Rethinking energy poverty and best practices for the governance of distributed renewable energy access

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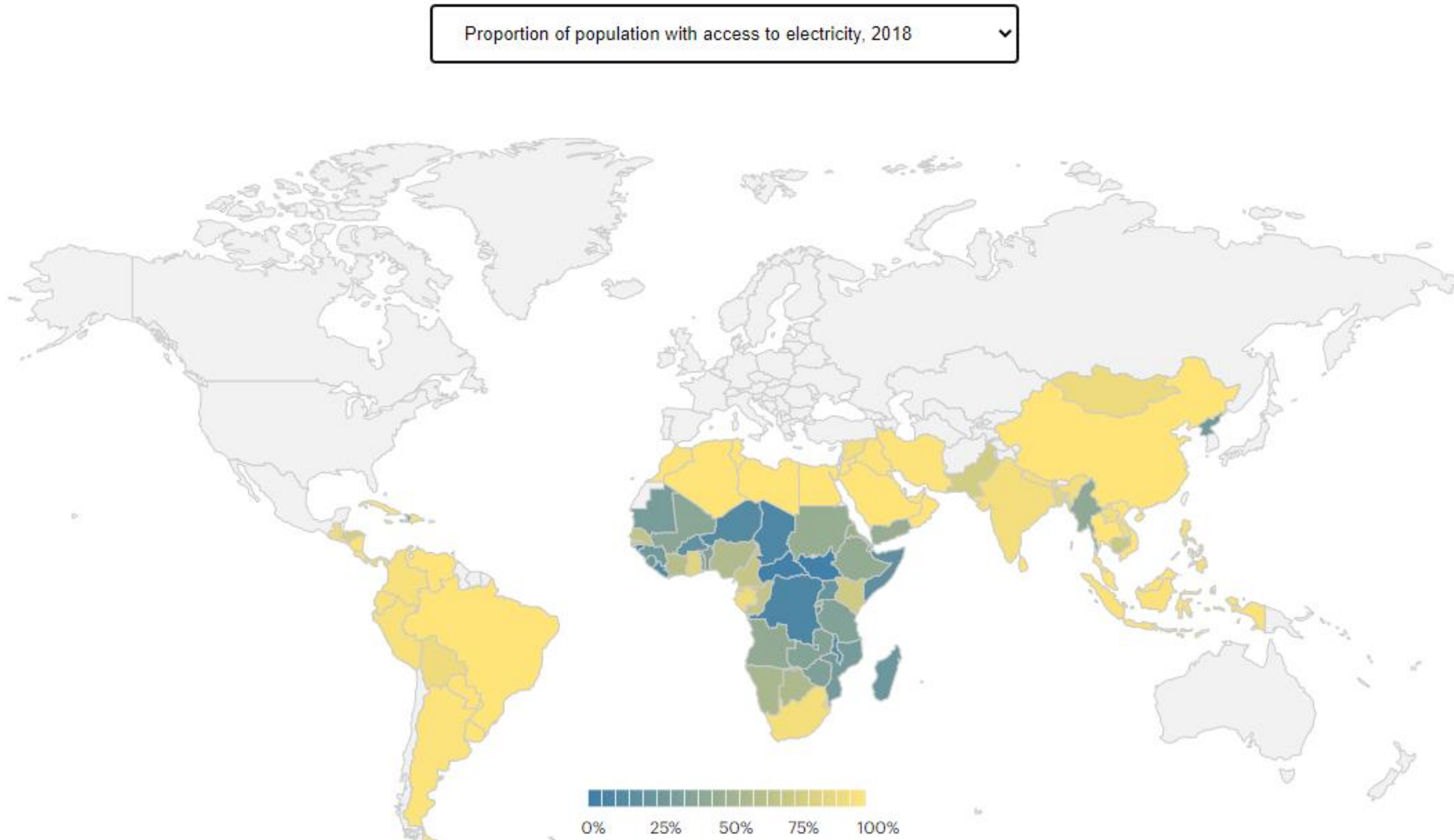
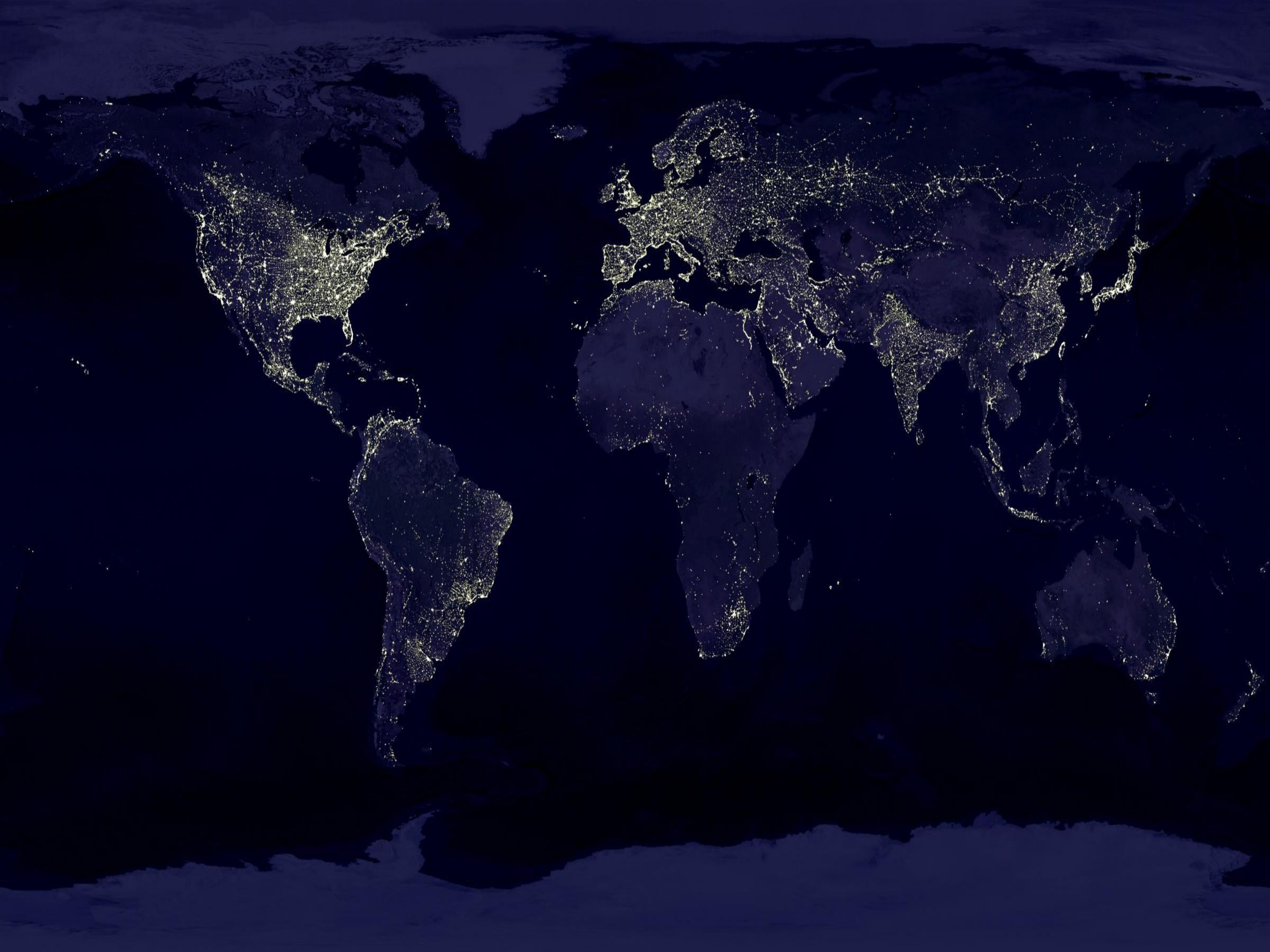
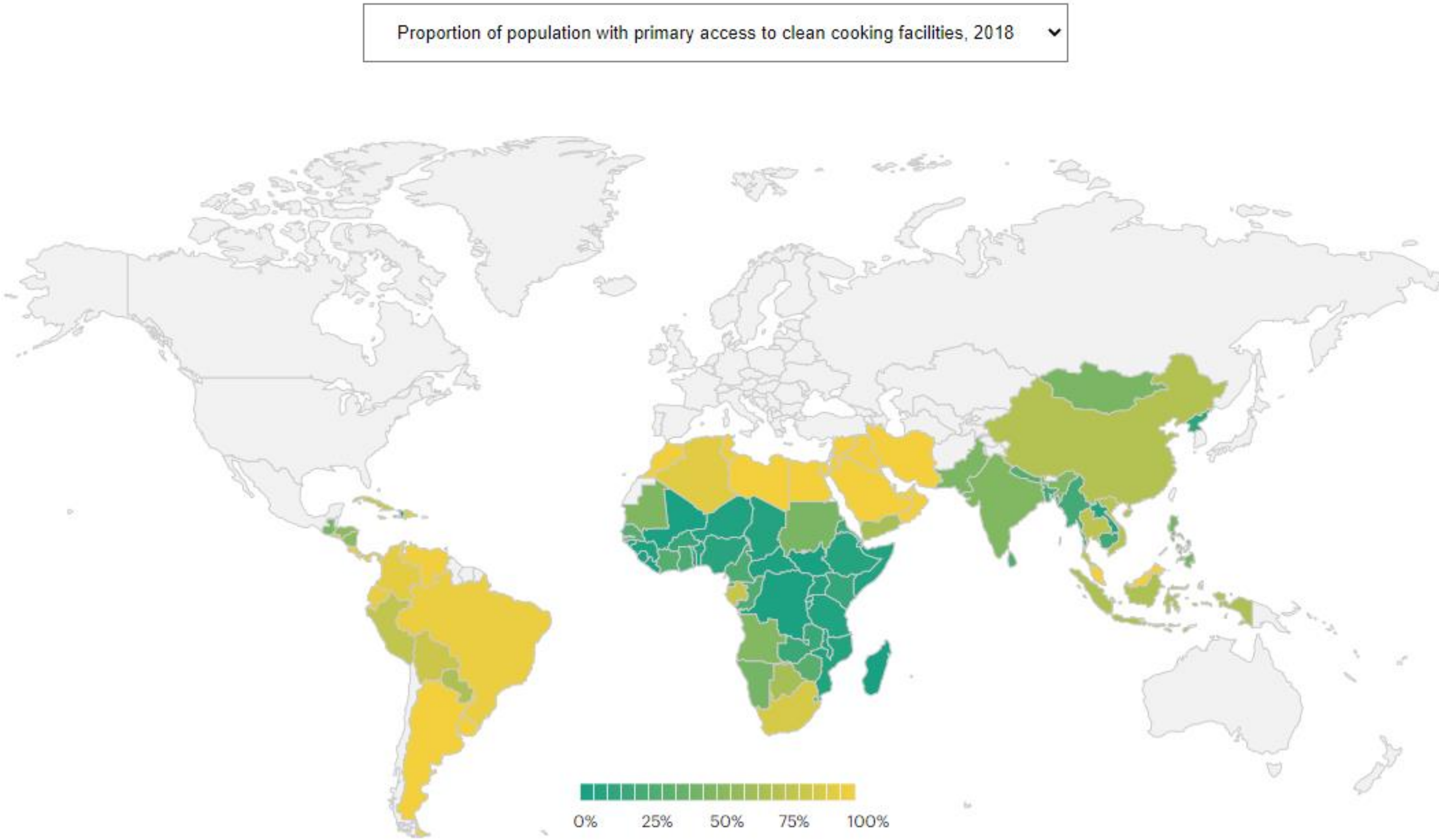
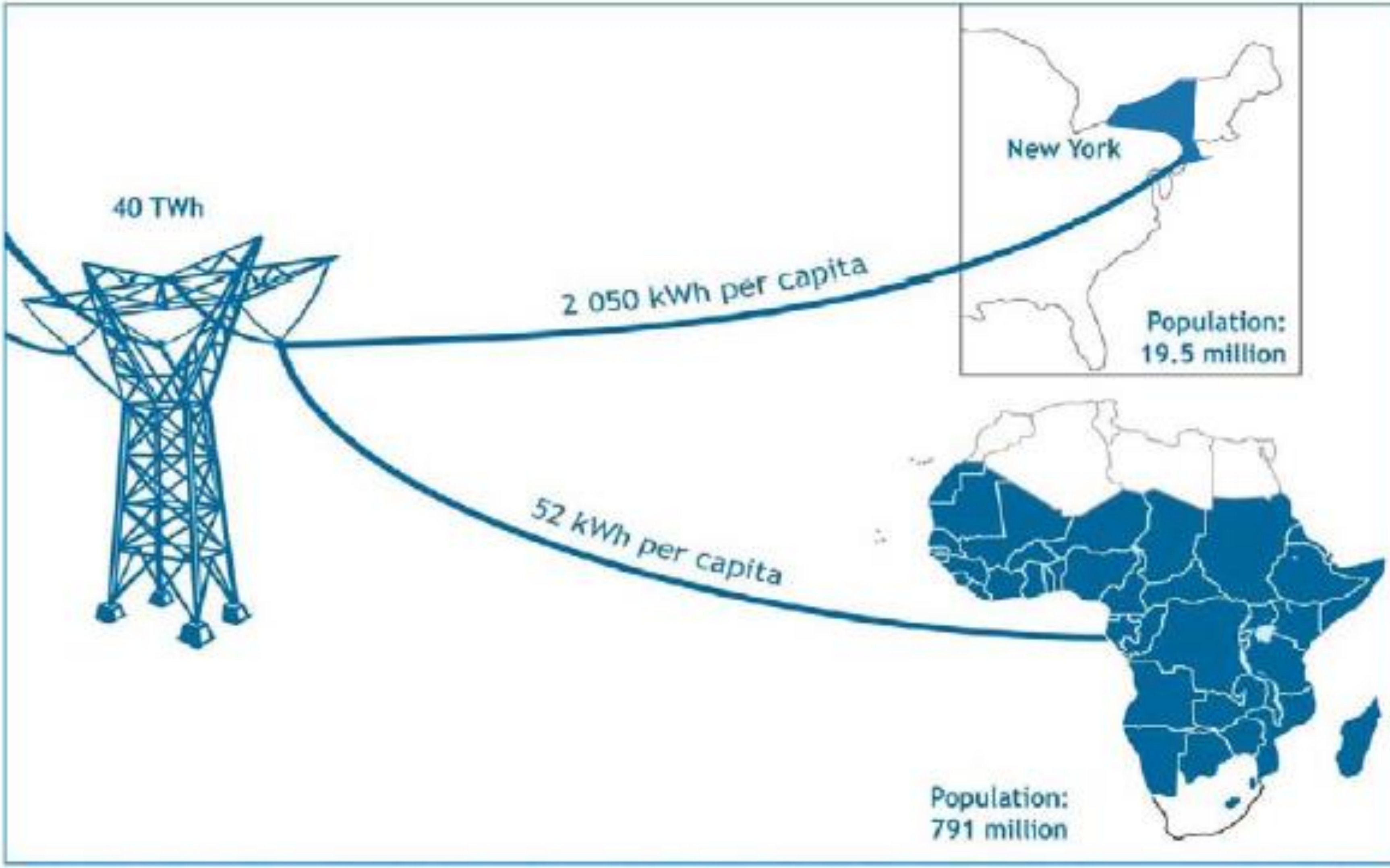


