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Measuring Energy Access

Introduction to the Multi-Tier Framework

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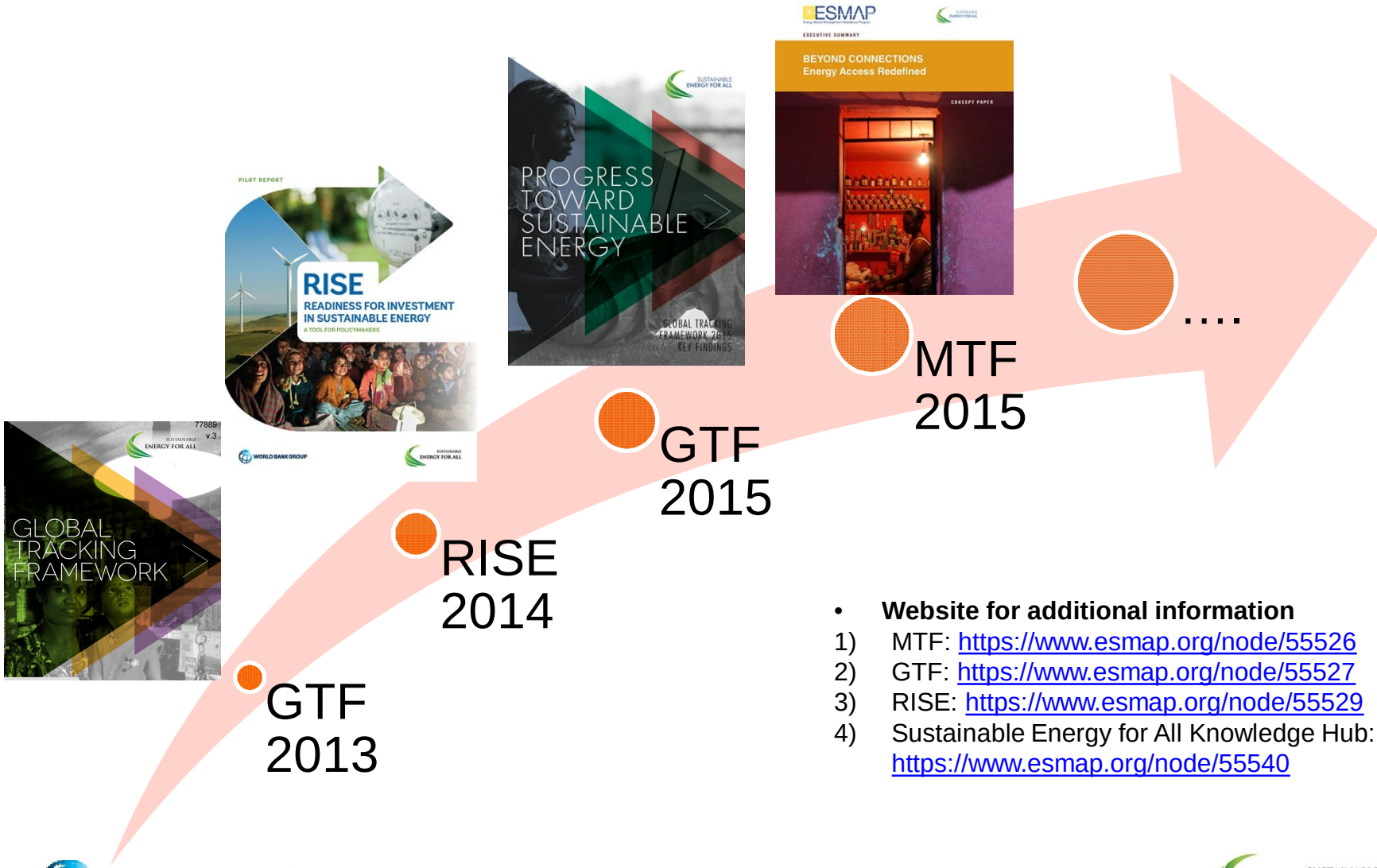
ESMAP
Energy Sector Management Assistance Program

SUSTAINABLE ENERGY FOR ALL

SE4ALL Knowledge Hub publications



- **Website for additional information**

1) MTF: https://www.esmap.org/node/55526
2) GTF: https://www.esmap.org/node/55527
3) RISE: https://www.esmap.org/node/55529
4) Sustainable Energy for All Knowledge Hub: https://www.esmap.org/node/55540

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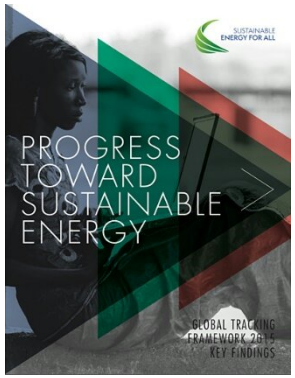
What is the Energy Access Challenge ?

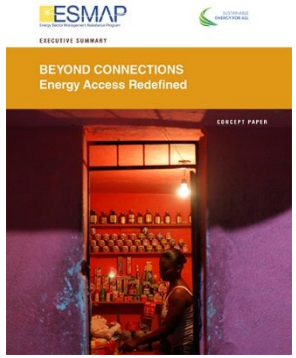
Challenge

1. **Defining**: How to define affordable, reliable, and modern energy service.
2. **Tracking**: how to measure the progress toward universal access

Response



The GTF presents initial system for regular reporting on progress in reaching SE4All targets and SDG 7 progress.



The MTF redefines energy access based on capacity, duration, availability, quality, reliability, affordability, legality, health and safety.

*ñThe knowledge hub … offers an invaluable tool for follow-up and review as we implement SDG7.ò*ï UN Secretary-General (Sep 16, 2015)

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MTF Has Been Developed with Inputs from the International Community

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The Universal Access Goal now Firmly Set

SE4ALL Goals

- By 2030, ensure universal access to modern energy services.

