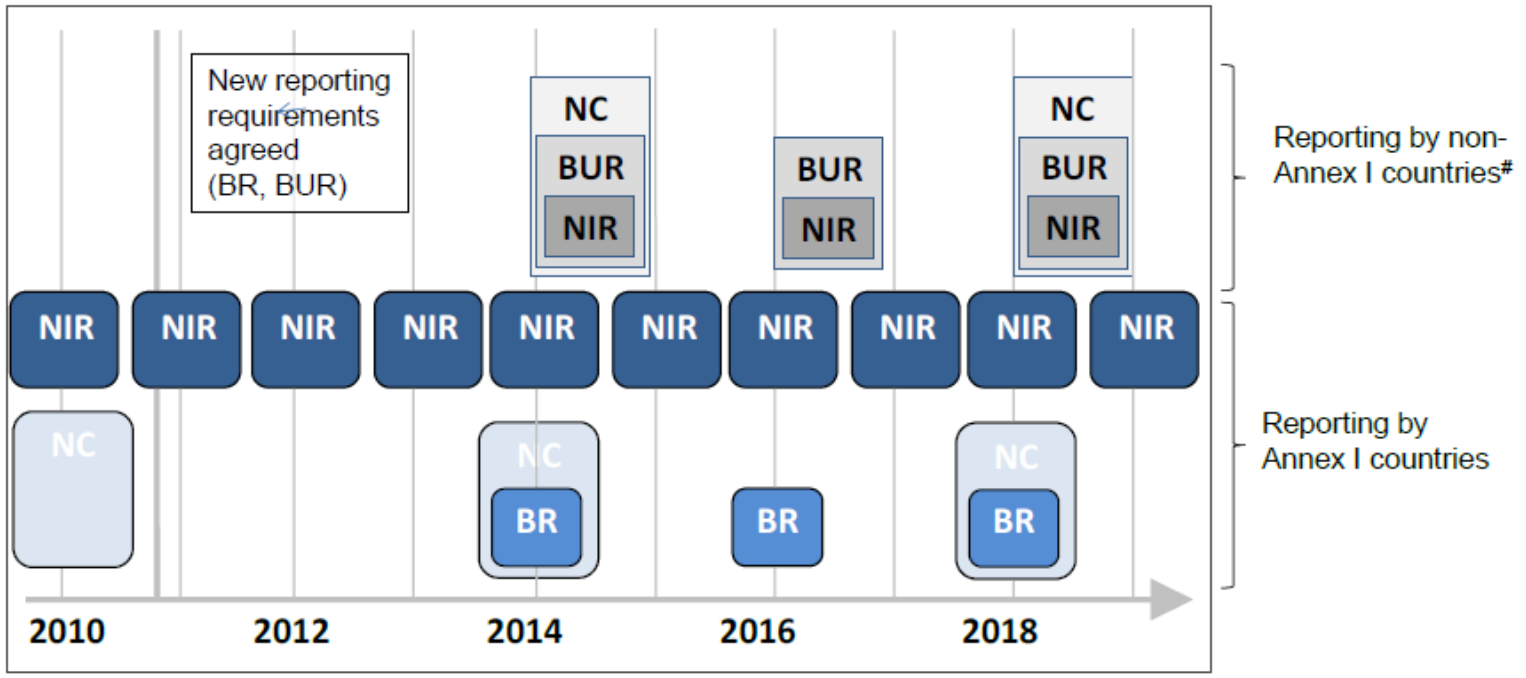
GHG Monitoring Reporting and Verification Systems

- Case study of the MRV system in building sector -

Current state of reporting



NC = National communication **BR/BUR** = Biennial (update) report **NIR** = National inventory report

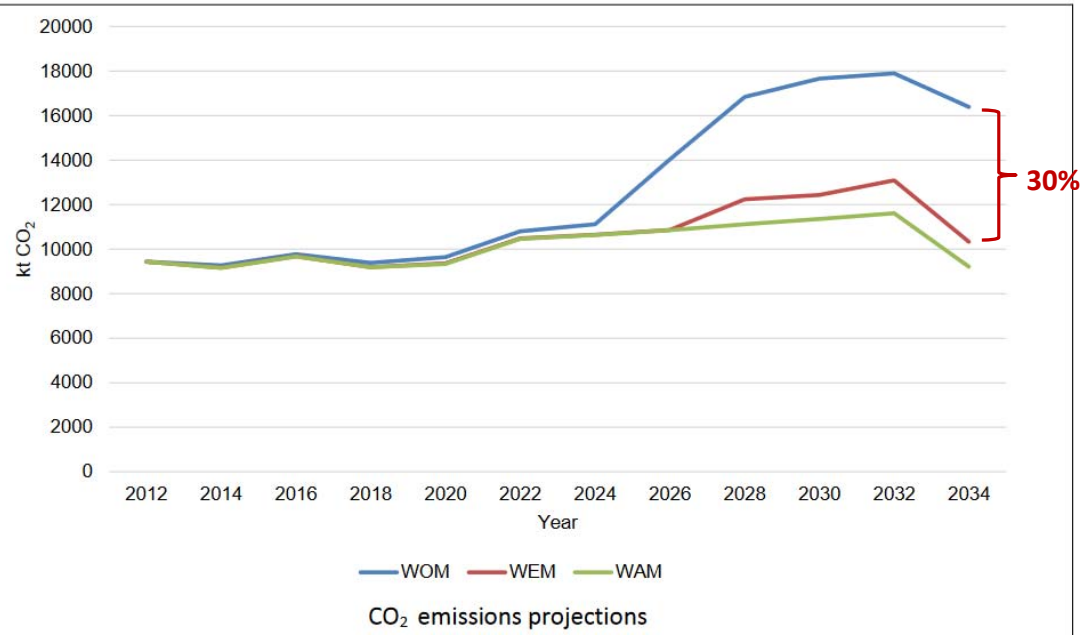
Source: Identifying and Addressing Gaps in the UNFCCC Reporting Framework, Ellis J., Moarif S., OECD, IAE, November 2015