- Even though it’s 2020 (where are our moon colonies?), about 770 million people still don’t have reliable electricity access

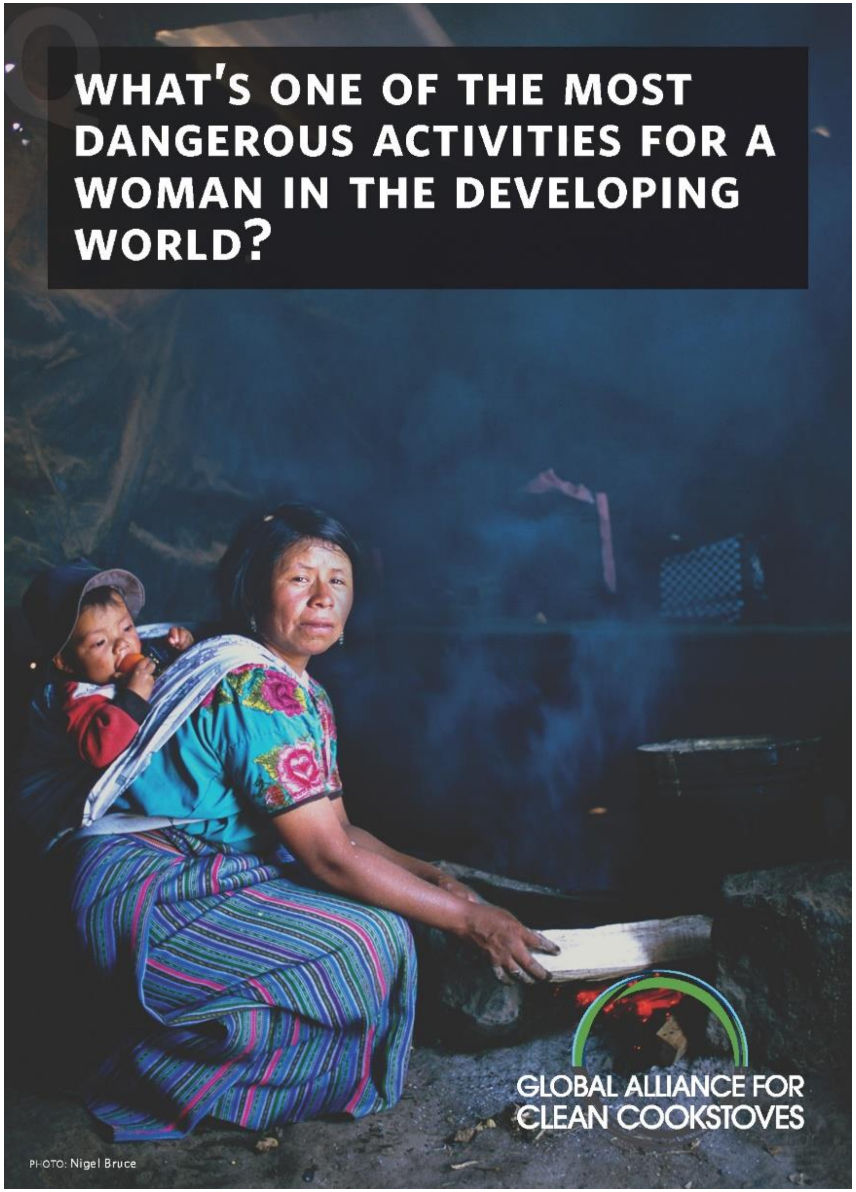


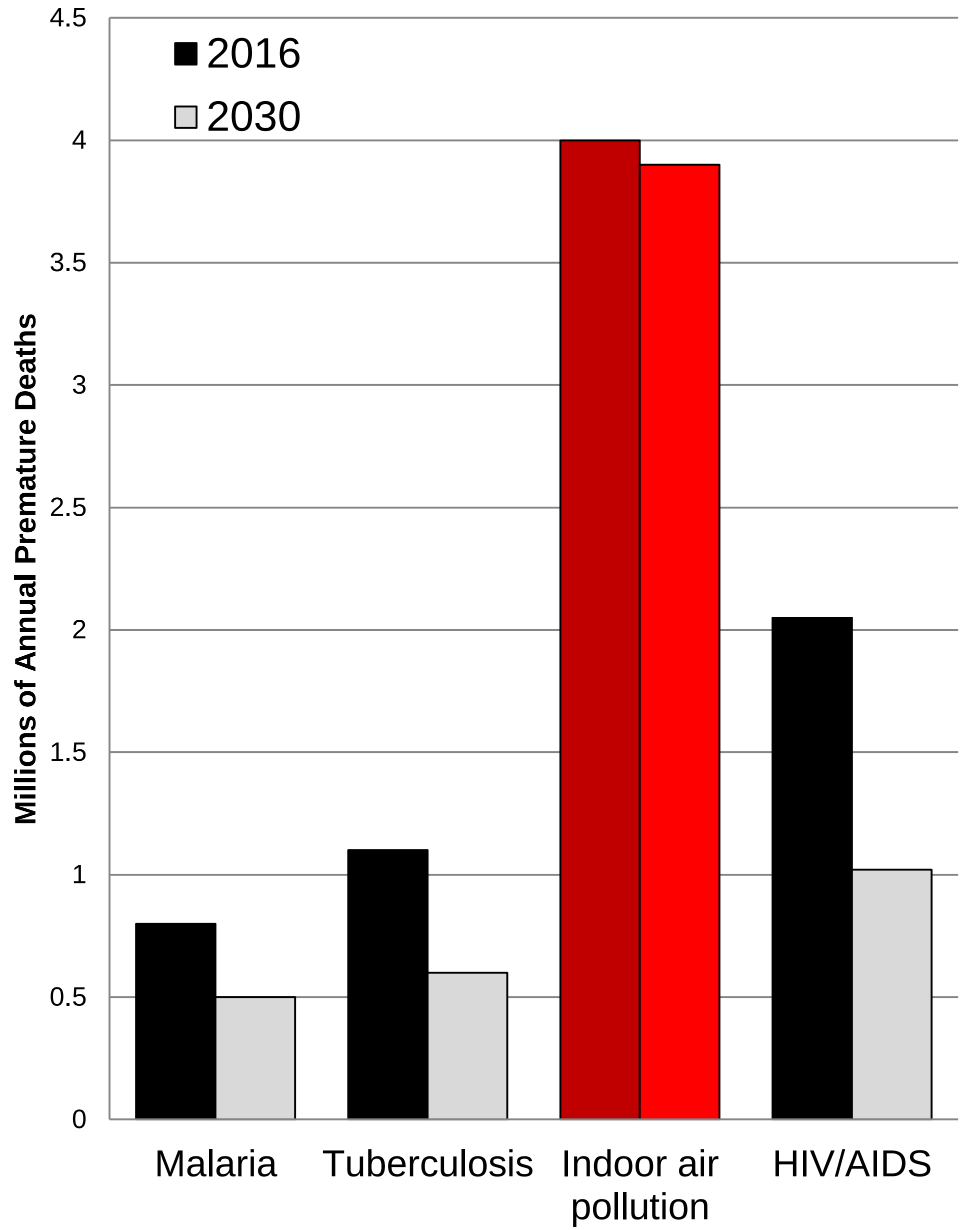


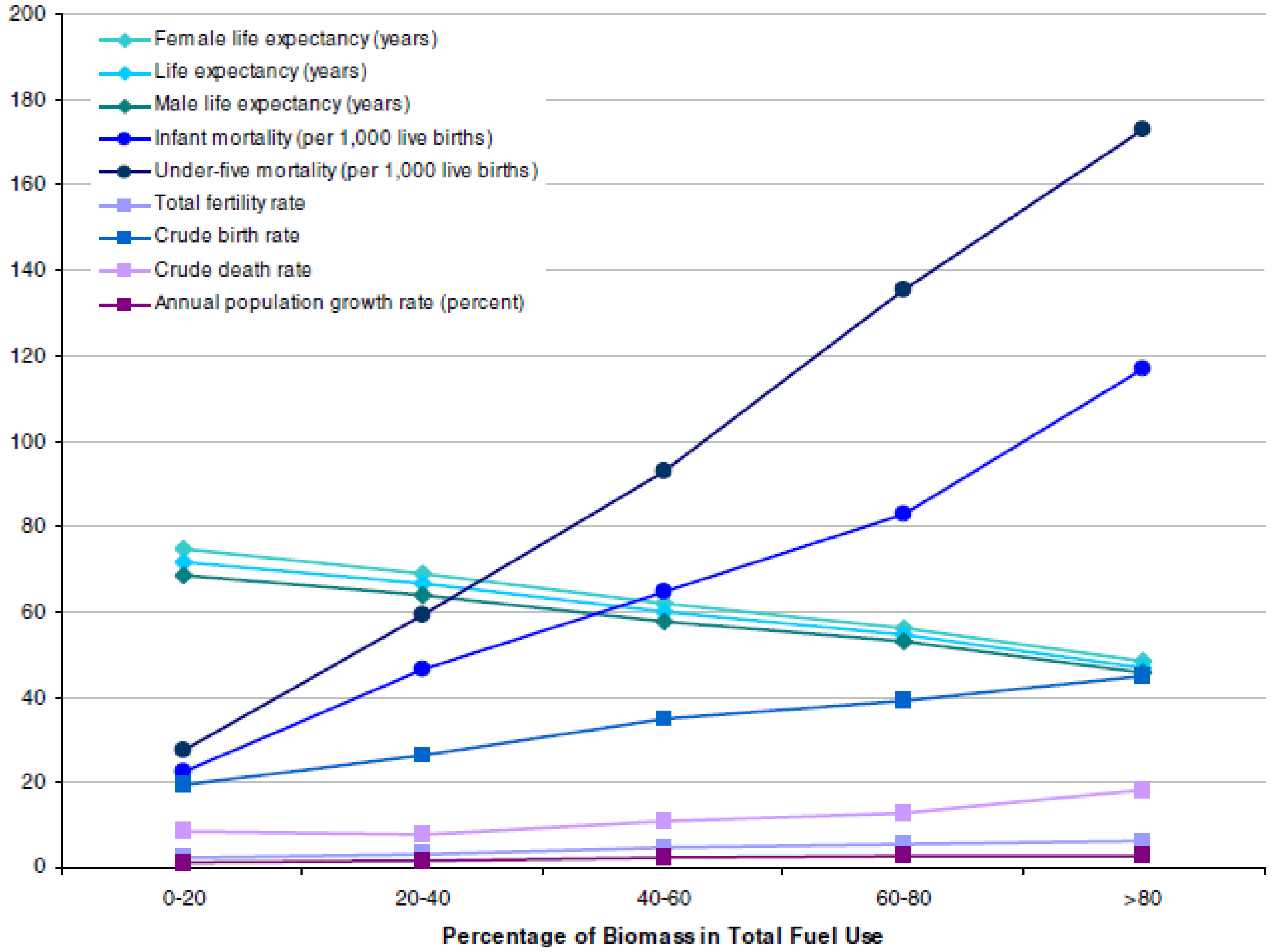
- And about 2.7 *billion* people cook over simple fires or cookstoves using technology older than Jesus Christ and the Bible



