

# **Assessment of Energy Efficiency Financing Options for Ternopil and Development of Business Strategy Plan**

Municipal ESCO Business Strategy Plan for  
TERNOPIL

March 2016



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## List of abbreviations

CA	City Administration
CoP	Coefficient of performance
DHW	Domestic Hot Water
ECM	Energy Conservation Measure
EE	Energy efficiency
EERF	Energy Efficiency Revolving Fund
EETP	Energy Efficiency Transformation Program
ESCO	Energy Service Company
ESMAP	Energy Sector Management Assistance Program
ESR	Energy saving ratio
GWh	Giga Watt Hour = 1,000,000 Kilo Watt Hours
HDD	heating degree-days
IPMVP	International Measurement and Verification Protocol
IHS	Individual Heating Sub-stations
LED	Light Emitting Diode
MWh	Mega Watt Hour = 1,000 Kilo Watt Hours
PBP (T)	Payback period (time)
RE	Renewable Energy
TE	Municipal enterprise “Ternopilmiskteplokomunenergo”, district heating company, vulgo Teploenergo
TESCO	Ternopil ESCO
UDP	Urban Development Project
U-value	Heat transfer coefficient; reciprocal factor of the sum of thermal resistance values of the materials of a structure
VAT	Value Added Tax
WB	The World Bank

## Executive Summary

### The business need

The City of Ternopil has expressed interest in establishing a sustainable financing mechanism for EE in its buildings and facilities. The City Administration has initiated the Energy Efficiency Transformation Program and is interested in **Energy Saving Performance Contracting (EPC)** as a delivery mechanism for EE investment projects in the public sector.

The primary objective is to advise the City of Ternopil in establishing financing mechanisms for EE in its buildings and facilities by drafting this business plan for a municipal Ternopil ESCO as a 'blue print' which enables commencing of EPC business in 2016. The vision of the city administration of Ternopil is furthermore to use a municipal EE Revolving Fund (EERF) as financial vehicle. The respective strategy for the set-up of such a municipal EERF has been linked with ESCO business plan.

The City Administration of Ternopil has established an ESCO already in 2011 and is now allocating funds that shall provide initiate investments to improve energy performance of selected and most economically viable buildings. The designed and proposed business model is based on **a revolving fund that will finance energy saving investments** carried out by the municipal ESCO.

The methodology is focused on a market assessment on viable buildings with significant saving potential and on an analysis of existing market for ESCO in Ukraine, considering latest legal development for municipal ESCO's. A financial assessment of selected model has been accompanied by recommendations on how to set up governance of proposed instruments, the EERF and the ESCO business model and by a detailed risk review.

Since not all buildings are appropriate for such a financing vehicle, all buildings have been screened and the most promising ones (from a technical and economic point of view) have been selected in a short list. The screening process thus reduced a list of 122 public municipal buildings to a pool of buildings for ESCO business comprising 20 schools and 26 kindergartens with a heat energy **saving potential in the range of 60-78%** in total up to 15.5 GWh per year. The table below shows the 10 most favorable objects top ranked by their payback period.

**Table 1: Top 10 Buildings for ESCO business plan (Based on Consultants Calculation)**

Facility	Heat Savings (% of baseline consumption)	Heat Savings (MWh/year)	Heat Cost Savings at 1 <sup>st</sup> year (UAH/year)	Equipment Costs (mln UAH)	Equipment Costs (USD)	Payback time (years) <sup>1</sup>
Kindergarten № 13	78%	231	305,790	3.0	110,162,	9
School № 2 (high)	71%	404	533,715	6.0	223,096,	11
KINDERGARTEN № 38	74%	263	346,946	4.0	148,881,	11
Ukrainian gymnasium	69%	337	445,821	5.4	201,677,	11
KINDERGARTEN № 31	74%	367	484,398	5.7	210,092,	11
technical liceum	78%	380	502,497	5.6	208,921,	12
KINDERGARTEN № 30	74%	351	463,910	5.7	210,893,	12
KINDERGARTEN № 19	74%	315	416,506	5.0	186,917,	12
SCHOOL-KINDERGARTEN № 28	73%	341	450,216	5.6	207,036,	13
KINDERGARTEN № 2	74%	289	381,389	4.7	173,321,	13

### The proposed solution

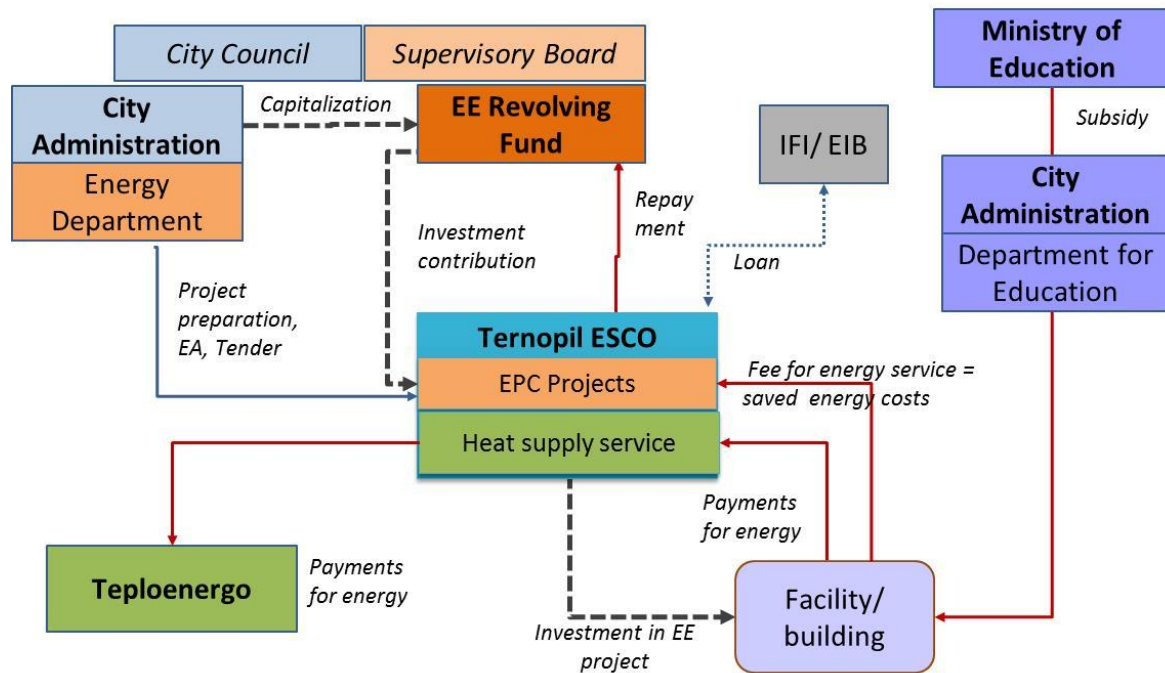
Governance and structure of the business model are defined and roles of all stakeholders are clearly described. The proposed design is **easy to implement** and **fits well into existing lines of authority** within different departments. In this structure TESCO, being owned by TE, is operating as heat Supply Company for end users, through a heat supply department. The new field of operation within TESCO will be organized in a department for Energy performance contracting (EPC).

The initial funding by the city will be arranged through an Energy Efficiency Revolving Fund (EERF). This EERF will be a separate, fenced account in the city budget, which will be established to arrange investment contributions for the EE projects identified by the Energy Office of the City. Savings resulting from investment will be used to repay the EERF until the initial investment is covered. This repayment can be used to finance further EE projects.

<sup>1</sup> This represents the simple Payback time, based on first year savings and does not take into account tariff increases.



Figure 1: Scheme of proposed Business Model (Consultants Illustration)



- TESCO will apply for tenders issued by the energy department of the City of Ternopil (Energy Office), which are financed by the EERF.
- EPC department of TESCO will take care of implementation of EE project and will charge a fee for saved energy, paid by the Facility.
- The Facility will pay costs for consumed electricity to Elektroenergo power utility and for heat to heat supply department within TESCO. So finally both departments of TESCO will invoice their services: EPC department for energy cost savings and heat supply unit for consumed energy. However final payment for all services will be lower than before.
- TESCO will pay TE for heat supplied to municipal entities under EPC contracts.
- Sector departments of the city (education, health, etc.) cover the energy costs of municipal entities as per a pre-determined baseline consumption
- TESCO will finally repay initial investment contribution to EERF from energy cost saving after deduction of an EPC service costs.

It is evident that City of Ternopil will have the sole responsibility to allocate sufficient financing sources and to operate a revolving fund in a transparent and effective way. The role of Municipal enterprise TE, district heating company is to **operate an ESCO** as independent business unit with the objective to provide high quality energy services. In addition, the proposed model has the potential to create the basis for a growing market of private ESCOs by demonstrating the functionality of the model and paving the path for private sector participants.

The City of Ternopil shows strong efforts to improve the energy performance in public buildings. In addition the CA committed to undertake additional steps to set-up effective organization for fast and efficient implementation. The CA will take advantage of the new legislation on EPC will act as a front runner in making a municipal ESCO operational.

The business model as outlined in this report is tailored to the specific needs of Ternopil and shows the potential to realize financial benefits from retrofitting and use such benefits to



finance additional investments. The Mayor of Ternopil confirmed that the developed strategy meets the expectations and will be followed by the City Administration.