United Nations Educational, Scientific and Cultural Organization | University Twinning and Networking Programme

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

Necessary progress

Emission projections



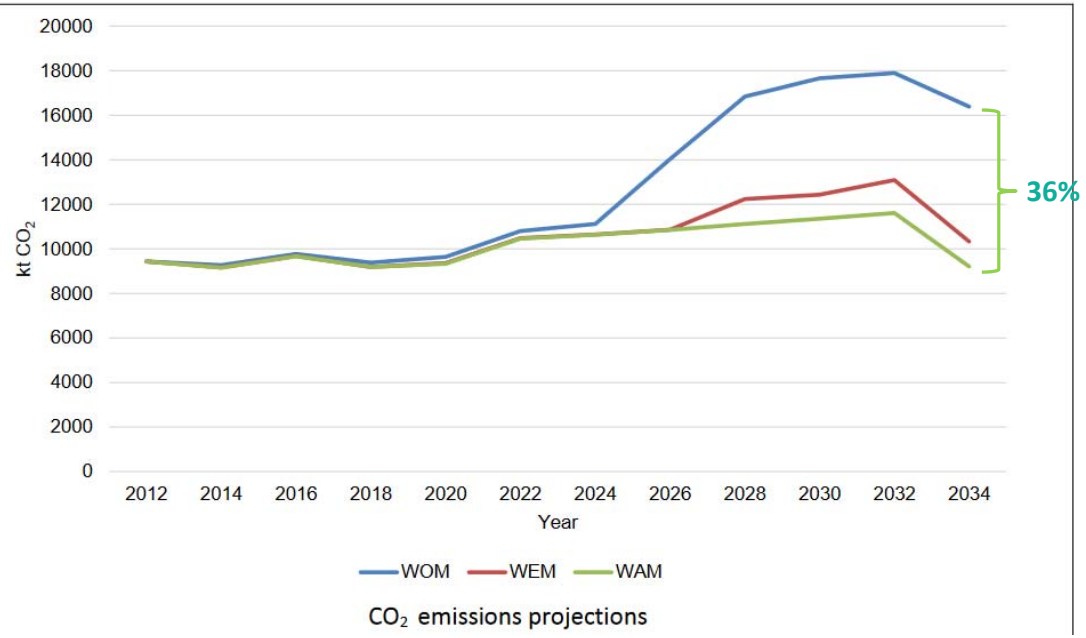
WOM – Business as Usual Scenario
WEM – Mitigation Scenario
WAM - Higher Ambition Mitigation Scenario

Source: Intended Nationally Determined Contributions of the Republic of Macedonia, UNFCCC August 4th 2015

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

Necessary progress

Emission projections

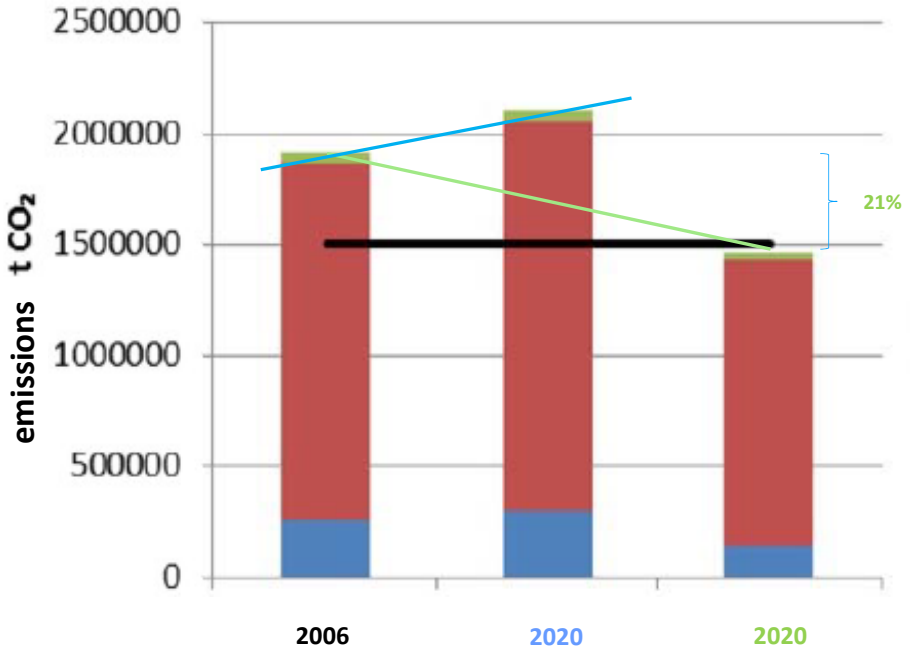


WOM – Business as Usual Scenario
WEM – Mitigation Scenario
WAM - Higher Ambition Mitigation Scenario

Source: Intended Nationally Determined Contributions of the Republic of Macedonia, UNFCCC August 4th 2015

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

Necessary progress



WOM – Business as Usual Scenario

WAM - Mitigation Scenario

Source: Sustainable Energy Action Plan of the City of Skopje

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

Katowice Rules

Article 4 of the Paris Agreement: national commitments:

The minimum contents of the NDCs are established (Annex I of the Katowice Rules).