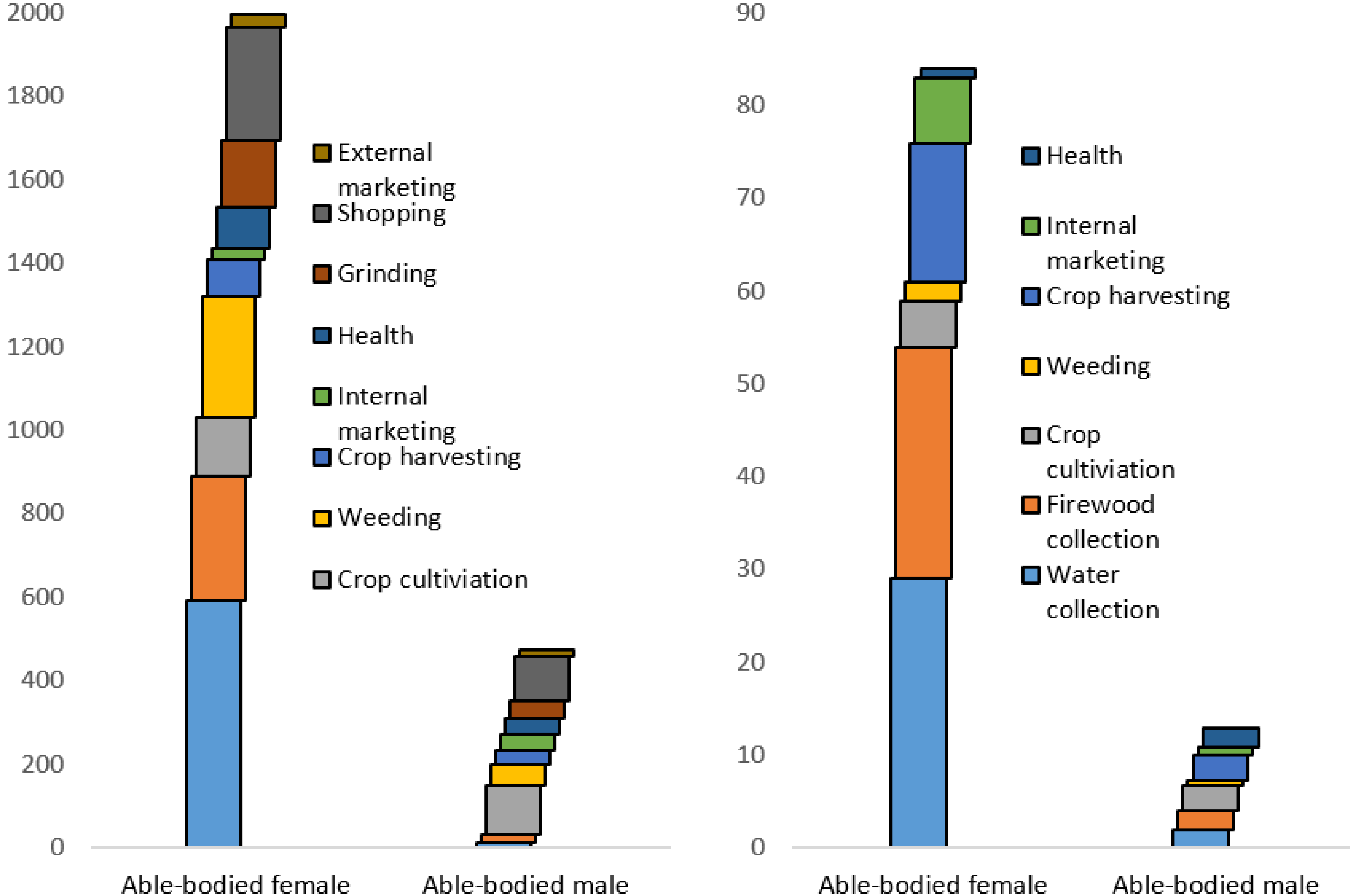
40 TWh
2 050 kWh per capita
New York
Population:
19.5 million
52 kWh per capita
Population:
791 million


WHAT'S ONE OF THE MOST DANGEROUS ACTIVITIES FOR A WOMAN IN THE DEVELOPING WORLD?
GLOBAL ALLIANCE FOR CLEAN COOKSTOVES
PHOTO: Nigel Bruce

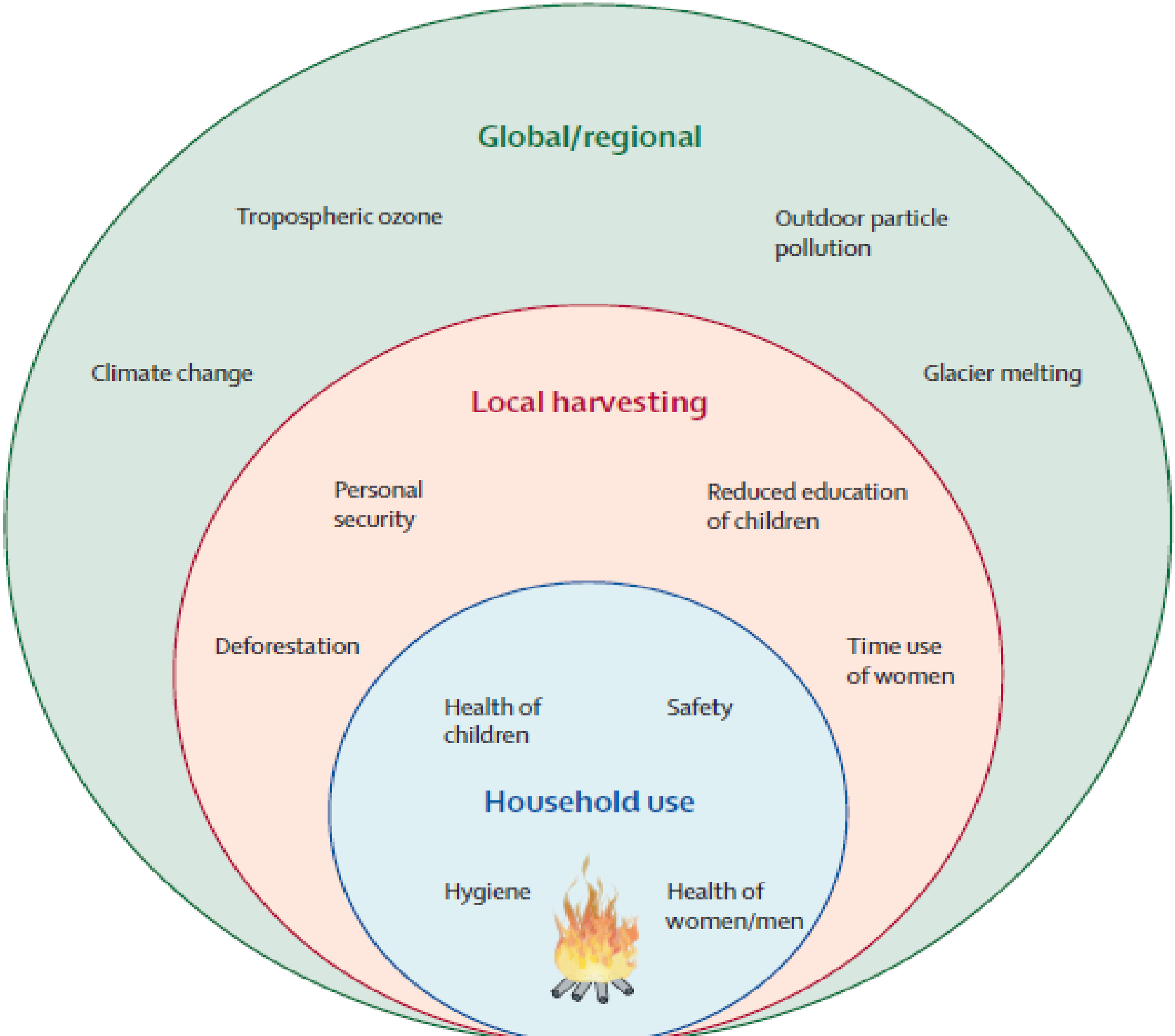

2016
2030
Millions of Annual Premature Deaths
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Malaria
Tuberculosis
Indoor air pollution
HIV/AIDS



200
180
160
140
120
100
80
60
40
20
0
Female life expectancy (years)
Life expectancy (years)
Male life expectancy (years)
Infant mortality (per 1,000 live births)
Under-five mortality (per 1,000 live births)
Total fertility rate
Crude birth rate
Crude death rate
Annual population growth rate (percent)
0-20
20-40
40-60
60-80
>80
Percentage of Biomass in Total Fuel Use



Annual Differences Between Women and Men in Tanzania for Chores and Hauling Items



Professor Kirk Smith: Wood and biomass is the fuel that warms “four times”

- Within renewable energy access and development programs of a certain type (more on this later), how are interventions structured, what are their benefits, what are their challenges?
- More broadly, what works, what doesn’t, what are the best practices that transcend geography, what lessons have been forgotten or ignored?