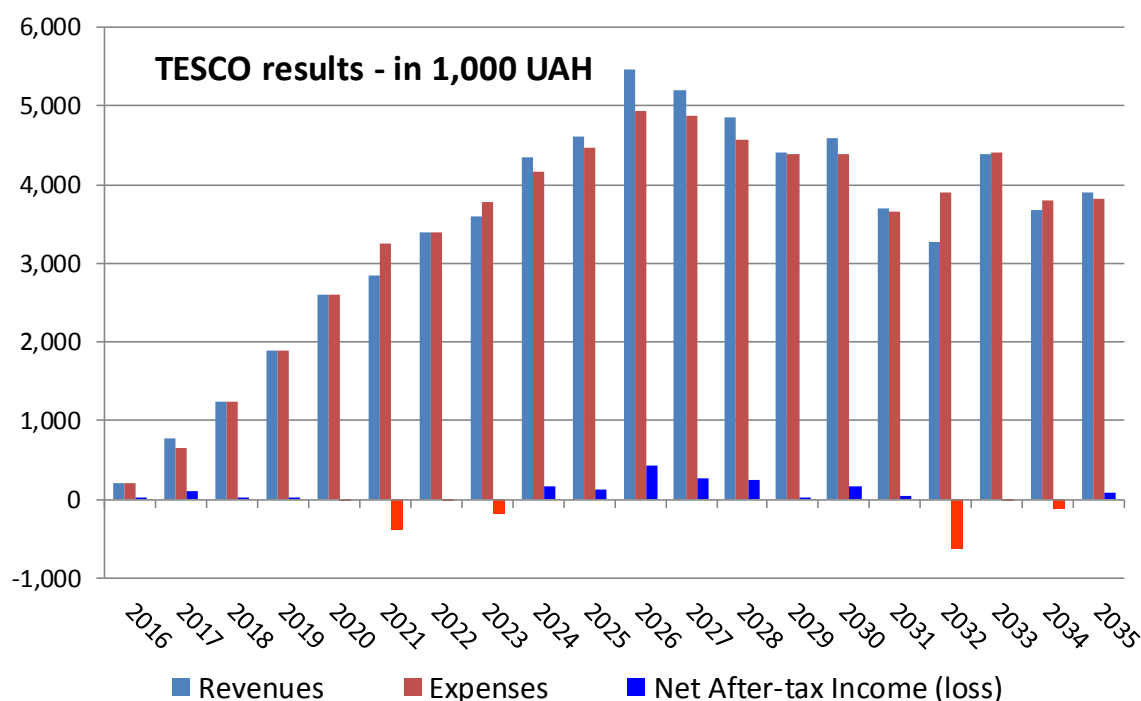
The proposed model will use up front funding from City budgeted as starting investment for retrofitting of 5 public kindergarten and schools via a dedicated energy efficient revolving fund. Implementing body will be existing municipal ESCO which will establish a new department for Energy Performance business. These recommended institutional settings will ensure transparent procedures on the one side and use existing capacities on the other side. Both will reduce transaction and operational costs significant.

Once measures are implemented financial benefits will flow back to the EERF and hence provide new capital for EE investment in the next building.

## The financial evaluation

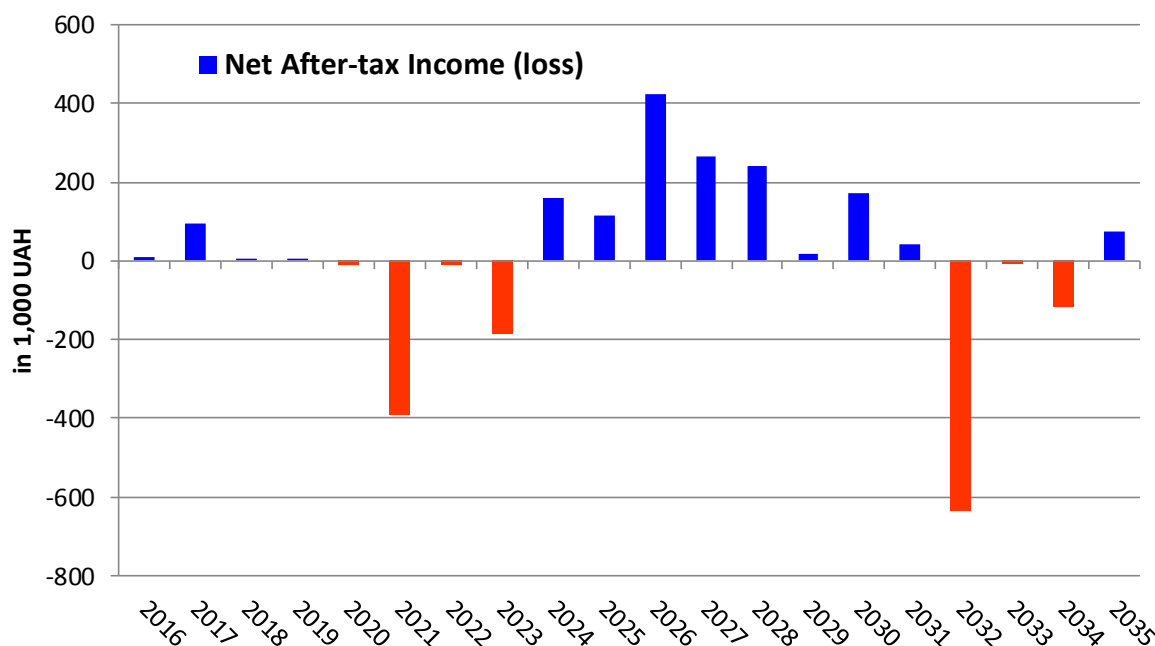
The financial assessment conducted in this project indicates that returns from identified energy efficiency project are relatively moderate in initial years. Presently low levels of energy tariffs result in low energy cost savings, which are projected to increase with rising energy tariffs. They can accommodate the assumed transaction costs but initially there is limited capability to also cover interest. Hence external low-interest financing from IFI sources is needed, as domestic loans are considered excessively priced.

**Figure 2: Cash flow outlook till 2035 (Based on Consultants Calculation)**



The continuous replenishment of the EERF from repayments through the ESCO-scheme is projected to finance a total value of 74.6 million UAH out of an initial investment provided by the city of some 30.4 million UAH during the first 5 years.

**Figure 3: Outlook on Income/losses till 2035 (Based on Consultants Calculation)**



The development of Income for TESCO is dependent on the timing of planning costs and returns from energy cost savings. Losses occur after the coverage of project planning costs ends after 5 years. In later years, losses can occur when project planning costs coincide with low levels of returns from energy cost savings.

IFI funding would provide a substantial further leverage to implement a large number of potential projects over the medium term. Suitable financing sources are potentially available from NEFCO, with appropriate loan sizes as well as compatible grant financing. IFI loan financing (e.g. NEFCO) would be denominated in local currency, thus eliminating currency risk from financing.

However, to attract IFI's it is strongly recommended to mitigate potential risks from the early beginning and ensure a transparent and clear conducive regulatory framework, sufficient access to finance, and a steady flow of viable projects. TESCO is strongly advised to have clear transparent procurement procedures and financial flows in place, to communicate proactively to the City administration, EERF and the public.

The substantially higher potential for economic benefits from energy cost savings out of EE investments due to the support from IFI financing is demonstrated by the comparison of total effects on all city related entities.

The following tables provide this comparison, also in terms of Net Present Value (NPV) allowing reading the results of the cash flows over time in present value terms.

## Scenario with CA financing only

in 1,000 UAH

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
TESCO - Cash flow	7	94	6	1	-13	-393	-11	-184	158	114	423	264	240	15	171	41	-638	-6	-117	73
Teploenergo - lost revenue	-	-67	-203	-316	-461	-633	-753	-799	-967	-1,025	-1,212	-1,284	-1,456	-1,543	-1,847	-1,957	-2,075	-2,406	-2,551	-2,704
City (departments and buildings)																				
EE investments	-3,183	-7,025	-5,026	-7,217	-7,969	-4,404	-	-6,102	-	-7,456	-	-5,405	-	-11,194	-	-	-11,595	-	-	-
Energy cost savings	-	336	1,016	1,579	2,303	3,166	3,767	3,993	4,835	5,125	6,059	6,422	7,280	7,717	9,233	9,787	10,374	12,032	12,754	13,519
Total cash flows - all city	-3,175	-6,662	-4,207	-5,952	-6,139	-2,265	3,002	-3,092	4,026	-3,241	5,270	-3	6,064	-5,005	7,557	7,870	-3,934	9,620	10,086	10,889
NPV at 3% discount rate	4,413 UAH																			

## Scenario with IFI financing

in 1,000 UAH

Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
TESCO - Cash flow	7	91	-680	-1,185	-1,182	-1,378	-787	-487	-155	479	664	1,163	404	88	178	-296	969	1,199	1,237	718
Teploenergo - lost revenue	-	-67	-512	-988	-1,174	-1,460	-1,668	-1,768	-1,967	-2,225	-2,358	-2,688	-2,849	-3,228	-3,422	-3,627	-4,072	-4,316	-4,575	-4,850
City (departments and buildings)																				
EE investments	-3,183	-23,525	-22,670	-7,396	-11,789	-6,629	-	-4,948	-7,779	-	-10,467	-	-11,661	-	-	-12,698	-	-	-	-13,810
Energy cost savings	-	336	2,561	4,938	5,869	7,298	8,341	8,842	9,835	11,125	11,792	13,438	14,245	16,140	17,109	18,135	20,360	21,581	22,876	24,249
Total cash flows - all city	-3,175	-23,166	-21,300	-4,631	-8,275	-2,168	5,886	1,639	-66	9,378	-370	11,914	139	13,000	13,865	1,514	17,257	18,464	19,538	6,308
NPV at 3% discount rate	18,070 UAH																			

## **Recommended next steps**

During the final consultation workshop the following determining actions for operationalizing Ternopil EERF and Ternopil ESCO have been presented and preliminary agreed:

- To take necessary legislation actions (acts) for creating the EERF and develop rules of the fund,
- To establish the supervision board (or committee), appoint the fund manager and additional staff if necessary,
- To authorize the EM department of City Administration to take over the function of the Fund Manager
- To commit funding and a funding schedule via the EERF and active fund raising
- To develop and approve operation guidelines (e.g., project selection criteria, operating procedures and monitoring & evaluation)
- To develop a project pipeline qualified by energy audits by autumn 2016
- To communicate the ESCO business plan
- To develop operational manual for ESCO
- To ensure institutional development/ staff/ capacities of ESCO

Under this perspective the CEETI (implemented for Ternopil city during the period 11/2014 to 03/2016) project was fully successful since it delivered mechanisms, capacities and financing to realize municipal EE investments. As result Ternopil received confirmation for donor funding of technical assistance for 90 municipal buildings energy audits and applied for loan funding by the recently established EIB facility.