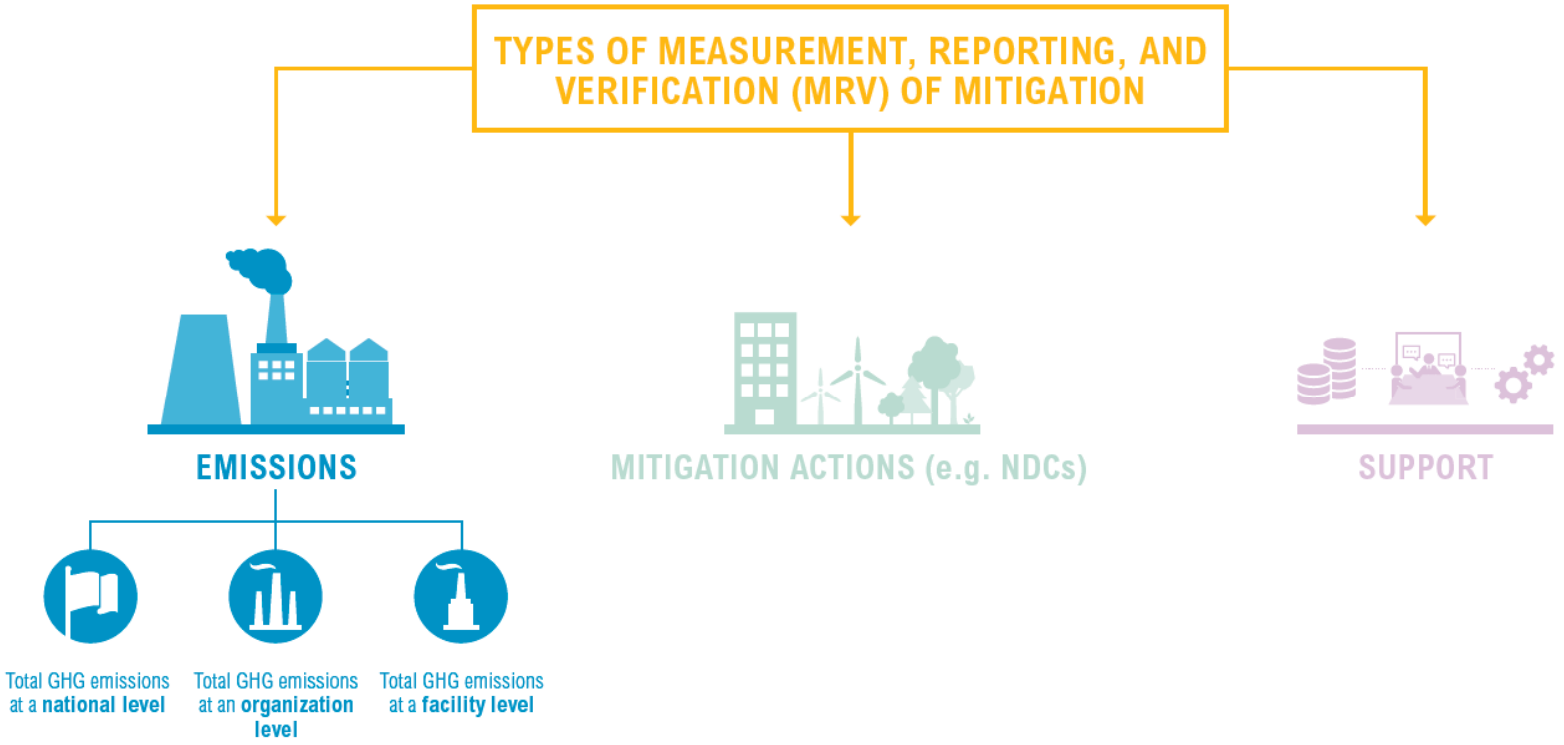
National GHG inventories: will be carried out using the most updated National IPCC Guidelines for Inventories. At this time, the latest version dates from 2006. However, these guidelines are under revision, and a new version is expected in 2019.

The NDCs of the countries will be registered in a public registry.

As of 2031, the NDCs will have a common time horizon, to be defined. Currently, some countries are developing NDCs with a horizon of 5 years, while others are considering a horizon of 10 years.

