WORLD BANK

Improving Energy Efficiency in Central Asia

Energy Unit - Europe and Central Asia Region

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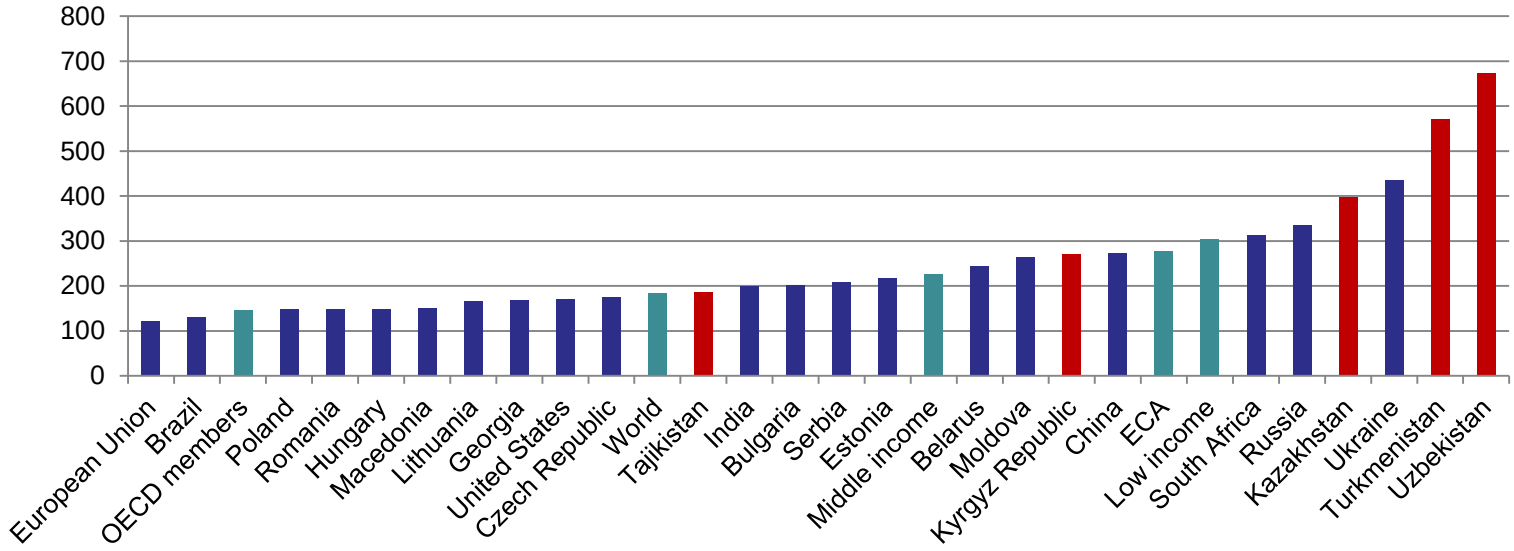
Contents

1- Inefficient Use of Energy in Central Asia

- **Inefficient use of energy is a common feature in all Central Asian Countries**
  - **Kazakhstan, Uzbekistan and Turkmenistan** are among the **10 most energy intensive economies** worldwide
  - **Tajikistan and Kyrgyz Republic** are less energy intensive than the average of other low income countries **but** use at least **5 times more electricity per capita** than similar income countries



Energy use 2009 per $1000 GDP (constant 2005 PPP) in kg oil equivalent
World Development Indicators (WDI), World Bank

2- How can EE improvements help Central Asia?

1. Help alleviate severe winter energy deficits in Central Asia and meet long term energy supply challenges

❑ Power shortages during winter months

- **Tajikistan:** Power shortages in 2009 estimated at 2.3 TWh on consumer level (> 14% of supply) with 56% of residential demand suppressed by load shedding
- **Kyrgyz Republic**: Power shortages in 2009 estimated at 2.2 TWh (> 33% of supply)
- **Uzbekistan/ Kazakhstan**: regional blackouts in Southern and Western regions in Uzbekistan (2-6 hours/day) and Southern Kazakhstan during winters

❑ Power shortages have negative impacts on social and economic development in Central Asia

- **Estimated cost of non-served energy** typically range between US$0.1-0.5/kWh for households and >US$1/KWh for industrial consumers
- **Uzbekistan**: power shortages were considered to be the third most significant obstacle in doing business in 2009 (Doing Business Report)
- **Tajikistan**: 58% of companies suffered outages in 2007 with costs > 15% of their revenues (World Bank Enterprise Survey, 2008)
- **Tajikistan and Kyrgyz Republic**: Due to widespread use of electric heating, power outages and insufficient heat supply have direct impact on the well-being of the population

References: ADB, Central Asia Power Sector Master Plan, 2012; World Bank Data Sources

2- How can EE improvements help Central Asia?