# **1. Introduction and Rationale**

## **1.1 Project background**

The World Bank has assigned the Austrian consulting company Kommunalkredit Public Consulting (KPC) to assist the City of Ternopil in establishing financing mechanisms for energy efficiency (EE) in its public buildings and facilities. The city of Ternopil is aware of the importance of implementing energy saving activities, not only in terms of sharply increasing energy costs, but also committing to political targets to save energy and reduce greenhouse gas emissions:

- The city of Ternopil has joined the European initiative “Covenant of Mayors” in 2012 and has made clear commitments to lower energy consumption and CO<sub>2</sub> emissions by 20% by the year 2020.
- The city has fulfilled in 2014 the requirement of the ordinance of the Ministry of Fuel and Energy to establish a department of energy saving in the administration.
- The Sustainable Energy Action Plan (SEAP), approved by decision of Ternopil City Council on 29.11.2013 №6 / 39/2, outlines the targets for 2020 on reduction
- The SEAP is currently under revision and the new version will consider key elements of EE recommendations which have been developed in the EE Transformation Program (EETP) for the city of Ternopil in 2015
- It is the declared intention of the City of Ternopil to develop Ternopil ESCO into an efficient service company, providing energy services to public buildings.

## **1.2 Rationale**

The city government of Ternopil recognizes investing in energy efficiency as a pillar of its energy sector strategy for reducing reliance on imported natural gas, mitigating the financial and fiscal stresses of high energy costs, and supporting economic recovery and long-term growth.

Facilitating and scaling up municipal energy efficiency finance should be a key component of the city's EE support agenda. The overall demand for modernization investment in municipal buildings far exceeds available long-term financing. Municipal buildings (health care, education, administration, etc.) are generally deprived of any significant investment, a situation that will likely continue without deliberate government support and intervention.

Efforts to improve EE in municipal buildings have a significant impact on the cost and quality of municipal services. Such efforts also support the development of the energy service market and foster local government EE leadership. For Ternopil, then, investing in EE is an essential part of the local agenda for economic management. It is the declared target by the City Council to integrate the Energy Performance Contracting (EPC) scheme in Strategic Development Plan of Ternopil until 2025 with allocation of municipal budget support and enabling private sector participation.

Investments in EE in municipal buildings will help make district heating affordable for consumers while increasing fiscal space for municipal economic and social development activities.

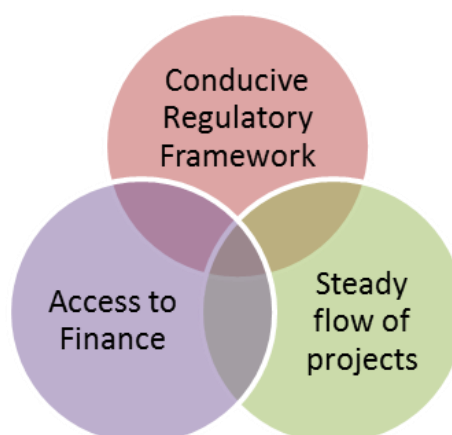
The most critical element of government support for municipal EE financing is to help create and foster the development of sustainable financing and delivery mechanisms. In the short term this would enable public funds to revolve, thus multiplying the impact of the initial

funding. In the long term it would attract and leverage commercial financing while maximizing private sector participation.

Financing is available but not always accessible and affordable—especially commercial financing. This highlights the importance of developing and promoting the use of sustainable financing mechanisms, such as Energy Performance Contracting.

The three preconditions for Energy Performance Contracting are:

**Figure 4: Preconditions for Energy Performance Contracting (Consultants illustration)**



Due to the now identified market potential and improved regulatory frame the city government has the opportunity to catalyze the market which in the long run can generate energy efficiency enhancement projects.

In the inception mission to Ternopil in December 2015, the Consultant assessed different options of how an ESCO can be used as an implementing vehicle and how a municipal revolving fund can be established for supporting investments implemented by this ESCO.

### 1.3 About Energy Efficiency Service Financing

According to experts<sup>2</sup>, there is a large potential of energy savings in public buildings in Ukraine of up to 70% of the current energy consumption. Considerable investments in the upgrading of the buildings are required to reap the benefits of these energy savings. However, sufficient funds to cover all these investments are not available from the municipal budget.

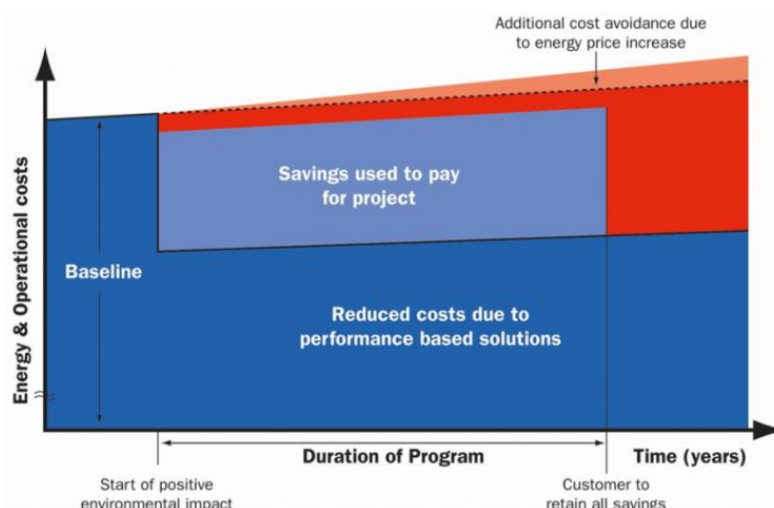
Hence one alternative mechanism for raising the required funds can be realized by setting up an Energy Service Company (ESCO). This ESCO will operate under a performance contract under which it will take the responsibility of implementing certain pre-defined Energy Conservation Measures (ECMs). The revenues of such ECMs will form the income of the ESCO.

In addition, the Municipality of Ternopil intends to establish an Energy Efficiency Revolving Fund (EERF) to acquire external financing, capture financial savings resulting from the ECMs, and re-invest them in further EE improvements. Figure 2 shows in a nutshell main characteristics of performance contracting:

<sup>2</sup> The experts involved in the project have a long track record of experience on energy efficiency in buildings in Ukraine and can draw back on a number of documents, such as sector reports and energy audits by certified auditors to estimate the energy saving potential,

Figure 5 - Overview Performance Contracting<sup>3</sup>

Energy related costs will be reduced by implementing energy saving measures. These measures are mainly related to technical improvements (insulation, new windows, heating system), new equipment (solar system, boilers, ventilation, etc.) or more efficient design and processes. New energy related costs (pure energy costs, but also services) are significantly lower than initial energy costs and part of savings will be used to repay investment. Once these investments are paid off, all benefits stays within customer. However, based on contract period and possible energy price increases, the customer can already benefit from day one of the agreement.



It is expected that the revenue stream for an ESCO from the energy savings component of the project will come from the difference between the payment of the energy costs as defined in the baseline period and the actual energy cost payments to be made by the ESCO to utilities during the course of the contract. The savings to be generated will come from the investments made by ESCO in ECMs in the different facilities that will be the focus of the contract with the Municipality

## 1.4 Report structure

This Assessment of Energy Efficiency Financing Options for Ternopil and Development of Business Strategy and Plan was developed under the auspice of the World Bank Project Energy Efficiency Transformation in Ukrainian Cities and was supported by the Energy Sector Management Assistance Program (ESMAP). The Energy Efficiency Project is sponsored by the Municipality of Ternopil and the Municipal Enterprise Ternopil Energy Service Company (Ternopil ESCO). To provide a sound but focused business plan, this report is structured into following sections:

- Chapter 1 Problem and background
- Chapter 2 Project framework (strategic and legal preconditions) and market for energy saving potential (including project pipeline), stakeholders, legal framework
- Chapter 3 Business model – structure, critical issues, proposed ESCO scheme, procedures, services, legal and institutional relations as well as project implementation
- Chapter 4 Financial Assessment including financing options
- Chapter 5 Governance
- Chapter 6 Risk management
- Chapter 7 Implementation schedule (yet to be decided)

<sup>3</sup> Source: <http://www.citelum.com>



## 2. Market Analyses

### 2.1 Assessment of Existing Situation

In Ternopil there are 122 public municipal buildings with local budget funding with a total floor area of **375,900 m<sup>2</sup>**. According to the assessment of the EETP<sup>4</sup> the overall annual space heating energy consumption in 2013/14 for all 122 municipal public building was about 69 GWh of which 78% was supplied by the communal enterprises “Ternopilmiskteplokomunenergo (=Teploenergo)” (TE) and 22% by individual boilers fired by natural gas. The specific space heating energy consumption is in the range of 150-170 kWh/m<sup>2</sup>. Approximately USD 8 million annually has been spent for energy supply in public buildings in the years 2013/14, which represents 8% of the annual municipal budget. This share increased in 2015 due to rising energy costs to over 10% of the municipal budget (which led to reduction of heat energy supply and hence “under-heating” of the buildings; not meeting the temperature set by norms and having negative impact on comfort level, especially in health care institutions, schools and kindergartens. Table 1 provides in a nutshell most relevant issues in the building sector.

