlighting deficiencies of the performance of the electricity as well as other fuels.

- An approximate estimation of cost for a household survey ranges from $50,000-200,000 per country, depending on the sample size.

For any further questions, please contact:

Nicolina Angelou nangelou@worldbank.org
Elisa Portale eportale@worldbank.org
Tim Raabe Tim.Raabe@giz.de

ESMAP
Energy Sector Management Assistance Program

Thank You.

The World Bank | 1818 H Street, NW | Washington DC, USA
www.esmap.com | esmap@worldbank.org