❑ Large investments needs in the energy sector in Central Asia

- Need to rehabilitate/ replace ageing energy infrastructure in Central Asia and add new capacity to meet future demand
  - **Most of the installed generation capacity >30 years**: Uzbekistan (75%), Tajikistan (74%), Kyrgyz Republic (64%) and Kazakhstan (44%)
  - **High technical and commercial losses**: Kyrgyz Republic (>30%), Tajikistan (≈18%), Uzbekistan (≈20%) and Kazakhstan (≈17%)
  - **Expected increase in gross electricity consumption** in Central Asia from 96 TWh to 163 TWh between 2011-2031 ≈ 66% increase (2.6% per year) by 2031
- Estimated investments costs amount to **US$ 15-17 billion next 10 years**

➢ **EE actions are quicker to implement than expanding supply facilities**

➢ **EE actions are in general more cost-effective:** US$1 of investment in demand-side EE can avoid/ delay US$2+ on the supply side

➢ **Large untapped EE potentials expected in Central Asia → EE as part of the energy sector planning**

➢ **EE eases public (and private) financing requirements in the energy sector**

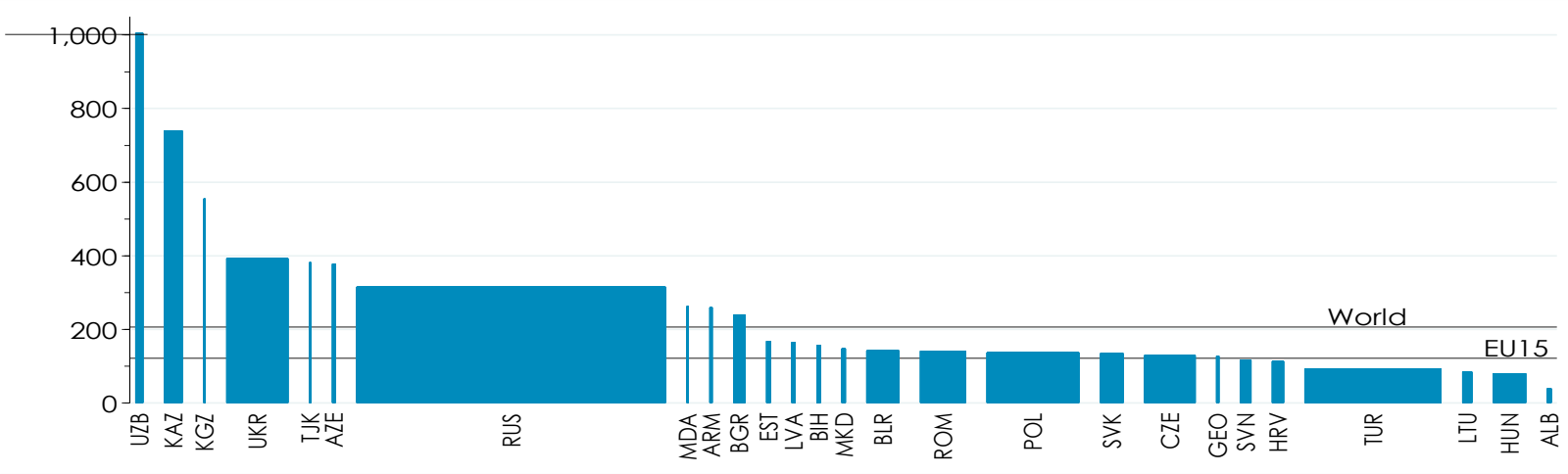
References: ADB, Central Asia Power Sector Master Plan, 2012; World Bank Data Sources

2- How can EE improvements help Central Asia?