Selection criteria for case studies:

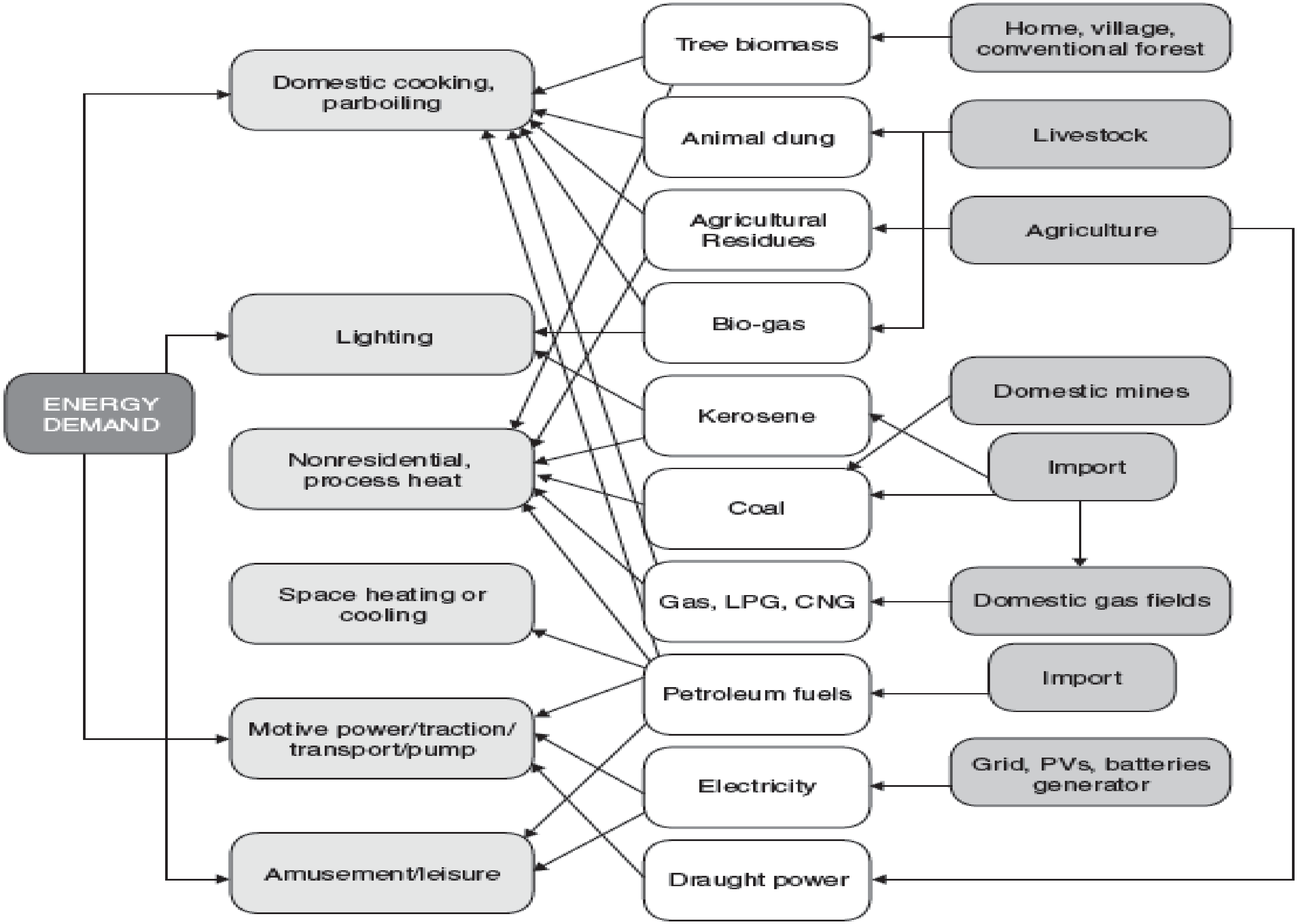
- It had to be in Asia (though this is no longer true), started with 1,156 possible examples from a 2-month literature review
- Eight phase selection process
  - Had to be in a middle-income country or below, no industrialized or high-income economies (998 left)
  - Had to involve provision of energy supply with 5 technologies (SHS, ICS, biogas, Microhydro, wind), no light bulbs or mobile phones (944 left)
  - Had to operate for at least 4 years, no pilot or demonstration projects (322 left)
  - Had to operate in off-grid or rural areas, no centralized, electricity-utility scale projects (290 left)
  - Had to have "moderate size," excluded programs with budgets less than $50k, with less than 750 customers, and/or with less than 100 kW of total capacity (117 left)
  - Had to be recent, in operation or completed in the past decade, no projects ending before 2000 (55 left)
  - Had to have sufficient data, at least 5 published sources of credible information (24 left)
  - Had to be an "extreme" or "clear cut" case of success or failure, 10 left)

Data collection process

TEN SMALL-SCALE, RENEWABLE ENERGY ASIAN CASE STUDIES*
Grameen Shakti, Bangladesh
Renewable Energy Development Project, China
Rural Electrification Program, Laos
Renewable Energy for Rural Access Project, Mongolia
Rural Energy Development Programme, Nepal
Energy Services Delivery Project, Sri Lanka
Village Energy Security Programme, India
Solar Home Systems Project, Indonesia
Small Renewable Energy Power Program, Malaysia
Teacher's Solar Lighting Project, Papua New Guinea

- **441 research interviews** and meetings with 189 institutions over the course of four years, anonymous
- *Government agencies* such as the Nepal Ministry of Energy, Indonesian Ministry of Finance, Indian Ministry of New and Renewable Energy, Chinese Ministry of Science and Technology, or Sri Lanka Sustainable Energy Authority;
- *Intergovernmental organizations* such as the South Asian Association for Regional Cooperation, the Global Environment Facility, and the United Nations Development Programme;
- *International civil society organizations* or *think tanks,* including Conservation International, Friends of the Earth, Transparency International, and the Stockholm Environmental Institute;
- *Local civil society organizations* or *think tanks,* including Grameen Shakti, Yayasan Pelangi Indonesia, and Pragati Pratishthan;
- *Electricity suppliers* including the Nepal Electricity Authority, Tenaga Nasional Berhad in Malaysia, Ceylon Electricity Board in Sri Lanka, and Papua New Guinea Power Limited;
- *Manufacturers, industry groups,* and *commercial retailers* such as Alstrom Hydro, Barefoot Power Systems, Sime Darby, Siemens, and Sunlabob;
- *Financiers* and *bilateral development donors* including Deutsche Gesellschaft für Technische Zusammenarbeit, United States Agency for International Development, the Asian Development Bank, and the World Bank Group; and
- *Universities* and *research institutes* including the

- Supplemented with 90 renewable energy site facilities in the ten countries
  - Variety of sources, systems, sizes, and capacities
  - Research laboratories
  - Testing centers
  - Factories
  - Assembly lines
  - Public and private
- Plus focus group discussions with almost 800 community members
  - Households
  - Village leaders
  - Political representatives
- Triangulated with a second, in-depth literature review of peer-reviewed and internet sources (especially project documents)