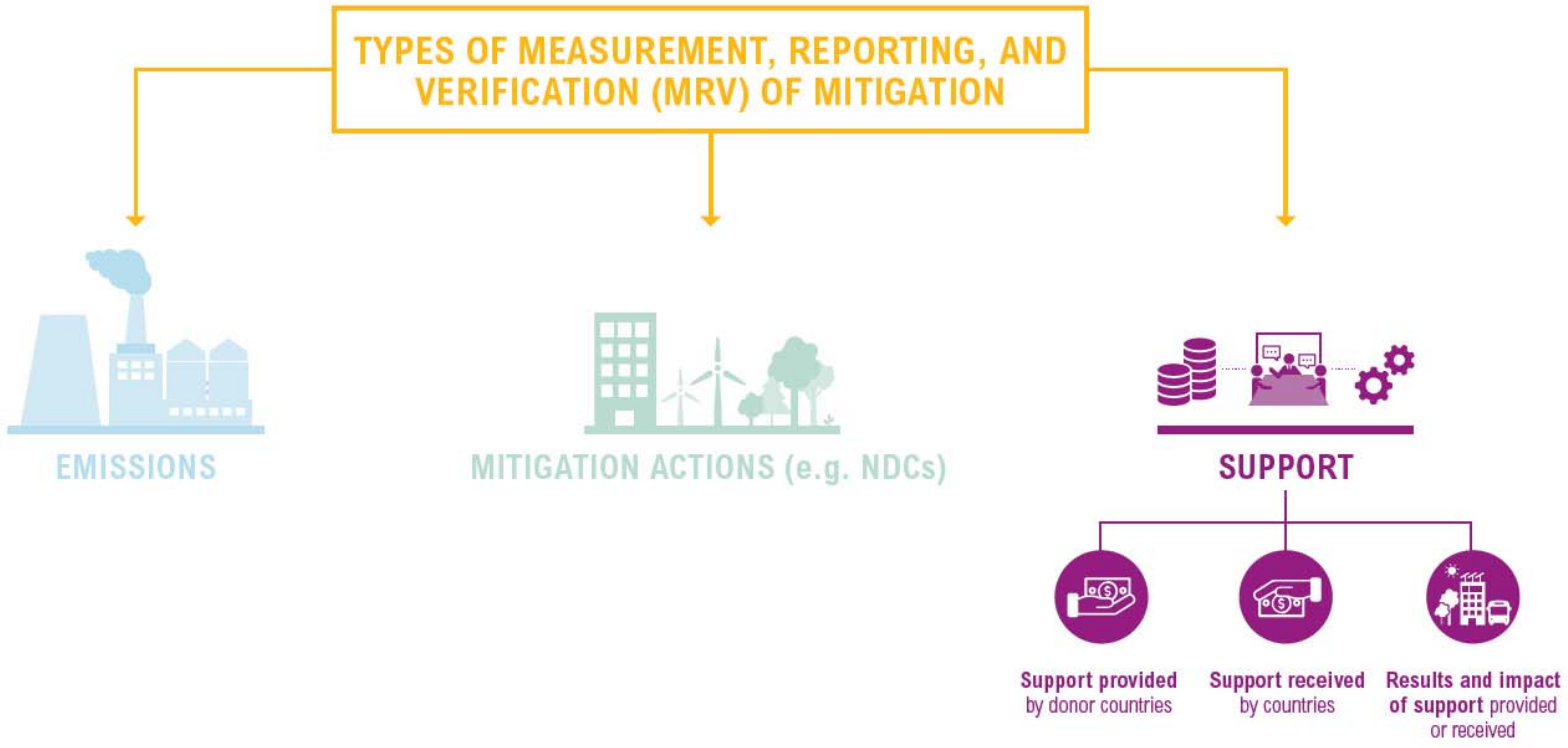
UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

Three types of MRV systems



Source: Identifying and Addressing Gaps in the UNFCCC Reporting Framework, Ellis J., Moarif S., OECD, IEA, November 2015