2. Help improve economic competitiveness and reduce industrial consumption

❑ High energy intensities in the manufacturing sector in Central Asia

- **Energy intensive industries**: aluminum, metallurgy, chemicals/petrochemicals, etc.
  - → Energy costs can account for an important share in total production costs (Aluminum: < 50%)
- **Central Asia has the highest average industrial energy intensity in ECA** → almost **7 x the Turkey** level;
- Energy intensity in **Kazakhstan, Tajikistan** and **Kyrgyz Republic** has increased 2006-2008



Note: The x-axis is proportional to value added of manufacturing at constant PPP in 2005 international price
References: World Bank staff calculation based on IEA (2011) and WDI (2011); *ADB, Central Asia Power Sector Master Plan, 2012*

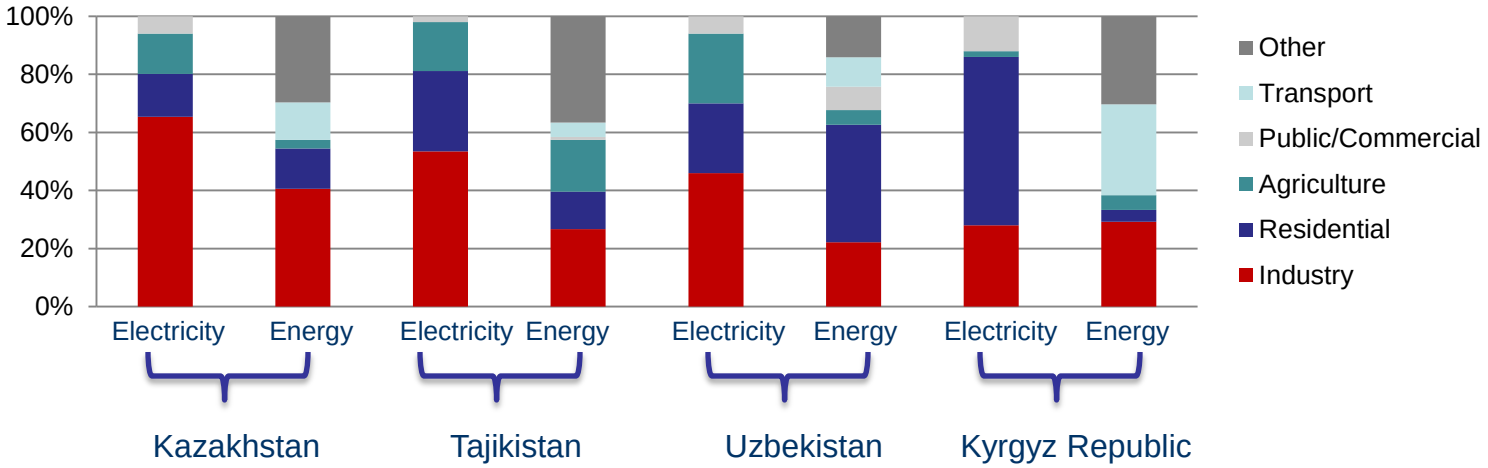
2- How can EE help Central Asia?

❑ High electricity intensity in the manufacturing sector in Central Asia

- **Tajikistan:** 10 x more intensive than Russia
- **Uzbekistan:** almost 3 x more intensive than Russia
- **Kazakhstan/ Kyrgyz Republic:** similar to Russia

❑ High share of electricity/energy consumption by industries

Electricity and energy consumption patterns by sectors



References: IEA (2011); ADB, Central Asia Power Sector Master Plan, 2012; World Bank, Draft Report on Industrial EE, 2012; World Bank, Draft Energy/ Power Issues Note for Uzbekistan, 2012

2- How can EE help Central Asia?

❑ Large energy saving potential in industrial sector

- **Uzbekistan**: Saving potential in SMEs expected between **19-24%** and in large enterprises between **7-16%** (World Bank, Survey Results 2012)
  - → EE investments of **US$170 million** over next 10 years is estimated to result in **15% reduction** in industrial electricity consumption by 2022
  - → Net benefit >US$2 billion (1.2% cumulative GDP) by 2022

➢ **High energy intensity jeopardizes industrial competitiveness in international markets.** This negative aspect will be exacerbated by:

- ➢ Greater market opening
- ➢ Increasing energy prices worldwide

➢ **EE actions in losses reduction and energy intensive industries would help to partially reduce energy shortages and increase amounts supplied to residential consumers**

2- How can EE Improvements help Central Asia?

