

POTENTIAL FOR REGIONAL USE OF EAST AFRICA'S NATURAL GAS

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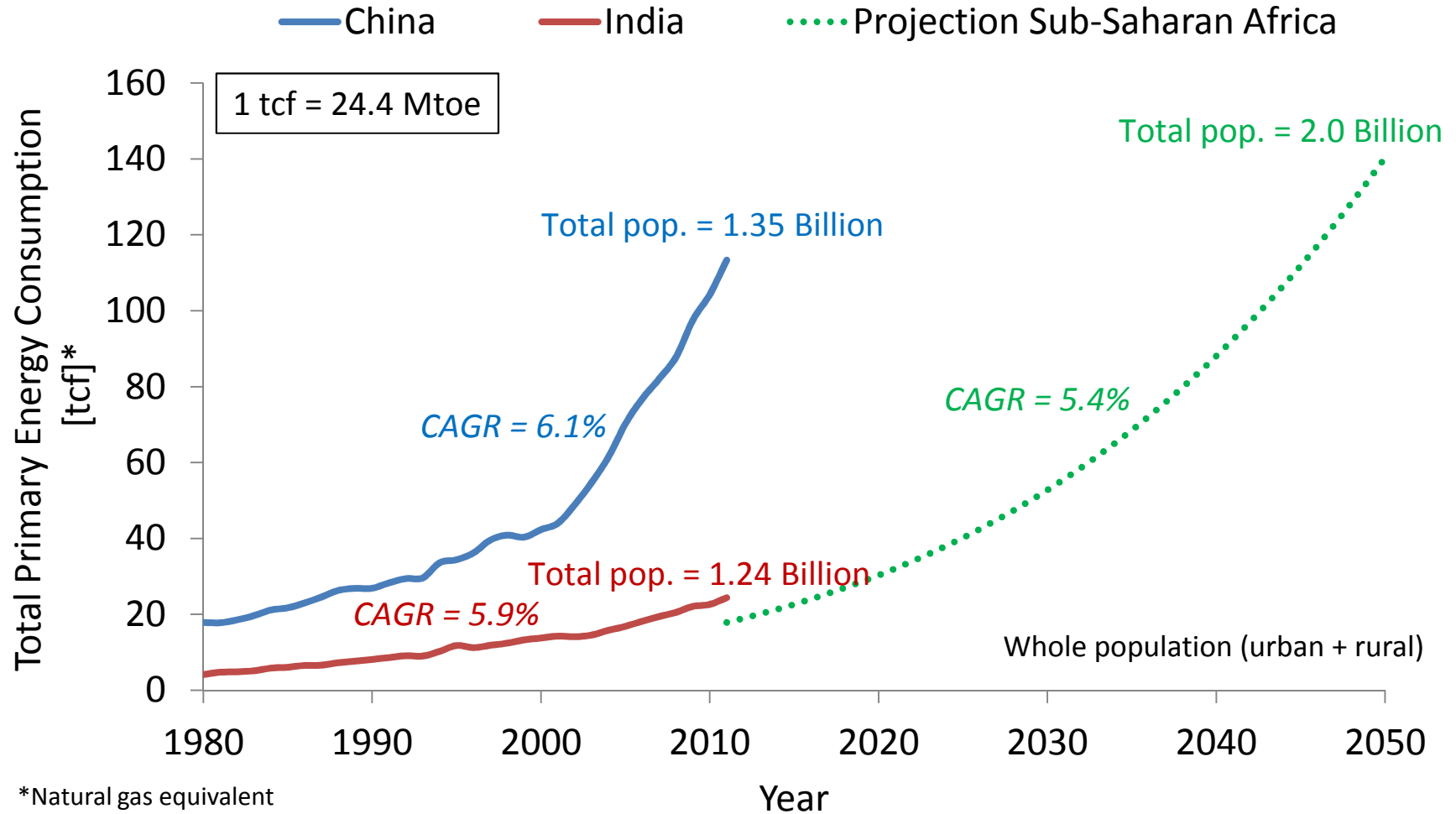
Addis Ababa, June 2nd, 2014

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MOTIVATION

- Longer term view
- Substantial fuel needs in cooking, transport, fertilizer prod, industry, power
- Same time, large gas finds
- Also working on synergy with renewables
- Benefits from similar integration in power
- Shared prosperity: meeting domestic needs in parallel with export incomes

Projection of Primary Energy Demand



*Natural gas equivalent

Sources:

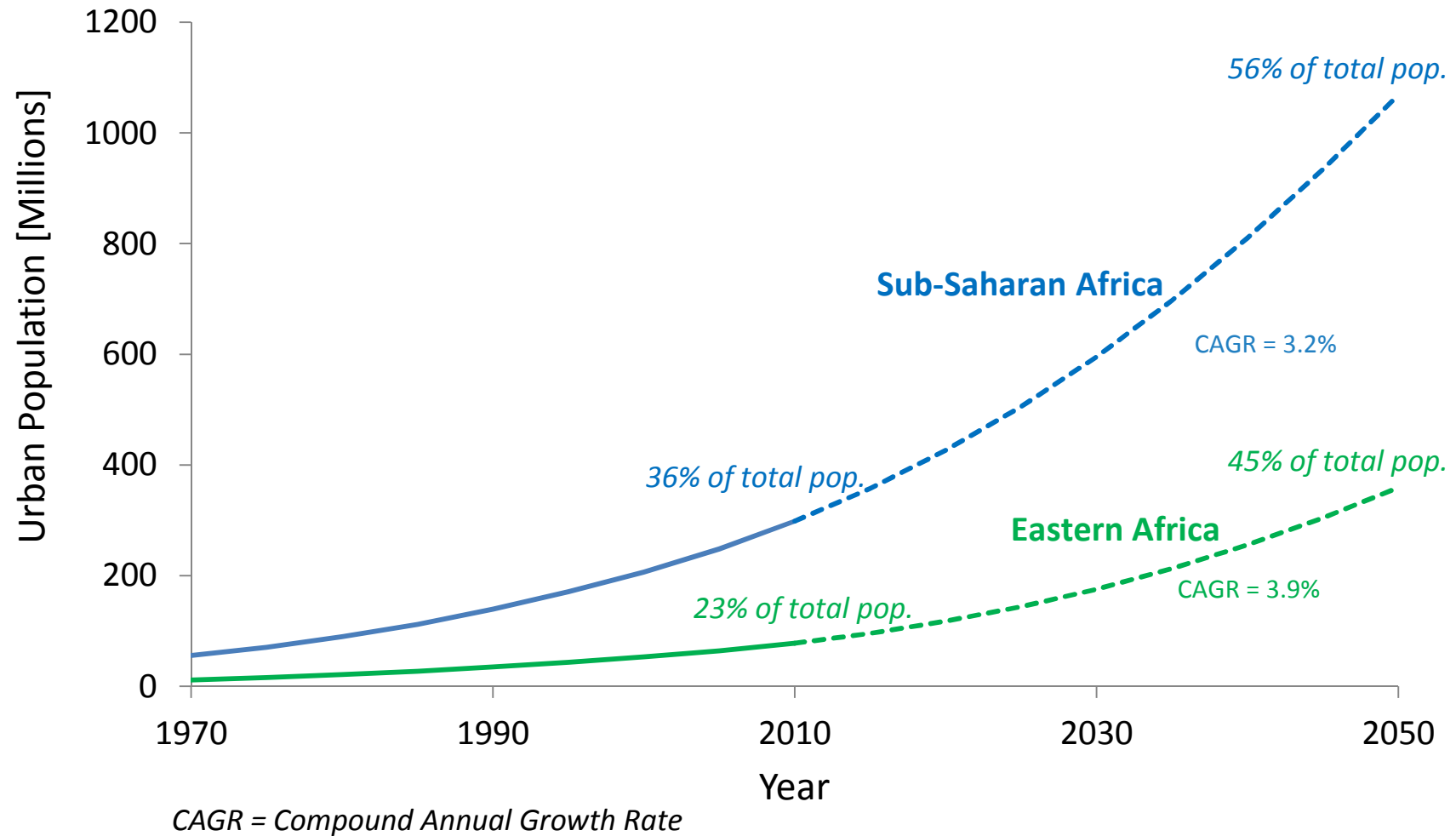
China's and India's consumption: EIA 2014