Finding (1): A complexity of optimal technologies and energy services

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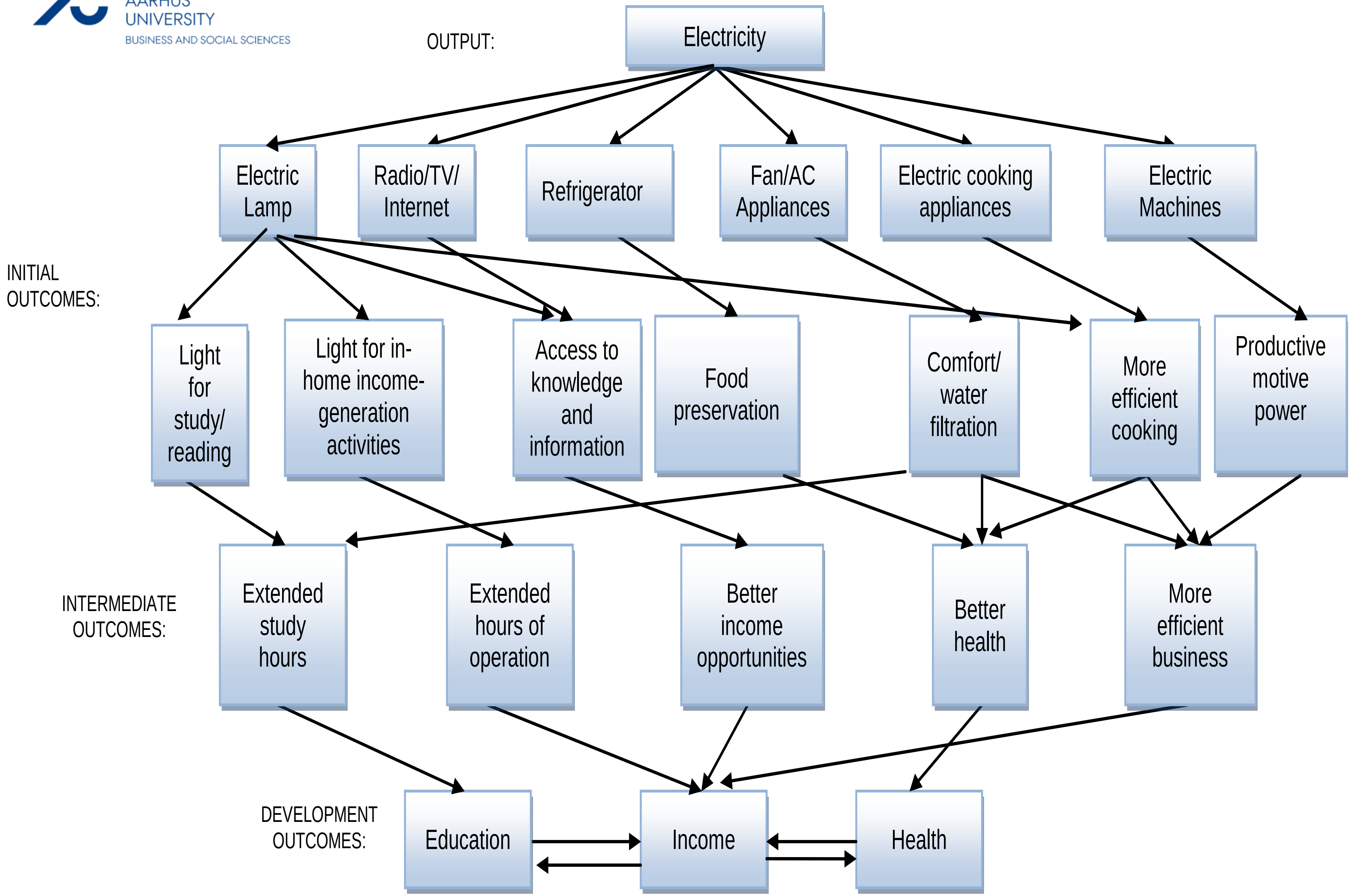