2. Reduce energy costs across stakeholders

- **EE in residential sector**
  - **can help mitigating impact of tariff reforms on the population**
  - **can help easing the impact of winter power deficits by improving efficiency of the heating system**
    - Particularly important in **Tajikistan and Kyrgyz Republic** (massively using **electric heating**)
      - Households with electric radiators use 50% more electricity than households with central heating
      - Electric heating increases the risk of power shortages in winter and amplify their impact on the population
      - **Challenge:** availability and affordability of alternative heating systems (e.g. price difference locally produced electricity and imported gas, dilapidated conditions of centralized heating system, unreliable and limited services, etc.)
  - **EE can reduce public energy expenditures**

2- How can EE Improvements help Central Asia

- **EE can enhance energy export revenues**
  - **Uzbekistan and Kazakhstan:** market value of flared gas in 2010 was US$500m and US$1 billion respectively
- **EE can reduce vulnerability to external energy price fluctuations and import dependency in Tajikistan and Kyrgyz Republic**

3. Cost-efficient reduction of GHG emissions and environmental impacts

- **Uzbekistan and Kazakhstan** are among the top four of most carbon intensive economies
  - Kazakhstan – 24th largest CO2 emitter and Uzbekistan 35th largest CO2 emitter worldwide

3- Key barriers to improve EE in Central Asia

Policy / Regulatory	Equipment/ Service Providers	End User	Financiers
Energy pricing	High project development costs	Lack of awareness, high discount rates	**New technologies and contractual mechanisms**
Lack of incentives to reduce losses	**Limited demand for EE goods/services**	High upfront and project development costs	**Small sizes/widely dispersed→ high transaction costs**
Procurement policies favor lower cost	Diffuse/diverse markets	**Ability/willingness to pay cost reflective rates**	High perceived risks – not traditional asset-based financing
Import duties on EE equipment	New contractual mechanisms (ESCOs)	Low EE benefits relative to other costs	Other higher return, lower risk projects
Unclear or underdeveloped EE institutional framework	**Limited technical, business, risk mgmt. skills**	Perceived risks of new technologies/ systems	**Over-collateralization**
Lack of appliance standards and building EE codes, lack of testing, poor enforcement	**Limited financing/ equity**	Concept of EE is “virtual” – cannot see	Behavioral biases
Limited and poor quality data		**Mixed/lack of incentives**	
		Behavioral biases	
		Lack of credible data	

4- World Bank EE Program in Central Asia

- **The World Bank EE Program in Central Asia is aiming to help:**
  - Addressing the **winter energy deficits**
  - Reducing **waste of scarce energy resources** on the **supply and demand side**
  - Moving towards **cost reflective energy pricing** while protecting vulnerable low income groups
  - Developing **robust, scalable and sustainable EE models**, which draw on lessons learned from the Europe and Central Asia region
  - Support Governments' efforts and capacity to improve the **enabling environment for EE**

4- World Bank EE Program in Central Asia

Uzbekistan

Project	EE related Objectives	Status	Budget (US$ M)
EE Facility for Industrial Enterprises	Improve EE in industries by a credit line and capacity building activities (incl. EE Strategy for industries)	Active	25 (IDA credit)
Advanced Electricity Metering Program	Reduce technical and commercial losses and support improved demand-side management	Active	180 (IBRD loan)
GEF Sustainable Agriculture and Climate Change Mitigation Project	Promote EE and RE in rural areas, including capacity building activities	Planned FY 13	12.69 (GEF (grant)
AF for EE Facility for Industrial Enterprises	Scaling-up EE improvements in industries	Planned FY14	100 est. (IBRD loan)
Rehabilitation and modernization of power distribution network	Improve reliability of distribution network will help to reduce technical and non-technical losses	Planned	100 est. (IBRD loan)
Global Gas Flaring Reduction Partnership	Overcome the barriers to reducing gas flaring by sharing global best practices and implementing country specific programs	Active	

4- World Bank EE Program in Central Asia

Kazakhstan

Project	EE related Objectives	Status	Budget (US$ M)
EE Project	Improve EE in public and social facilities and improve the enabling environment for EE financing	Planned FY13	24.4 (TF grant)
Moinak and Alma Transmission projects	Modernizing transmission infrastructure and reduce transmission losses	Active	126 (IBRD loan)

Kyrgyz Republic

Project	EE related Objectives	Status	Budget (US$ M)
DPO	Including tariff reforms and energy governance	Planned	13.4 (IDA grant)
Electricity Supply Reliability and Transparency	Reduction of losses and larger sector transparency and accountability	Planned	15-20 (tentative)
EE Assessment in the buildings sector	Prepare Energy Efficiency Action Plans that would identify specific options to reduce energy consumption by buildings and help address the winter electricity shortages	Planned FY13/14	0.5

