

Armenia: Energy Efficiency Roadmaps

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Energy Efficiency – why care?

Security

- Many countries import substantial share of energy resources

Deficit

- Growing demand & aging capacities may be leading to an emerging supply gap

Affordability

- Growing energy prices (in the long-run) & affordability concerns

Economic growth

- Export competitiveness

Environmental Footprint

- Local and global environmental concerns

Energy Efficiency – why should Armenia care?

2/3 of all energy resources imported

Emerging supply gap:

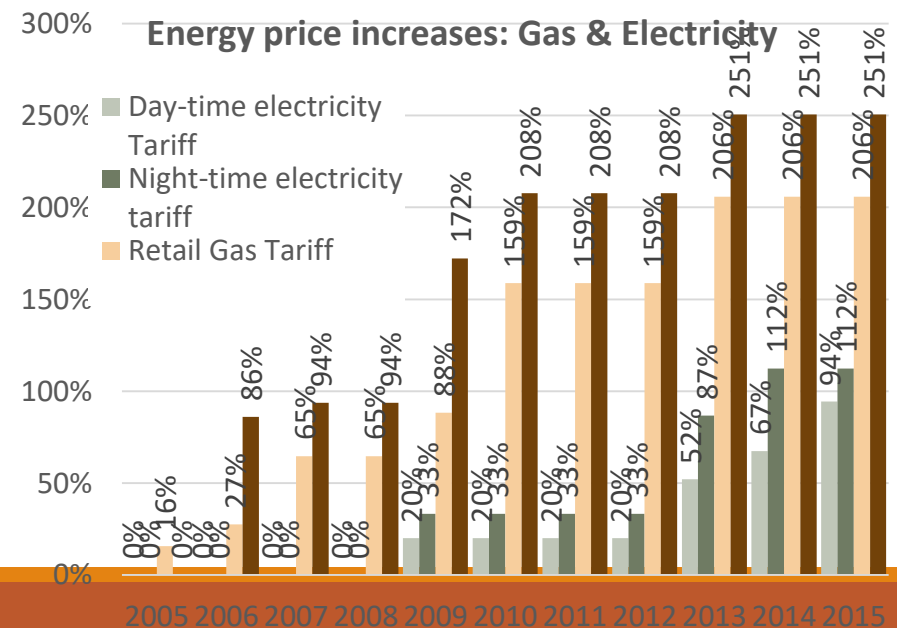
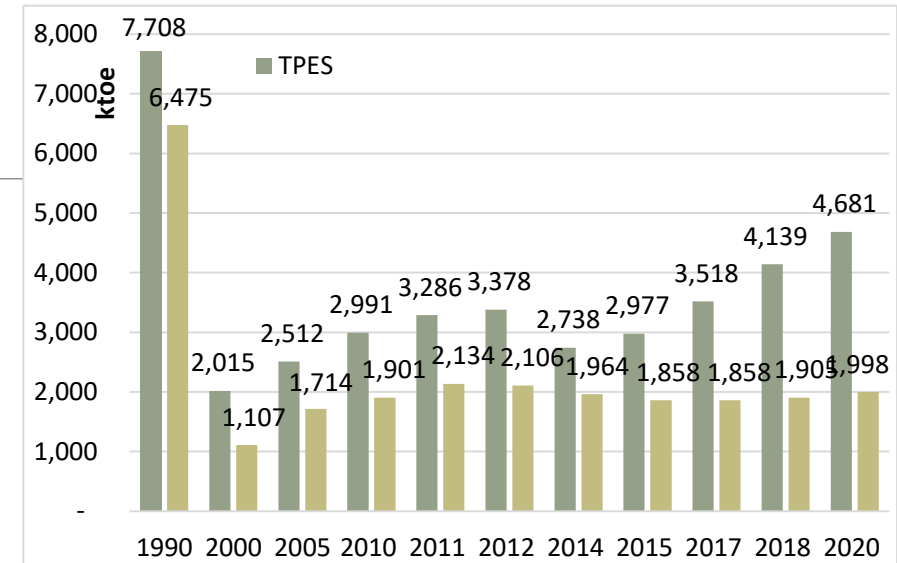
- Demand grew and forecasted to grow further, existing supply capacities insufficient to meet the growing demand
- Future demand supplied by aging capacities to require 2-3 times more TPES

Energy price hike in the last decade poses affordability and competitiveness problems

- Electricity price rose by 94-112%
- Natural gas price rose by 200-250%

Armenia's economic indicators dragging:

- Global competitiveness index dropped from 117 to 85 during 2013-14 (WEF)
- GDP growth dropped from 7.2% to 3.4% during 2012-14 (WB)



Why is Energy Efficiency Important for Armenia?

Energy Efficiency can:



create conditions for economic growth while improving the country's energy security.

reduce the energy intensity of the national economic output, improve cost-effectiveness & competitiveness

maintain a safe, sustainable and affordable energy supply, while mitigating climate change

help meet increasing energy demand, capturing “lost opportunities” for saving energy in new construction

Improve the quality of life for the Armenian population, create jobs and help local economy

reduces utility bills for all consumer groups

reduces use of limited natural resources and pressure on endangered forest resources

Under conditions of extreme energy import dependence, energy that Armenia's citizens, businesses, and infrastructure do not use is the cheapest, cleanest, and most secure energy resource.

Energy Policy Roadmap



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graph LR; A[Baseline Assessment] --> B[Long Term EE Policies]; B --> C[Implementation];
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Baseline Assessment

- Statistics
- Footprint
- Forecast
- Security

Long Term EE Policies

- Targets
- Measures

Implementation

- Regulations
- Financing
- MRV
- Further reform

Review of Policies, Strategies, Regulations in EE

Energy policies and instruments and their implementation

- Energy Sector Development Strategy of 2005
- Law on Energy Saving and Renewable Energy
- National Program on Renewable Energy and Energy Efficiency
- 1st National Energy Efficiency Action Plan targeting 2013
- 2nd NEEAP (targeting 2017-2018-2020)
- 2012-2025 Long-Term Strategic Development Program
- National Energy Security Concept
- Least Cost Generation Plan
- RE Roadmap & SREP Investment Plan 2014

Secondary Legislation & Regulatory Framework

- Adopted Building Construction Norm on Building Thermal Protection
- Resolution 1504 on Mandatory EE In State Investment Programs
- Draft Technical Regulation on “Buildings and structures/premises, construction materials and products. Safety”
- Draft Technical Regulation on “Building Energy Efficiency”
- Normative-technical documentation

International Treaties

- Energy Charter Treaty
- Observer Status in Energy Community
- United Nations Framework Convention on Climate Change
- EU Covenant of Mayors
- Eurasian Economic Union documentation

Baseline Energy Assessment

Consumption status

Total Primary Energy Consumption

Total Primary & Final Energy Consumption

Major Consumers

Major Fuels

Supply & Demand

Import Dependence

Indigenous Production

Demand Projection

Price Trends & Affordability

Footprint / Analysis

Nation-wide and sectoral energy intensities

GHG Emissions

Synergy with Sectoral Development Strategies

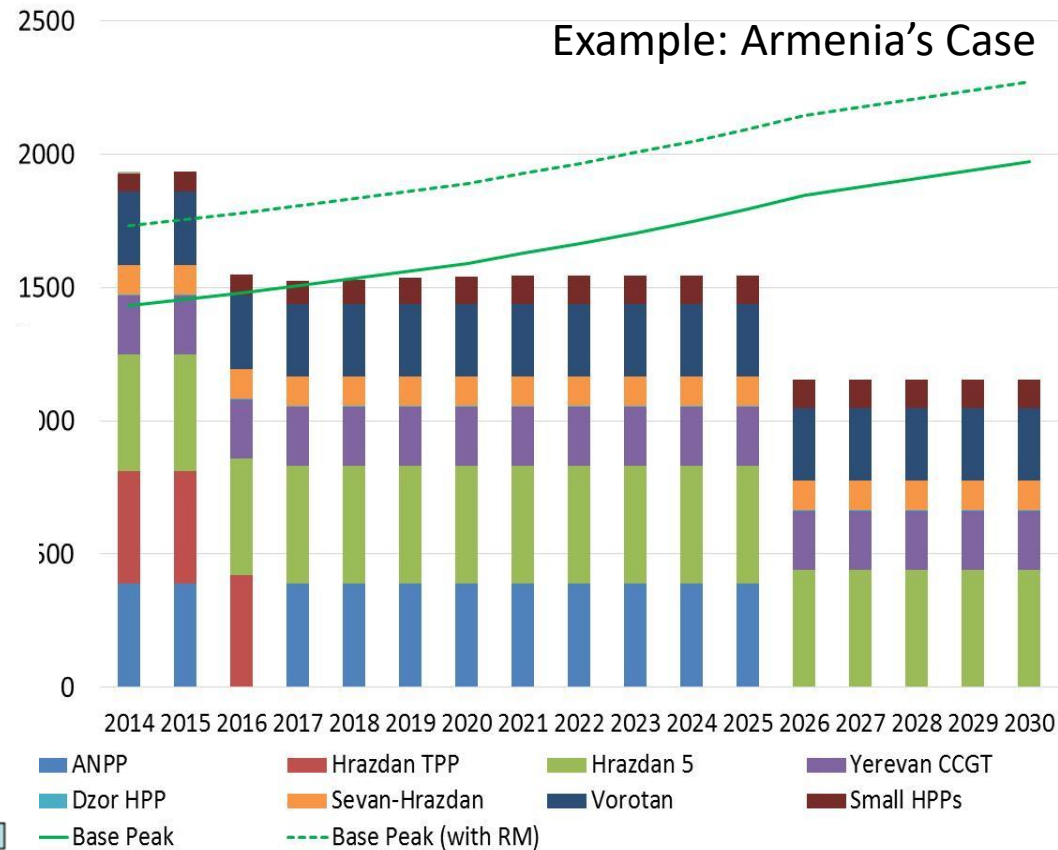
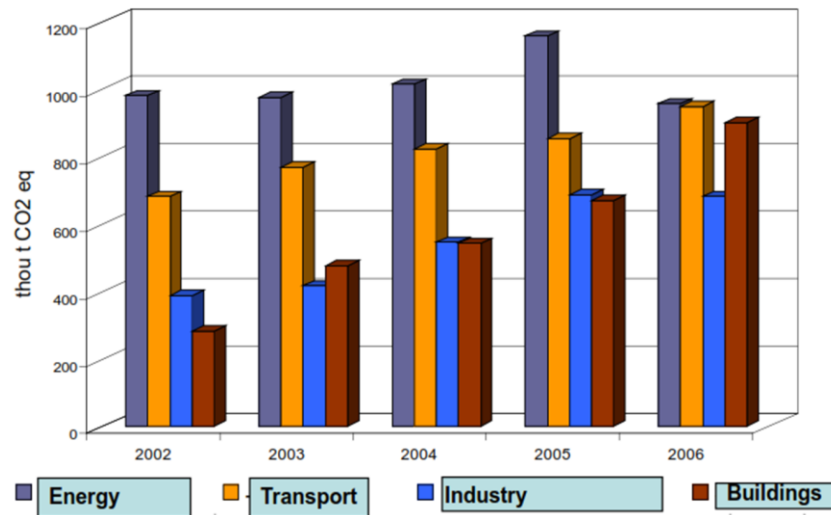
Comparison against benchmarks, previous targets

Etc.. (country-specific)

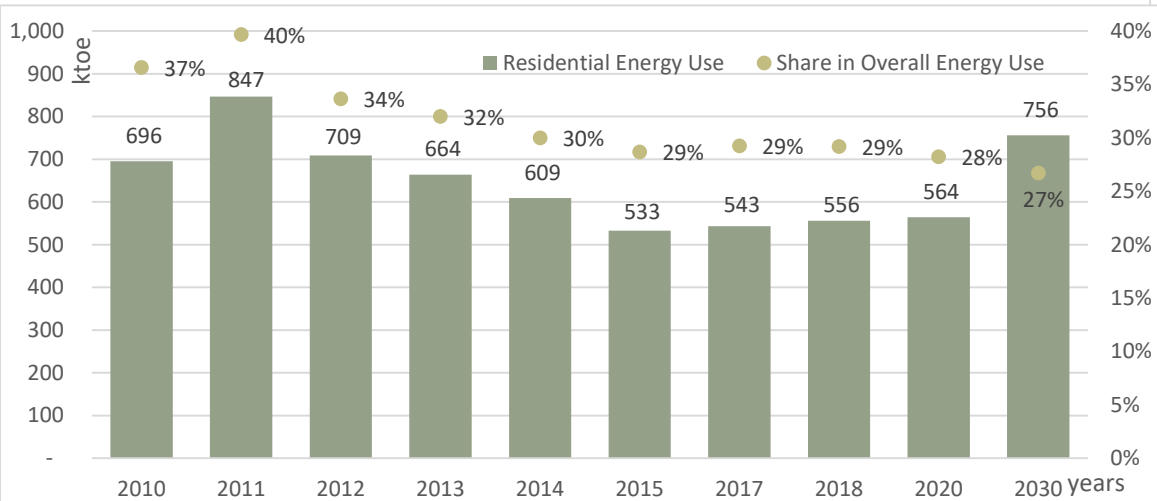
Baseline Assessment Concludes:

Problems & Consequences without action:

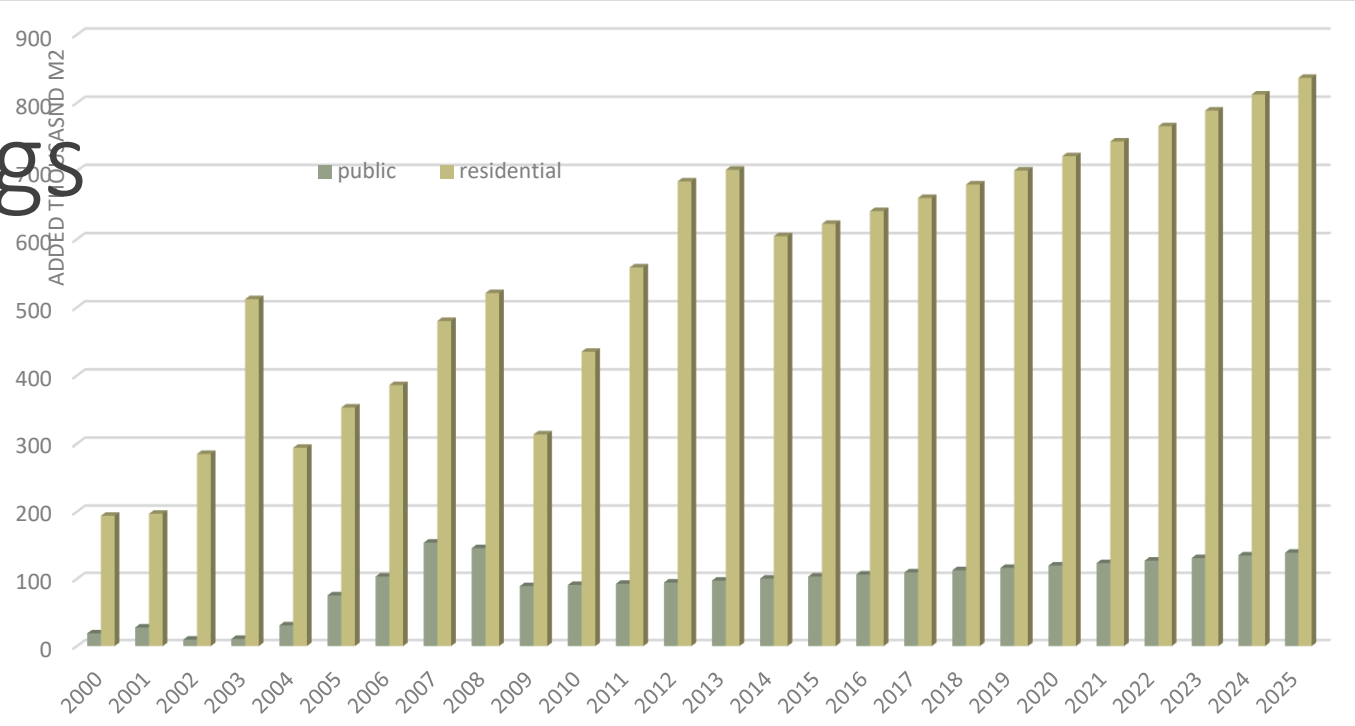
- Import dependence
- GHG emissions
- Energy Intensity
- Looming supply gap



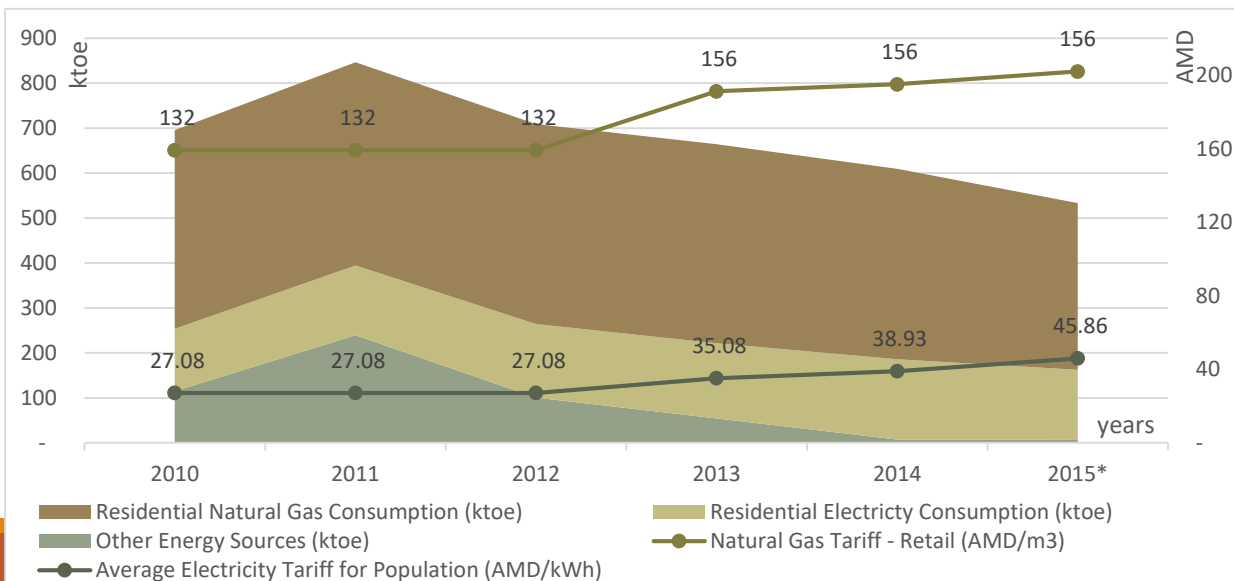
Buildings Sector/ Existing Residential Buildings



Energy Use in Residential Sector, 2010-2030.

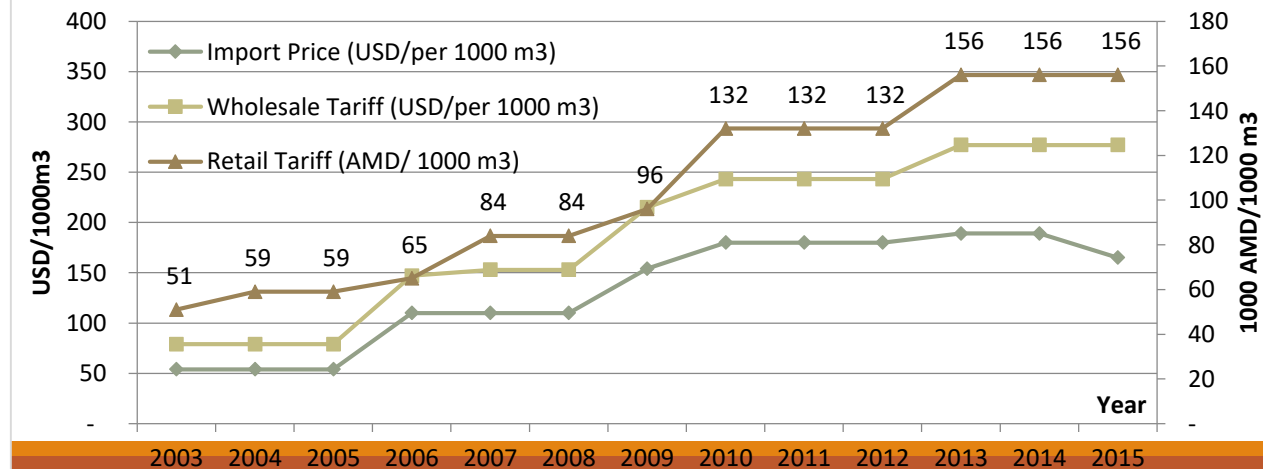


Growth dynamics and forecast for residential and public building stock in Armenia



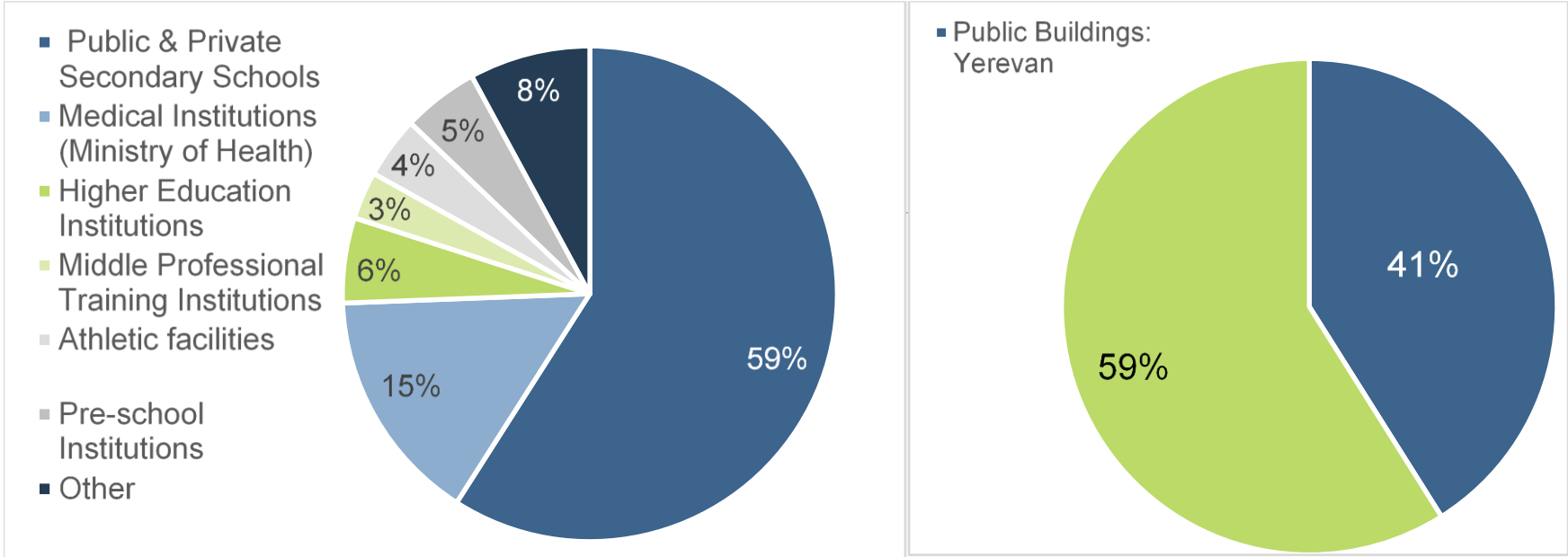
Energy tariffs and Energy Consumption in Residential Sector, 2010-2015