Sub-Saharan Africa's projection: own calculations

CAGR = Compound Annual Growth Rate

Urbanizing World: 45% of total by 2050

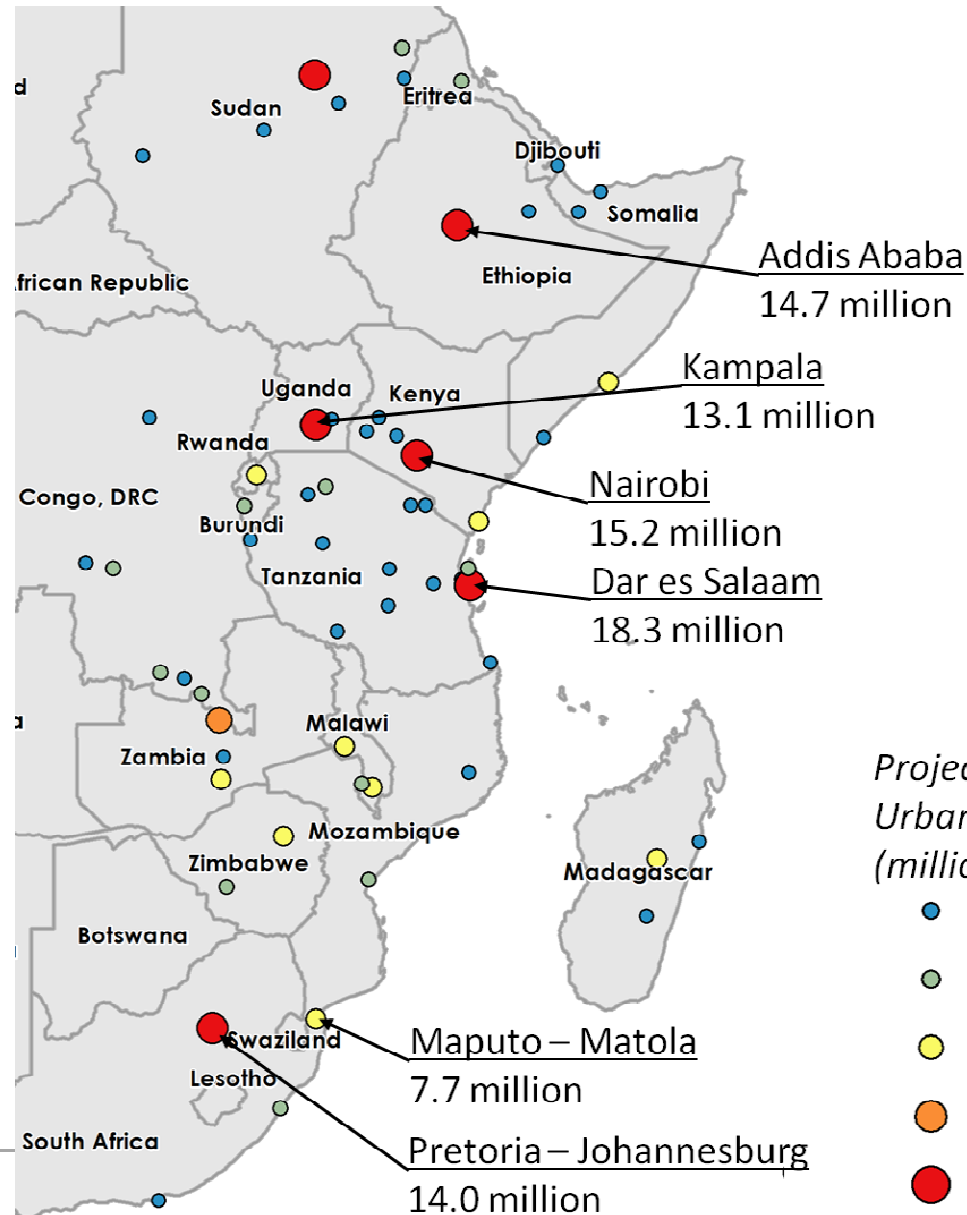
Eastern Africa (UN DESA definition)