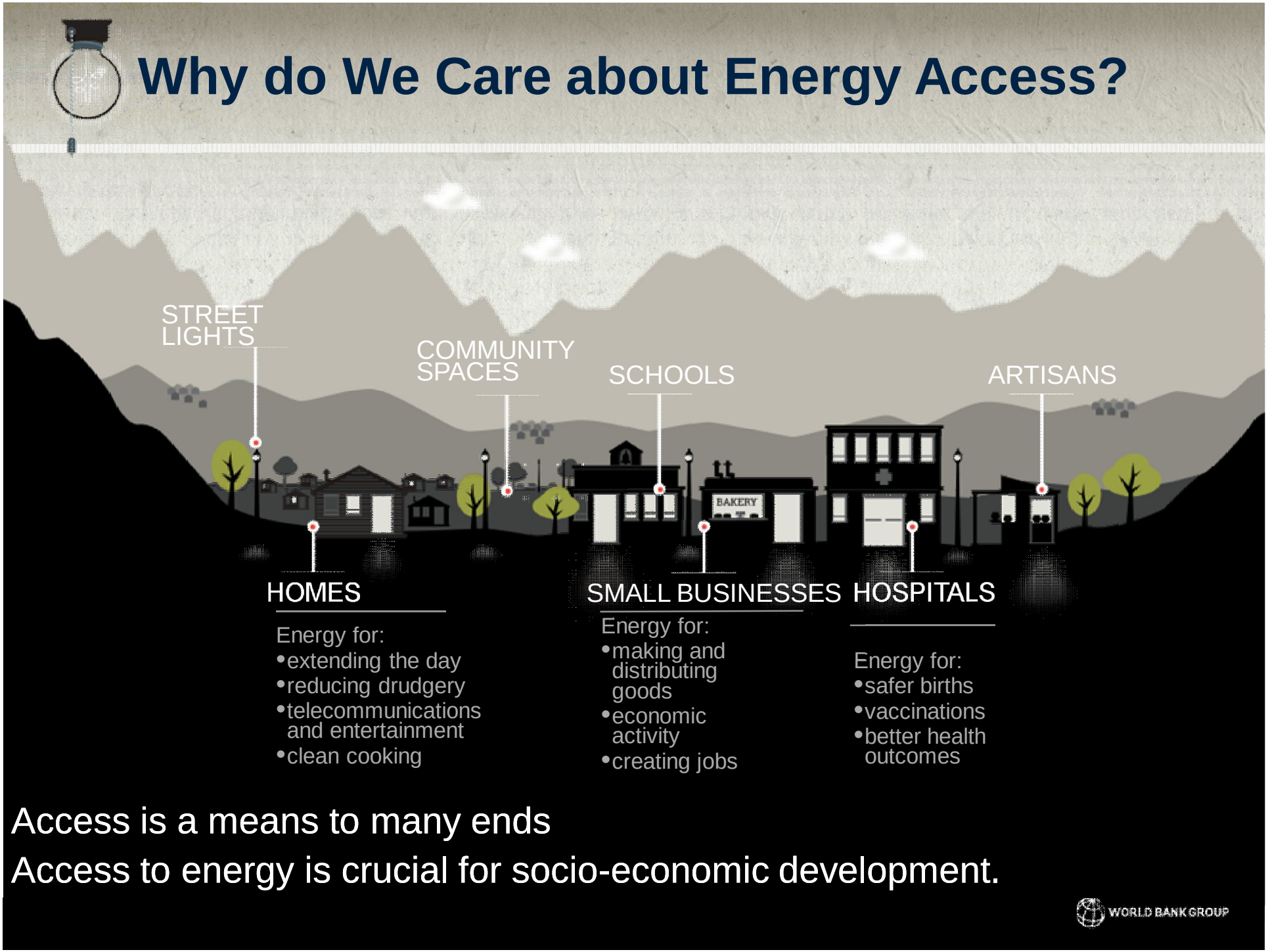
SDG 7

- Target 7.1: 2030, ensure universal access to affordable, reliable and modern energy services

COP 21

- Post-COP 21 – Focus on Sustainable Energy

Why do We Care about Energy Access?



Access is a means to many ends

Access to energy is crucial for socio-economic development.

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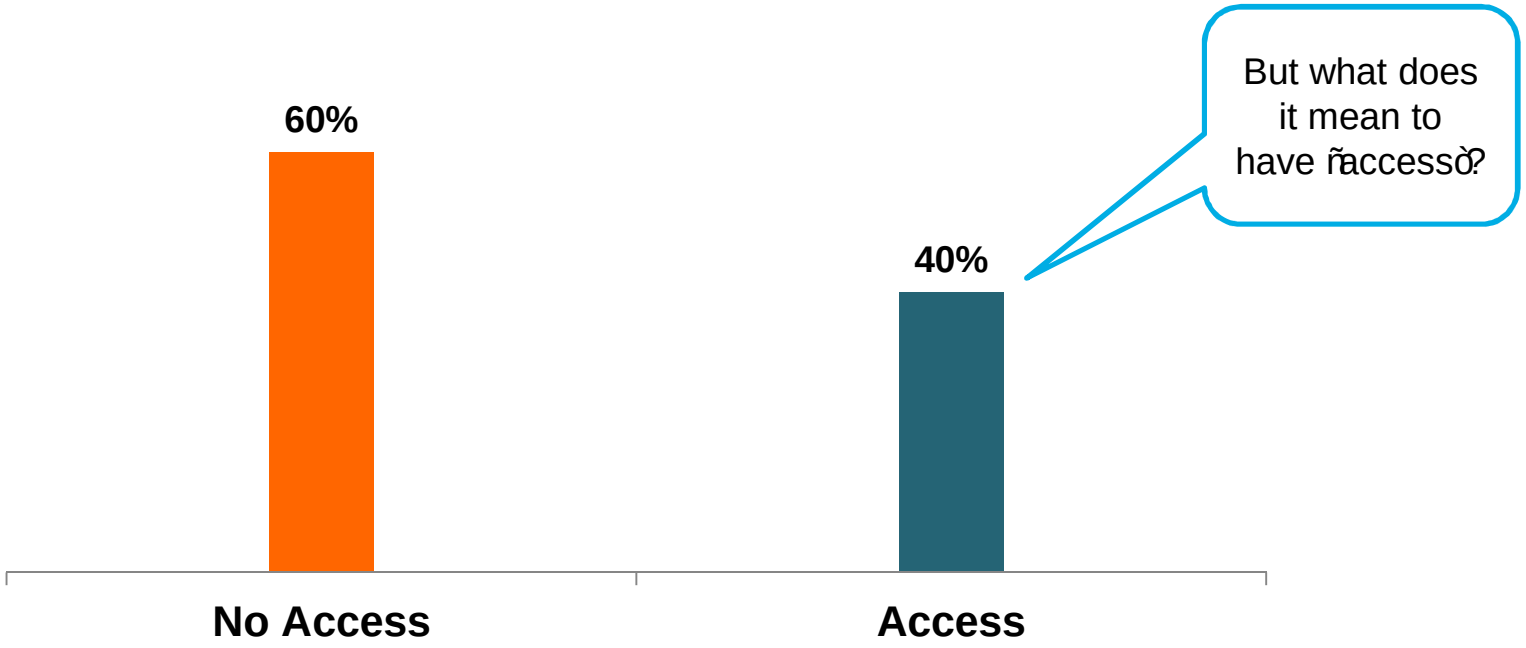
How is Access Typically Measured?

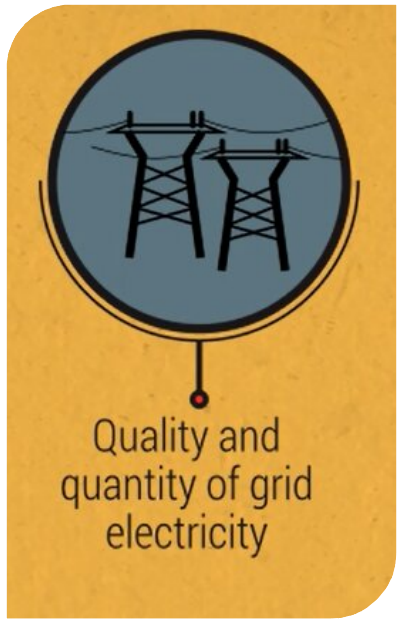
Energy access has been measured using **binary** indicators