4- World Bank EE Program in Central Asia

Tajikistan

Project	EE related Objectives	Status	Budget (US$ M)
Energy Audit and EE Action Plan at Talco	Develop EE Action Plan to identify EE options and reduce Talco's electricity consumption	Active FY13	0.35 (TF grant)
Energy Loss Reduction Project	Supply and installation of electricity/gas meters and implementation of electricity/gas tariff policies	Active	18 (IDA grant)
Energy Emergency Recovery Assistance Project	Support winter demand management as well as energy loss reduction measures	Active	15 (IDA grant)
EE Assessment in the buildings sector	Prepare Energy Efficiency Action Plans that would identify specific options to reduce energy consumption by buildings and help address the winter electricity shortages	Planned FY13/14	0.5

5- Effective loss reduction programs

- **Supply**
  - **Reduction of technical losses implies significant investments in rehabilitation/upgrading/replacement of transmission and distribution networks**
  - **But those investments are needed to improve service quality and in general more cost-effective than expansion of installed generation capacity and have a direct impact on the more efficient use of available energy supply**
- **Demand**
  - **Effectiveness of "demand side EE" is maximized if:**
    - **Every consumer is metered and billed according to actual energy use**
    - **Price system and rates reflect cost of efficient service provision**

5- Effective losses reduction programs

- **Reduction of non-technical losses (currently unbilled consumption)**
  - **Consumption becoming increased sales improves financial situation of the service utility but has no impact on EE**
  - **But comprehensive experience in other developing countries (Latin America, South Asia) shows that a significant percentage of formerly unbilled consumption becomes reduced demand (same effect than reduction of technical losses):**
    - **20% for large industrial consumers**
    - **40-60% for large and medium commercial and residential consumers**
  - **Structure of market served by electricity utilities helps to address actions: 1-3% of large customers represent 40-50% of current sales**
  - **Actions must be focused initially on this "high value" segment**

5- Effective losses reduction programs

- **Reduction of non-technical losses (currently unbilled consumption)**
  - **Revenue protection projects (RPPs) based on systematic recording and monitoring consumption of large customers and adopting consistent corrective action allow to achieve significant sustainable reduction of non-technical losses**
  - **Application of Advanced metering infrastructure (AMI) makes implementation of RPPs technically viable and financially very attractive**
  - **But RPPs are not "smart metering" projects:**
    - **Core aspects are organizational arrangements adopted by the utility to actually monitor consumption of targeted users on a systematic manner and adopt consistent corrective action if needed**
    - **The utility must implement one or more "Metering Control Centers (MCCs)"**

5- Effective losses reduction programs

- **Reduction of non-technical losses (currently unbilled consumption)**
  - **Metering Control Centers (MCCs) must be staffed with staff characterized by adequate technical skills and ethics**
  - **Young engineers with no previous experience are in general a very good option**
  - **Staff of MCCs will be trained in the use of the IT applications supporting their job:**
    - **Software package (Meter Data Management; MDM) specifically designed for recording and monitoring consumption (not for billing purposes)**
  - **Periodic rotation between staff operating the MDM and carrying out field inspections based on analysis of metering data is strongly recommended**
  - **Metering installations of targeted consumers must be inspected before they are incorporated to the MCC (otherwise MCCs monitors continuation of a former fraud)**
  - **Information provided by the MDM should be transparently available companywide to enable audits and other controls**