Major Urban Centers of the Region

In 2050

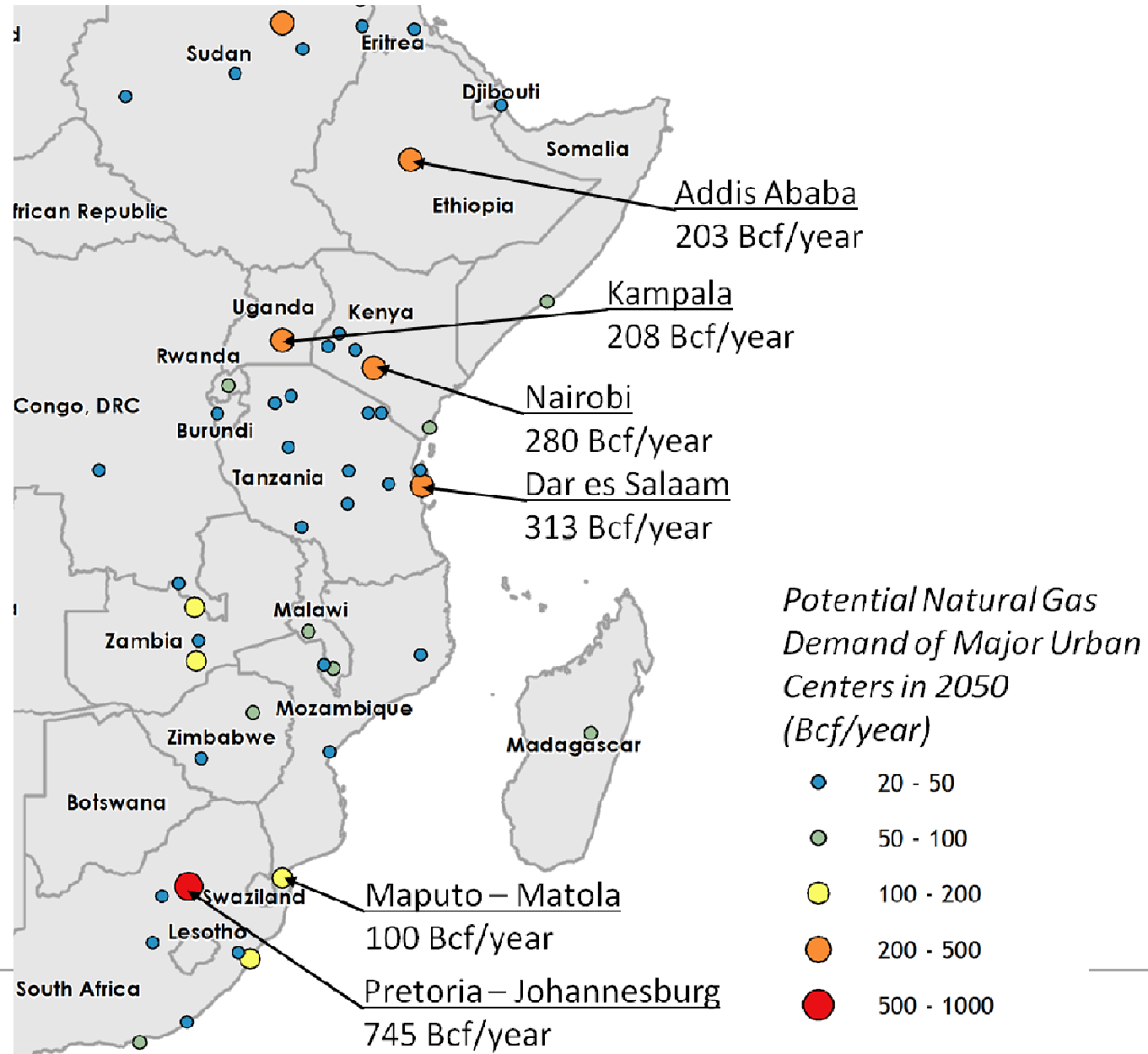
- 6 Cities with more than 12 million
- 16 Cities with more than 4 million



Projected Population of Major Urban Centers in 2050 (millions)



Potential City Gas Demand in the Region



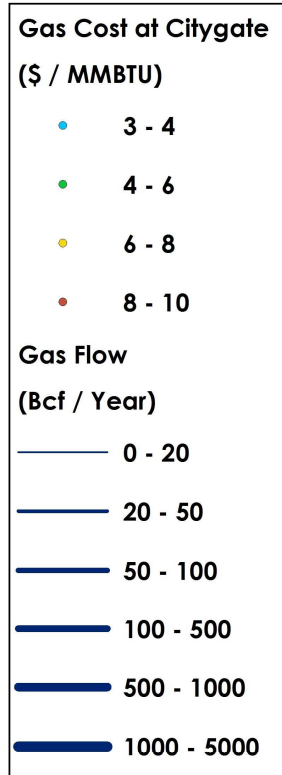
Natural Gas: Which Uses and at What Price?

	Est. Max Price at City Gate* [\$/MMBtu]	Alternatives
Cooking	10 - 20	Retail Wood, Charcoal, Kerosene, LPG
Power generation	12 - 48	Existing dispatchable generation (from gas to diesel)
Transportation	25 - 52	Diesel, Gasoline
Fertilizer Production	14 - 24	Retail imported Price

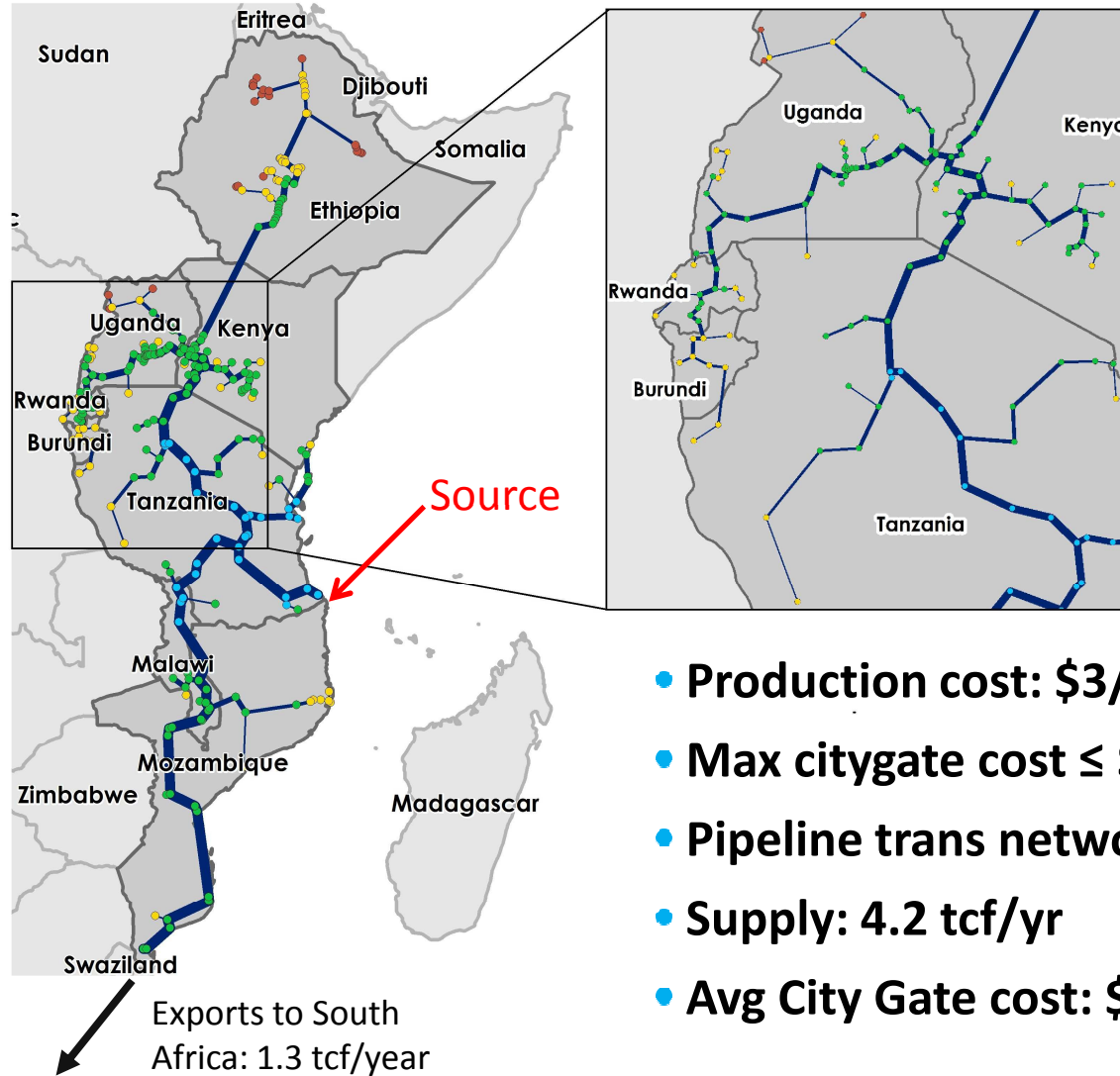
* Maximum natural gas price at city gate to compete with existing alternatives. An additional \$5/MMBtu is taken into account for distribution within the city (cooking) and an additional 25% is considered for CNG at refueling stations (transportation).