**Table 2: Existing situation and identified deficiencies (Consultants illustration)**

Typical building facility/ subject (during heating / winter period)	Deficiencies at existing situation	Reason for deficiency	Effects and risk of deficiency	Sustainable solutions
<b>HEATING:</b> Indoor room temperature (class rooms, corridors, other rooms)	Reported as insufficient at cold winter days Over and under-heated parts of the building Some building are under-heated	High transmission and mechanical ventilation losses through building envelope Capacity of heating system insufficient and no control	Uncomfortable conditions for learning Health hazards for children, pupils and teachers Some rooms are not usable in cold winter days	Reduction of heat energy losses at building envelop (windows, doors, walls, roof, floor) Control of heat supply according to temperature Demand to meet norm room temperature of 20°C
<b>VENTILATION:</b> Humidity in occupied class rooms	In occupied rooms high humidity and dew point temperature	Recently replaced windows reduce mechanical ventilation Not existing/ operating ventilation systems provide insufficient free ventilation	Mildew at structural elements (window frames), reduction of lifetime Health hazards for pupils and teachers	Installation or reactivation of ventilation system
<b>Losses and operation effort of heating system</b>	High losses for internal distribution of heat and / or heat energy generation Significant over and under-heated rooms in heating	No hydraulic or heat flow balancing at radiators Outdated central heating system Outworn boiler,	Leakages of water heating system in building, reducing the lifetime	Rehabilitation or replacement of heat distribution system, radiators, controls and hydraulic balancing

<sup>4</sup> Energy Efficiency Transformation Program for the city of Ternopil (2015) which includes detailed sector analysis.

	transitional period	with insufficient manual control
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This existing situation and expected increases in of energy prices are the main drivers to invest in energy saving measures. The technical solutions to improve energy performance and increase comfort by reducing costs are quite often well-known and available, but financing capacity is limited. Therefor a prioritization is needed to select those buildings that best fit the municipality’s overall strategy and business models.

### 2.1.1 Criteria for the selection of facilities for the pool of projects

The key criteria for the selection of facilities are listed to establish a pool of facilities, which are appropriate for the ESCO business and will be subject for the further analysis of the market potential. These key criteria are most appropriate to meet because they allow that the City can directly act and intervene without other stakeholders, has direct access to all facilities and can hence replace outdated equipment on own purpose only which makes planning, procurement and implementation much easier. Also all benefits will stay with the City or facilities fully owned by the city. Finally good baseline data and high saving potential are essential for every viable project.

**Table 3: Facilities with the following properties shall be eligible (Consultants illustration):**

Criteria	Key aspect	Applicability for ESCO Ternopil eligibility
1) Full and guaranteed <b>ownership</b> by municipality	<ul style="list-style-type: none"> <li>Owner and main user of the object belong to the same organization/ institution</li> <li>Sufficient structural certainty on the ownership of land of the object</li> </ul>	Full power by City administration of Ternopil For at least the following 10 years
2) Secured <b>prospective occupation</b> and use of the facility	<ul style="list-style-type: none"> <li>plans for closure, downsizing or privatization</li> <li>facility shall have stable use structure</li> </ul>	No plans over next 10 years
3) <b>Access</b> to the facility	<ul style="list-style-type: none"> <li>Access for operation, metering and influencing behavior of users</li> </ul>	City Administration departments or municipal owned entities have full access
4) Access and <b>control on energy costs</b> and payment	<ul style="list-style-type: none"> <li>access to energy costs savings as revenues from EE</li> <li>energy savings can be determined clearly separable for the entity and controlled for rechanneling into the EE funding procedure</li> </ul>	City Administration has full access
5) <b>Energy consumption and energy cost</b> are sufficiently high to justify transaction costs for EPC	<ul style="list-style-type: none"> <li>Heated area shall be above 2.000 m<sup>2</sup></li> <li>Annual time of use of building shall be above 200 days including heating season</li> <li>The main part of the building shall have a Normative indoor temperature of 18/20 °C</li> </ul>	Selection of facilities → Possibility for pooling smaller facilities
6) High <b>energy saving potential</b>	<ul style="list-style-type: none"> <li>current specific heat energy consumption shall be minimum above 30% over the norm requirement of 100 kWh/m<sup>2</sup></li> <li>The calculated EE potential with a standard set of ECM is above 50%</li> <li>No recent or planned short-term major retrofits or ECM measures</li> </ul>	Preference given to buildings with specific consumption > 150 kWh <sub>th</sub> /m <sup>2</sup> Facilities shall have the potential to replace at least 40-50% of the windows as ECM
7) Existing good quality baseline data	<ul style="list-style-type: none"> <li>area, heated area, type of use, users, metered energy consumption, etc.</li> </ul>	Sufficient baseline data as of the following assessment

**Table 4: Further soft criteria for the selection are (Consultants illustration):**

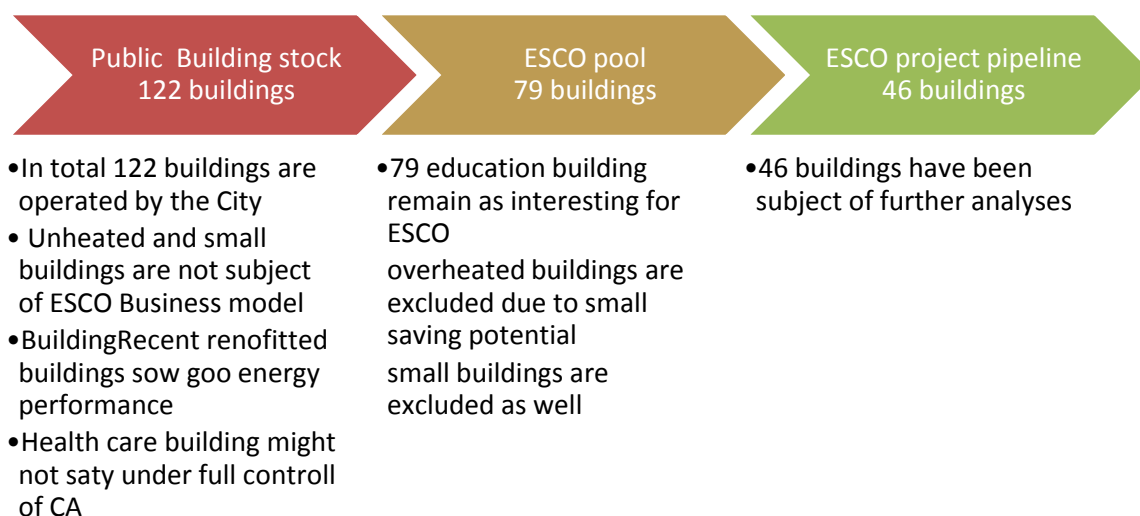
Criteria	Key aspect	Application for Ternopil ESCO
High degree of social co-benefits	<ul style="list-style-type: none"> <li>health, comfort, safety, etc.</li> </ul>	To be proven by feasibility study/ Energy audit
Ease of implementation	<ul style="list-style-type: none"> <li>project can be implemented in a reasonable time frame</li> <li>No resettlement needs (of users) during implementation period</li> <li>High probability to get construction permissions for retrofit</li> </ul>	Proven retrofit technologies and materials will be applied Overall time for implementation at one facility is approx. 4-5 months, Indoor retrofit shall be implemented during 3-month summer vacation period, envelop retrofit measures can be realized during occupation period
Potential for replication and demonstration		Preference on standardized type of buildings first to gain experiences for follow-up facilities

Those criteria are applied in the following to condense the list of 122 public municipal buildings to those, which are candidates for the ESCO business.

### 2.1.2 Selection of facilities for the ESCO pool

The strategy is to consider EE measures primarily at building blocks with a high level of occupancy and components of high heat energy losses during heating period, with the target that a high number of users can benefit from investments.

**Figure 6: Selection process for ESCO project pipeline (Consultants illustration)**



Among the total of 122 buildings there is a number of the facilities which are operated by the City Administration (CA) Departments of Culture and the Arts, Social Policy Management, Family, Youth, Sports and Tourism; which are small, unheated or un-used and thus are not suitable for the ESCO business model.

The administrative facilities of the city administration (city council building, town hall and office buildings) show relatively good energy performance due to recent retrofits (in particular windows) and ongoing refurbishment. There is therefore only a small energy saving potential, which makes them not attractive for the ESCO.

The City Administration - Department of Health and Medical Care reports 7 buildings under their current responsibility, including 1 hospital and Polyclinics/ Centers for primary medical

care. According to the latest governmental plans on administrative reform, the ownership of medical and health care facilities will be transferred from the city to regional administration in due time. The majority of health care centers are lodged in private or commercial owned buildings which limits the access for investments. Due to these circumstances the hospital and polyclinics will be dropped from the assessment for the pool for ESCO project.

The City Administration Department of Education and Science is the owner and responsible for the operation of 79 facilities, which include 34 schools, 30 kindergartens, and 15 mixed-purpose education facilities. The 79 facilities have a combined 245,000 m<sup>2</sup> heated floor area and consumed a total of 48.5 GWh in 2014, of which 7% is electricity, 5 % natural gas and 88% district heat.

Those 79 facilities comply with the first set of key criteria for ESCO eligibility.

- Full and guaranteed ownership by municipality
- Secured perspective occupation and use of the facility
- Access to the facility
- Access and control on energy costs and payment
- Good baseline data available.

The preliminary analysis of the current energy consumption patterns and the conditions of the building allows the second step of concentration by applying the criteria of

- High Energy consumption and energy cost
- High energy saving potential

The City Administration Department of Education and Science provided a set of data for the buildings on:

- Geometry and conditions of the building: heated area, floors, source of energy for space heat (DH, gas boiler), key features of building envelope, such as structure and thickness of outside walls, type of roof, share of old and/or replaced windows. This information has been validated and - on demand - supplemented by the technical consultant with assumptions on, e.g. demand of domestic hot water, geometry share of building structures, and other missing or inconsistent data. The accuracy and validity of data has been checked.
- Energy consumption and costs: last 3 years metered heat, gas and electricity consumption, energy spending and number of pupils/ users per building.