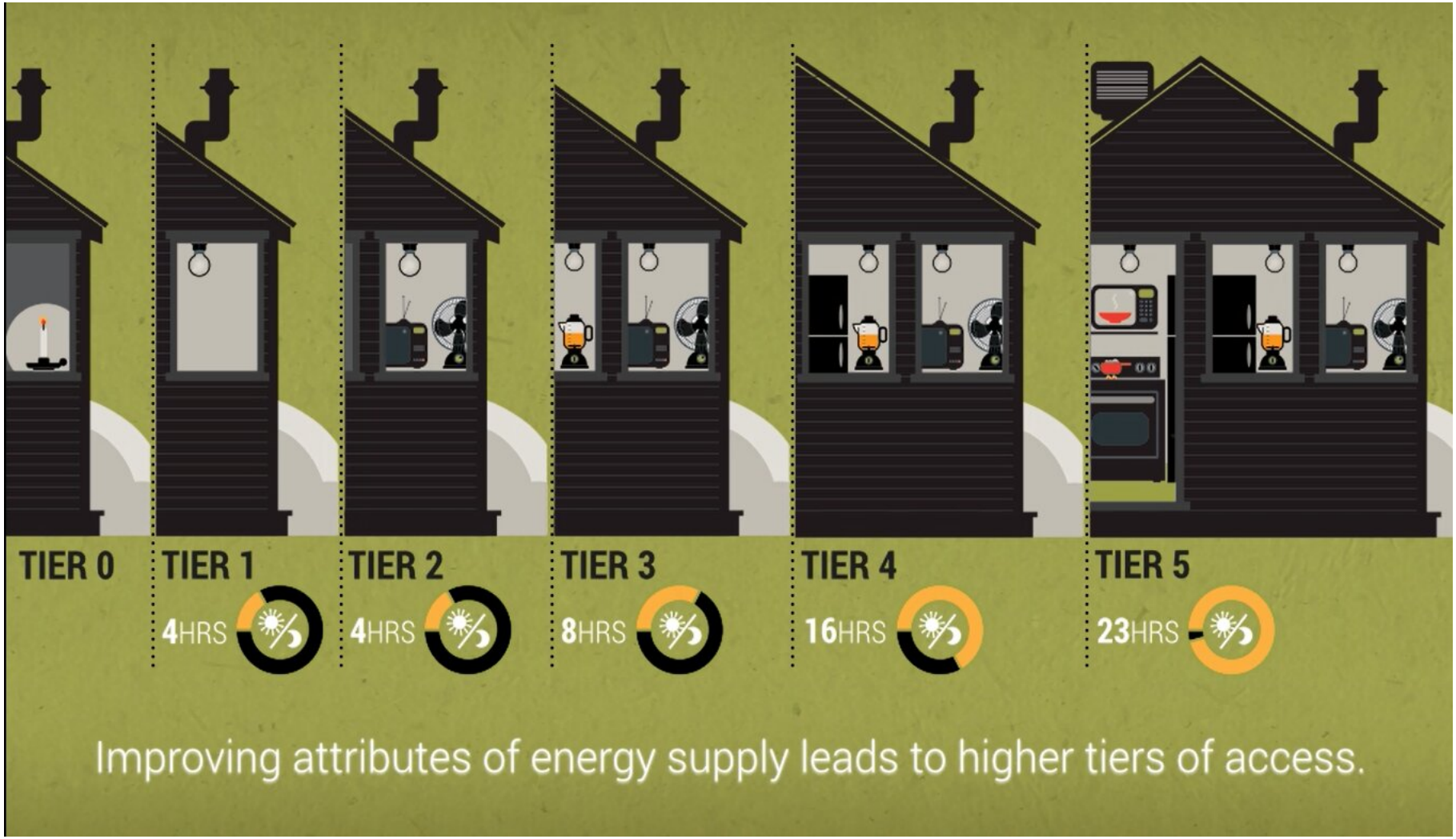
Is the Binary Measure Enough?

- How do we know if “access” is sufficient to satisfy household and businesses needs, and to support socio-economic development – does a “connection” provide “service” at desired quantity and quality?

- How do we compare different technologies providing different levels of access (e.g. solar lantern vs. grid connection; improved cookstove vs. LPG)



Defining Access as a Continuum of Service Levels



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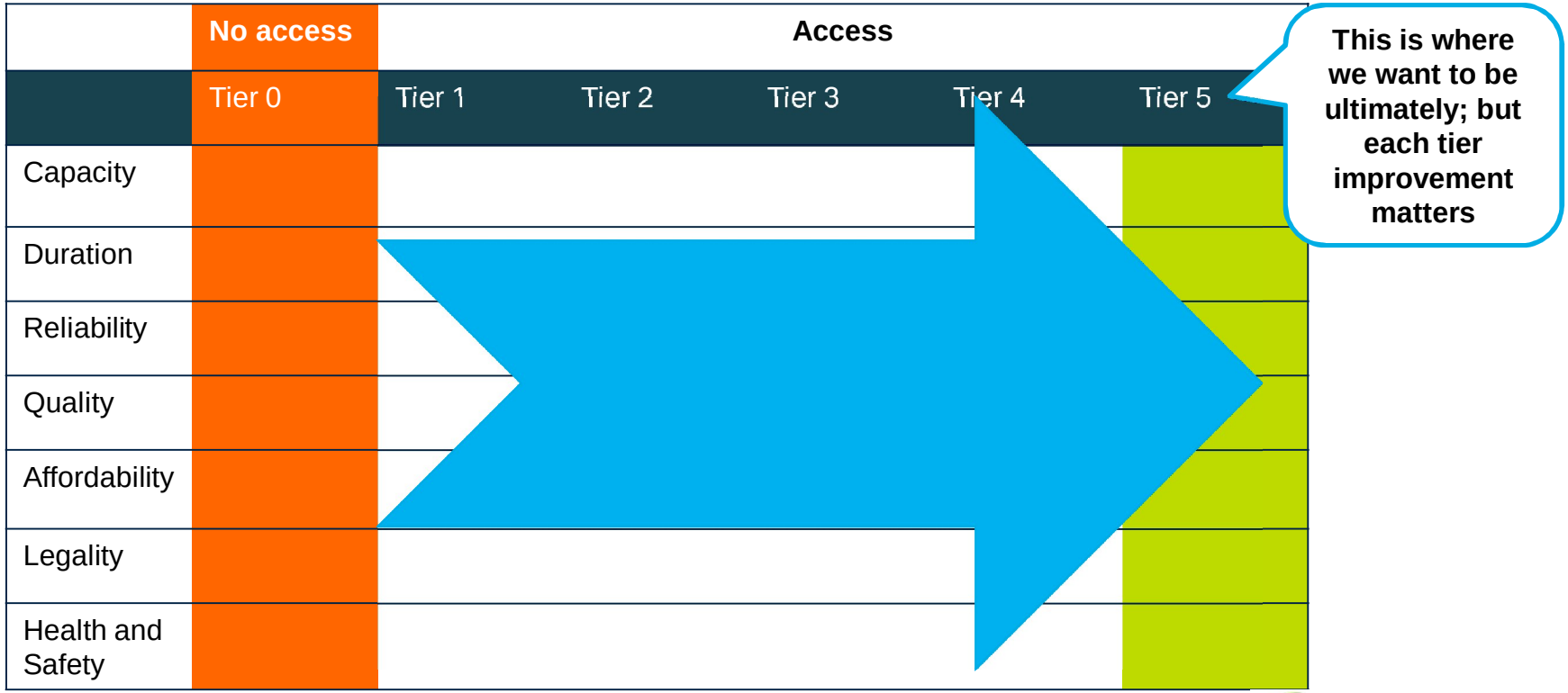
Multi Tier Framework

- MTF measures not only whether users receive energy services, but also whether these services are of **adequate quality, reliable, affordable, safe and available when needed**

- MTF provides a path towards universal access that can be customized for each country circumstance; acknowledging progress as households move from lower to higher tiers

Multi-tier matrix for access to household electricity supply*



*a similar framework developed for access to cooking solutions

Multi-Tier Framework for Electricity

Multi-Tier Framework for Electricity

	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Capacity		Capacity (from 3W to above 2kW) and ability to power appliances (applicable for off-grid solutions)				
Duration - day		From at least 4 hours a day to over 23 hours a day				
Duration - evening		From at least 1 hour in the evening to over 4 hours				
Reliability					Number and duration of outages (applicable for Tier 4 & 5 only)	
Quality					Voltage problems do not affect the use of desired appliances (Tier 4&5)	
Affordability				Basic service less than 5% of a household income (Tiers 3-5)		
Legality					Service provided legally (Tier 4&5)	
Health and Safety					Absence of accidents (Tier 4&5)	