 **A price at city gate < \$10-15/MMBtu may allow a large penetration of natural gas**

Transmission Network: Baseline Scenario

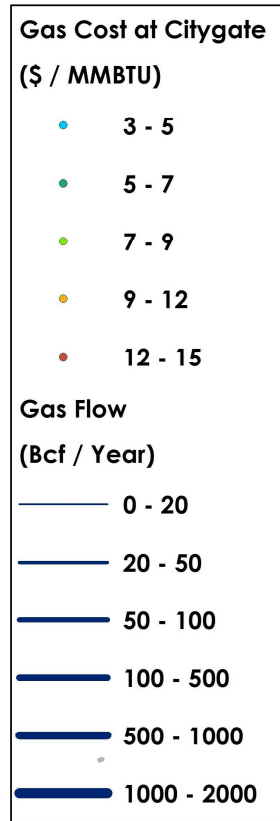


Year 2050

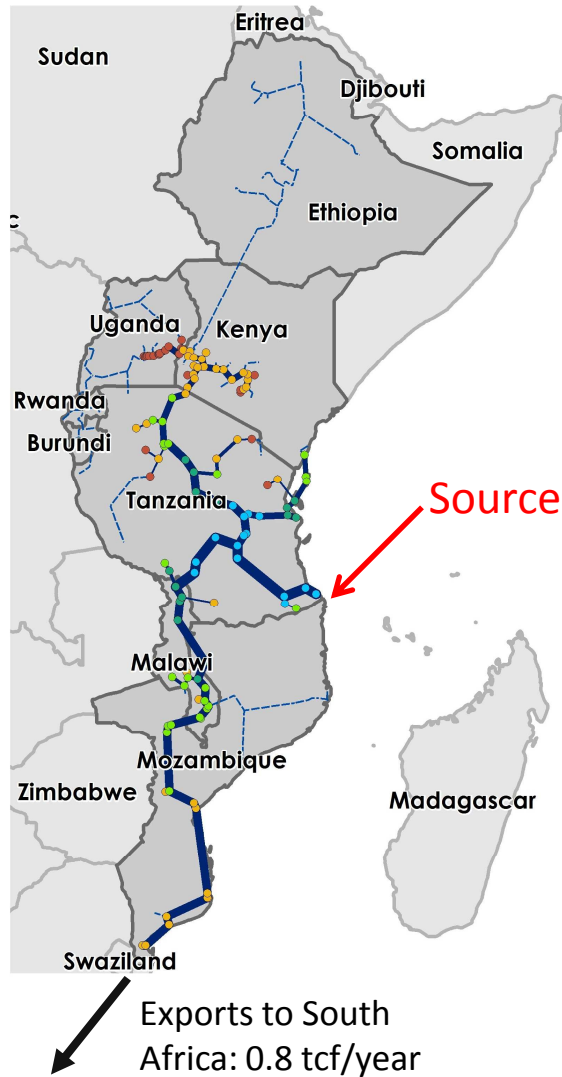


- **Production cost: \$3/MMBtu**
- **Max citygate cost \leq \$10/MMBtu**
- **Pipeline trans network: \$57 B**
- **Supply: 4.2 tcf/yr**
- **Avg City Gate cost: \$5.2/MMBtu**