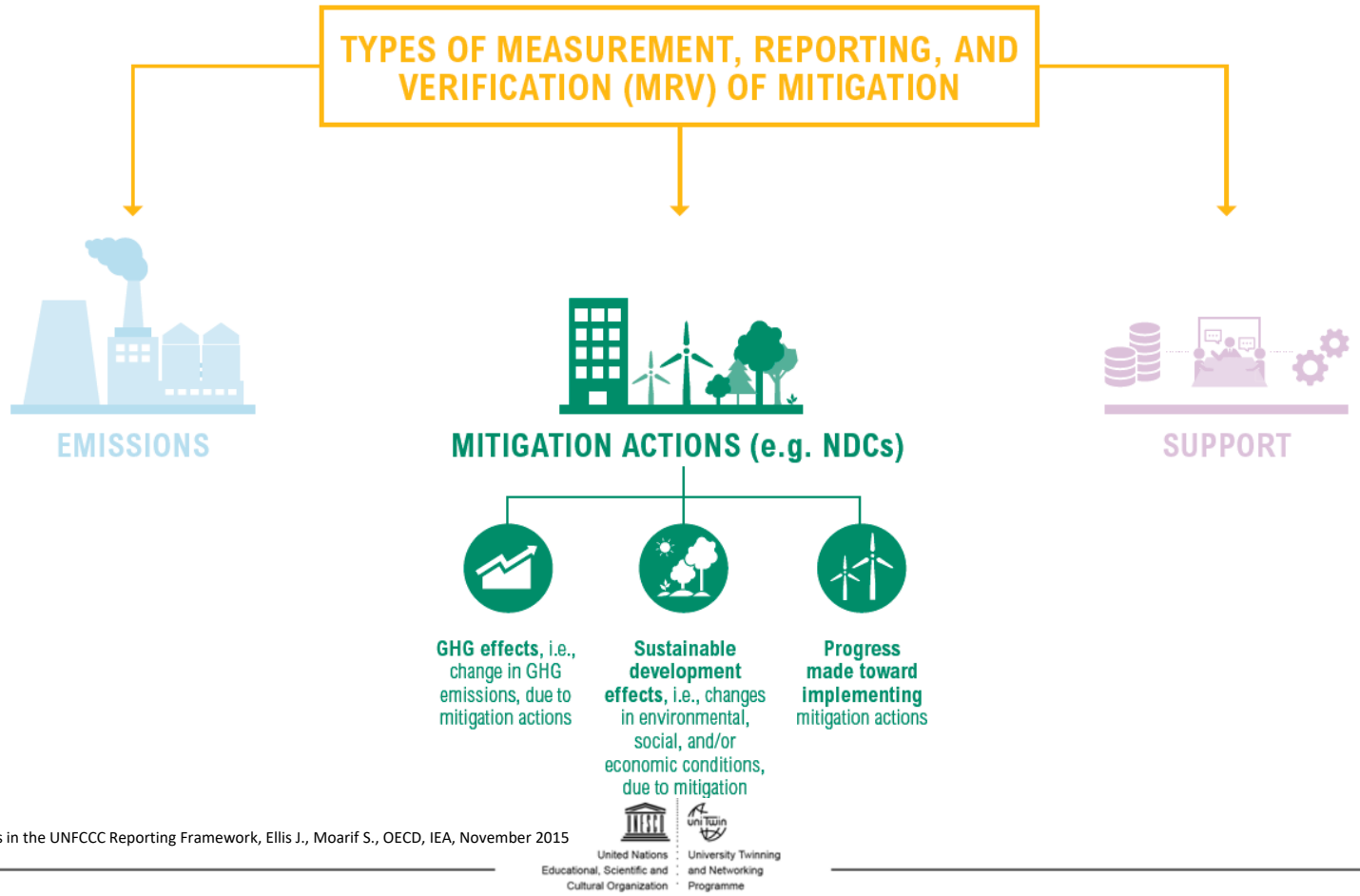
Three types of MRV systems



Source: Identifying and Addressing Gaps in the UNFCCC Reporting Framework, Ellis J., Moarif S., OECD, IEA, November 2015

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

Three types of MRV systems



Source: Identifying and Addressing Gaps in the UNFCCC Reporting Framework, Ellis J., Moarif S., OECD, IEA, November 2015

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

Basics of the mitigation MRV - IPMVP

HOW TO CALCULATE ENERGY SAVINGS?

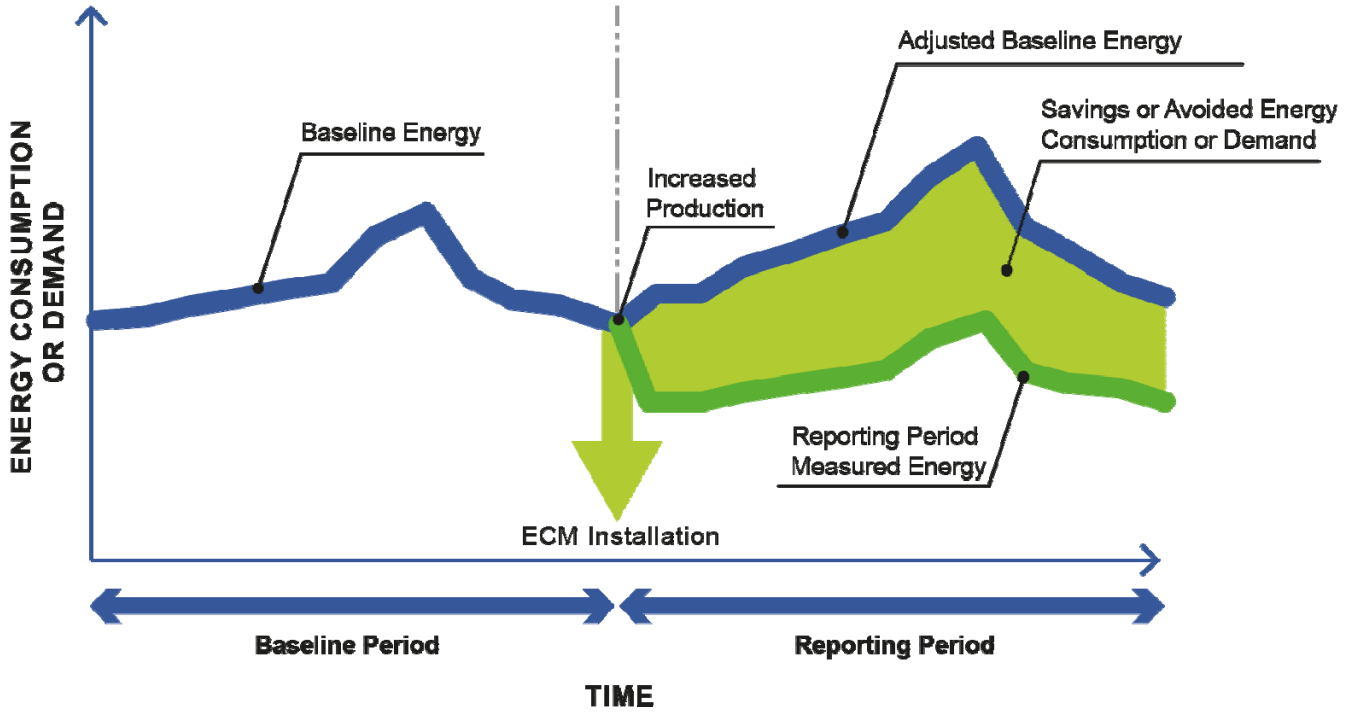
Savings Reported for Any Period =

Baseline Period Energy – Reporting Period Energy

+/- Adjustments

Source: EVO IPMVP Volume 1, 2010, Chapter 4.1.