Out of this data the performance indicators of specific heat energy consumption per heated area and level of energy costs have been aggregated. This information allows the preliminary identification of opportunities and needs for ECM.

Buildings with the following characteristics have been eliminated for the further analysis:

- Specific heat energy consumption below for 120 kWh/m<sup>2</sup> for schools and below 180 kWh/m<sup>2</sup> for kindergartens, since below this threshold the energy performance of the building seems quite acceptable
- energy heat costs for the facility of less than 230,000 UAH per year
- heat energy saving potential with a standard set of ECM of less than 55%
- Demand for window replacement of less than 50% (considering that the majority of "changed windows" over the last 10 years does not comply with EE norms, thus need to be replaced.)

### **2.1.3 Methodology for Assessment of Energy Saving, EPC market potential, and project pool of eligible projects for EPC business**

The following graphical overview presents the sequence of analytic steps which has been undertaken:

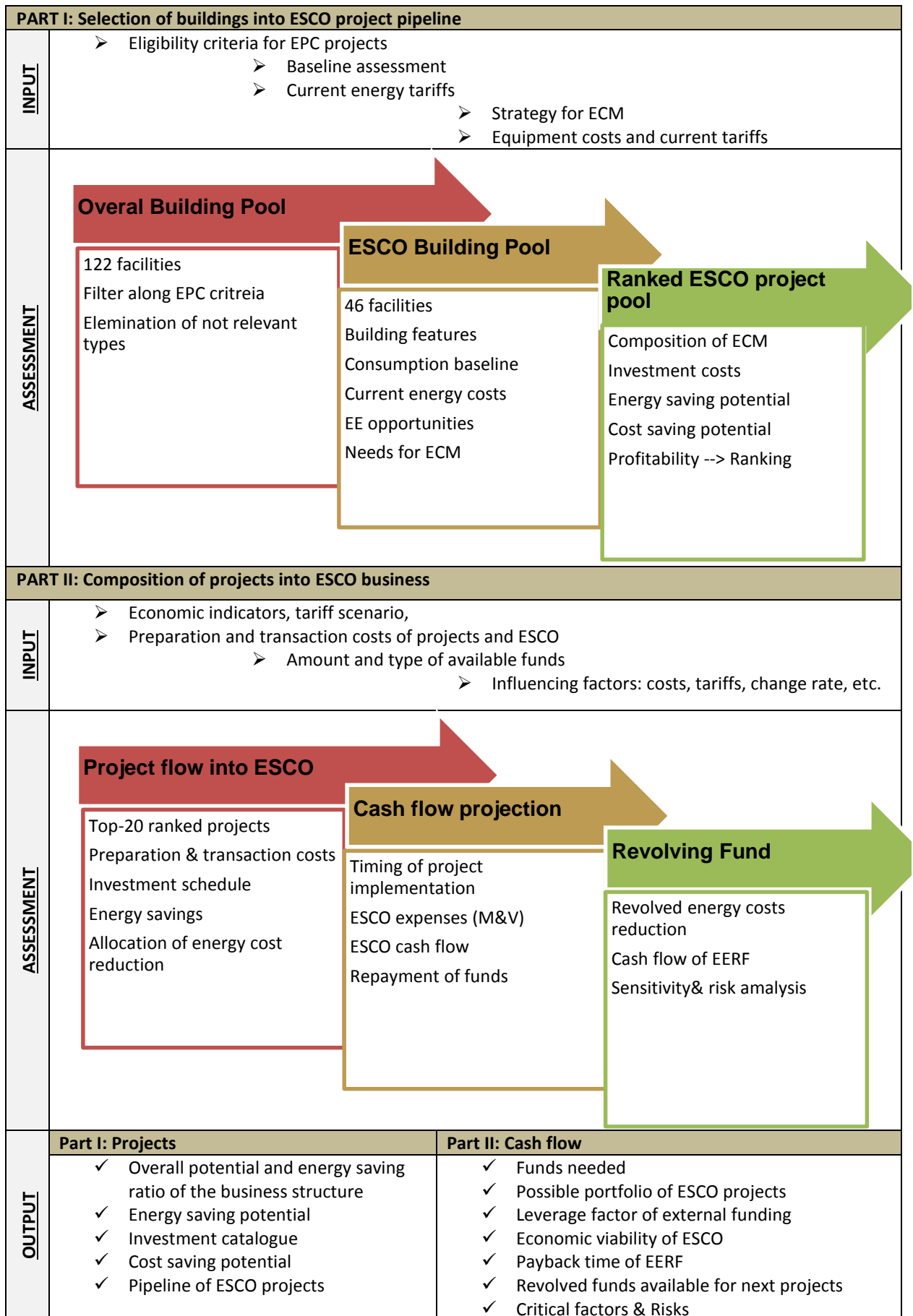
- the identification, selection and ranking of buildings, preliminary technical and economic assessment of the EE project pool in Part I
- subsequent composition of projects into ESCO business pipeline along with the ESCO and EERF financial cash flow projections in Part II

Specifically in a first step all municipal public buildings in Ternopil have been screened if they meet the above outlined set of eligibility criteria for the ESCO model. As result out of a total of 122 buildings 46 facilities are grouped into an ESCO building pool.

In a second step, for those buildings of the ESCO building pool (i) the current energy performance has been analyzed (preliminary baseline assessment), (ii) the catalogue of energy saving measures and investments has been composed and (iii) the energy saving and costs saving potential has been calculated. The results of this exercise are a ESCO building pool ranked by profitability as well as key information for each project on investment costs and potential annual energy costs reduction. The top 20 projects with an energy saving ratio of above 1.5 kWh/USD investments (or simple payback time of less than 15 years) are considered as suitable projects for the start-up phase of the ESCO.

In a third step the ranked list of ESCO projects have been composed into an investment pipeline for the ESCO model with an implementation sequence according to expected available funding. These results into the cash flow projection for the ESCO as well as energy cost reduction which are used to payback investment contributions by the EERF, the City Administration or external sources. Out of the overall economic viability of the ESCO and EERF can be drawn.

**Figure 7: Methodology of assessment (Consultants Illustration)**



The result of this selection is a list of buildings, which complies with the set of the key criteria. From the assessment of the baseline and economic performance of the pool of projects one can classify 3 categories of building projects. Buildings which have a current comfort level that is higher than the norm, which means they are overheated, are most promising for the EPC business because of a large the energy saving potential will less specific investment costs.

**Figure 8: Classification of buildings (Consultants Illustration)**

Profitability Baseline Comfort level	< 10 yrs PBT <sup>5</sup>	> 10-18 yrs PBT
Overheated buildings	Very good for EPC → Top Priority	Good for EPC
Under heated buildings		Baseline is too low to generate attractive EE cost returns

Out of the pool of 46 buildings, 4 schools and 6 kindergartens seem to be currently overheated and 50% of them can be found within the top 10 ranked projects.

For buildings with low baseline comfort level, which means that they are under heated by not meeting the norm temperature, measures must be undertaken to bring them up to norm temperature comfort level after implementation of ECM. In this case the energy saving potential is lower and higher specific investments per energy saving are needed. Those projects are not attractive for EPC business model due to the lower potential of real energy costs reduction. In turn, the City must allocate funds for investments in the respective facilities to achieve first a temperature comfort level on demand<sup>6</sup>. For that purpose a grant component shall be considered, either financed out by the City itself, donor funds or regional/national funds.

## 2.2 Project pipeline

The following table provides an overview of 46 facilities of the pool, ranked by the best simple payback time according to the preliminary calculated specific energy costs saving at the first year after EE project implementation and the investment volume (starting from 9 years). Based on selection criteria as outlined above, only buildings from education department have been selected. Buildings owned by other departments are either not heated, recently renovated, not under full control of CA or do not show attractive energy saving potential.

The TOP-10 projects of this pool with best economic performance shall be considered as start-up facilities for the ESCO business. Please refer to Annex 5 which provides a project profile with details of the prioritized facility for the kick-off of the ESCO model.

**Table 5: Ranked list of the pool of buildings for ESCO model based on preliminary assessment**

<sup>5</sup> PBT = simple Pay back Time, based on first year savings and does not take into account tariff increases.

<sup>6</sup> Note for the under heated buildings: The PBT is calculated statically on the basis of energy costs of 2016. In case of commencing those EE projects later (in some 5-8 years) the increased tariff will improve the viability. However subsidies will remain needed.