Gas Tariff Increases in Armenia



Natural gas import price and tariffs by consumer groups (2003-2015)*

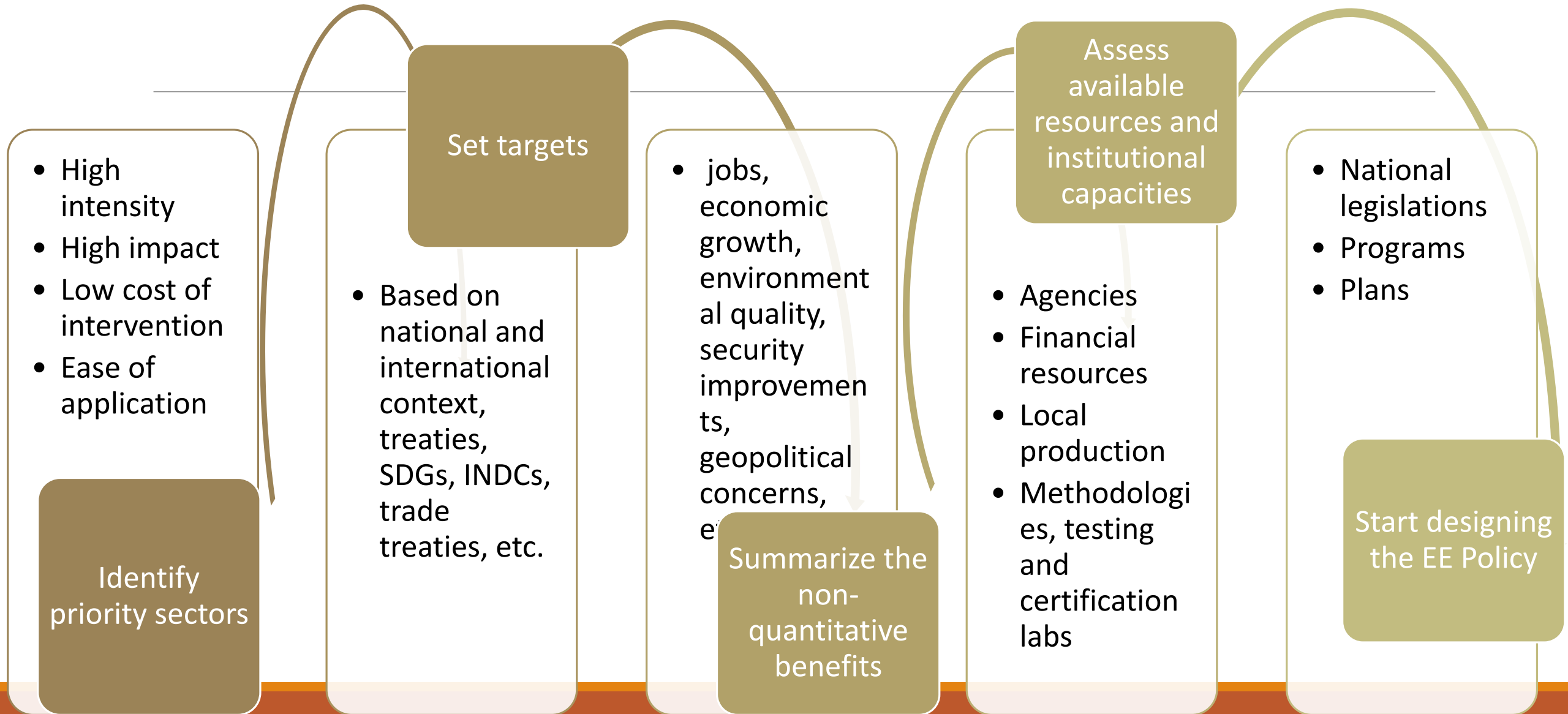
Public Buildings and Services



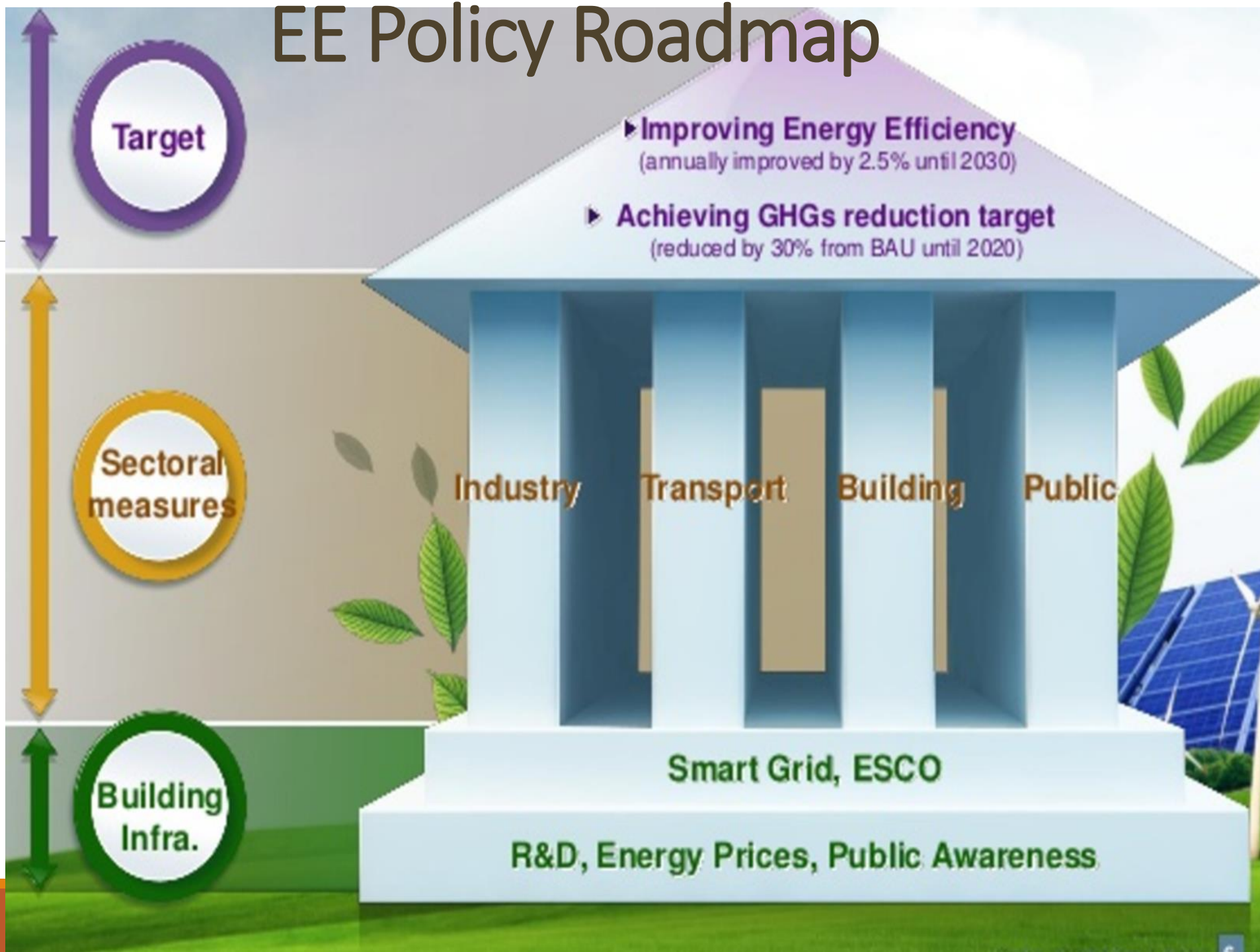
Energy Saving Potential in Public Buildings

Total Area of public buildings in Armenia (m2)	13,787,397
Total energy consumption in Public Buildings (MWh/year)*	1,764,787
Annual Energy Saving Potential (MWh/year)*	896,181
* - based on R2E2 experience with 56 projects.	
Average energy consumption prior to EE in public buildings	128 kWh.m/yr
Average energy consumption after EE	63 kWh.m/yr
Average energy saving rate	51%
Investment need (AMD) at average of AMD 8400/m2 for typical ESMs	115,814,134,238
Investment need (USD) - exchange rate 473	\$244,850,178
Total Financing currently available (GEF and KfW)	\$ 27,270,296

Next Step: EE Policy framework

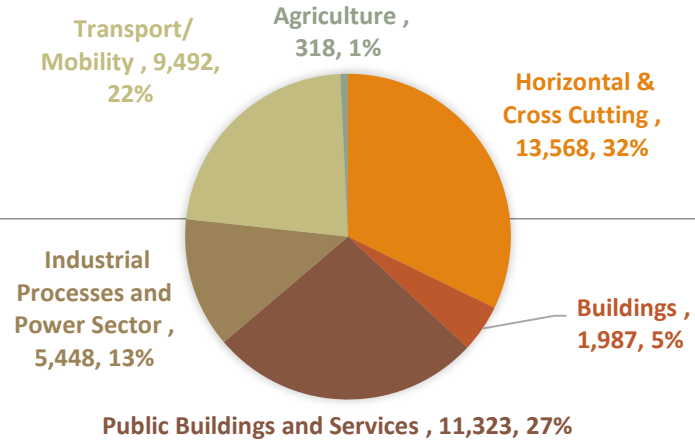


EE Policy Roadmap

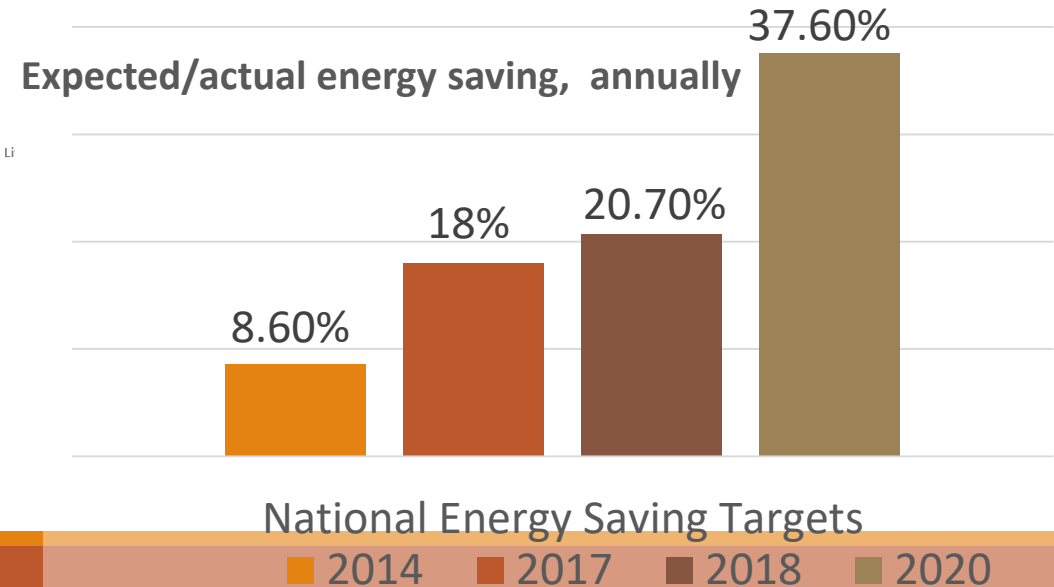
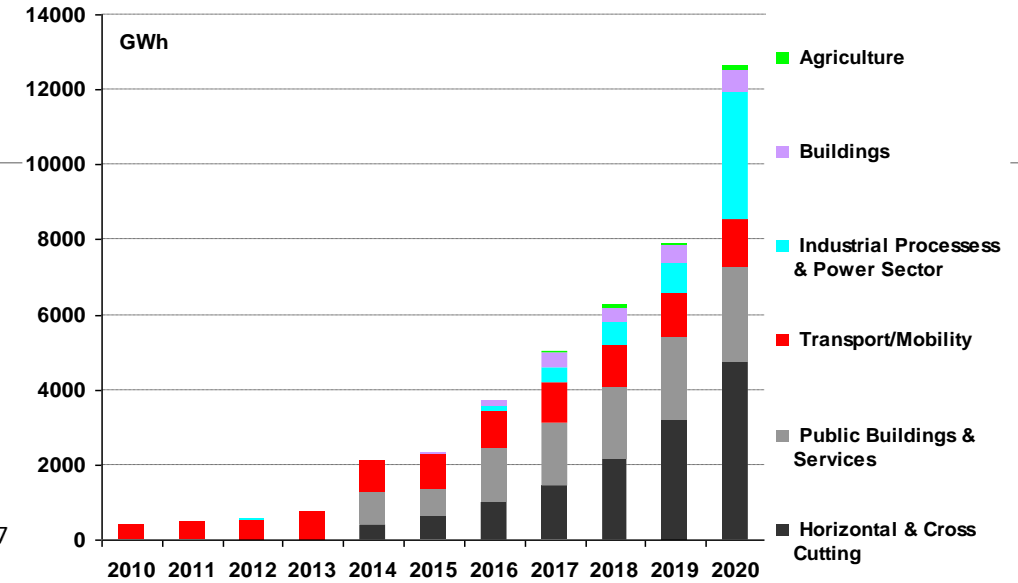
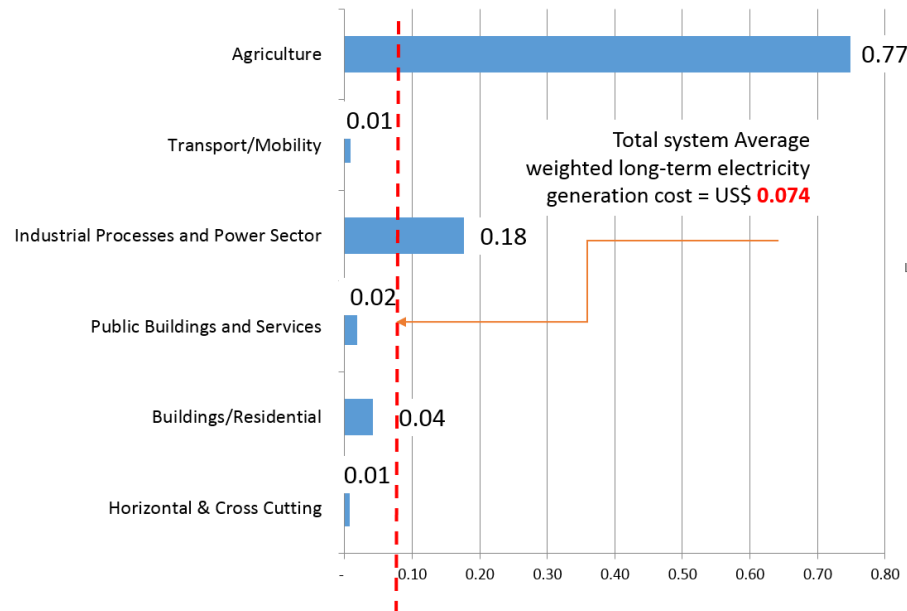


Energy Efficiency

POTENTIAL BY SECTOR (GWH, %)



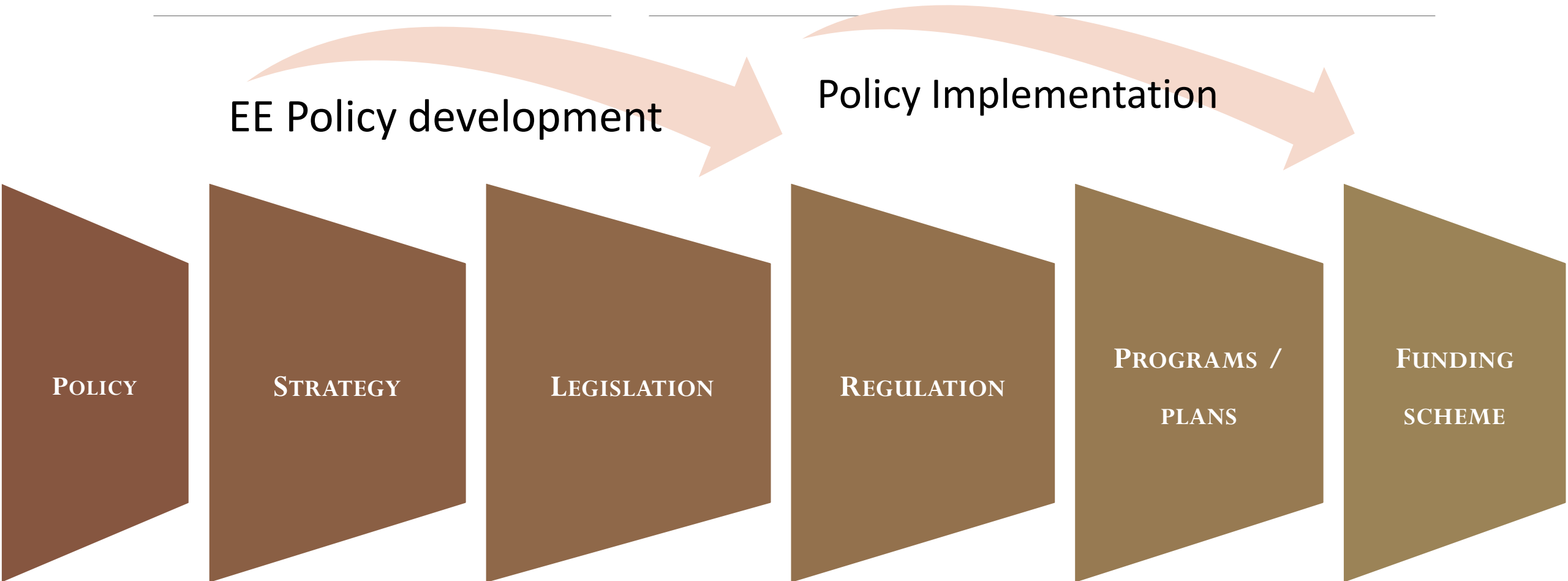
Weighted average cost of reduction of 1 kWh energy by sectors (USD) [over NEEAP lifetime 2010-20]