Transmission Network: High-Cost Scenario



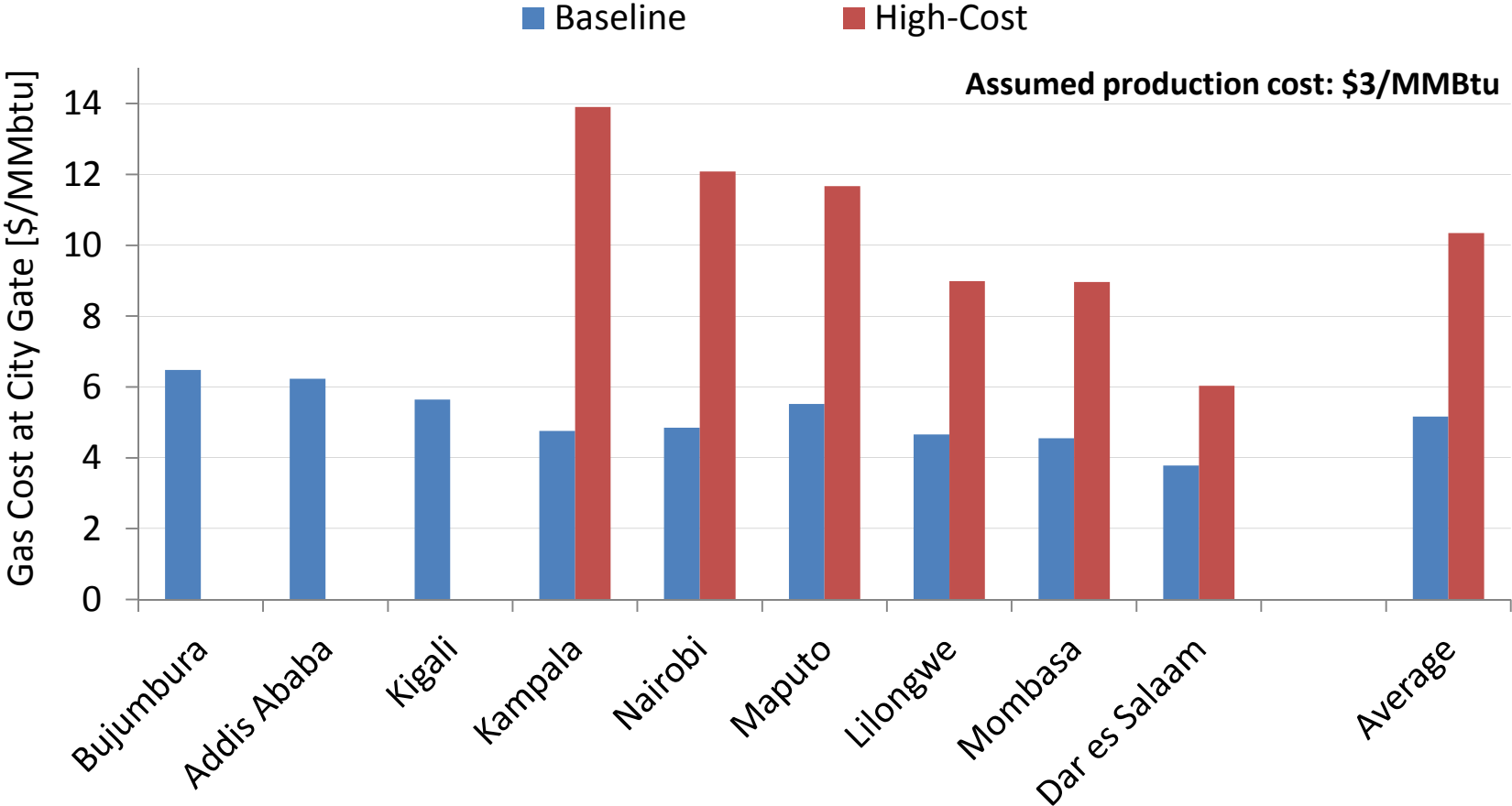
Year 2050



**Avg at City Gate:
\$10.3/MMBtu**

- Ethiopia, Rwanda, and Burundi not connected

Delivered Gas Cost for the Major Cities



Bujumbura, Addis Ababa, and Kigali not connected in the high-cost scenario (delivered cost > \$15/MMBtu)

Population Benefitting in 2050 (baseline scenario)

National-level population: 614 Million (urban+rural)

Countries: Mozambique, Malawi, Tanzania, Kenya, Uganda, Burundi, Rwanda and Ethiopia

	Population Impacted	Assumptions
Power	461 million	75% access to electric grid 25% of electricity from gas
N Fertilizer needs	614 million	100% of urban + rural needs

Population Benefitting in 2050 (baseline scenario)

Urban population supplied by gas: 185 Million

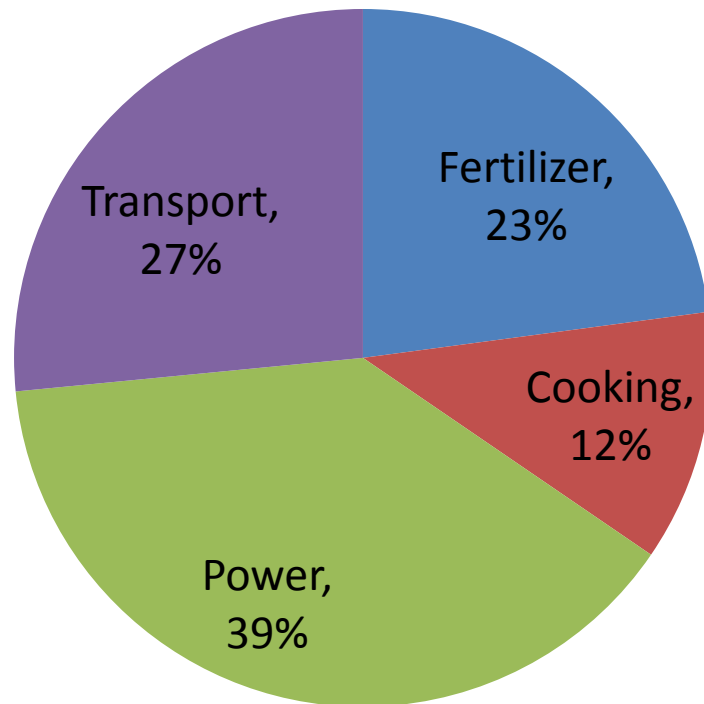
Countries: Mozambique, Malawi, Tanzania, Kenya, Uganda, Burundi, Rwanda and Ethiopia

	Population Impacted	Assumptions
Cooking	185 million	100% of the population in connected cities
URBAN Passenger transport	185 million	85% of LDV and Public transport in connected cities

Consumption by Sector in 2050

Baseline Scenario

Countries: Mozambique, Malawi, Tanzania, Kenya, Uganda, Burundi, Rwanda and Ethiopia