**Table 6: List of assessed Buildings**

Facility	Heat Savings (MWh/year)	Heat Savings (% of baseline consumption)	Equipment Costs (mln UAH)	Equipment Costs (USD)	Payback time (years) <sup>7</sup>
Kindergarten № 13	231	78%	3.0	110,162,	9
School № 2 (high)	404	71%	6.0	223,096,	11
KINDERGARTEN № 38	263	74%	4.0	148,881,	11
Ukrainian gymnasium	337	69%	5.4	201,677,	11
KINDERGARTEN № 31	367	74%	5.7	210,092,	11
technical liceum	380	78%	5.6	208,921,	12
KINDERGARTEN № 30	351	74%	5.7	210,893,	12
KINDERGARTEN № 19	315	74%	5.0	186,917,	12
SCHOOL-KINDERGARTEN № 28	341	73%	5.6	207,036,	13
KINDERGARTEN № 2	289	74%	4.7	173,321,	13
KINDERGARTEN № 10	256	75%	3.9	144,528,	13
Special general-education school	289	73%	4.8	176,415,	13
SCHOOL-KINDERGARTEN № 1	335	73%	5.6	208,155,	13
KINDERGARTEN № 23	330	73%	5.6	206,394,	14
SCHOOL-KINDERGARTEN № 32	196	74%	3.2	117,197,	14
KINDERGARTEN № 22	303	73%	5.1	188,695,	14
KINDERGARTEN № 25	280	73%	4.7	173,814,	14
KINDERGARTEN № 20	296	74%	4.7	173,409,	14
KINDERGARTEN № 14	326	72%	5.6	208,049,	14
KINDERGARTEN № 6	287	73%	4.8	176,007,	14
KINDERGARTEN № 27	322	72%	5.6	207,186,	15
SCHOOL-KINDERGARTEN № 35	310	72%	5.4	199,816,	15
KINDERGARTEN № 33	296	72%	5.2	193,010,	15
Secondary school № 3	294	65%	5.7	211,484,	15
KINDERGARTEN № 37	261	73%	4.4	162,553,	16
Secondary school № 7	384	66%	7.0	260,210,	16
Classical gymnasium (foreign lang)	289	73%	5.5	202,863,	17
School № 12 "Йосифа Снігоро"	317	71%	6.6	244,140,	17
KINDERGARTEN № 34	237	72%	4.2	157,164,	17
KINDERGARTEN № 16	159	72%	2.7	101,401,	17
KINDERGARTEN № 29	146	73%	2.4	88,739,	19
Kindergarten № 12	305	76%	4.4	164,675,	19
KINDERGARTEN № 15	224	75%	3.3	123,801,	21
School № 4	450	73%	11.7	434,034,	22
School № 9	419	71%	10.4	384,920,	23
Secondary school № 5	327	65%	8.3	307,403,	24
School № 23	672	66%	16.0	591,195,	24
School № 20	490	68%	11.9	440,817,	25
School № 21	523	71%	12.9	479,060,	25
School № 22	565	63%	12.7	470,407,	26

<sup>7</sup> This represents the simple Payback time, based on first year savings and does not take into account tariff increases.

School № 8	452	72%	10,5	390,588,	26
School № 14	405	60%	10,0	371,127,	26
Kindergarten № 24	133	73%	2,3	84,064,	27
School № 11	593	67%	14,8	549,164,	27
School № 19	481	69%	12,4	460,867,	30
School №10	290	60%	7,4	273,388,	34

## 2.3 Saving potential & renovation costs

The pool of buildings for ESCO business comprises of 20 schools and 26 kindergartens with a heat energy saving potential in the range of 60-78% in total up to 15.5 GWh per year.

All of the above described facts and assumptions of the baseline conditions as well as type, costs and benefits of the Energy Conservation Measures (ECM) have been aggregated (for all 46 related buildings, one-by-one) in an EXCEL model for the calculation of the EE project and ESCO market potential. This model will be provided to Ternopil ESCO for further use.

The identified and analyzed pool of 46 buildings for the ESCO business comprise an energy saving potential of 15,500,000 kWh/year (15.5 GWh/yr) which represents a saving of 62% compared to the baseline consumption of the pool (25 GWh/yr).

The total investment costs for the implementation of a recommended package ECM (including equipment, material and works, but excluding project preparation) in the 46 buildings will amount to approx. **303 million UAH or 11.2 million USD** (including 10% contingencies). The specific investment costs are in the range between 60 and 110 USD per m<sup>2</sup> heated area, average 85 USD/m<sup>2</sup>. The level of investments depends on the composition of ECM according to the conditions and needs of the individual building.

The specific energy savings vary in the range between 1.0 to 2.0 kWh annual energy savings per USD investment - in average 1.4 kWh/USD - which are comparable to public building EE retrofit measures in most Eastern European Countries.

The simple payback time for the set of ECM in the respective building varies from 9 to 30 years, which the majority of building EE retrofit programs can achieve a payback of 12 to 18 years, which is – considering expected tariff developments over the next decades - an acceptable value and less than the equipment life time.

## 2.4 Energy saving benefits

The main benefit of the implementation of Energy saving rehabilitation of the buildings is the significant reduction of energy costs.

Assuming as baseline the current energy demand (power, heat and gas) at the tariff levels of 2016 the annual energy costs for all 46 facilities of the pool will be 31.5 million UAH. In case of implementation EE investments in all buildings at once the energy costs in the following year – under same tariff level assumption – will be at approx. 13.8 million UAH. There is a **potential for energy cost cut by 56% or 17.6 million UAH**, in the first year after the EE project.

By applying the tariff increase scenario (as explained in section 4.1.2) and an average lifetime of the new equipment (or materials of the building) of 20 years the lifetime energy

costs savings sum up over 20 years to theoretically to 700 million UAH<sup>8</sup> (or 26 million USD), which is more than double than the investment costs. Under these rough theoretical economic assumptions, the EE investment program is long-term viable..

In addition, the Project will significantly improve the indoor environment for children and teachers at the Schools and the Kindergartens. Currently the buildings regularly fail standards for heating-period indoor air temperature.. After implementing the ECMs, the buildings will be able to meet this standard while using less energy. Temperature controlled classrooms/playrooms heating according to norm temperature will improve the health of children and teachers and the educational process while decreasing absence rates.

By saving heat energy at the level of annually 15.5 GWh, which is generated in gas boilers (at the DH Company or individual boilers) the consumption of natural gas for the heating of the pool of municipal buildings can be reduced by approx. 2 million m<sup>3</sup> per year. This gas saving effect will have two benefits: a) emission reduction of approx. 4,000 tons CO<sub>2</sub> emissions per year and b) contribution to the set gas saving targets of Ternopil (33 million m<sup>3</sup>) by 2020 of 6%.

## 2.5 Technical approach for energy conservation measures

The strategy for the selection and composition of the energy conservation measures (ECM) follows five generic targets:

<b>1. Reduction of energy consumption &amp; costs</b>	→ Decrease of heat losses, energy consumption and costs
<b>2. Improvement of indoor conditions</b>	→ Increase of heating comfort <sup>9</sup> by meeting norm room temperature
<b>3. Compliance with technical norms</b>	→ Meeting standards by Ukrainian regulation
<b>4. Sustainable operation</b>	→ Life-time benefits, low operation costs and risks
<b>5. Least cost solutions</b>	→ Most economic viable solutions

**Following guiding principles and assumptions** are applied for the analysis:

- Only EE Equipment and materials which are available in the Ukrainian market and for which experience for application is available.
- Standard available dimensions of material (in particular insulation thickness) in the Ukrainian market.
- Materials for building retrofit (such as insulation, roofing, floor,) as well as simple technologies (such as windows) shall originate from Ukraine,
- No application of advanced, complicated or unconventional costly EE technologies to ensure technical sustainability of the solution (such as heat pumps, solar technologies), and high benefit-cost ratio. Only those EE materials and equipment are considered for which local capacities for qualified installation and commissioning as well as operation experience are available at the Ukrainian market.
- Consideration of current market prices of material and equipment in Ukraine and local costs of works and installation. The cost estimates are verified and based on a

<sup>8</sup> Estimated projections on general inflation have been applied based on the most recent country report of IMF. Inflation was forecast to show a rapid decline from a high level of 27.6% in 2015 to 10.6% in 2016 and further to 6% in 2019. The latter rate was applied continuously from 2019 onwards.

<sup>9</sup> Room comfort means in this respect the controlled indoor room temperature according to the Ukrainian standard (20/22 °C) and by that avoiding over-heated or under-heated rooms.

number of recent reference applications/ realized EE projects in the public building sector. The unit costs of material and equipment including works were calculated with great care by experienced EE specialists with good knowledge on market situation.

- Remain with the current source of heat supply. DH supplied buildings should remain supplied by the DH system in order to avoid load reduction, which has negative effects on the DH company and may result in heat tariff increase in the long run.
- Fuel switch from individual gas boilers to biomass is placed back. In the detailed energy audit technical and economic opportunities will be analyzed which are in line with targets of the ESCO and cost optimal supply of energy. The DH company already has experience with purchasing heat energy generated by biomass boilers from independent heat producers. On occasion this will be extended and applied for individual buildings with independent boiler.

In the following the preferred technical solutions for ECM for typical buildings are outlined by assessing the current condition and needs, brief technical specification of the ECM, specific costs, specific energy saving result, and other benefits.

**EE Package A** – The thermal retrofit of the building envelop has the target of the reduction of heat transmission losses through structural elements and by that the space heat demand of the respective building block. This package comprises:

- Replacement windows
- Replacement of external doors
- Insulation of external walls
- Retrofit of floor ceiling at ground floor
- Insulation of roof ceiling

**EE Package B** – Heating and ventilation system. The target is to supply space heat energy with low level of energy consumption and high level of comfort, meeting the requirements by norms. Heat generation and distribution losses shall be minimized or avoided. Some proposed measures are:

- Reconstruction of internal heating system:
  - Re-Zone and provide Direct Digital Control (DDC) based Automatic Control valve system to control different heating zones for buildings.
  - Balancing of heating system
  - on demand up-grading of the Individual Heating Substations with automatic control for temperature setback at nights and weekends
  - Replacing all radiators with new cast iron radiators and retrofit radiators with thermostatic control valves
  - Pipe insulation in the basement and other unheated spaces
- For individual boilers: Fuel switch from gas to biomass,
- Reactivation of the ventilation system

## 2.6 ESCO market

In general, the market for ESCOs in Ukraine faces several challenges, including limited access to finance, low demand for energy services, a mismatch between demand and supply, and lack of understanding and awareness of ESCOs.

The ESCO market in Ukraine has previously seen some development, but the market failed to reach sustainability. During the 1990s, the development of ESCOs and their activities in

Ukraine began mostly in the industrial sectors. Although the companies did not offer a full range of ESCO services, some examples were UkrESCO, a state-owned joint-stock company mostly financed by the European Bank for Reconstruction and Development (EBRD); and several regional ESCOs, such as ESCO-East, ESCO-Centre and ESCO-West, established with the financial assistance of USAID (Econoler/IFC, 2011). The 2008-10 global financial crisis negatively affected the growing energy services market, however, as projects were interrupted by the fleeing of foreign investment from Ukraine. Today the number of companies that may be defined as ESCOs, offering the full range of services has fallen to less than five.