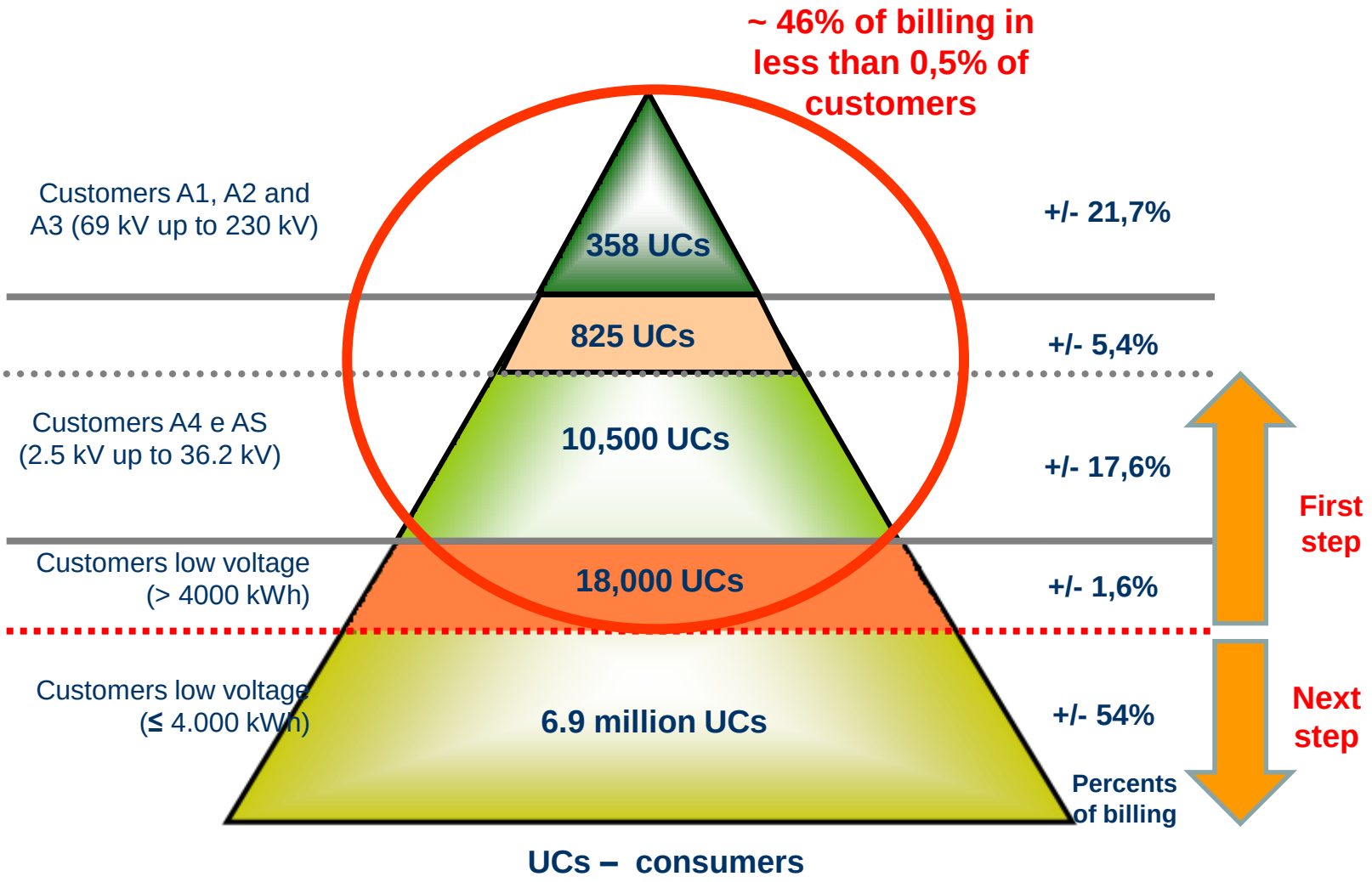
5- Effective losses reduction programs

- **Reduction of non-technical losses (currently unbilled consumption)**
  - **Medium and small consumers could be progressively incorporated to the MCCs, following a “top down” approach**
  - **Implementation of MCCs should be complemented with the incorporation of a Commercial Management System (CMS) to support development of all commercial processes and activities involving 100% of customers: metering, billing, collection, unpaid bills, new services, attention of customers (call centers, agencies, WEB, etc.)**
  - **CMS and AMI are IT applications enabling the implementation of approaches for management that improve operational and financial performance and enhance corporate governance within the company and also at the sector level (if information is made available to regulators and other external stakeholders).**

Revenue Protection project in CEMIG Brazil

- 7 million customers served in Minas Gerais state
- Served area: 578,400 km2
- Number of cities supplied: 774
- Number of locations served: 5,415
- Urban network: 90,180 km
- Rural network: 353,345 km
- Current technical losses: 8%
- **Current non-technical losses: 2%**
- **Non-technical losses went up 2 percentage points countrywide in the last 4 years following increases in average retail tariffs**

Structure of market served by CEMIG



CEMIG's Metering Control Center

Functionalities of the Meter Data Management (MDM) used in CEMIG's MCC

- ✓ Revenue protection (detection of theft, frauds, etc.)
- ✓ Automatic meter reading
- ✓ Remote disconnection / reconnection
- ✓ Time of use (TOU) rates
- ✓ Load control
- ✓ Outage detection

Results of the Implementation Revenue Protection Project in CEMIG

- ✓ The company managed to “decouple” from the growing trend of non-technical losses countrywide: current value is around 1.5%

- ✓ More importantly: the adopted approach ensures sustainability on time of the company’s good performance

- ✓ Transparency, accountability and corporate governance in management of large customers were significantly enhanced