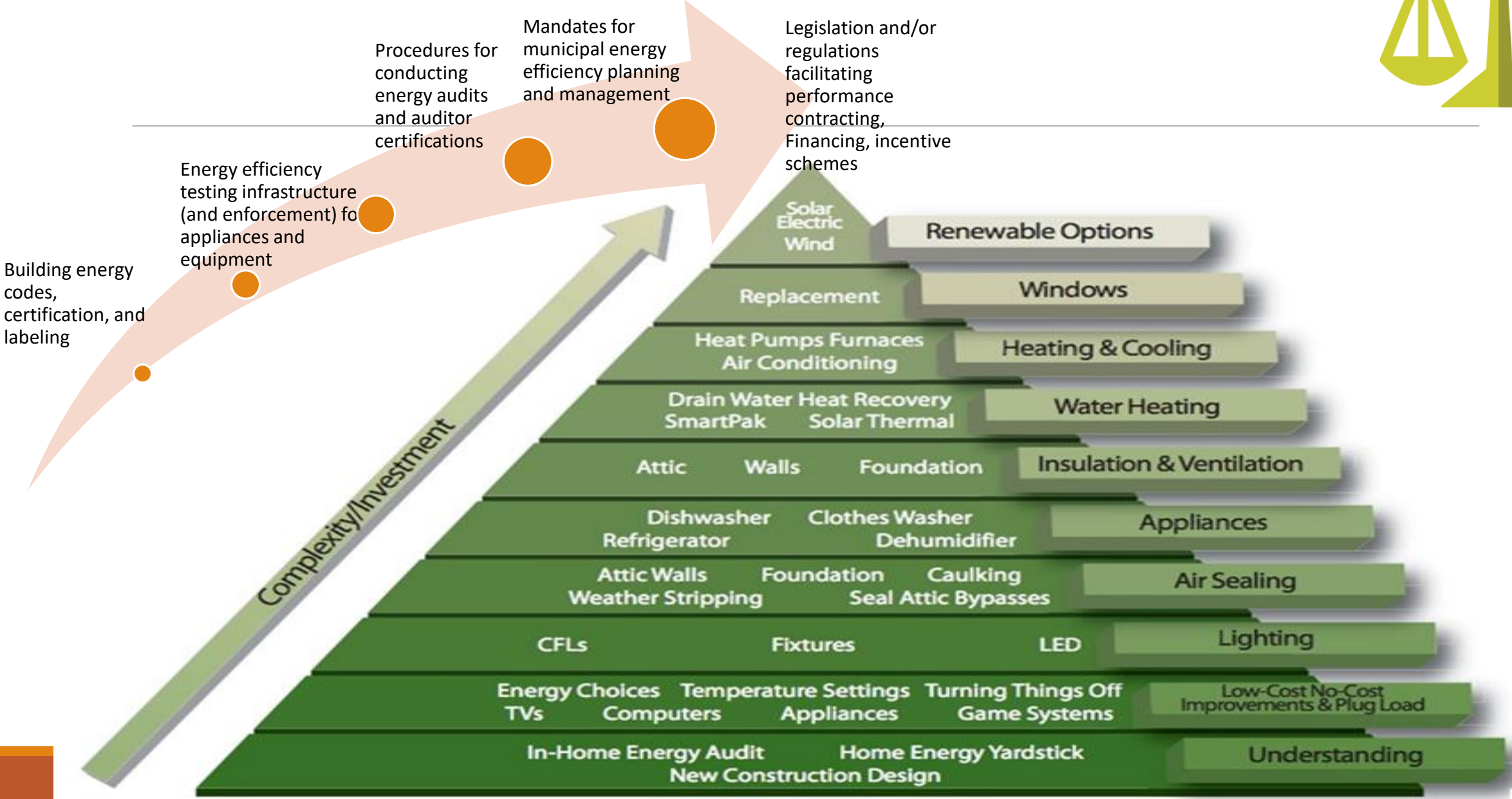
National Energy Saving Targets

2014 2017 2018 2020

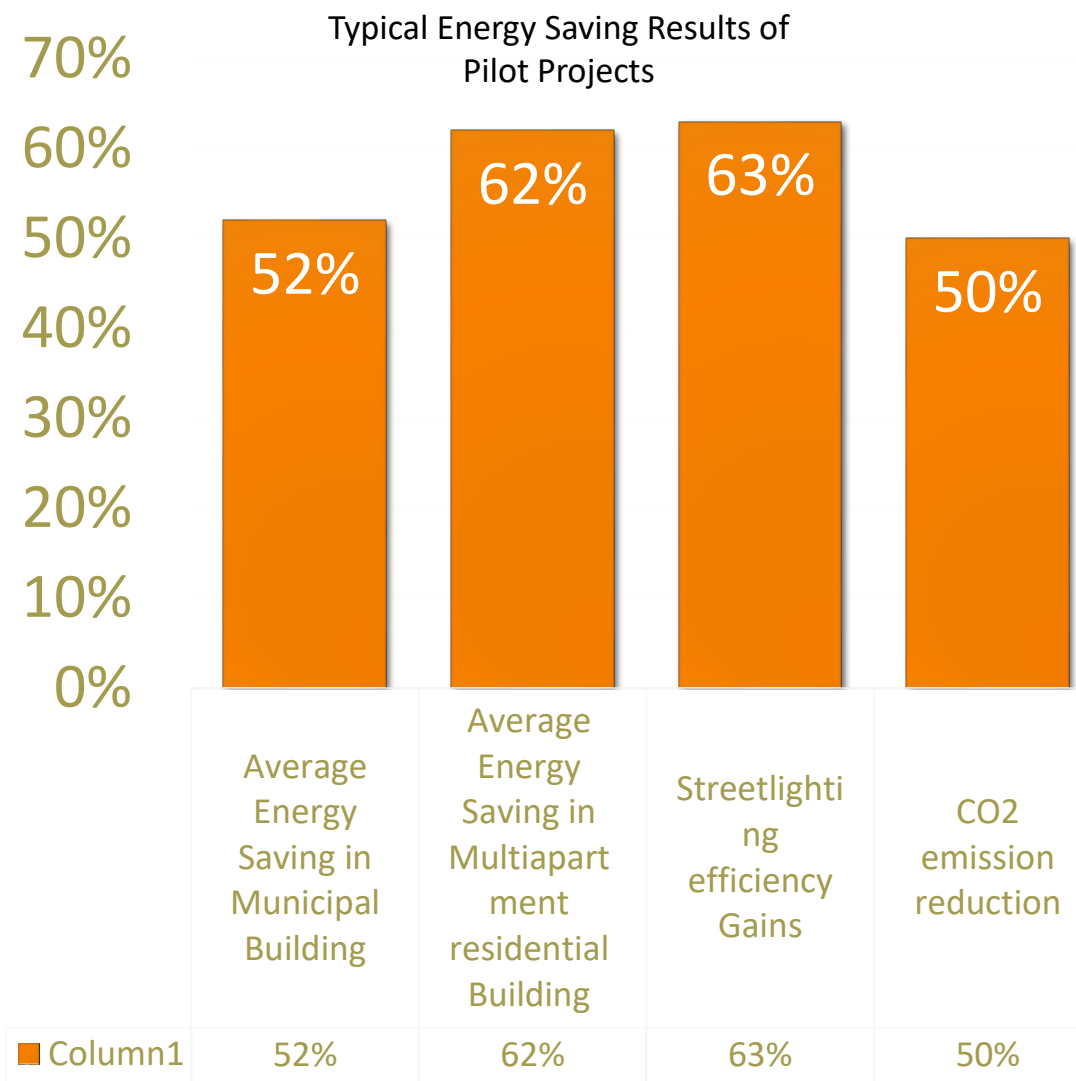
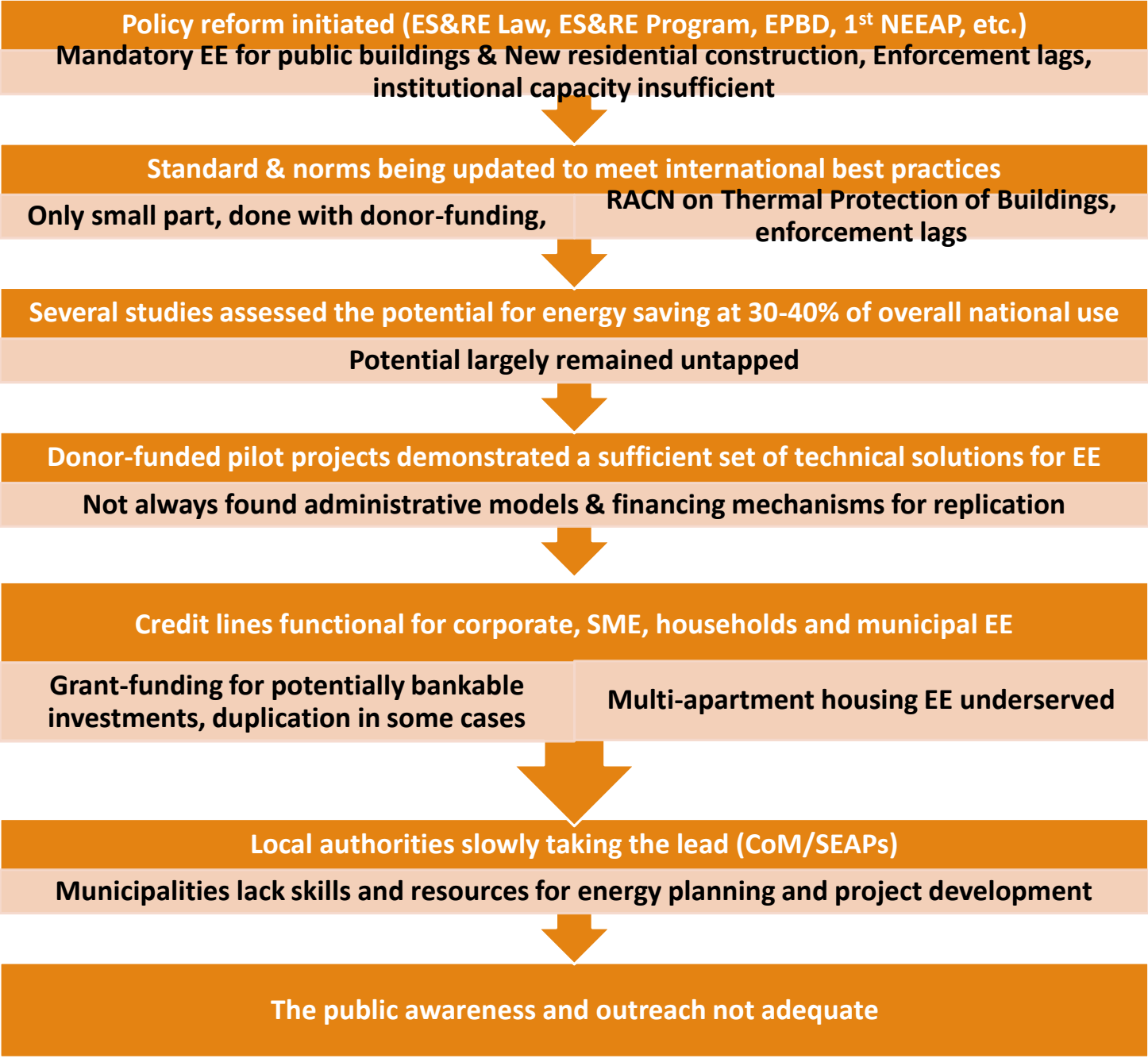
EE Policy Framework and Implementation Infrastructure Transition