However, the potential of ESCOs in Ukraine is still largely untapped. Most of the ESCOs operating in the Ukrainian market are small (ranging from 3 to 15 employees) and cannot offer the full range of ESCO services for a typical energy efficiency project lifecycle. The State Agency on Energy Efficiency and Energy Saving of Ukraine (SAEE) estimates that the ESCOs market could reach a cumulated volume of EUR 4.4 billion by 2030, starting with EUR 130 million/year in 2015 and reaching EUR 311 million/year in 2020 (SAEE, 2015). However, the recent situation in the country suggests that this scenario may be optimistic, considering the lack of ESCOs that can self-finance large-scale projects and the lending conditions in Ukraine which – coupled with inflation levels – are very complicated for investments with payback periods longer than one to two years (as is usual in the case of ESCOs).

The ups-and-downs of Ukraine's ESCO market over the past two decades highlight the lack of an adequate framework for a well-functioning and self-sustainable private sector for energy efficiency.

Numerous barriers exist, including difficult access to finance, lack of accounting and tax regulations on energy performance contracts (EPCs), lack of information, and skills shortages in the market.

Under improving conditions the city of Ternopil currently provides the right ingredients - such as, commitment, willingness, analyzed needs and potential - to develop a case for a municipal ESCO and to show how barriers can be overcome.

## **2.7 Stakeholders**

The entities involved in the provision, consumption and cost coverage of energy in the municipal framework are in many cases separate legal entities. This chapter describes

- on the consumption side the characteristics of schools, representing a key category with municipal buildings funded by the city's budget and
- regarding the provision of energy, the main supplier, in particular in cost terms, is TE
- the role and characteristics of the Ternopil ESCO itself
- the functions of the city administration related to energy costs in the sector targeted by the Ternopil ESCO along with the framework surrounding the establishment of an EERF

A generic description of other utilities, such as Electroenergo, and IFIs is omitted here for their features are considered to be available in the public domain.

### 2.7.1 Schools

Out of a total school budget approximately 55% are for salaries and 12% are for social security and taxes. A share of some 33% is attributable to utilities (energy, water, waste disposal, communication). Out of the total utility costs, 90% are for heat. Schools have their own accounting, which provides information from their records for budgeting by the city. In case of actual costs exceeding budgeted values additional cost coverage must be applied for by the school with the city. Schools have their own supply agreements with utilities based on (tendered) common tariffs and metered consumptions. Tariffs are presently

- For gas: 9.915 UAH/m<sup>3</sup>
- For electricity: 1.916 UAH/kWh
- For heat: 1,533 UAH/GCal

Based on discussions with school administrations, schools would be allowed and willing to enter into ESA type agreements if positive advice will be given by the city.

### 2.7.2 Kindergartens

Municipality of Ternopil is responsible for operating all kindergartens. All related costs are financed out of City budget, buildings and facilities are 100% owned by Ternopil. The energy tariffs are same as for schools.

This gives the City of Ternopil a strong position to implement energy saving measures and to benefit from energy cost cutting investments.

### 2.7.3 Ternopilmiskteplokomunenergo” (Teploenergo; “TE”)

“Ternopilmiskteplokomunenergo” (Teploenergo; “TE”) is the 100% municipality owned district heating company of Ternopil. The company presently prepares to put Ternopil ESCO into operation. In order to create an operational basis for the Ternopil ESCO, TE plans to transfer heat sales business<sup>10</sup> worth 70-80 mn. UAH per year.

Moreover, to establish an asset base for Ternopil ESCO, a pool of 89 Individual Heating Substations (IHS) in schools and kindergartens are to be transferred (equity in kind) by September 2016 from Teploenergo., These facilities have been funded from the local budget at a value of approximately 7 mn. UAH. Thus energy supply contracts and transferred assets are intended to serve as a basis for loans.

### 2.7.4 Ternopil ESCO

Per Statute, the Ternopil ESCO was established for providing services to the district heating and domestic hot water supply systems for customers in the City of Ternopil and implementing energy saving measures and technologies for Municipal infrastructure. The Company shall perform the following main operational activities:

- Providing services to district heating and domestic hot water supply for customers in the City of Ternopil
- Optimizing and automating the district heating and hot water supply systems
- Improving the reliability and efficiency of the thermal equipment

<sup>10</sup> This intention was expressed by the management of TE. No specific details on how this activity is to be organized were received. It is assumed, that TESCO is to be entered as an intermediary, i.e. with heat volumes to be sold to TESCO, which again would further sell to user entities.



- Identifying, developing, financing, implementing and monitoring energy efficiency projects for energy supply and consumption to improve their financial viability and reduce emissions
- Various other activities for maintenance and development of energy related services in the sphere of district heating

Ternopil ESCO's Managing Director is Mr. Leonid V. Nanotsky. Mr. Bogdan Myskiv is the Deputy Director. Mr. Myskiv's contact information is presented in Figure 2.

Although the Ternopil ESCO did not operate in recent years, the Municipality considers their ESCO as the most appropriate entity for developing, financing and implementing ECOs at municipal buildings.

The Ternopil ESCO's borrowing for public sector investment projects is governed exclusively by the Ternopil City Council.

### **2.7.5 The City of Ternopil**

The cost coverage of schools is handled by the city through its Department of Education. Funding is subsidized through an allocation from the Ministry of Education. The amount of subsidy is based on a formula considering

- The number of pupils per school
- A Normative budgetary provision per pupil determined by the Ministry (9,280 UAH in 2016)
- An Adjustment coefficient per school type (e.g. 0.841 for secondary schools, 2.5 for special general education facilities and kindergartens)

Kindergartens are budgeted by the city based on the previous year's costs plus escalation factors for various cost categories received from the Ministry of Finance. For 2015 and 2016 this escalation factor is 1.014.

The Department of Education of the City of Ternopil is planning for 7 to 8 energy related refurbishments (windows, doors) in 2016 at a budgeted value of approximately 2 mn UAH (1.8 mn UAH in 2015), out of the total Development Fund<sup>11</sup> of the city for 2016 value at approximately 10 mln UAH.

The decision on the institutional structure for EE financing was taken by the City Council. However, the initial capitalization of the ESCO is not yet contained in the budget. It is estimated to be 3 mn. UAH.

In order to create a sustained flow of funding from the city, amounts in the order of magnitude of some 3 to 5 mn UAH, as are presently applied for energy related refurbishments, are planned to be dedicated to the EERF. For this purpose, an approval of the City Council is required. Such an annual allocation enables a funding to the EERF controlled by the city to establish pilot operations of energy efficiency related projects. These

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<sup>11</sup> The Municipality owned Development Fund is regulated by Paragraph 71 "Local Budget Development Fund" of the Budget Code of Ukraine. Main provisions are (1) It is a part of the Local Budget Special Fund; (2) The purpose is to address the capital investments for socio-economic development of regions, investment projects, construction, refurbishment and reconstruction of the social, housing and communal facilities etc. (3) The funds allocated by the decision of the city council; The possible expenditures are: local debt repayment capital expenditures, including capital transfers to other budgets development of planning documentation at the local and regional levels.



projects can serve as prove of concept for funding applications to international financing institutions such as EIB, NEFCO or EBRD.

## **2.8 Legal framework**

Ternopil ESCO acts in accordance to applicable law of Ukraine and the Statute of the organization. The recent changes in Ukrainian legislation described below, enabled TESCO to provide energy services to public sector and start the large-scale renovation of public facilities in the city of Ternopil. This includes additional procurement rules, basic terms for ESA, budget allocations and payments. The TESCO is able to participate in tenders on providing the energy services to public facilities, gets financing from local budget within the secured (guaranteed) budget code, and concludes long-term agreements. In case the open tender announced by LA (Local Authority) for energy service procurement, and insufficient proposals submitted, the LA may apply the negotiated tender procedure and buy services directly from TESCO.

In order to implement the actions that are foreseen in this document, the Ternopil ESCO have to follow the requirements of the national law:

- Law of Ukraine No. 327-VIII “On the Implementation of New Investment Opportunities, Ensuring Rights and Legitimate Interests of Individual Entrepreneurs for the Performance of Large-Scale Energy Sector Modernisation” dated 09 April 2015
- Law of Ukraine № 328-VIII “On Amendments to the Budget Code of Ukraine on introduction of new investment opportunities, guaranteeing the rights and interests of businesses large scale energy modernization” dated on 09 April 2015
- Resolution by the Ministry of Finance #333 13.03.2012 “Regulation for use of economic classification of the budget expenditures...”
- Procedure and conditions for providing the educational subvention from the state to local budgets approved by the Resolution of the Cabinet of Ministers #6 dated 14 January 2015

### **Energy service agreement (ESA)**

On 20th October 2015 the Model Energy Service Agreement (ESA) was officially approved by resolution of the Cabinet of Ministers of Ukraine №845. This document is developed in line with the above mentioned Law No. 327-VIII “On the Implementation of New Investment Opportunities, Ensuring Rights and Legitimate Interests of Individual Entrepreneurs for the Performance of Large-Scale Energy Sector Modernisation”. The agreement’s primary goal is to implement international ESA practice in Ukraine, which is widely recognized as an efficient financial vehicle for funding energy efficiency programmes.

The ESA provides the following:

- An energy service is a set of technical and organizational energy efficiency measures, provided by an Ternopil ESCO for a customer;
- The ESCO’s remuneration is directly tied to the savings achieved. The cost of the initial investment and ongoing management will be paid back from the savings over the term of the contract (10 years maximum).
- Ternopil ESCO and the customer (facility/building owner) shall determine:
- the customer’s baseline consumption of energy resources and utilities (by volume and in monetary form), and
- the stipulated level of energy saving in natural indicators,

- the price of the agreement.