Basics of the mitigation MRV - IPMVP



Source: https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

Challenge

De-risking and scaling-up investment in energy efficient building retrofits in Armenia

Implemented by the Ministry of Natural Protection and UNDP

Funded by Green Climate Fund, City of Yerevan, UNDP and the Ministry

Total value of the project: appx. 30.000.000$ with additional 60.000.000$ EIB

Expected results

264,3GWh/annum, 69TCO2eq/annum, total 4mTCO2eq, 1.700 jobs created

Beneficiaries

6000 – single family individual buildings

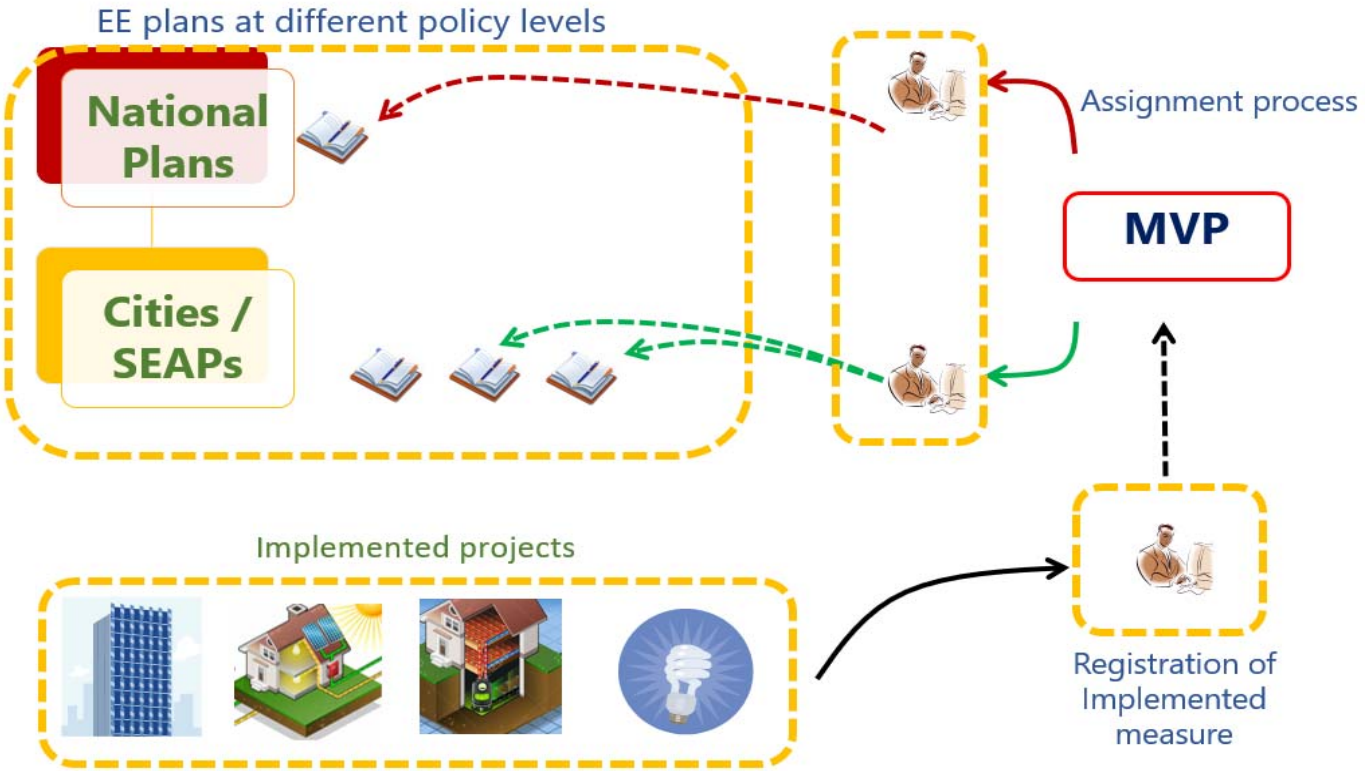
290 – multi-apartment buildings

23 – complex demand public buildings (hospitals)

150 – simple demand public buildings (schools and kindergartens)