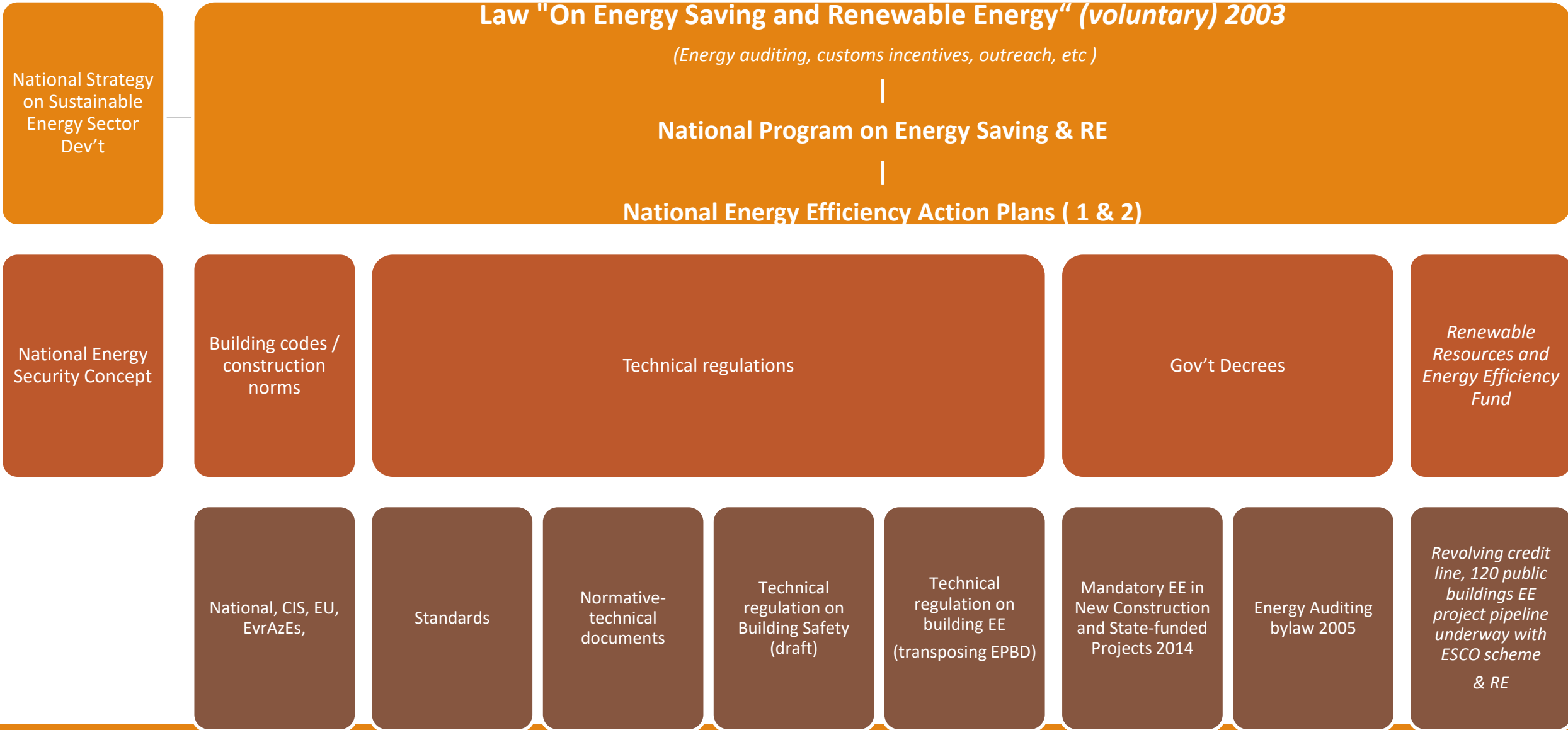
Legal Foundation for EE Improvement in Buildings: Strong Primary Legislation



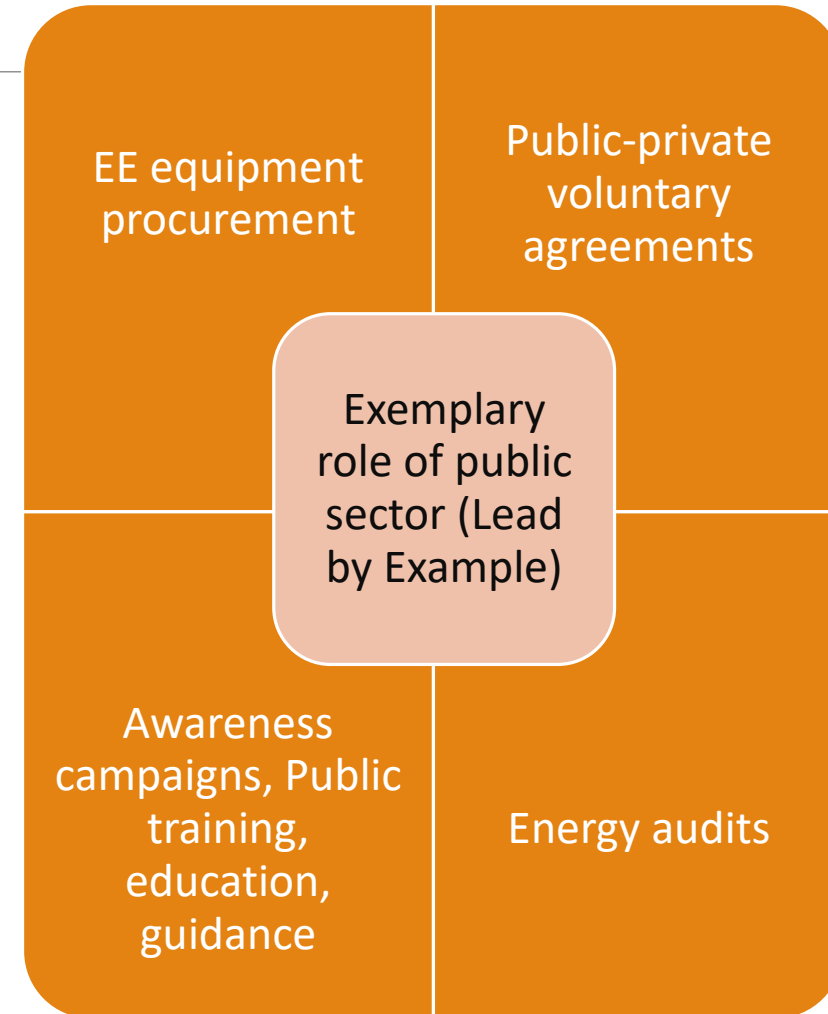
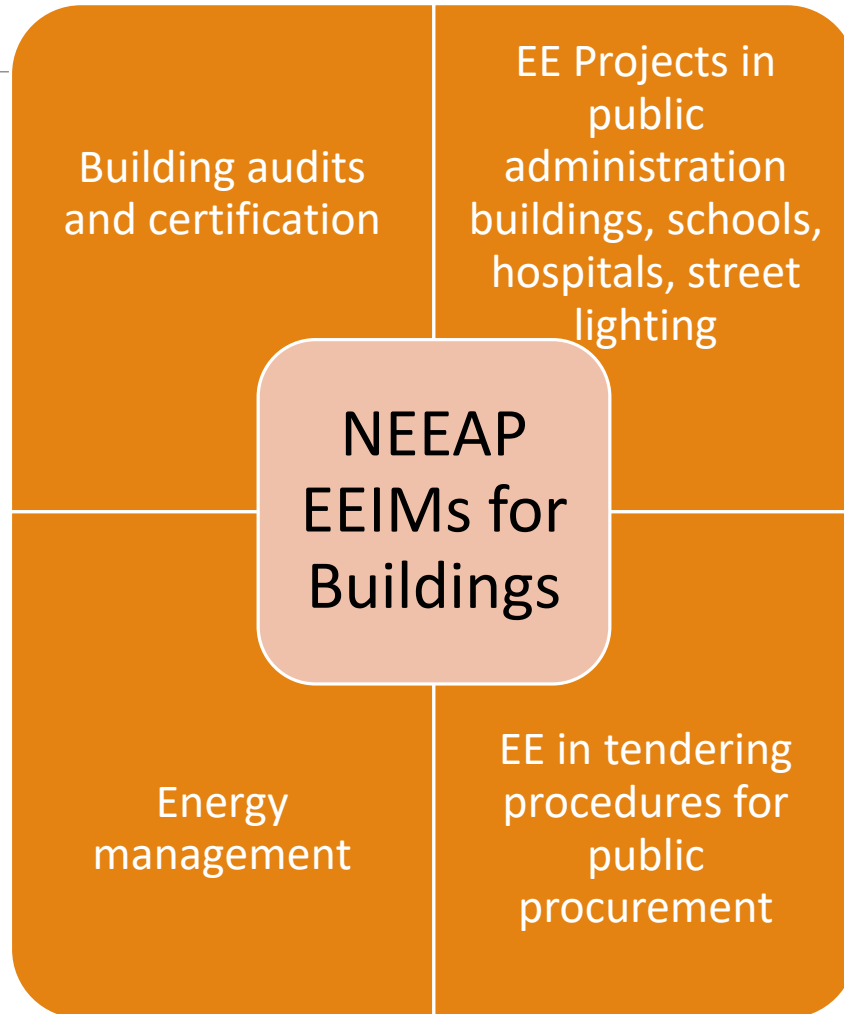
Positive Steps & Successes to Date and Remaining Issues



EE Policy Framework in Buildings in Armenia



NEEAP EE Improvement Measures & Buildings Sector



Norms & Standards in Building EE

National Norms & Standards

- RACN II-7.01-96 Construction climatology;
- CNM II-7.101-98 Construction of settlements, buildings and structures under the climatic conditions of the RA;
- RACN II-7.02-95 Construction thermal physics of envelopes; design norms;
- BCM/CNM II-7.102-98 Construction thermophysics of envelopes (Manual on RACN II-70.2-95 norms/codes);
- RACN II-8.03-96 (MCH 2.04-05-95) Artificial and natural lighting;
- RACN IV-12.02.01-04 Heating, ventilation and air-conditioning
- SNiP 2.03.13-88 Floors; SNiP 2.08.01-89 Residential buildings; SNiP 2.08.02-89 Public buildings and structures;
- SNiP 2.09.04-87 Administrative and residential buildings; and SNiP 3.04.01-87 Insulation and decorative coatings.
- RACN II-7.02-95 “Construction thermal physics of the building envelopes; design norms” and the CNM II-7.102-98 Construction thermal physics of envelopes”
- AST 1434-1-2010 Heat Meters
- RACN 24-01-2016: Thermal Protection of Buildings

Adapted International Norms & Standards

- ISO 16818 Building Environment Design. Energy Efficiency. Terminology
- ISO 23045 Building Environment Design. Energy Efficiency Assessment Guide for New Buildings
- EN 15316-1 Heating Systems in Buildings. A Method for Calculation of System Energy Demand and System Efficiency
- EN 15217 Energy Performance of a Building. Methods for Expression of Energy Performance and Energy Efficiency Certification of a Building
- EN 15603 Energy Performance of a Building. Shared Energy Use and Determining Energy Efficiency Ratings
- In 2004 the RA voted for the following ICNs adopted by the Interstate Scientific and Technical Commission for Standardisation, Technical Norms and Certification in Construction of CIS countries (MHTKC):
- MSN 2.04-02-2004 Thermal protection of buildings (currently under revision); and
- MSN 3.02-04-2004 Multi-apartment residential buildings.
- AST 1434-1-2010 Heat Meters: Part 1. General Requirements
- AST 1434-1-2010 Heat Meters: Part 6. Installation, Operation Delivery, Work Control and Maintenance

Pending Adoption

- EN ISO 13790:2008 . Energy performance of buildings – Calculation of energy use for space heating and cooling
- EN ISO 13789:2007 . Thermal performance of buildings – Transmission and ventilation heat transfer coefficients – Calculation method
- EN ISO 10211:2007 . Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations
- EN ISO 14683:2007 . Thermal bridges in building construction – Linear thermal transmittance – Simplified methods and default values
- EN 15242 :2007 . Ventilation for buildings – Calculation methods for the determination of air flow rates in buildings including infiltration
- EN ISO 9251 . Thermal insulation – Heat transfer conditions and properties of materials – Vocabulary

NEEAP EE Improvement Measures & Public Sector Leadership Roles

In the NEEAPs of Armenia (as in all of the European countries), common EE improvement measures include:

- Building audits and certification
- EE Projects in public administration buildings, schools, hospitals, street lighting
- Energy management
- EE in tendering procedures for public procurement

In NEEAPs, the public sector is given an exemplary role in:

- EE equipment procurement
- Public-private voluntary agreements
- Awareness campaigns
- Public training, education, guidance
- Trainings and EE related publications for professionals
- Energy audits

Cross-cutting & Horizontal Measures

Regulatory

Implementation of a regular national “Energy Statistic” (with annual updates)

Implementation of a “National EE&RE Energy Agency”