Pie Chart: 2.4 tcf

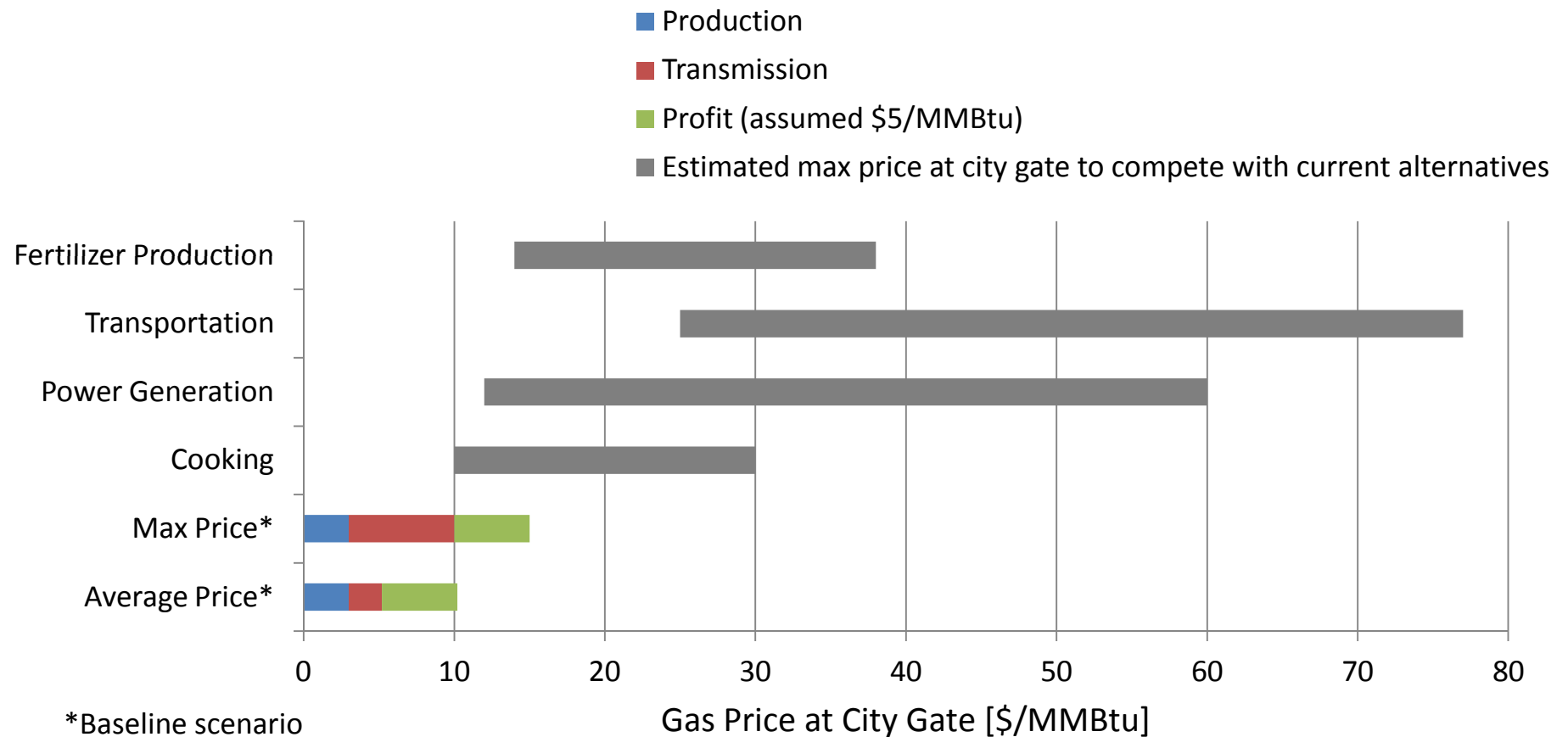
Other indus/commercial: 0.5 tcf

Exports to South Africa 1.3 tcf

TOTAL: 4.2 tcf/yr

Similar Profits than with LNG exports

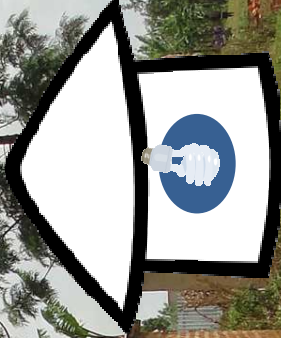
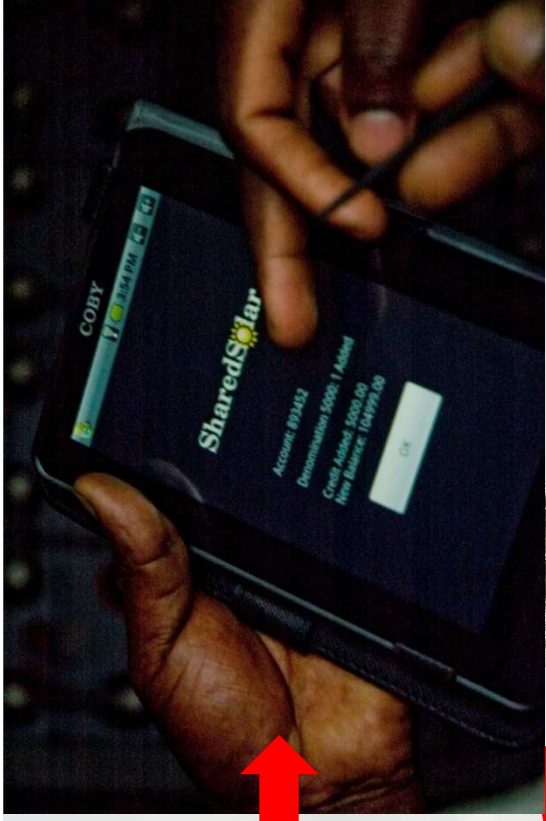
- Estimated profit for LNG exports to Japan (medium term): \$1-7/MMBtu
- Assuming \$5/MMBtu profit for the domestic market, natural gas would still be a very affordable alternative



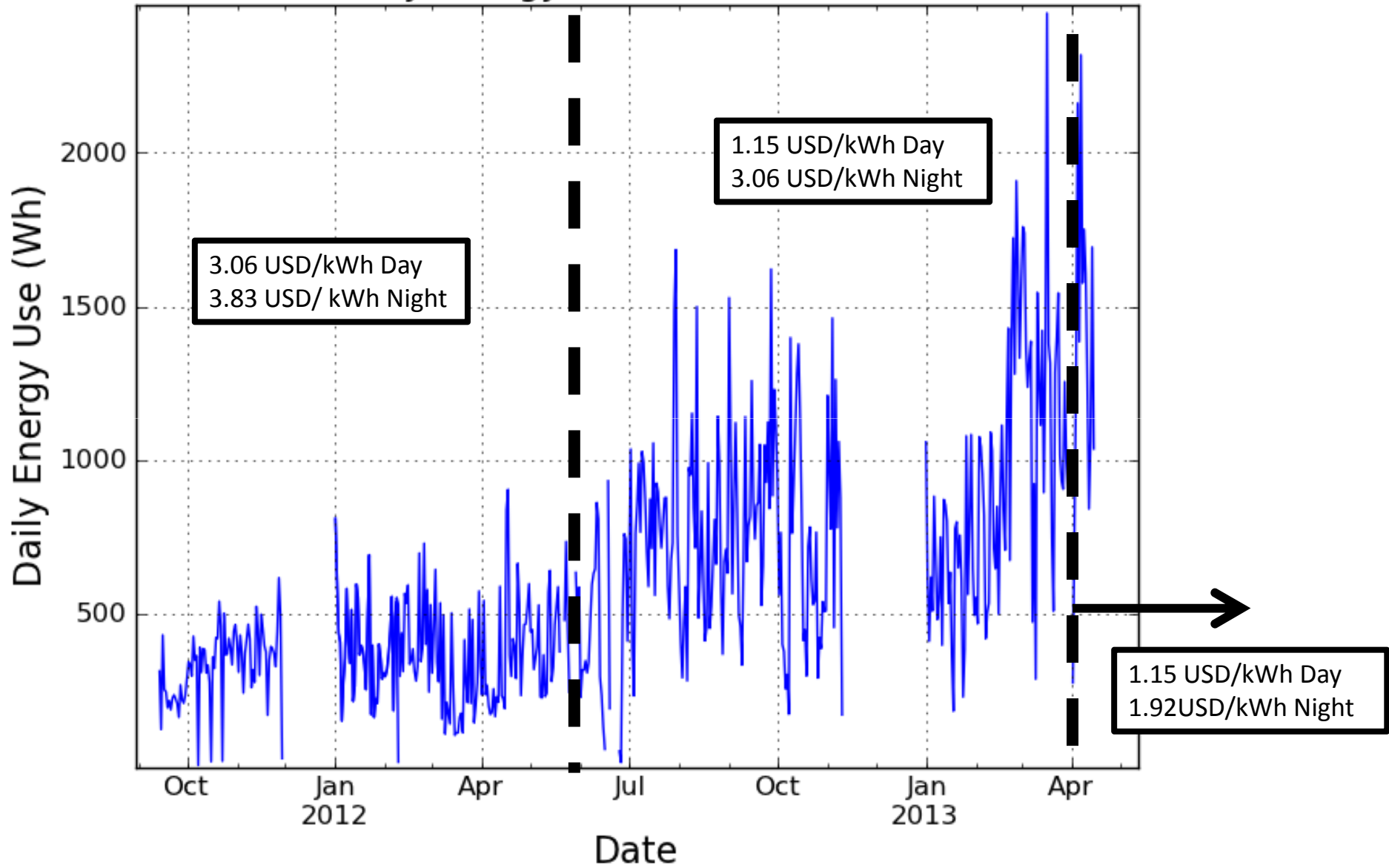
CAN THE POOR PAY FOR ENERGY SERVICES?