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

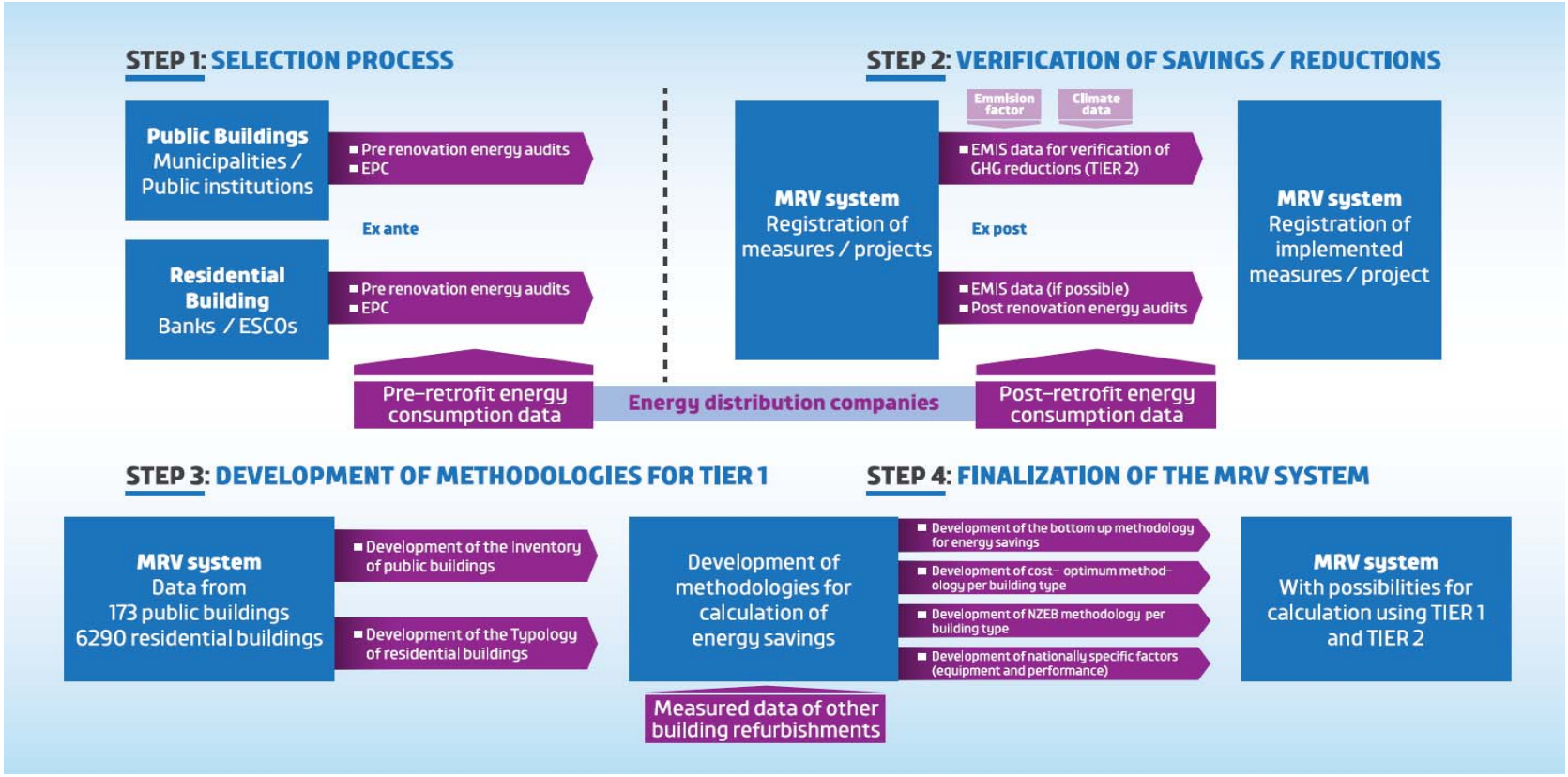
Monitoring and reporting platform



Source: Dr. A. Teskeredzic, Sazdovski I, Monitoring and Verification Platform, Training for the Ministry of Economy, Skopje, January 15th 2015.

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

Monitoring and reporting platform

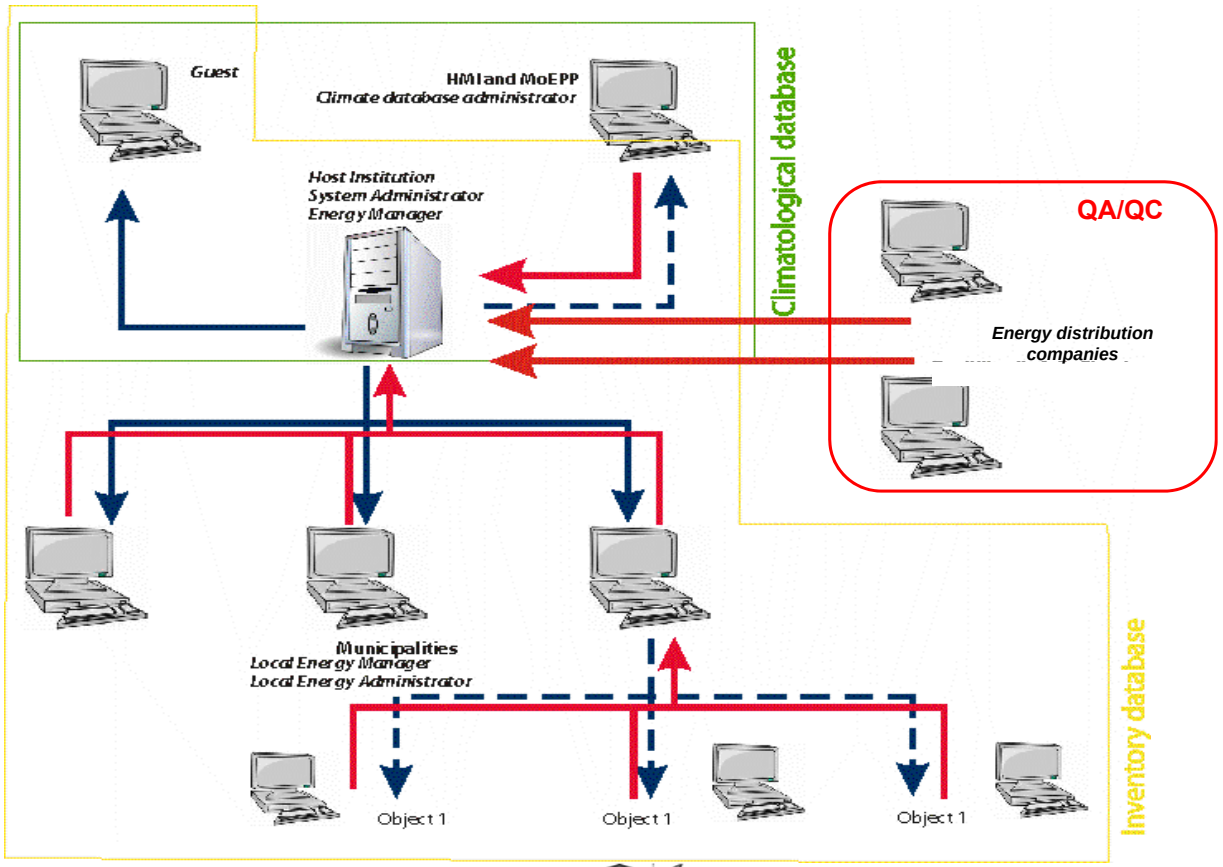


Source: Sazdovski I, Terms of reference for the MRV system in the building sector in Armenia, UNDP Armenia, November 2018.