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Multi-Tier Framework for Cooking

Multi-Tier Framework for Cooking

	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Indoor air quality		Concentration of PM2.5 and CO; tiers aligned with WHO guidelines				
Efficiency		Tier benchmarks under development, awaiting results of ISO process				
Convenience			Stove preparation time and fuel collection and preparation (applicable from Tier 2 on)			
Safety			Absence of accidents and alignment with the ISO process (from Tier 2 on)			
Affordability					Levelized cost of cooking solution < 5% of household income	
Quality and availability of fuel					Cooking not affected by seasonal variations in fuel quality and	

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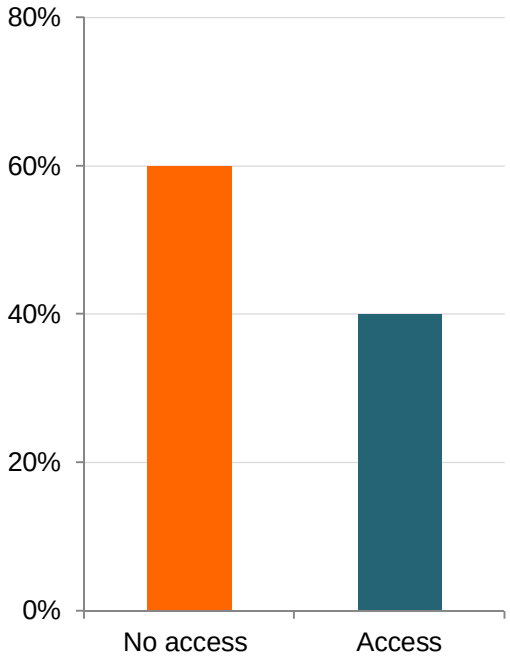
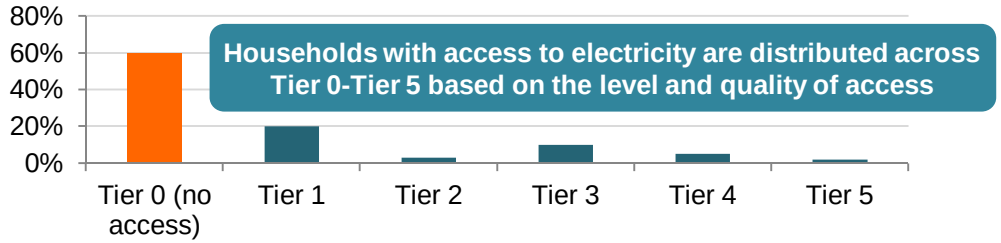
Comparing Binary and Multi-tier Measurement

Binary Measurement

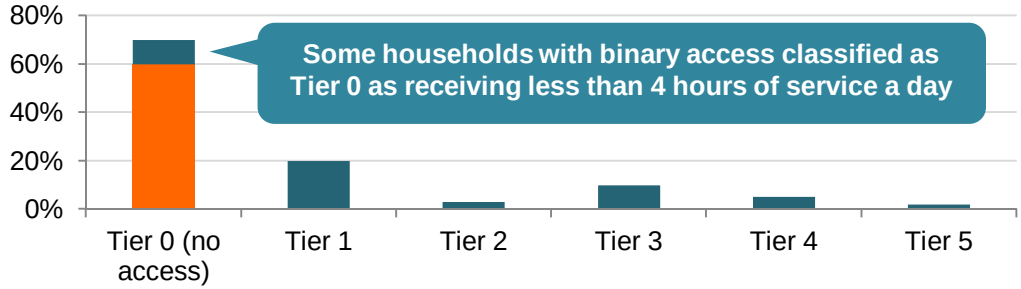


Multi-tier Measurement

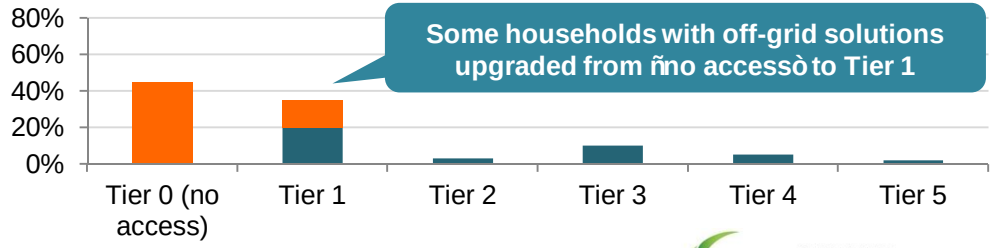
- *Case 1: binary access = Tier 1-5 access*



- *Case 2: binary access >Tier 1-5*



- *Case 3: binary access < Tier 1-5*



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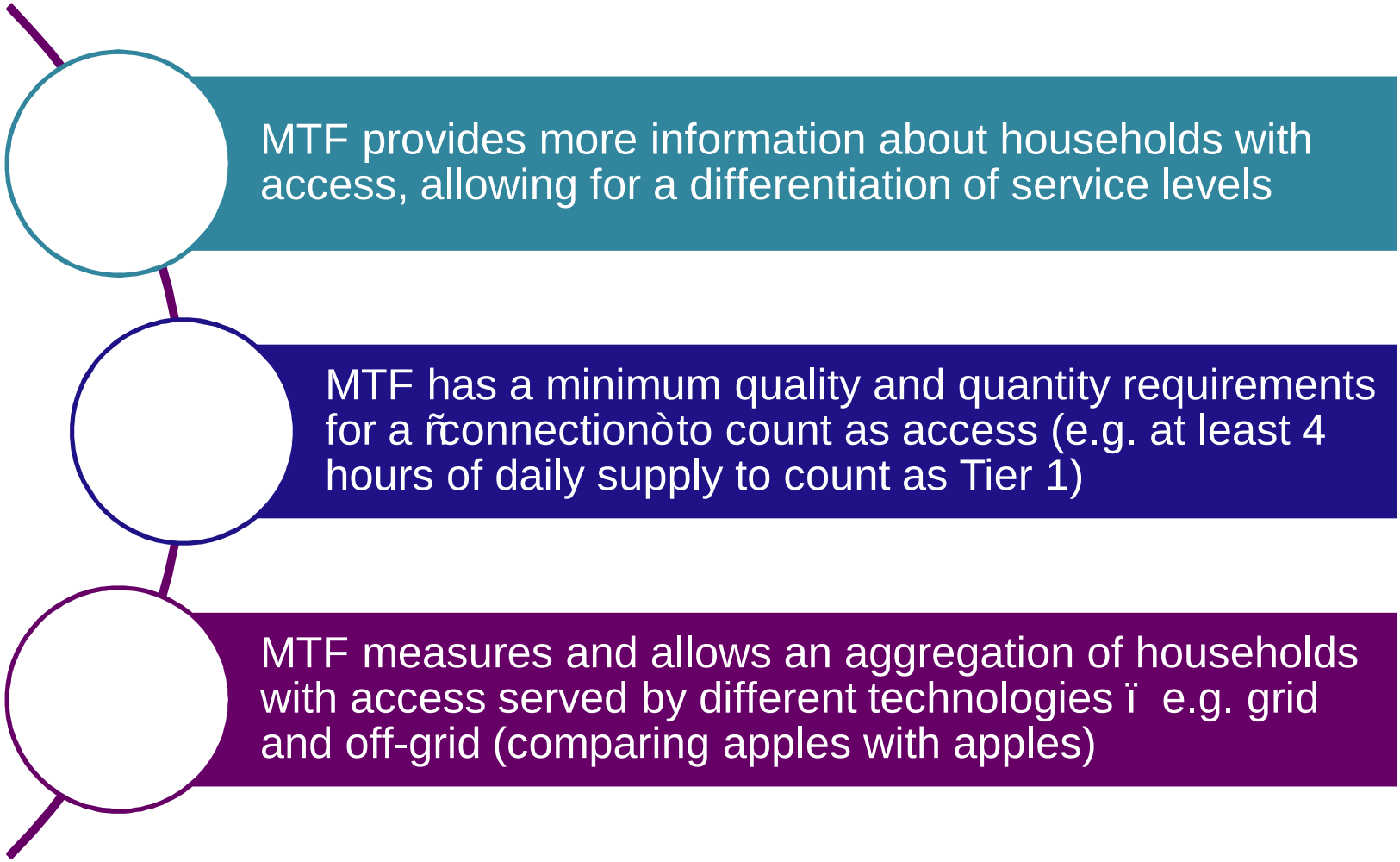
Benefits of Multi-Tier Energy Access Results