SOLAR MINIGRID DEPLOYMENTS IN UGANDA AND MALI. PAY-AS-YOU-GO SMART MODULAR MINIGRIDS





UG01: Daily Energy Use in Wh (Sum of Circuits)



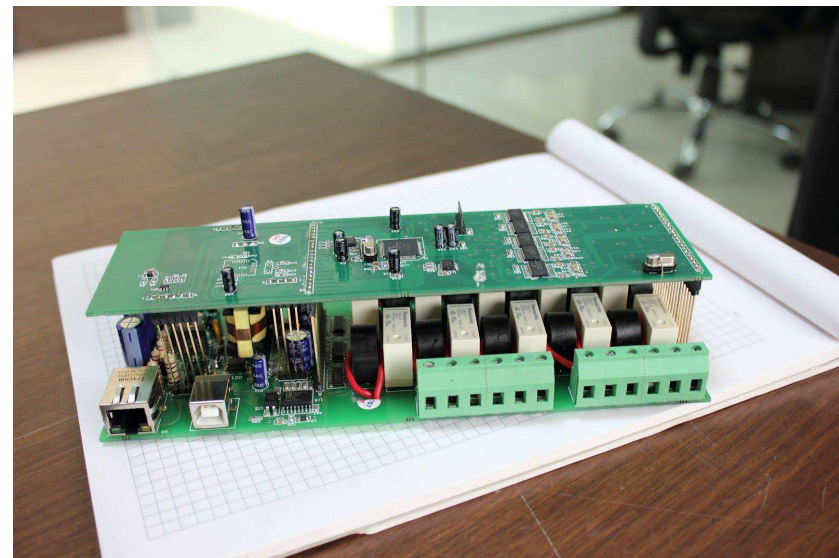
10 Consumer System: Metering + Communications

Meter Enclosure



Version 1: 40 cm x 30 cm x 20 cm

Version 2: 15 cm x 7 cm x 7 cm



Needed Investment by Sector by 2050

Baseline Scenario

Countries: Mozambique, Malawi, Tanzania, Kenya, Uganda, Burundi, Rwanda and Ethiopia

Needed investments in the 4 main sector to develop the demand in addition to the \$57 Billion for the transmission system

	Investments [Billion \$]
Distribution Networks within Urban Centers	13.9
Power Plants	43.9
CNG Refueling Stations	9.3
Fertilizer Plants	33.2
Total	100

GUJARAT, INDIA: A CASE STUDY IN GAS AND GAS INFRASTRUCTURE FOR DOMESTIC GROWTH

Mr. Pandian

Additional Chief Secretary

Sec, Energy and Petrochemicals



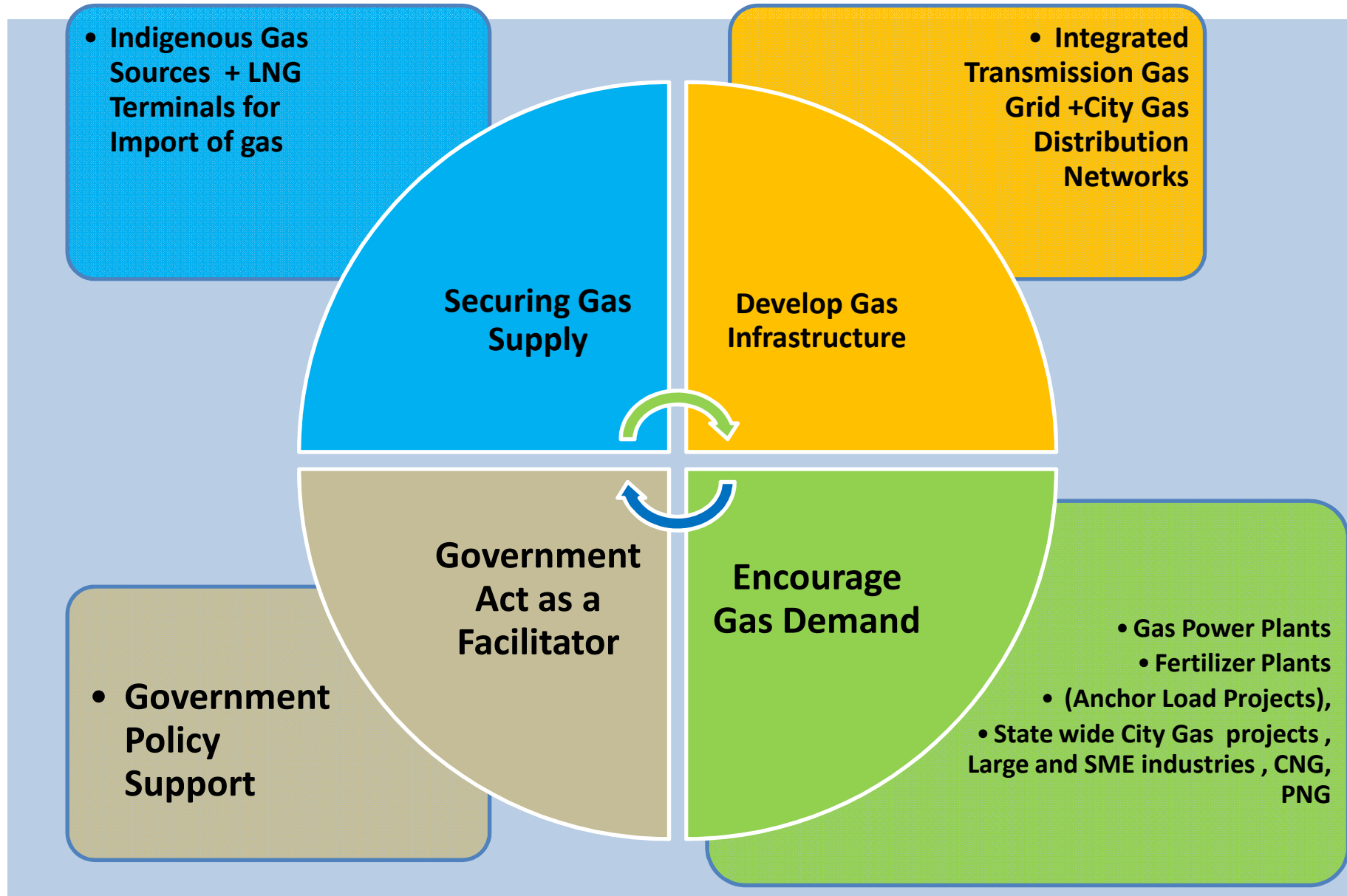
CHICKEN AND EGG PROBLEM

- No market demand without infrastructure
- No infrastructure without market demand
- Infrastructure and Market demand useless without assured gas supply!