Financial Support for Energy Efficiency measures in all Sectors

Information campaigns,
training, education in EE
improvements

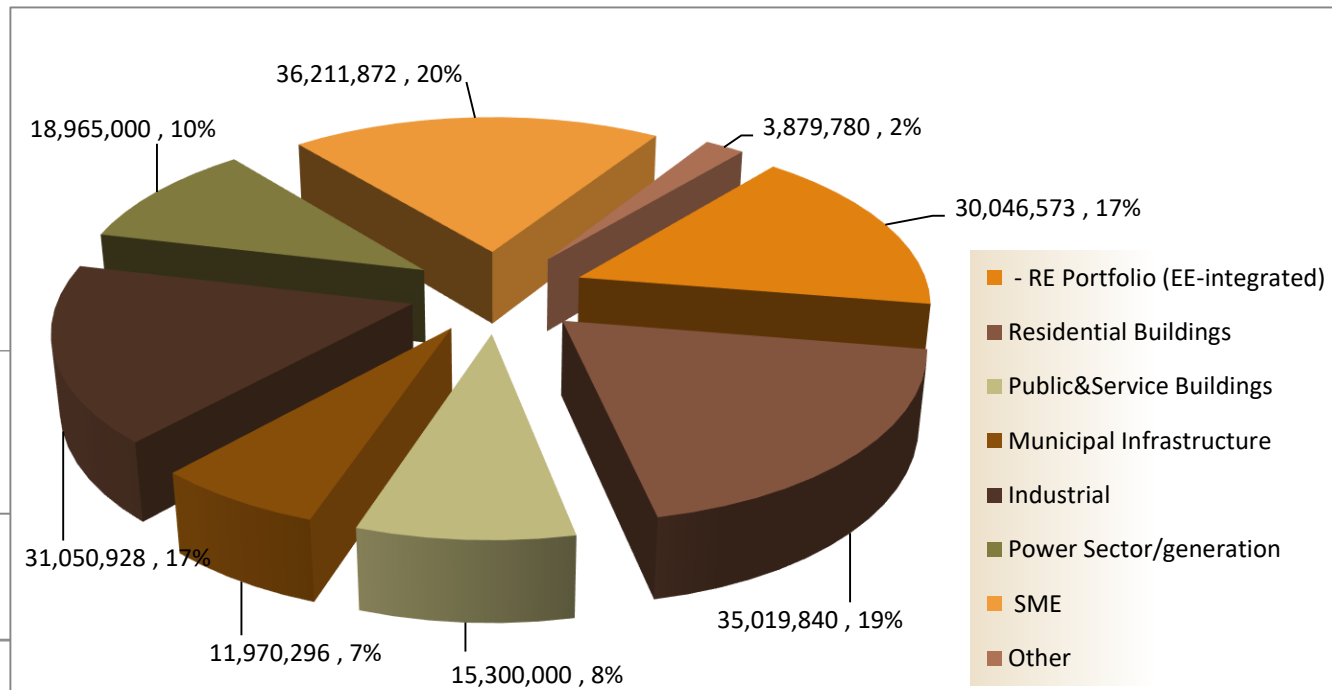
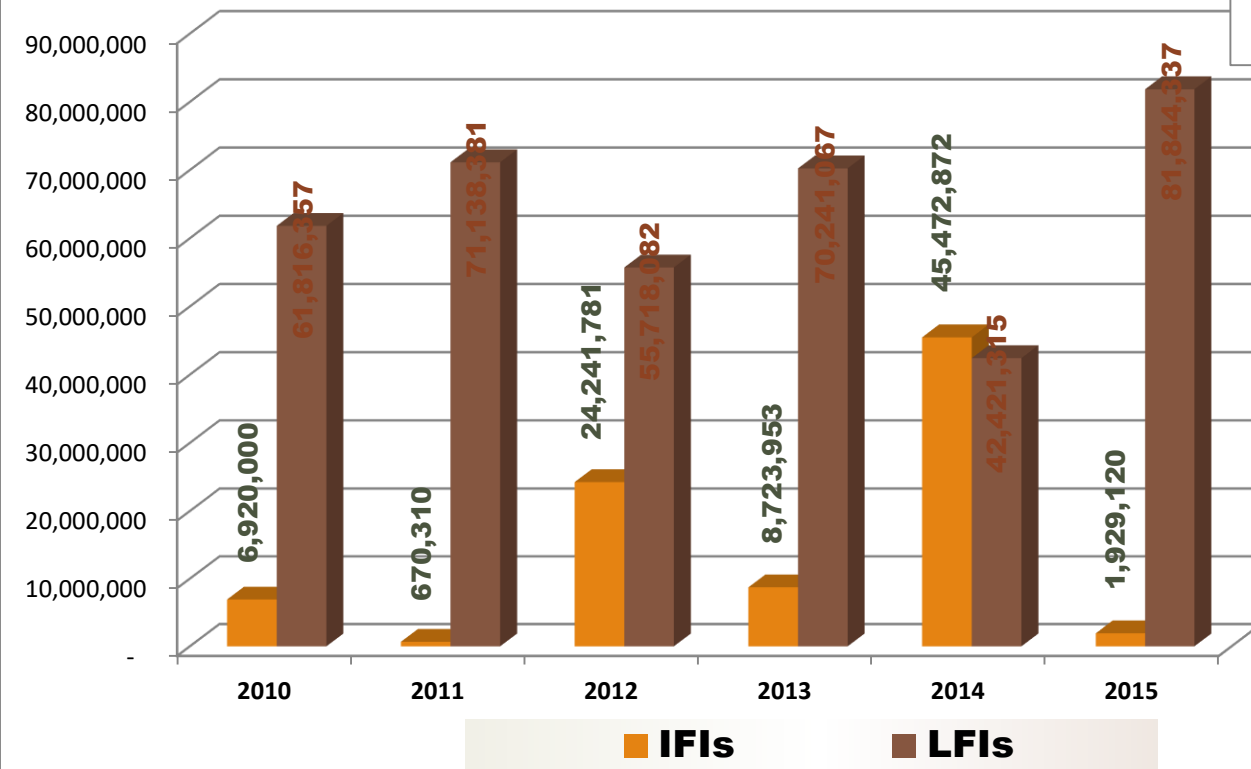
General Regulatory demand-side measures

Removing inadequate gas & electricity tariff structure to encourage EE

Programmatic

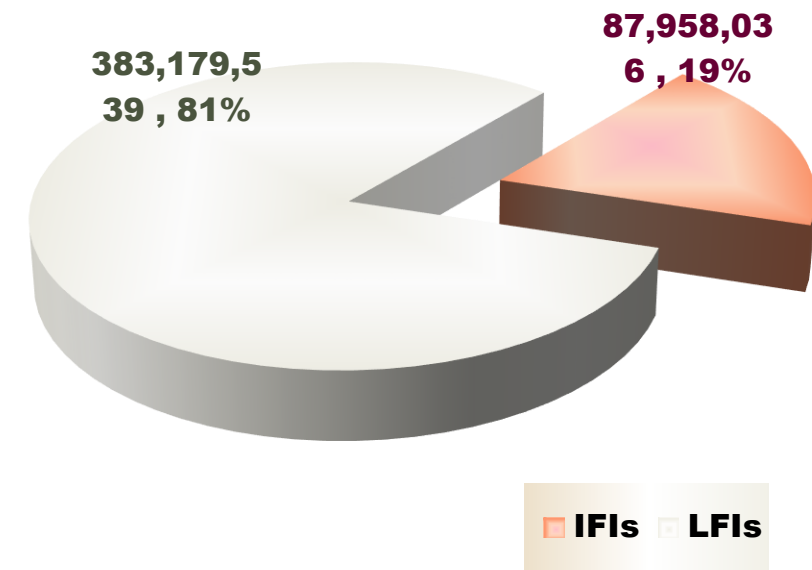
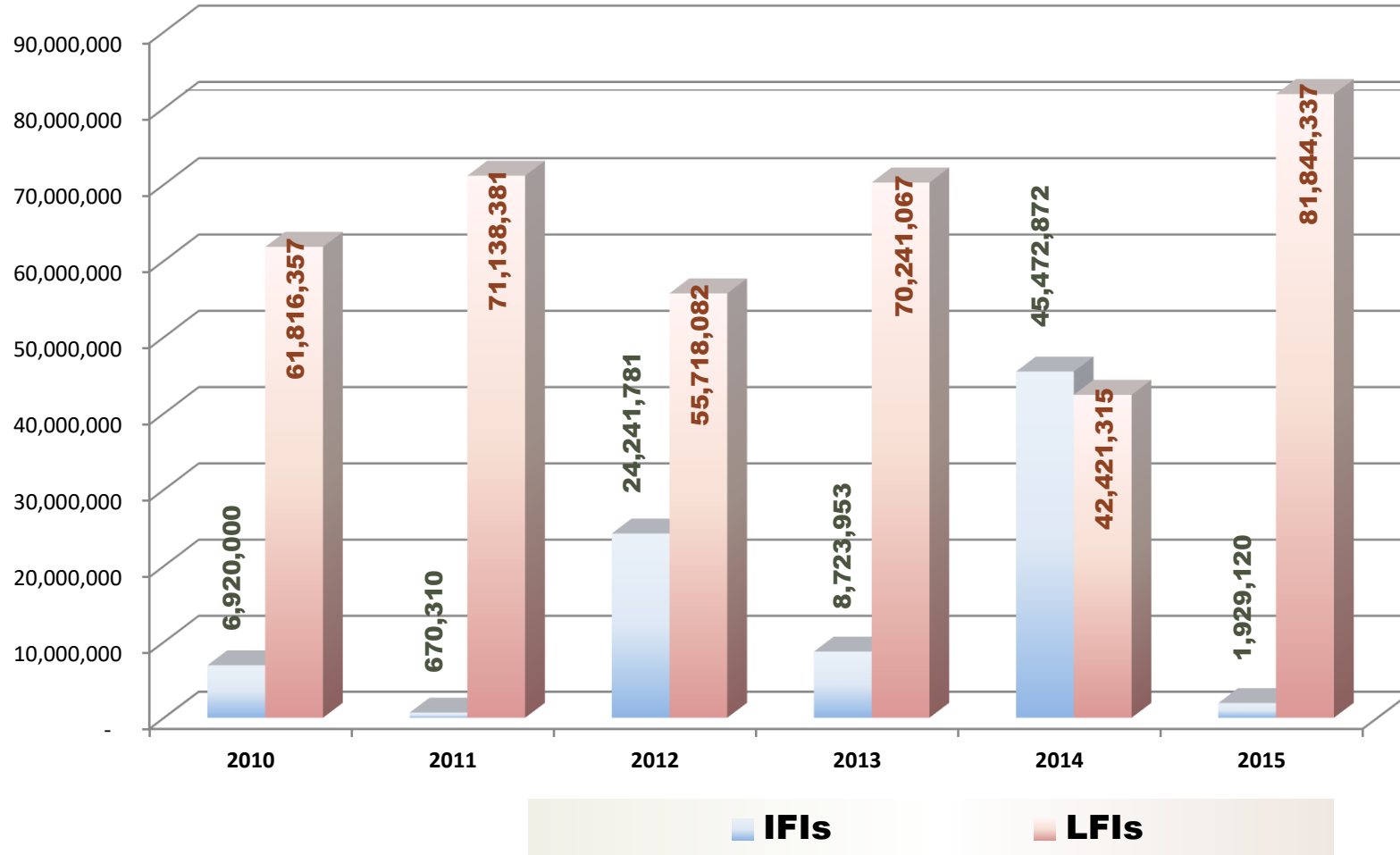
- **Financing for Energy Efficiency: GGF**
 - **Financing for Energy Efficiency: IFC EE loans for households and SMEs**
 - **Financing for Energy Efficiency: EE loans for residential and business clients, EBRD ArmSEFF**
 - **Financing for EE: Eastern European Energy Efficiency and Environment Partnership (E5P)**
- **Removing inadequate gas tariff structure to encourage energy savings**
 - **Support to Armenian Municipalities in Sustainable Energy Action Planning**

Cross-cutting / Financing EE Investments: EE&RE Lending Portfolio Analysis



About 150 thousand TOE was saved in 2010-2015 through EE lending, and more than 18.30 mln TOE would be saved in 2016-2020, due to the cumulative effect of savings from past investments. GGF is going to be the main player in this activity with its estimated share in total savings expected to be about 97.2%. This may potentially be due to the fact, that majority of IFIs has failed to provide reasonable forecast of lending plans beyond 2015.

EE / RE LOANS PROVIDED BY LFIs and IFIs IN 2010 - 2015, USD



Amount of EE / RE Loans provided by LFIs, including International Financial Institutions' (IFI) funds, increased from \$68.74 mln in 2010 to \$83.78mln in 2015, i.e. 2.71% per year, which is about 1.72 times less than the annual GDP growth rate. **So, Armenia had about \$340 mln unutilized EE investment potential in 2010-2015.**

EE Improvement Measures planned (1st NEEAP)

Building Sector: Horizontal Regulatory Measures

II.1. National Building Code considering energy performance of buildings

II.2. Standards and calculation methodology to assess energy performance in buildings

II.3. Institutional capacity-building for implementing and enforcing new standards

II.4. QA/QC standards for certification of key building materials

II.5. Methodology for assessment of energy performance for pilot buildings

II.6. Training and education on building energy performance

II.7.
Pilot Project: Design competition & construction of several “best-practice” buildings

Residential Buildings: Programmatic & New measures

II.7. Financing for EE & Pilot projects (UNDP/GEF BEEI project).

II.9.a. Financing for EE: Household energy efficiency loans and EE mortgage loans (NMC/AFD)

II.9.b. Financing for EE: Residential energy efficiency bank-based commercial loan through HFHA Condo, REELIH and SUDEP Projects

II.9.c. Financing for E: KfW Housing EE credit line

II.10. Mitigating Tariff Increase with Low-income Energy Efficiency Program

II.11. EE Retrofits in existing residential buildings: National Program and Action Plan for MAB Renovation & EE [potentially: UNDP/GEF De-risking EE investments in Residential Housing of Armenia]

II.12. Appliance Energy Labeling Awareness Campaign

Public Buildings & Services: Programmatic & New measures

III.1. Public Building EE: Implementation of energy saving activities in municipal and social public facilities (R2E2/GEF/WB)

III.1.a Public Building EE: Implementation of energy saving activities in municipal and social public facilities (R2E2/GEF/WB)

III.2. NAMA project to Support EE in Public Buildings and Social Housing

III.3. Financing for EE & Public Procurement for EE: UNDP Green Urban Lighting Project GHG Emission reduction by increasing EE in municipal lighting in the cities of Armenia

III.4. Financing for Energy Efficiency & Public Procurement for EE: EE-integrated reinforcement of Schools by KfW

III.5. EBRD Loan-funded Yerevan streetlighting

III.6. USAID Clean Energy and Water Program for EE & RE solutions in community energy and water use

III.7 Yerevan - Jur Rehabilitation and Modernization

Ways to Eliminate Gaps and Move Forward...