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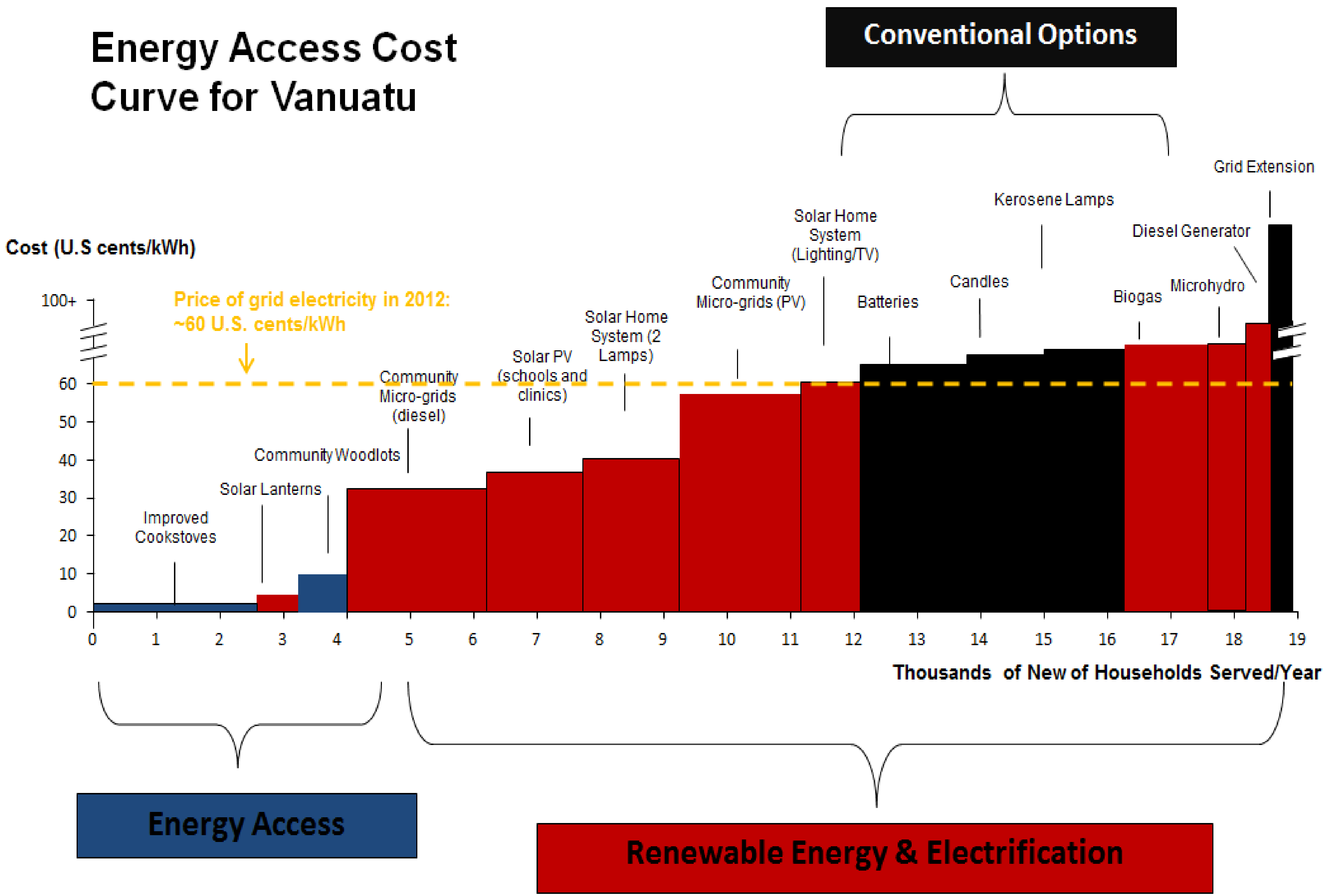
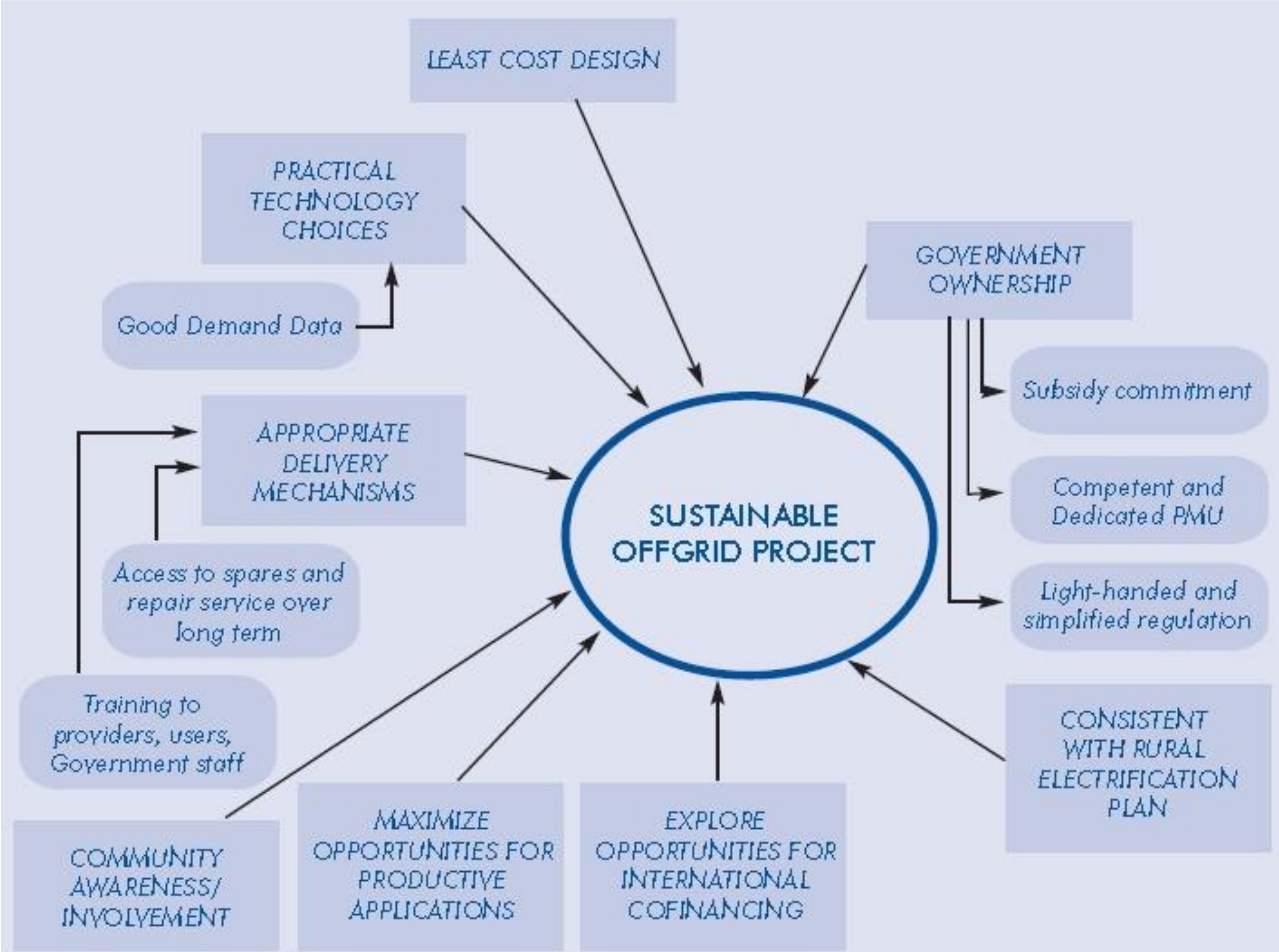
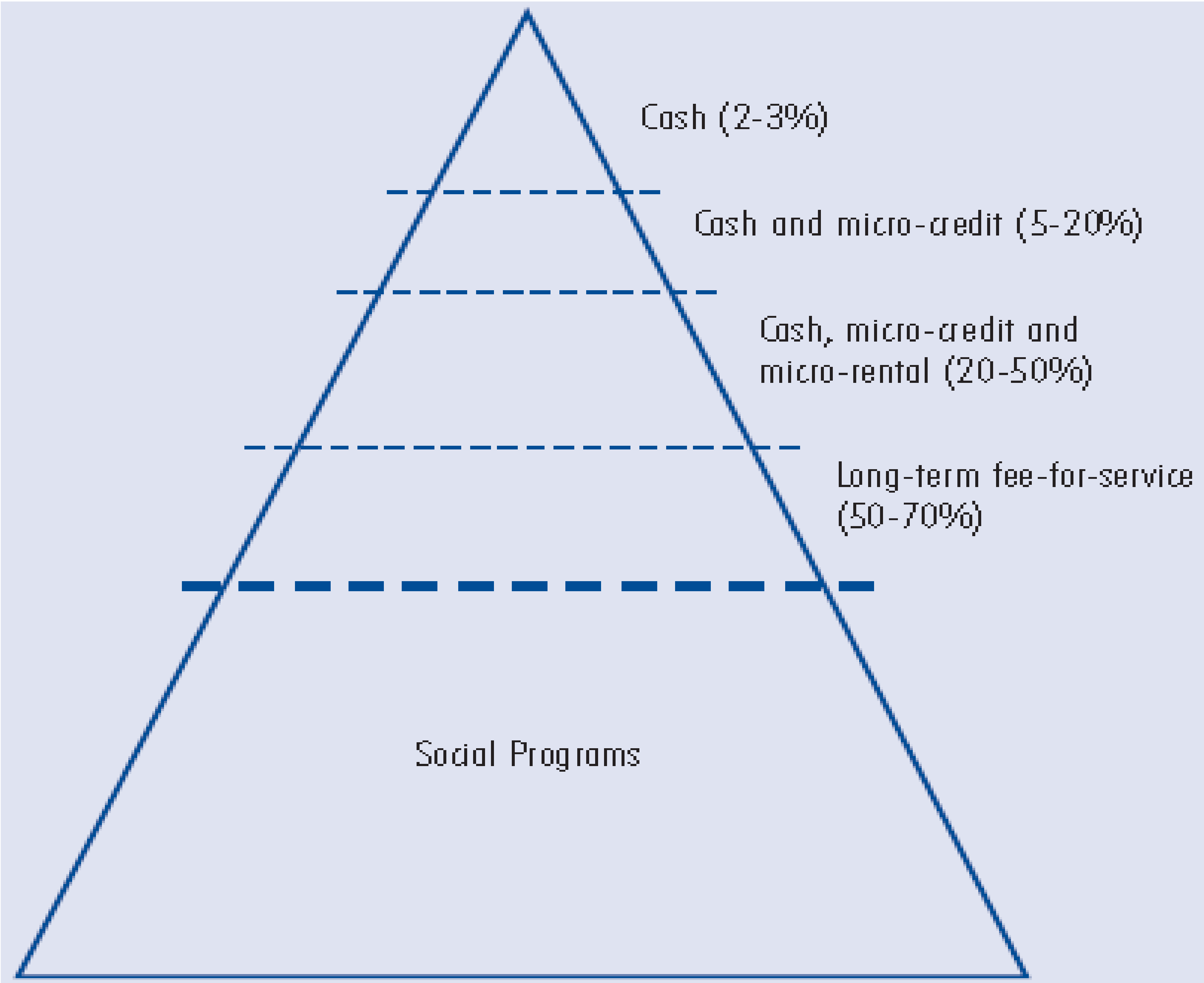

Energy Access Cost Curve for Vanuatu
Conventional Options
Cost (U.S cents/kWh)
Price of grid electricity in 2012: ~60 U.S. cents/kWh
100+
60
50
40
30
20
10
0
Improved Cookstoves
Solar Lanterns
Community Woodlots
Community Micro-grids (diesel)
Solar PV (schools and clinics)
Solar Home System (2 Lamps)
Community Micro-grids (PV)
Solar Home System (Lighting/TV)
Batteries
Candles
Kerosene Lamps
Biogas
Microhydro
Diesel Generator
Grid Extension
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Thousands of New of Households Served/Year
Energy Access
Renewable Energy & Electrification

Model	Description	Example
Technology improvement and market development	A sort of "supply push" structure where the PPP develops a renewable energy technology to reduce costs	China's Renewable Energy Development Program
End-user microfinance	A sort of "demand pull" which gives loans to energy users to that they can purchase renewable energy equipment	Grameen Shakti in Bangladesh
Project finance	Where small- and medium-scale projects are supported with loans and financial assistance from commercial banks	Energy Services Delivery Project in Sri Lanka
Cooperative	Where communities own renewable energy systems themselves	Cinta Mekar Microhydro Project in Indonesia
Community mobilization fund	Where revenues from renewable electricity or energy production are invested back into local communities	Microhydro Village Electrification Scheme in Nepal
Energy services company (ESCO) "fee-for-service"	Where private sector enterprises purchase technology and then charge consumers only for the renewable energy "service" that results	Zambia's PV-ESCO Project
Hybrid (cross-subsidization and ESCO)	Where tariffs on one type of electricity are then funneled into a fund to support renewable energy	The Rural Electrification Project in Laos
Hybrid (end-user microfinance and ESCO "fee-for-service")	Where private sector enterprises purchase technology and then charge consumers only for the renewable energy "service" that results	India's Solar Lantern Project

Finding (2): Policy mechanisms or business models can be just as important as technology



Elements of a Successful Off-Grid Electrification Project


Cash (2-3%)
Cash and micro-credit (5-20%)
Cash, micro-credit and micro-rental (20-50%)
Long-term fee-for-service (50-70%)
Social Programs

