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
Necessary progress

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
Necessary progress

WOM – Business as Usual Scenario
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Source: Intended Nationally Determined Contributions of the Republic of Macedonia, UNFCCC August 4th 2015
Necessary progress

Source: Sustainable Energy Action Plan of the City of Skopje
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.
Three types of MRV systems

- **EMISSIONS**
  - Total GHG emissions at a national level
  - Total GHG emissions at an organization level
  - Total GHG emissions at a facility level

- **MITIGATION ACTIONS (e.g. NDCs)**

- **SUPPORT**

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

- Emissions
- Mitigation actions (e.g. NDCs)
- Support
  - Support provided by donor countries
  - Support received by countries
  - Results and impact of support provided or received

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

- Emissions
- Mitigation Actions (e.g., NDCs)
- Support

Types of Measurement, Reporting, and Verification (MRV) of Mitigation:

- GHG effects, i.e., change in GHG emissions, due to mitigation actions
- Sustainable development effects, i.e., changes in environmental, social, and/or economic conditions, due to mitigation
- Progress made toward implementing mitigation actions

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

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)
Monitoring and reporting platform

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

**STEP 1: SELECTION PROCESS**
- **Public Buildings**
  - Municipalities / Public institutions
  - Pre-renovation energy audits
  - EPC
- **Residential Building**
  - Banks / ESCOs
  - Pre-renovation energy audits
  - EPC

**STEP 2: VERIFICATION OF SAVINGS / REDUCTIONS**
- **MRV system**
  - Registration of measures / projects
  - Ex ante
  - Energy distribution companies
  - Post-retrofit energy consumption data
  - Pre-retrofit energy consumption data

**STEP 3: DEVELOPMENT OF METHODOLOGIES FOR TIER 1**
- **MRV system**
  - Data from 173 public buildings
  - 6290 residential buildings
  - Development of the inventory of public buildings
  - Development of the typology of residential buildings

**STEP 4: FINALIZATION OF THE MRV SYSTEM**
- **MRV system**
  - With possibilities for calculation using TIER 1 and TIER 2
  - Development of the bottom-up methodology for energy savings
  - Development of costing methodology per building type
  - Development of NZEB methodology per building type
  - Development of national specific factors (material and performance)

Source: Sazdovski I, Terms of reference for the MRV system in the building sector in Armenia, UNDP Armenia, November 2018.
Tier 2 calculation method (EMIS)

# TIER 2 calculation method (EMIS)

## 8 key equations for calculation of energy savings and GHG reductions

### 11 key parameters

<table>
<thead>
<tr>
<th>Data / Parameter</th>
<th>$EC_{before}$</th>
<th>$EC_{after}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data unit</td>
<td>kWh or MWh</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Annual Electricity consumed by the project building before and after the refurbishment</td>
<td></td>
</tr>
<tr>
<td>Source of data</td>
<td>Smart meters, Electricity meter of the distribution company or electricity distribution billing system</td>
<td></td>
</tr>
<tr>
<td>Measurement procedures (if any)</td>
<td>National standards described by the Regulatory Commission</td>
<td></td>
</tr>
<tr>
<td>Monitoring frequency</td>
<td>Preferably weekly, minimum frequency once per month</td>
<td></td>
</tr>
<tr>
<td>QA/QC procedures</td>
<td>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 are 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.</td>
<td></td>
</tr>
<tr>
<td>Any comment</td>
<td>For all data gathered from the EDC, it is recommended that direct link through 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</td>
<td></td>
</tr>
</tbody>
</table>

## Example Equations

1. **$N_{AECy} = a365 + bHDDy + cCDDy \pm (yx)$**

2. **$GHG_{after} = \frac{EC_{after}}{1-TDL_{after}} \times EF_{elaftery} + \sum_{i=1}^{n} FC_i \times NCV_i \times EF_{co2i}$**

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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

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

\[ \Delta E \quad \text{annual energy savings}; \quad SDH \quad \text{specific heat demand}; \quad A \quad \text{heated area } \left[ \text{m}^2 \right] \]

\[ \eta = \eta_{boi} \cdot \eta_{dis} \cdot \eta_{em}; \left[ \% \right] \]

Seasonal efficiency of heating system (before/after)

<table>
<thead>
<tr>
<th>Construction year</th>
<th>SHD residential</th>
<th>SHD non-residential</th>
</tr>
</thead>
<tbody>
<tr>
<td>before 1940</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>1940 – 1970</td>
<td>250</td>
<td>250</td>
</tr>
<tr>
<td>1970 – 1987</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>1987 – 2006</td>
<td>150</td>
<td>150</td>
</tr>
</tbody>
</table>

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
Thank you

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