United Nations Educational, Scientific and Cultural Organization | University Twinning and Networking Programme

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

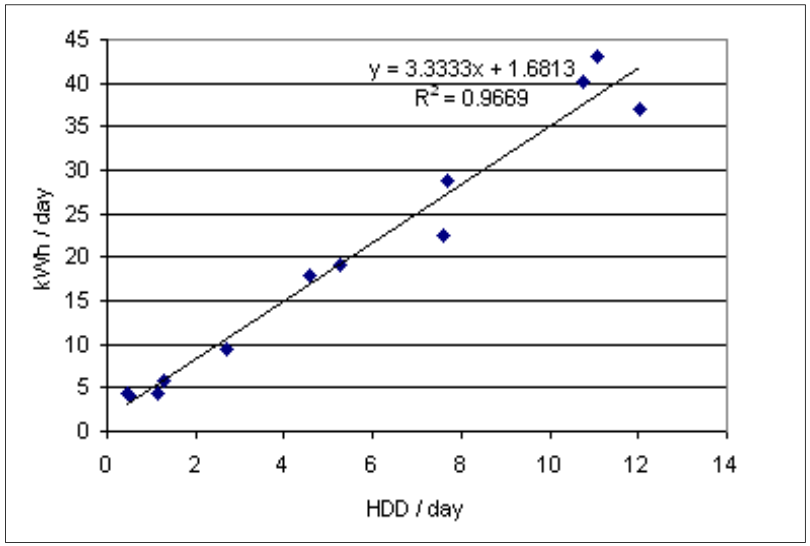
TIER 2 calculation method (EMIS)



Source: Sazdovski I, Terms of reference for the EMIS system in the building sector, UNDP Macedonia, 2011.

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

TIER 2 calculation method (EMIS)



8 key equations for calculation of energy savings and GHG reductions

11 key parameters

Data / Parameter	$EC_{before,}$ EC_{after}
Data unit	kWh or MWh
Description	Annual Electricity consumed by the project building before and after the refurbishment
Source of data	Smart meters, Electricity meter of the distribution company or electricity distribution billing system
Measurement procedures (if any)	National standards described by the Regulatory Commission
Monitoring frequency	Preferably weekly, minimum frequency once per month
QA/QC procedures	If the data are transferred directly from the billing system of the electricity distributor, or smart meters, there is no need of additional QC procedures. Possible estimates, needed to be performed in the energy audit in case the energy measures of electricity is mixed with other sources of energy consumption like electrical appliances. Data controlled by the Local Energy Manager or National Energy Manager based on the procedure for monitoring and verification for the EMIS software.
Any comment	For all data gathered from the EDC, it is recommended that direct link trough cloud base is provided where the EDC will transfer data from their billing system. If that possibility is not enabled, the data should be verified by the Local Energy Management Team

$$\boldsymbol{NAECy} = \boldsymbol{a}365 + \boldsymbol{bHDDy} + \boldsymbol{cCDDy} \pm (\boldsymbol{\gamma x})$$

$$\boldsymbol{GHG_{after\ y}} = \frac{\boldsymbol{EC_{after\ y}} \times \boldsymbol{EF_{el,aftery}}}{1 - \boldsymbol{TDL_{after\ y}}} + \sum_{i=1}^{n} \boldsymbol{FC_i} \times \boldsymbol{NCV_i} \times \boldsymbol{EF_{co2i}}$$

12 pages of static and dynamic database parameters

Source: Sazdovski I, Terms of reference for the MRV system in the building sector in Armenia, UNDP Armenia, November 2018..

TIER 1 calculation method (CS)

Refurbishment measures of existing buildings

Measures at consumption side (wall, roof, insulation, replacement of windows)
Via SHD values. Measures at generation, distribution and emission heat
via η value (new boiler, new automatic control, balancing, TSV at radiators

$$\Delta E = \left(\frac{SDH_{before}}{\eta_{before}} - \frac{SDH_{after}}{\eta_{after}}\right) * A;\ [KWh]$$

EEI measure(s)
$SHD_{after} < SHD_{before}$
AND/OR
$\eta_{after} > \eta_{before}$

ΔE – annual energy savings; $\left[\frac{KWh}{a}\right]$

SDH – specific heat demand; $\left[\frac{KWh}{m^2 a}\right]$

A – heated area $[m^2]$

$\eta = \eta_{boi} * \eta_{dis} * \eta_{em};\ [\%]$

Seasonal efficiency of heating system (before/after)

CO_2

Reference *SHD* values

Construction year	SHD residential	SHD non-residential
before 1940	180	180
1940 – 1970	250	250
1970 – 1987	150	150
1987 – 2006	150	150

Appx. 15 equations
App. 30 code tables

Source: Dr. A. Teskeredzic, Monitoring and Verification Platform, Training for the Ministries of Economy, Energy Community Secretariat, Vienna, October 2014

UNESCO CHAIR IN LIFE CYCLE AND CLIMATE CHANGE

Thank you

Ilija Sazdovski
Researcher
UNESCO Chair in Life Cycle and Climate Change ESCI UPF

United Nations Educational, Scientific and Cultural Organization

UNESCO Chair in Life Cycle and Climate Change

School of International Studies

United Nations Educational, Scientific and Cultural Organization

University Twinning and Networking Programme

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**

UNESCO CHAIR IN **LIFE CYCLE AND CLIMATE CHANGE**