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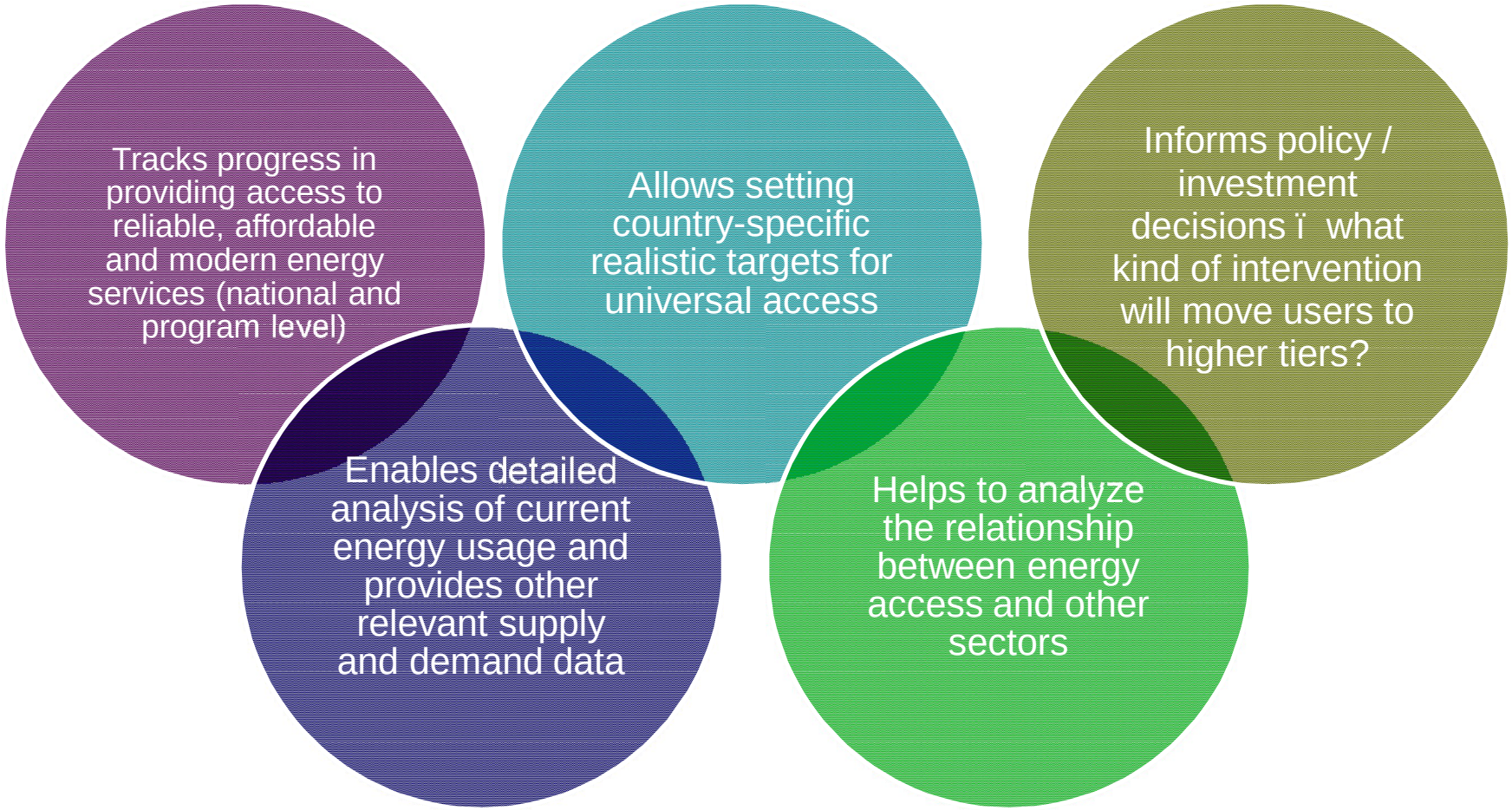
Better Information can Lead to Better Policy Decisions

What is the policy relevance of MTF?



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Applying MTF ï Where Are We?

Support from more than 20 agencies in conceptualization
PILOTS:
- Aug.-Sep. 2013: Kinshasa, DRC.
- Oct.-Dec. 2013: Uganda
- May 2015: Bihar, India.
- Dec 2015: Malawi

Jun.-Dec. 2015: MTF survey in Guinea (3,000 HH)

Apr. 2016: Launch of MTF Global energy access survey in 15 countries.

: This is where we are

Conceptualization and piloting

Application

2011 2012 2013 2014 2015 2016 2017

UN General Assembly declares ñDecade of Sustainable Energy for Allò 2014-2024

The UN General Assembly declares ñInternational Year of Sustainable Energy for All.ò

SDG 7: ñ**Ensure access to affordable, reliable, sustainable and modern energy for allò**

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Global Survey to Cover 10-15 High Access Deficit Countries

Country selection factors

- Highest electricity access deficit
- Highest modern cooking deficit
- Focusing on SREP countries
- Regional balance
- Governments interest

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MTF Implementation Plan: Survey Tools

MTF Energy Global Survey

- Estimated time: 45 mins
- Nationally statistically representative Rural/Urban
- Provides data for multi-tier Supply and Demand information
- Implemented by a local survey firm supervised by WB team
- Need to collaborate with National Statistical Office

MTF Energy module – integrated in National Surveys*

- Estimated time: 15 mins
- TA and training available and funded by SREP/ESMAP
- Key supply and demand information allowing tier calculation
- Additional simplification of monitoring being tested – e.g. use of cell phone surveys
- Need to collaborate with National Statistical Office

Additional modules in the energy survey

- Productive and community use of energy
- Can be added to the MTF baseline household survey in case of Government/donor interest
- Evaluates access for community services (schools, hospitals etc.) and productive uses

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* Collaboration with the World Bank survey group