Continued reform:

- Enforcement of the recent amendments of the Law on Energy Saving and Renewable Energy
- Adoption/ enforcement of bylaws on energy auditing and EE in public procurement
- Development/ enforcement of EE standards, codes and labeling for all uses

EE funding:

- Continued operation and expansion of R2E2 Fund operations
- Smooth integration of E5P grant co-financing for non-bankable projects
- Leveraging IFIs & LFI resources to address underserved segments of EE financing market

New/improved housing legislation:

- Create favorable investment environment in multi-apartment buildings
- Introduce private sector participation through private maintenance companies & ESCOs

Tariff reform:

- Revise tariffs to incentivize energy efficiency
- Low-income assistance for implementation of energy efficiency measures

EE-integrated renewables:

- Incentives for wider combined energy efficiency-integrated renewable energy application

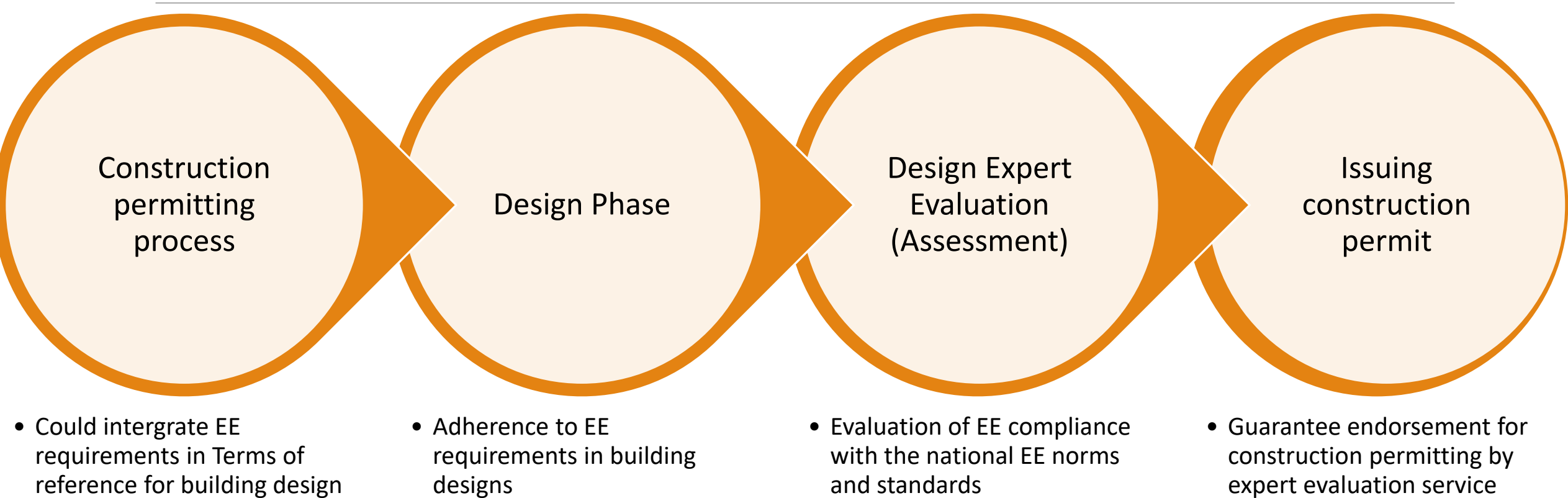
Information and outreach:

- Improvement of energy efficiency data collection and periodic energy balance calculation
- Development and provision of technical assistance in best available energy efficiency technologies for the industrial and agricultural sectors (e.g., greenhouses and aquaculture)

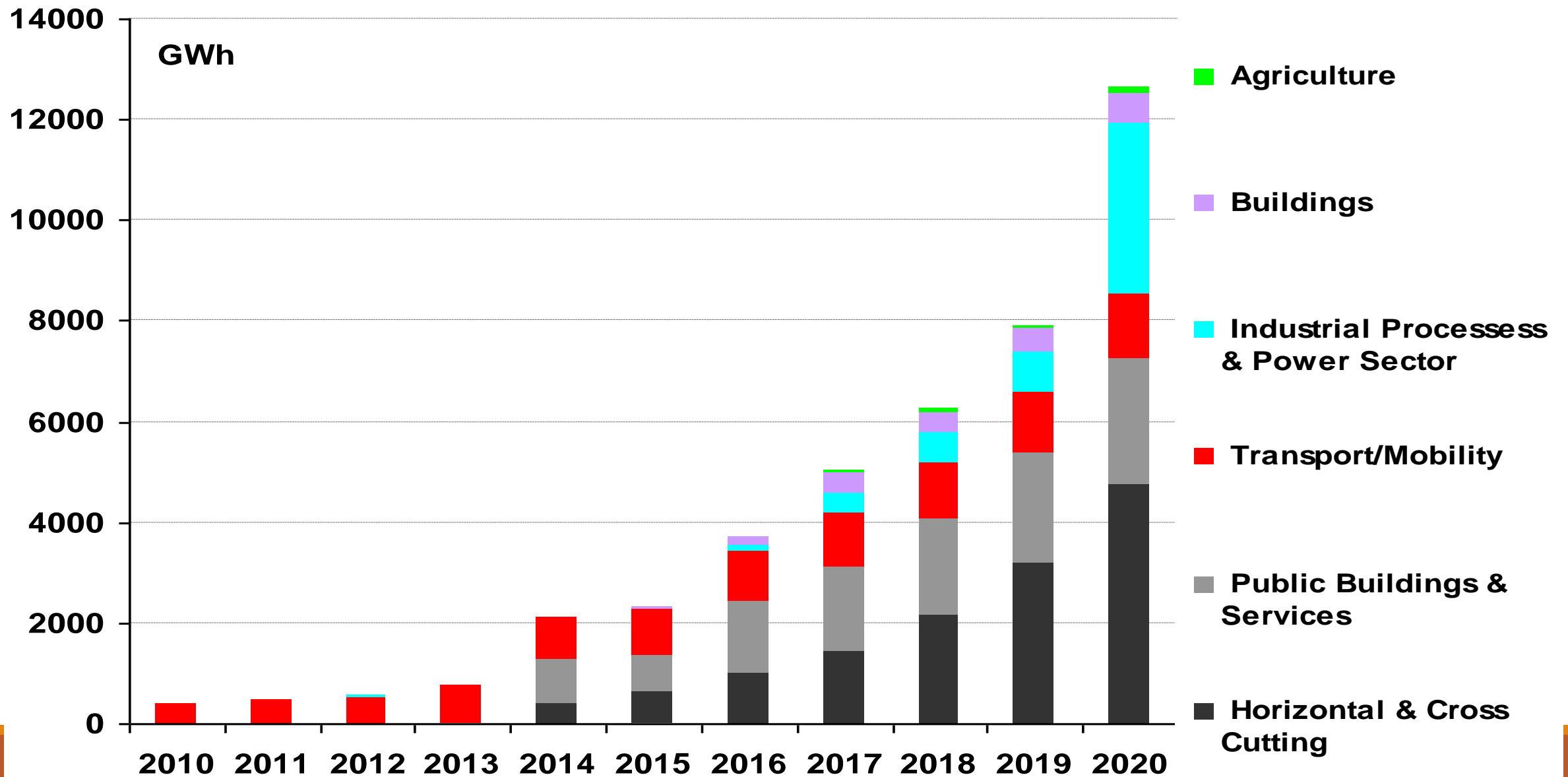
Capacity Building:

- Strengthen capacities among HOAs, SMEs, ESCOs, municipalities to plan and implement EE
- Strengthening the institutional capacity of the State to develop and implement EE policy.
- Create/assign capacities to oversee NEEAP implementation, conduct MRV

Integration of EE in construction permitting process (municipal architecture-construction services)



Achieved (expected) annual energy savings 2010-2020



Progress against NEEAP 1 targets and New (Revised) Targets

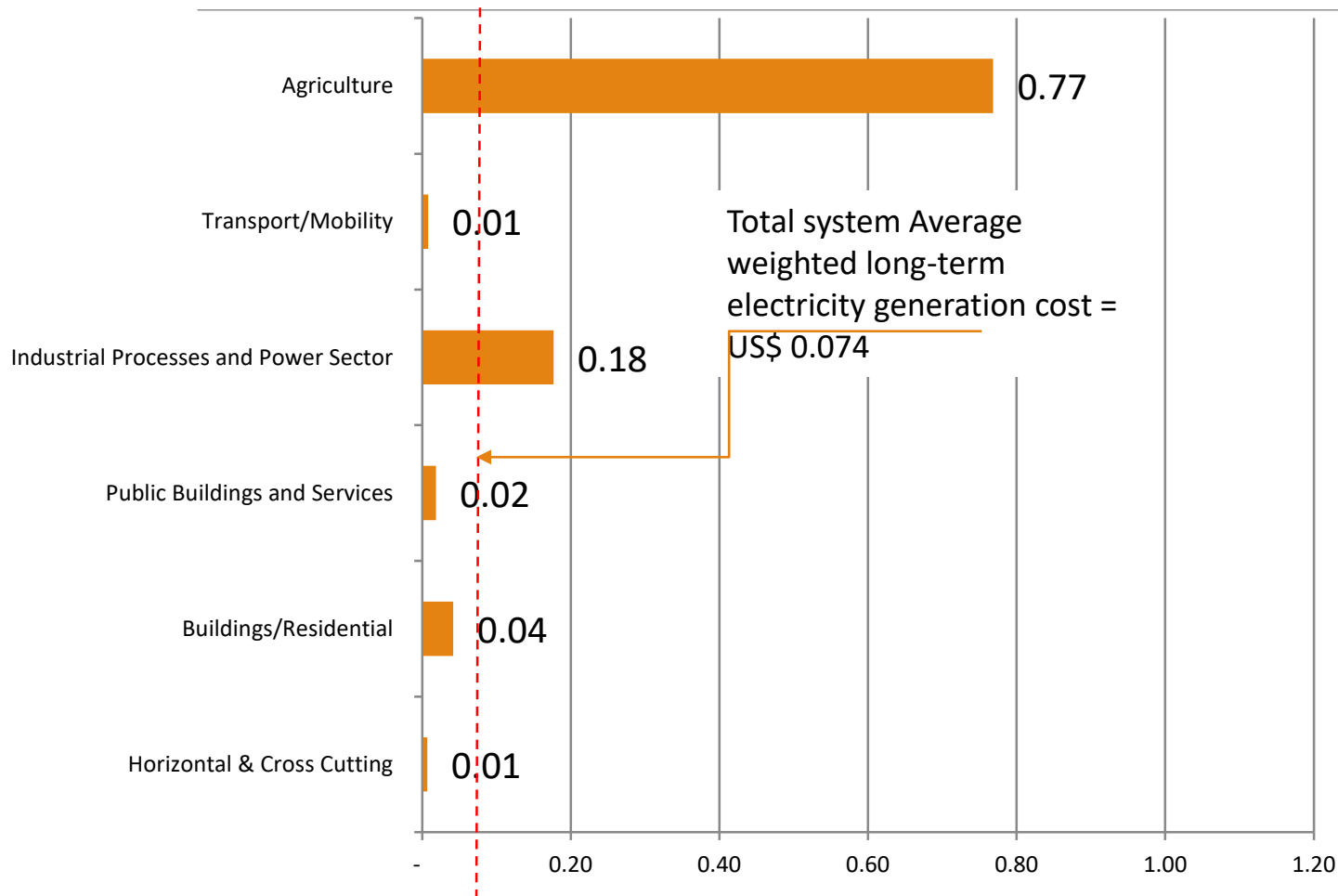
40.00%		Baseline Final Energy Consumption	Estimated annual savings SECTOR TARGET based on 2010 baseline (% and ktoe)		Sector target in 2014 (ktoe)	Baseline Final Energy Consumption	Estimated annual savings per measure based on 2010-2012 average baseline (% and ktoe)				Aggregated savings target by 2020	
Sector/Measure												
35.00%		2010 (in ktoe)	annual/cumulated savings	Cummulative 1st NEEAP TARGET set for 2014 (in ktoe)	ACHIEVED	Avg for 2010-2012 (in ktoe)	Cummulative for 2017 (1st NEEAP)	Cummulative for 2017 (2nd NEEAP revised)	Cummulative for 2017 (2nd NEEAP revised)		in ktoe (1st NEEAP)	Cummulative for 2020 (2nd NEEAP revised)
30.00%												
I.	Horizontal /Cross-cutting	no target	NO TARGET									
			Cummulative ktoe		35.7			61.0				91.5
II.	Buildings (Residential)	695.7	Cummulative %	2.7%	0.0%	750.5	9.9%	4%	13.5		23.0%	7%
			Cummulative ktoe	18.8	0.1		74		101		172.6	51.4
III.	Public & Private Service Sector	206.9	Cummulative %	1.7%	18%		6.		8.4		14.6%	80%
			Cummulative ktoe	3.5			16		22		39.1	215.3
IV.	Industry & Power	358.3	Cummulative %	6.7%			19.		26.2		23.3%	80.5%
			Cummulative				7		94		84.4	291.6
V.	Transport /Mobility	499.6	Cummulative %	8.60%			9.		11.4		20.3%	22%
			Cummulative	2014			46		59		105.7	109.5
VI.	Agriculture	140.1	Cummulative %	1.1%	0.1%	145.7	2.3%	2.77%	2.7%	4.8%	14.0%	7.4%
			Cummulative ktoe	1.5	0.13		3.4	4.9	3.9	7.0	20.4	10.7
VII.	Total	1900.6	Cummulative %	3.3%	8.6%	2047.0	10.4%	18%	13.8%	20.7%	22.3%	37.6%
			Cummulative ktoe	63.3	163.1		212.6	367.4	282.0	424.6	422.2	770.1
		22.10 GWh	Cummulative GWh	0.7	1.9	23.8	2.5	4.3	3.3	4.9	4.9	9.0