- Gujarat had domestic gas so a study was carried out to use domestic gas

- Even with R-LNG it is viable today in Gujarat
- Of course with domestic piped gas is much better

STATE GOVT. GROWTH STRATEGY FOR GAS



IN WHAT ORDER WAS IT DONE? WITHIN A DECADE

Anchor Loads

- Power (State and Private)
- Fertilizer (State actors to support agriculture)
- Industry (Private, eg ceramic industry)

City Gas Distribution

- Started with CSR demo. near LNG terminal
- Domestic cooking (state and Private)
- Public Transport (state)

GSPL GAS GRID



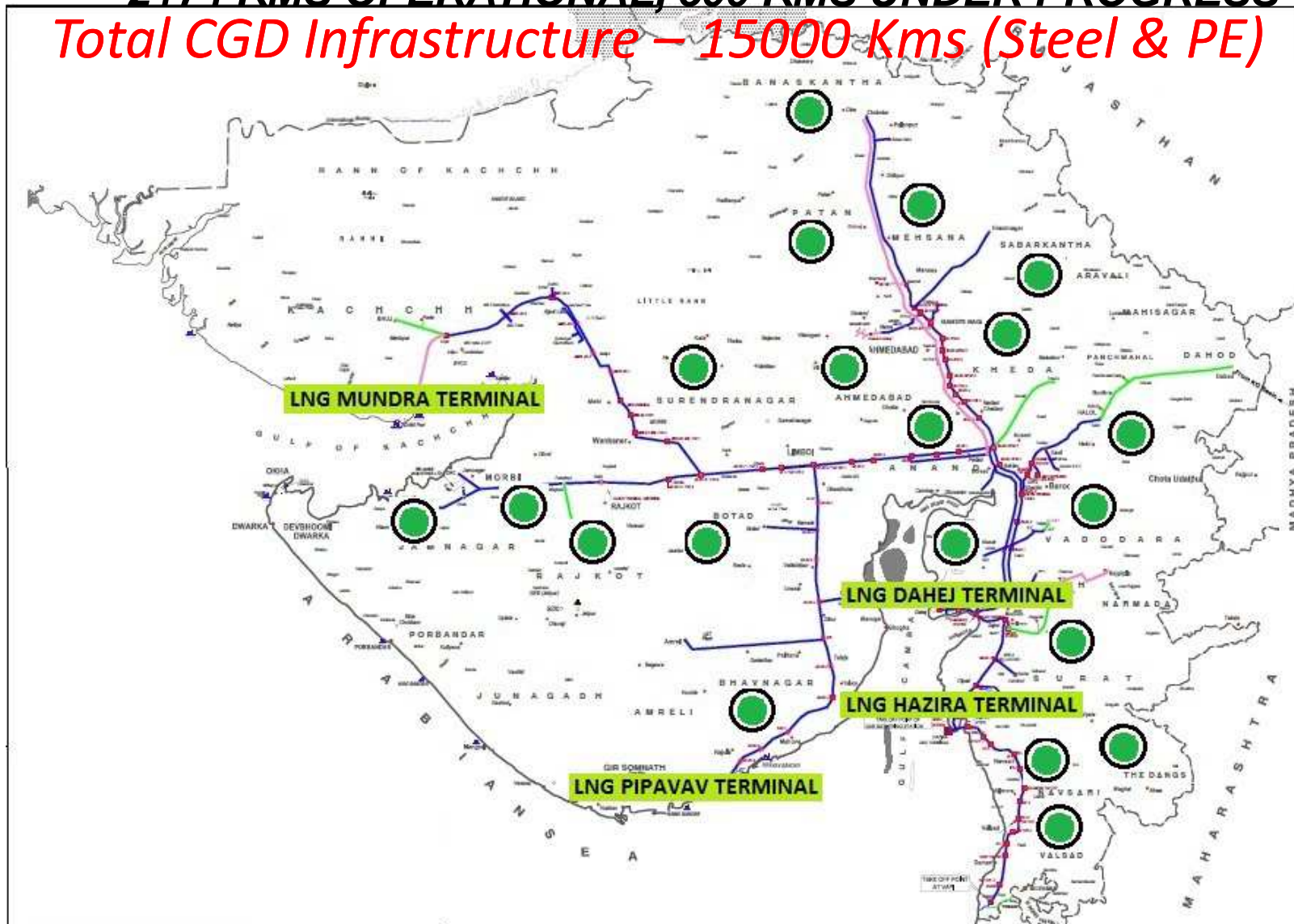
CGD COVERAGE IN GUJARAT

Sr. No.	Name of CGD	No of Ind. Cust.	No of Domestic Cust.	No of Com. Non-Com. Cust.	No of CNG Stations	CNG Sales tons/Day	No of CNG Vehicle/Day	Daily Gas* Sales (MMSCMD)
1	GSPC Gas	1,892	490,000	1,893	159	445	90,000	5.00
3	GGCL	794	440,000	8,951	57	275	64,000	2.60
5	Adani Gas	760	190,000	1,460	52	320	62,300	0.88
Total		3,789	1.3 Million	15K	331	1200	254K	9.90

STATE URBAN POPULATION 3 Million HH
Done in 10 years
HOW?

GAS TRANSMISSION NETWORK IN GUJARAT

2174 KMS OPERATIONAL, 500 KMS UNDER PROGRESS
Total CGD Infrastructure – 15000 Kms (Steel & PE)



CITY DISTRIBUTION

- Typical CNG+PNG city network
- Cost Rupees 250-300 crores (\$50 million) to supply 1.5 MMSCMD of gas
- \$5M/yr for 15 Million MMBTU/yr
- With O&M and profit: \$4/MMBTU
- Large cities could be \$3.50



ADDED NEW PUBLIC TRANSPORT CAPACITY

CNG BUSES and RICKSHAWS
ANCHOR PUBLIC DEMAND



Facts File : Ahmedabad BRTS
Operational Corridor – 63 kms.
Corridor under Implementation – 25 kms.
BRT stations – 104
Buses – 127



TODAY:

HH of 5 spends \$6/month on cooking

CAN BE DONE

Took Political Will and Administrative skill

Thank you