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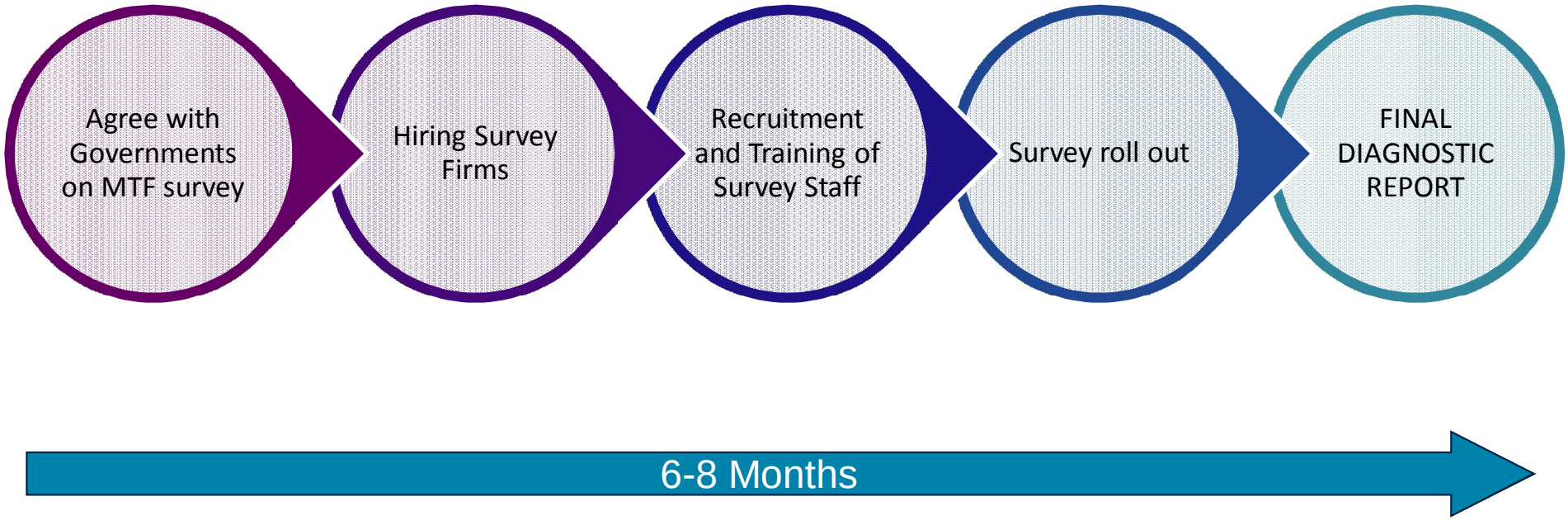
World Bankôs Role in Implementing MTF in the Selected Countries



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What Information will the Surveys Provide?

HOUSEHOLD ELECTRICITY ASSESSMENT

- **SOURCE**: including mini-grid, off-grid solution and solar lantern
- **SUPPLY CHARACTERISTICS:** duration, reliability, quality, affordability, legality, health and safety
- **DEMAND CHARACTERISTICS:** Use of appliances, energy expenditures, affordability of services

HOUSEHOLD COOKING ASSESSMENT

- SOURCE: Combination of fuel/cookstove for up to 5 cookstoves
- **SUPPLY CHARACTERISTICS:** information on the fuels and physical characteristics of the cookstove (efficiency, convenience…)
- Information on cooking location to determine air pollution
- **DEMAND CHARACTERISTICS:** Cooking expenditures, affordability

GENDER ASPECTS

- Gender disaggregation
- Use of time by gender (collecting fuel, cooking etc)

POVERTY AND IMPACTS

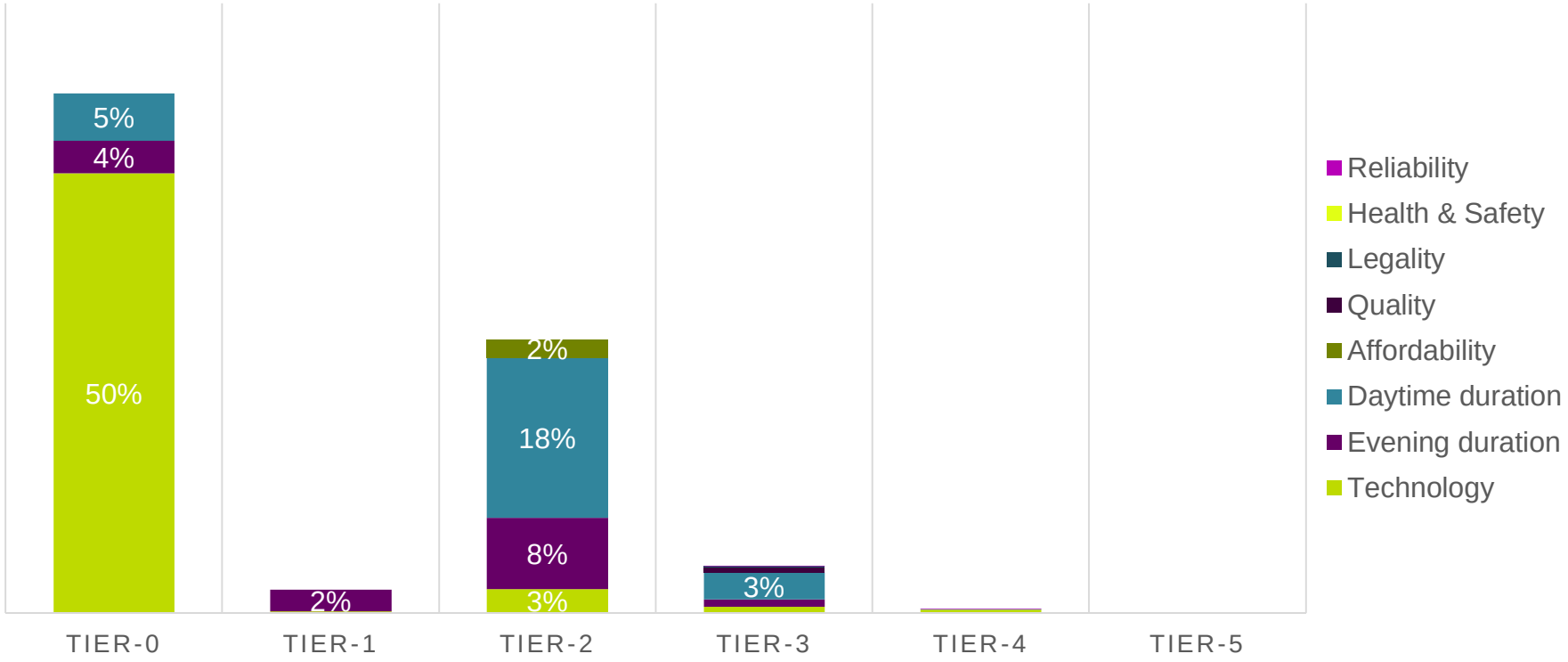
- Electricity and cooking aspects evaluated by poverty quintile
- Impacts of access on quality of life in the household

Snapshot from a Diagnostic Report (1)

*a similar framework developed for access to cooking solutions

Snapshot from a Diagnostic Report (2)

How MTF can be used to target access interventions



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Thank you!