Lesson	Factor	Bangladesh	China	Laos	Mongolia	Nepal	Sri Lanka	India	Indonesia	Malaysia
Net Beneficial Energy Access	Expanded access to energy services	X	X	X	X	X	X	X	X	X
	Job creation	X	X	X	X	X	X	X	X	X
	Lowered fuel consumption/prices	X	X			X	X			
	Improved technological quality	X	X			X	X			
	Reduced morbidity and mortality			X			X			
	Fewer greenhouse gas emissions	X			X	X				X

Finding (3): Best practices or design principles do exist (12/42)

Lesson	Factor	Bangladesh	China	Laos	Mongolia	Nepal	Sri Lanka	India	Indonesia	Malaysia	Papua New Guinea
Appropriate Technology	Feasibility studies	X	X	X	X	X	X				
	Scaling up	X	X				X				
	Service rather than technology orientation	X	X	X	X	X	X				
	Technical standards and certification		X		X		X				
	Cultural sensitivity	X	X	X	X	X	X				
Community Commitment	Community ownership/operation/participation	X	X	X	X	X	X				
	Minority/gender empowerment	X		X		X					
	Monetary contributions (cash, savings, collateral)	X	X	X	X						
	Non-monetary contributions (time, labor, land, materials)					X	X				

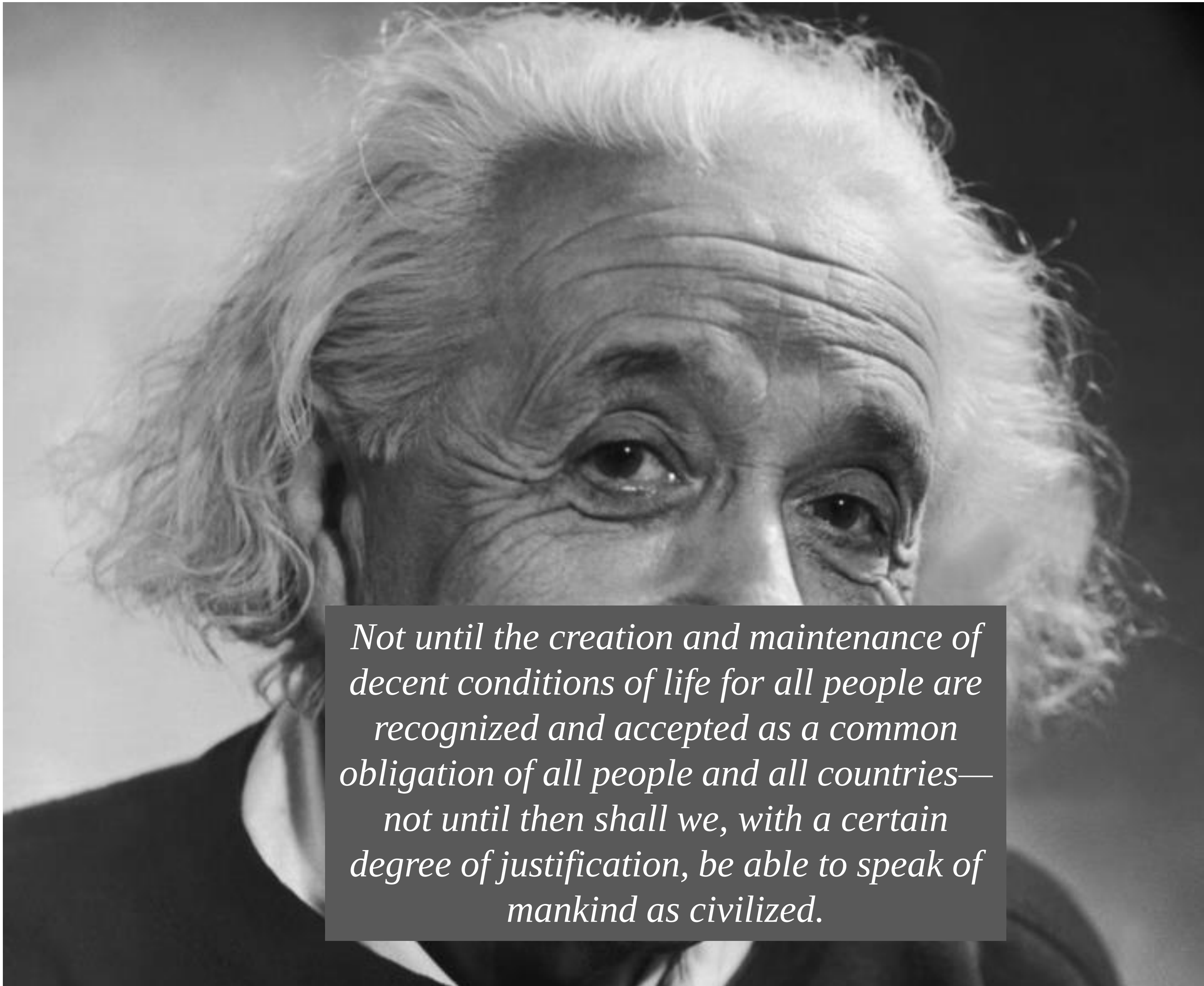
Lesson	Factor	Bangladesh	China	Laos	Mongolia	Nepal	Sri Lanka	India	Indonesia	Malaysia	Papua New Guinea
Awareness Raising	Marketing and promotion	X	X	X	X	X	X	X		X	X
	Demonstration	X	X		X	X	X				
After-sales Service	Product guarantees/warranties/buy back	X		X	X						
	Training/funds for maintenance	X	X	X	X	X	X				
Income Generation	Classes in productive end-use	X	X	X	X	X	X		X	X	
	Scholarships	X									
Institutional Diversity	Involvement of non-state-actors/private sector	X	X	X	X	X	X	X		X	X
	Polycentricity	X	X	X	X	X	X				
	Cost sharing	X	X	X	X	X	X				
	Avoidance of corruption					X					

Lesson	Factor	Bangladesh	China	Laos	Mongolia	Nepal	Sri Lanka	India	Indonesia	Malaysia	Papua New Guinea
Affordability	Provision of credit/microcredit/ ESCO “fee-for-service” model	X	X	X	X	X	X	X	X		X
	Revenue collection	X		X		X	X				
	Support for manufacturing/ industry		X		X						
	Lower programmatic costs	X	X			X					
Capacity Building	Institution building	X	X	X	X	X	X				
	Outsourcing			X							
	Improved business practices (accounting, auditing, revenue collection, marketing)		X		X	X	X				
	Self-sufficiency	X	X		X	X	X				

Lesson	Factor	Bangladesh	China	Laos	Mongolia	Nepal	Sri Lanka	India	Indonesia	Malaysia	Papua New Guinea
Flexibility	Diversity of eligible technologies	X	X	X	X	X	X				
	Follow-up project		X	X		X	X				
	Promotion of both grid/off-grid systems			X	X	X	X				
	Adjusted targets/extended deadline		X	X		X	X	X	X	X	X
Evaluation and Monitoring	Independent evaluator	X	X	X	X	X	X	X	X		X
	Penalties for noncompliance	X	X		X	X	X				
Political Support	Policy integration	X	X	X	X	X	X			X	
	Dedicated or experienced implementing agency	X	X	X	X	X	X				
	Project champion/political leadership	X	X	X	X	X	X				

Conclusion - energy access is:

- **Multi-scalar**: involving households, neighborhoods, and city/village councils as well as state planners, national regulators, and international donors
- **Multi-institutional**: not just a single type of actor (consumer or supplier), but faith-based groups, environmental think tanks, renewable energy suppliers, inventors and innovators, etc.
- **Multi-sectoral**: electricity and energy as well as agriculture, education, public health, and gender equity (to name a few)
- **Multi-dimensional:** a variety of energy end-use services (cutting across cooking, heating, etc.) and elements beyond technology


Not until the creation and maintenance of decent conditions of life for all people are recognized and accepted as a common obligation of all people and all countries—not until then shall we, with a certain degree of justification, be able to speak of mankind as civilized.

Further reading:

- Sovacool, BK, C Cooper, M Bazilian, K Johnson, D Zoppo, S Clarke, J Eidsness, M Crafton, T Velumail, and HA Raza. "What Moves and Works: Broadening the Consideration of Energy Poverty," *Energy Policy* 42 (March, 2012), pp. 715-719.
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- Gregory, J and BK Sovacool. "Rethinking the governance of energy poverty in sub-Saharan Africa: Reviewing three academic perspectives on electricity infrastructure investment," *Renewable & Sustainable Energy Reviews* 111 (September, 2019), pp. 344-354.