Tons of CO₂ emission avoided by target year based on Sectoral Measures

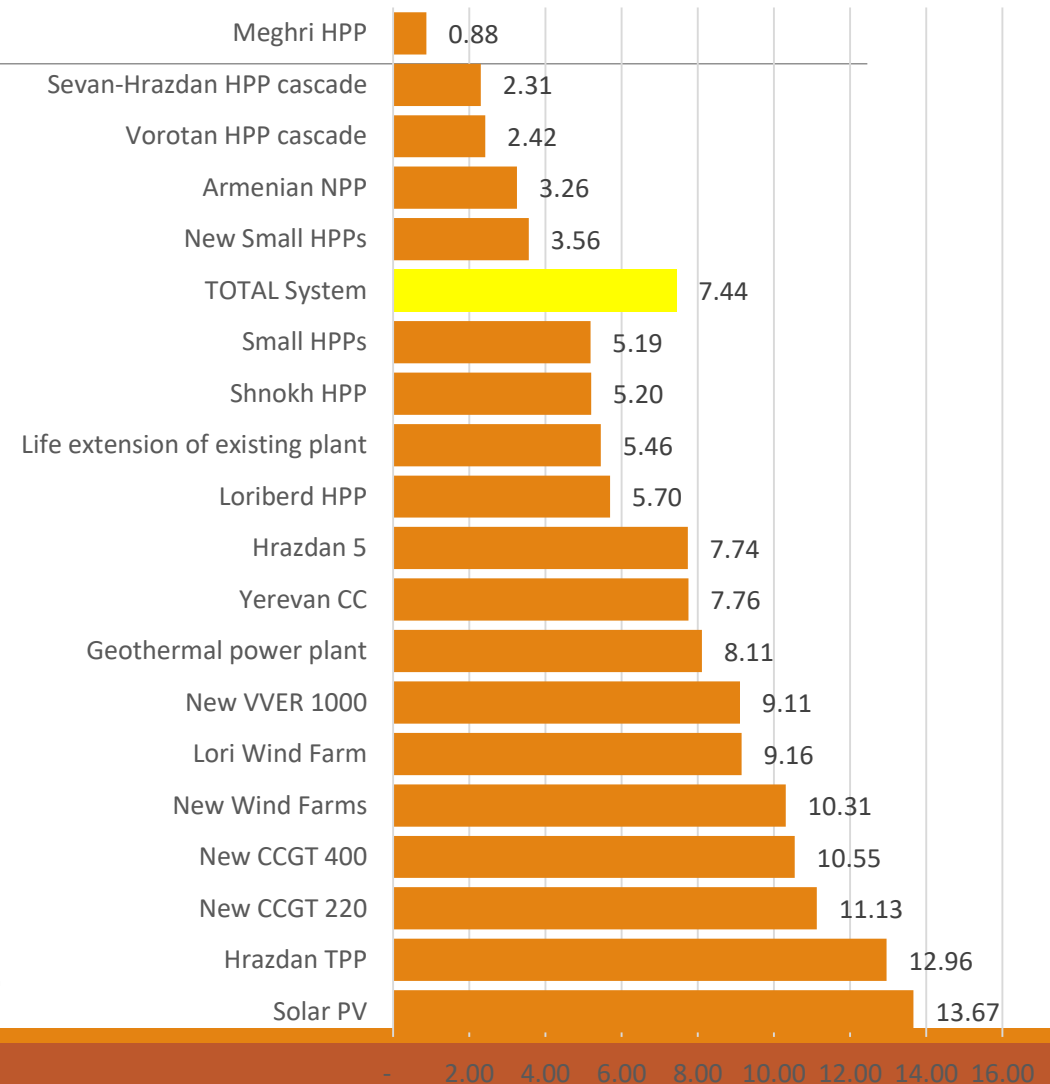
Sectors	Tons of CO ₂ emission avoided by target year			
	2014	2017	2018	2020
Horizontal and CC	183,157	209,515	222,694	271,732
Buildings (Residential)	1,366	28,860	28,860	28,860
Public Buildings and Services	186	25,493	27,293	31,250
Industry	311	791	951	1,270
Transport	31	40	43	49
Agriculture	-	7,637	15,318	22,955
Total GHG Avoided (tons CO2)	185,650	282,464	309,349	356,116

Weighted average cost of 1 kWh energy GENERATED & SAVED

Weighted average cost of reduction of 1 kWh energy by sectors (USD) [over NEEAP lifetime 2010-20]



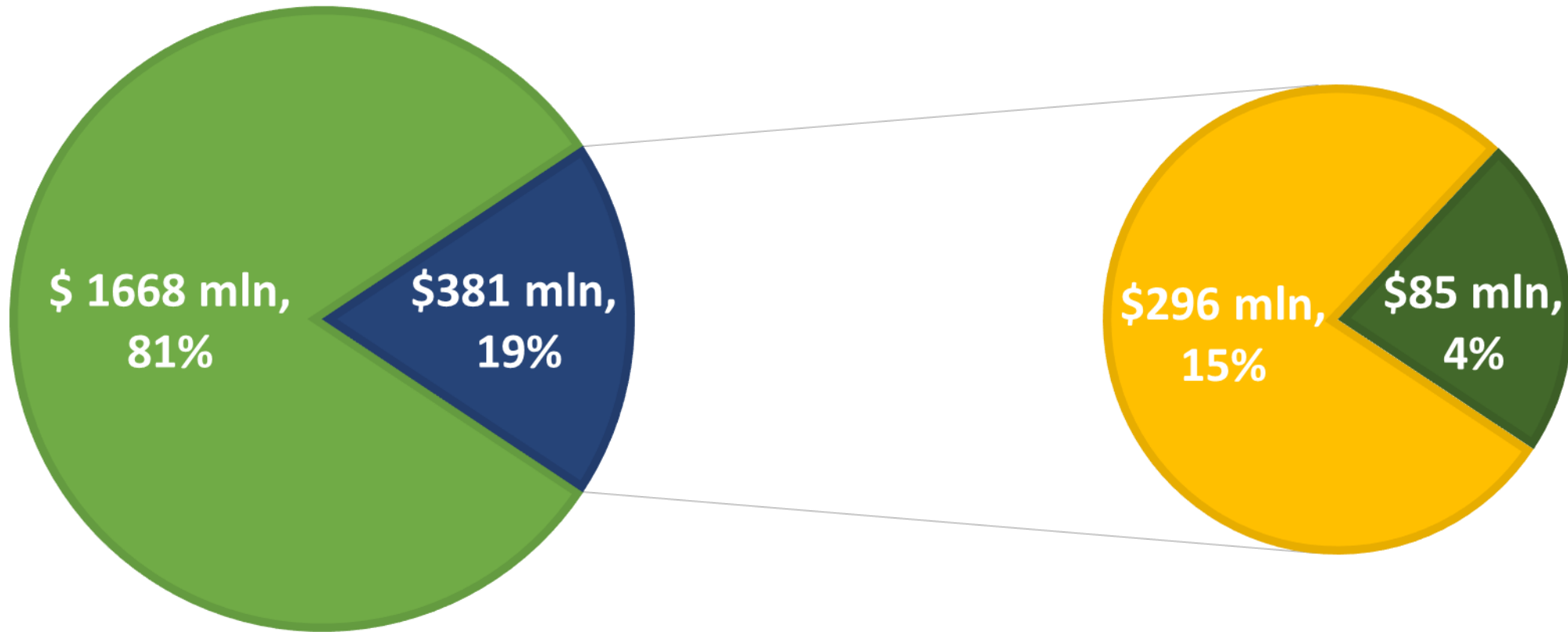
Average weighted long-term electricity generation cost (US cents)



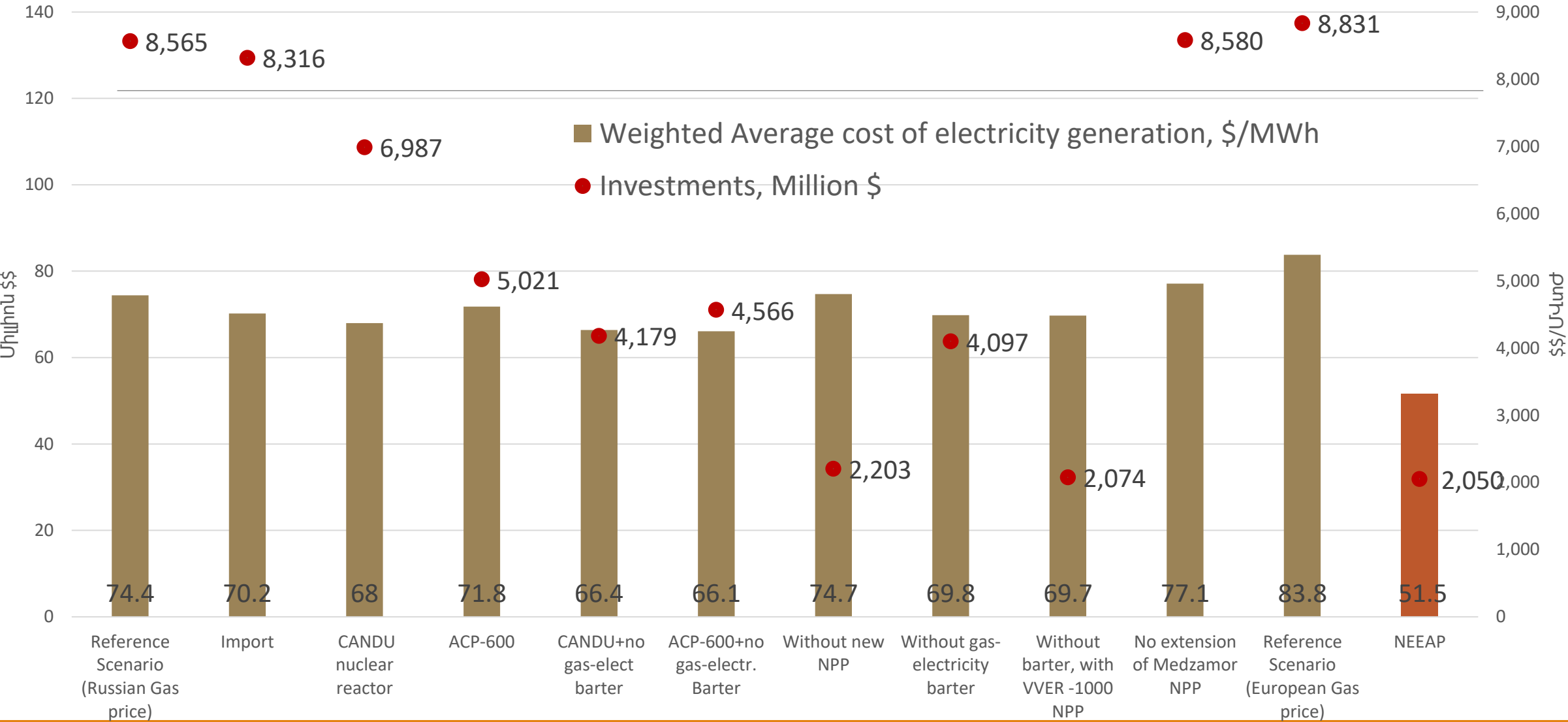
Cost of the NEEAP: Investments over 2010-20 time horizon \$2,05 million

NEEAP FUNDING OVER 10 YEAR HORIZON (US\$ MILLION)

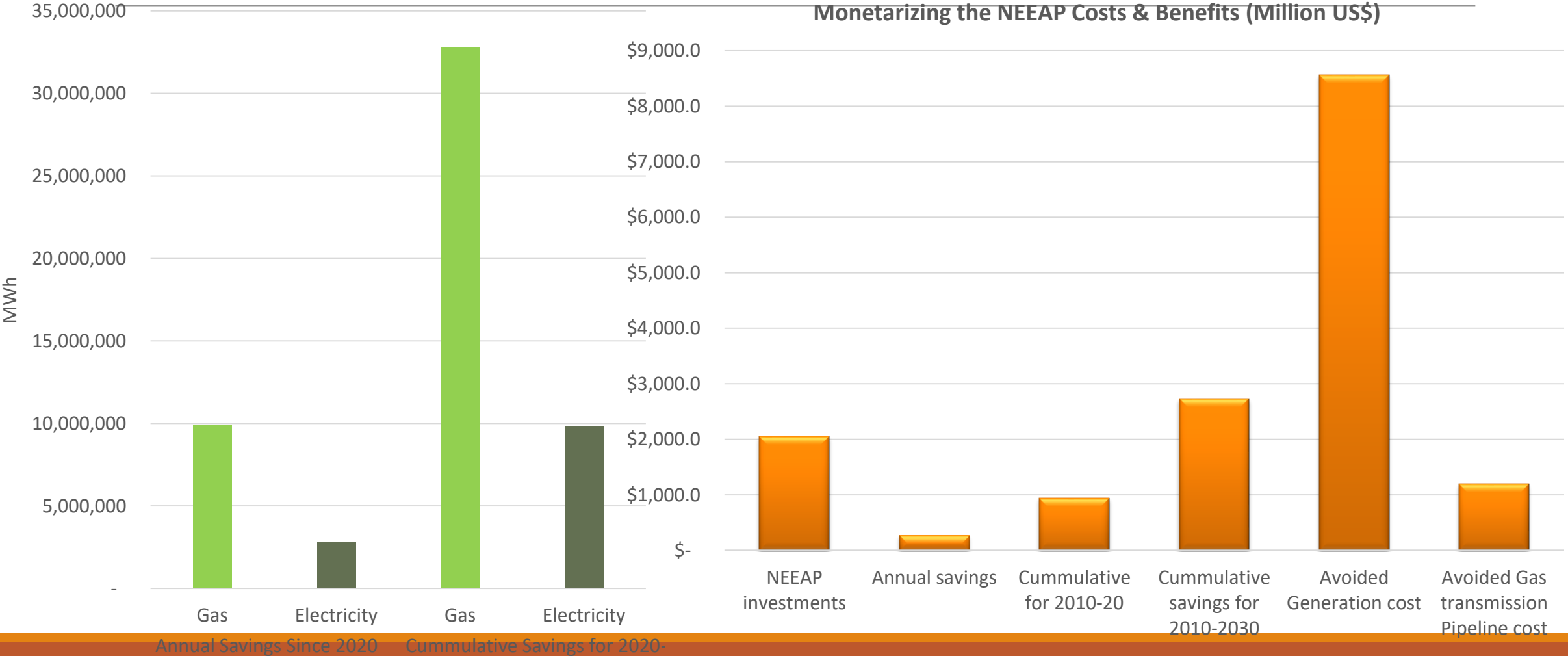
■ Obligated Funding ■ Funding needed: Hardware Investments ■ Funding needed: Soft Cost (Market Opening)



Comparative Analysis of 2nd NEEAP implementation scenario with the existing scenarios of energy sector development of the Republic of Armenia



The Economic Gains from the NEEAP Implementation



Thank you

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