For more information on the report:

https://www.esmap.org/node/55526

Contacts:

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ANNEXES

MTF: Example for Classifying Household Access

- **Tier determined by the lowest applicable attribute.**

Multi-tier matrix for access to household electricity supply*

	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Capacity					
Day duration				X	X
Evening duration			X	X	X
Reliability				X	X
Quality				X	X
Affordability					
Legality					
Health and Safety					

Household access classified as Tier 2 for not fulfilling Tier 3 criteria for evening supply => at least 3 hours of service in the evening

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*a similar framework developed for access to cooking solutions

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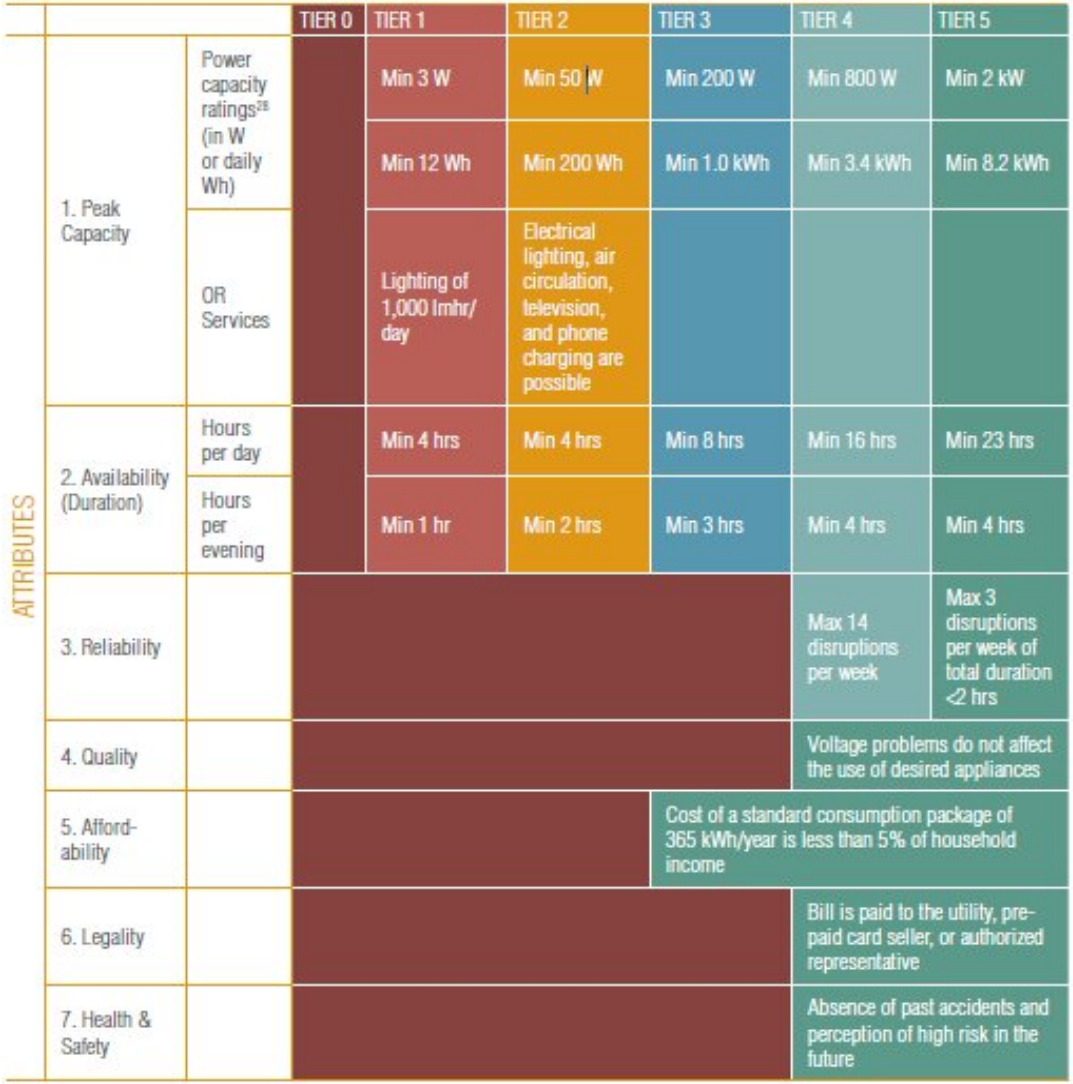
Tier Calculation: Household Electricity Supply



ATTRIBUTES			TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
	1. Peak Capacity	Power capacity ratings[28] (in W or daily Wh)		Min 3 W	Min 50 W	Min 200 W	Min 800 W	Min 2 kW
				Min 12 Wh	Min 200 Wh	Min 1.0 kWh	Min 3.4 kWh	Min 8.2 kWh
		OR Services		Lighting of 1,000 lmhr/ day	Electrical lighting, air circulation, television, and phone charging are possible			
	2. Availability (Duration)	Hours per day		Min 4 hrs	Min 4 hrs	Min 8 hrs	Min 16 hrs	Min 23 hrs
		Hours per evening		Min 1 hr	Min 2 hrs	Min 3 hrs	Min 4 hrs	Min 4 hrs
	3. Reliability						Max 14 disruptions per week	Max 3 disruptions per week of total duration <2 hrs
	4. Quality						Voltage problems do not affect the use of desired appliances	
	5. Afford-ability					Cost of a standard consumption package of 365 kWh/year is less than 5% of household income		
	6. Legality						Bill is paid to the utility, pre-paid card seller, or authorized representative	
	7. Health & Safety						Absence of past accidents and perception of high risk in the future	

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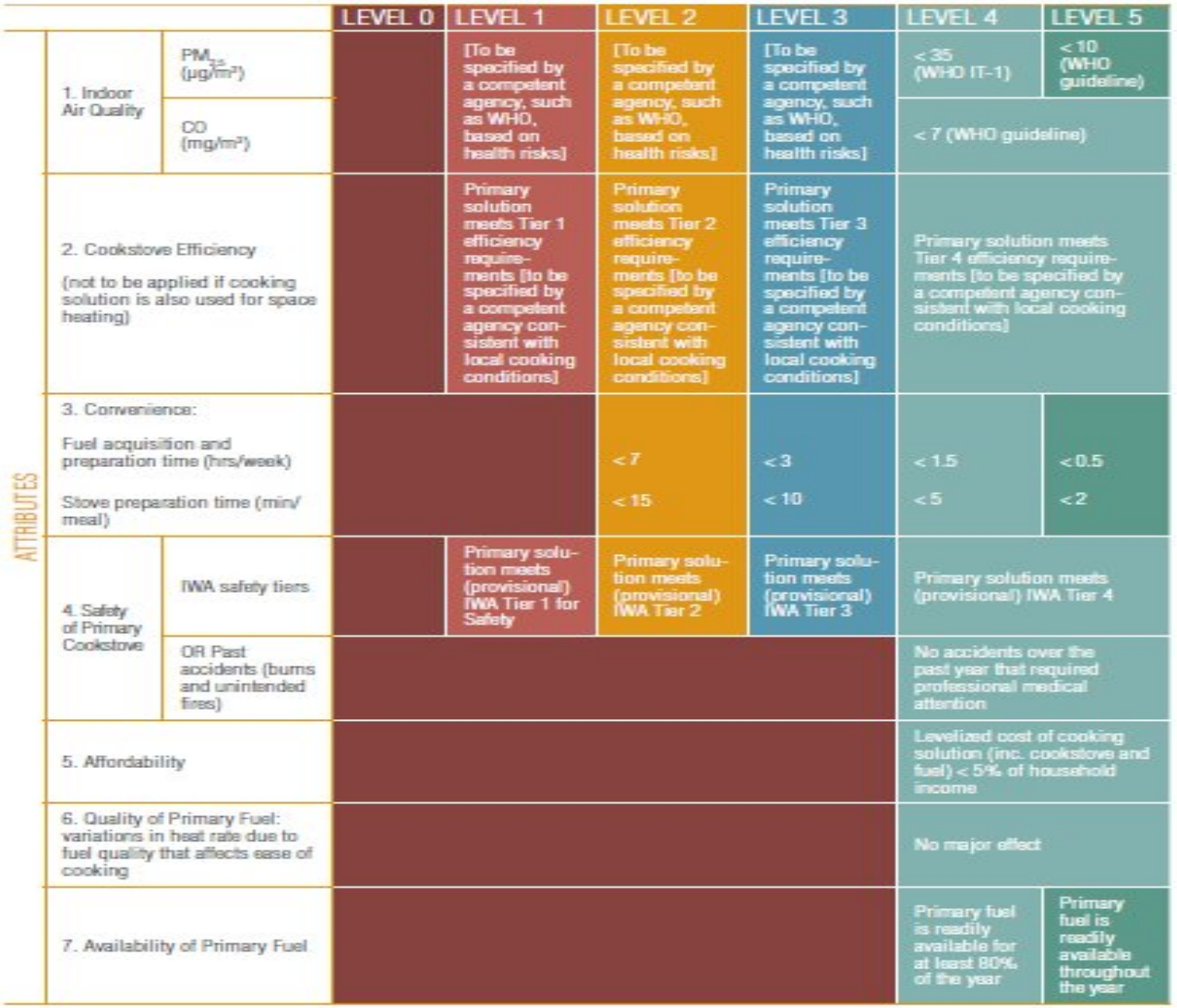
Tier calculation: Household cooking solutions



ATTRIBUTES			LEVEL 0	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5
	1. Indoor Air Quality	$PM_{2.5}$ ($\mu g/m^3$)		[To be specified by a competent agency, such as WHO, based on health risks]	[To be specified by a competent agency, such as WHO, based on health risks]	[To be specified by a competent agency, such as WHO, based on health risks]	< 35 (WHO IT-1)	< 10 (WHO guideline)
		CO (mg/m^3)					< 7 (WHO guideline)	
	2. Cookstove Efficiency (not to be applied if cooking solution is also used for space heating)			Primary solution meets Tier 1 efficiency require-ments [to be specified by a competent agency con-sistent with local cooking conditions]	Primary solution meets Tier 2 efficiency require-ments [to be specified by a competent agency con-sistent with local cooking conditions]	Primary solution meets Tier 3 efficiency require-ments [to be specified by a competent agency con-sistent with local cooking conditions]	Primary solution meets Tier 4 efficiency require-ments [to be specified by a competent agency con-sistent with local cooking conditions]	
	3. Convenience: Fuel acquisition and preparation time (hrs/week)				< 7	< 3	< 1.5	< 0.5
	Stove preparation time (min/meal)				< 15	< 10	< 5	< 2
	4. Safety of Primary Cookstove	IWA safety tiers		Primary solu-tion meets (provisional) IWA Tier 1 for Safety	Primary solu-tion meets (provisional) IWA Tier 2	Primary solu-tion meets (provisional) IWA Tier 3	Primary solution meets (provisional) IWA Tier 4	
		OR Past accidents (burns and unintended fires)					No accidents over the past year that required professional medical attention	
	5. Affordability						Levelized cost of cooking solution (inc. cookstove and fuel) < 5% of household income	
	6. Quality of Primary Fuel: variations in heat rate due to fuel quality that affects ease of cooking						No major effect	
	7. Availability of Primary Fuel						Primary fuel is readily available for at least 80% of the year	Primary fuel is readily available throughout the year

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Piloting of MTF ï Status & Strategy

We surveyed almost 10.000 HH to pilot the methodology

Survey Status	Country	Area	Sample size	Topic
Completed	DRC	Kinshasa area	2505 HH	HH cooking, HH electricity
Completed	Uganda	National	3335 HH	HH Cooking
Completed	Ethiopia	Amhara Region	Small sample Validation of the software	HH cooking, HH electricity
Completed	India	Bihar (6 districts)	4870 HH	HH cooking, HH electricity
Completed	Malawi	Lilongwe area	70 HH Validation of the questionnaire	HH cooking, HH electricity, Productive uses, Community uses

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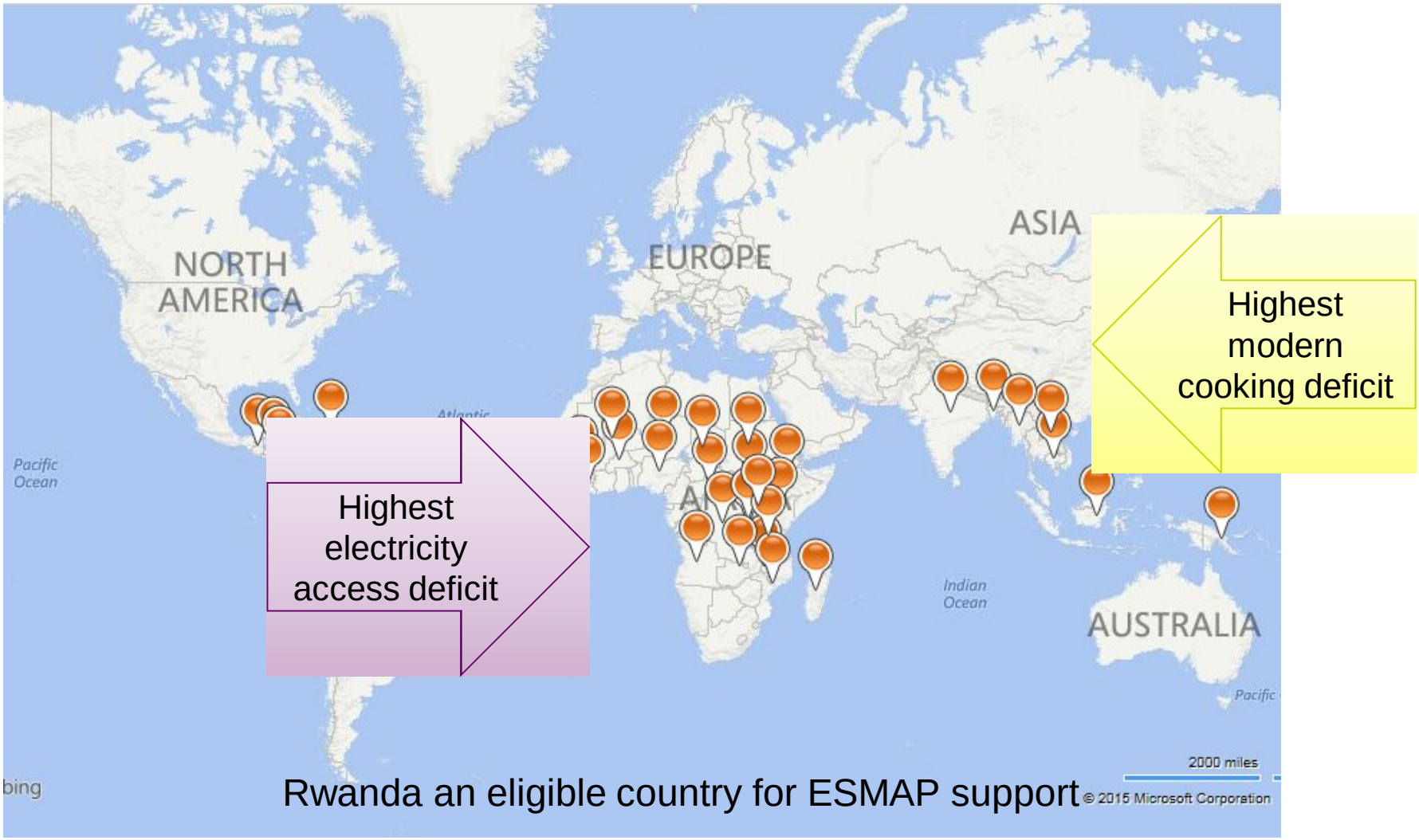
Long List of Countries



Rwanda an eligible country for ESMAP support

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