The model ESA regulates relations between TESCO and facility regarding the energy services, and cannot be applicable to energy supplying services. The most sensitive issue is a selection of the baseline energy consumption as majority of public buildings are under-heated. This would mean only bringing the normal indoor conditions to the buildings instead of energy and/or costs reduction. However, TESCO are able to choose the most suitable variant of baseline for them and adjust the results during the ESA implementation in accordance to the real weather conditions and operational mode of the facility. It requires the conduction of the independent energy audit that will satisfy all parties.

### 3. Proposed solution – ESCO Business Model

The need for energy efficiency improvements and resulting energy cost savings has been identified. Political decisions have been made and roadmaps and strategies have been outlined through a SEAP and a Transformation Programme. A large pool of data on possible measures has been screened. Legal prerequisites recently conceived are considered. In consequence a solution is to be developed, which clearly describes

- Operational institutions and their relational structure – a business model
- Financial requirements and projections – a financial analysis
- Regulations and procedures – governance rules
- Uncertainties to be handled – risk management
- First steps required – an implementation schedule

to enable EE measures over a medium term planning horizon.

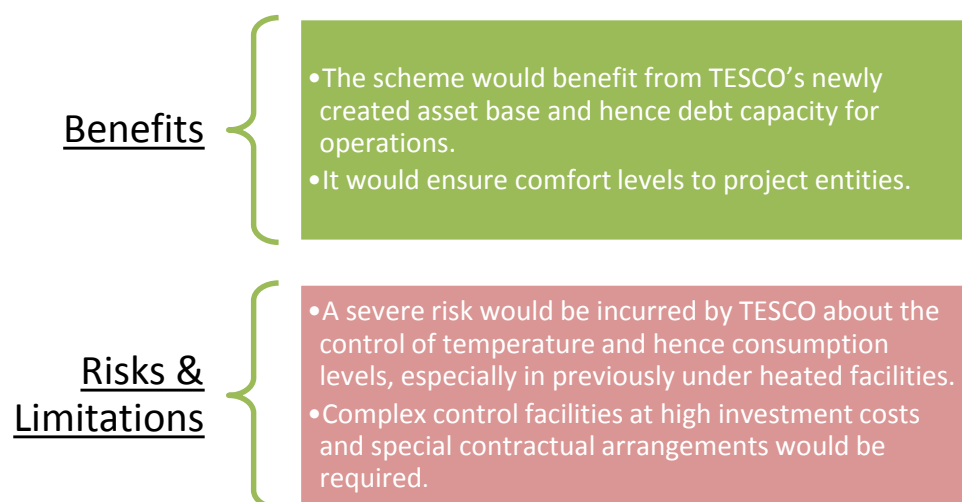
#### 3.1 Institutional Structure

All relevant stakeholders involved in the financing and implementation of EE projects have to be considered in a structure targeting the efficient and sustainable operation of the pipeline of identified measures. For this structure three alternatives have been considered:

##### 3.1.1 Version A – Type: Facility Management – based on heating service quality

The existing company, TESCO, would guarantee room temperature levels to project entities, while buying heat from TE

##### Evaluation:

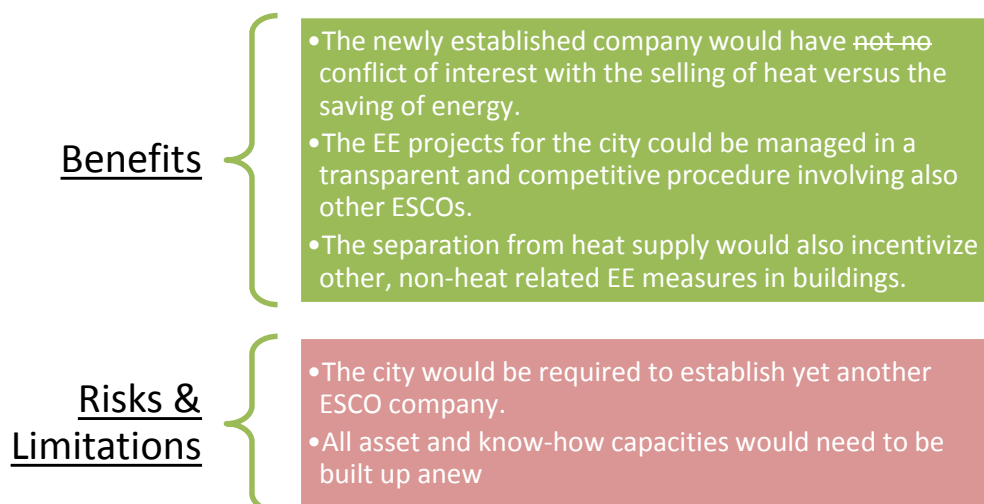


**Conclusion:** The structure is not suitable for Ternopil given facilities of the project pipeline.

##### 3.1.2 Version B – Type: ESCO – fee for service based

A new company would be established, independent from TE, to offer energy efficiency services only.

##### Evaluation:

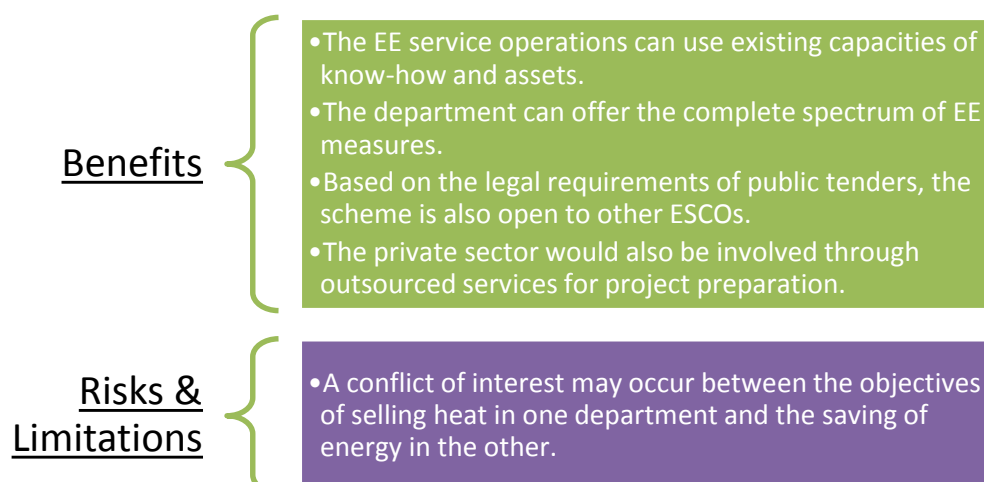


**Conclusion:** Given the risks of creating a new vehicle for EE operations and the city's preference to proceed with the existing framework, this alternative was also ruled out.

### 3.1.3 Version C – Type: Hybrid ESCO – combined EE service and heat supply

The existing company TESCO adopts a new department dedicated to energy efficiency services.

#### Evaluation:

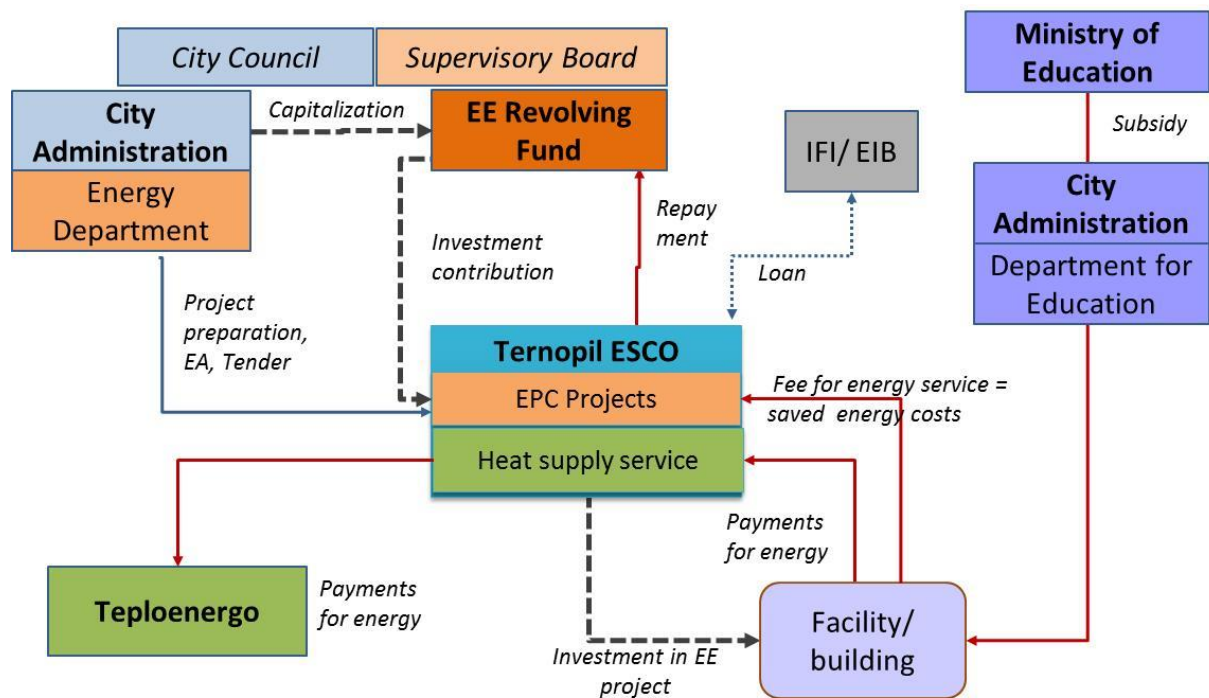


**Conclusion:** Given, that the dedication of the EE department can be ensured to target optimum energy cost savings for the benefit of the City of Ternopil, the common owner of all parties involved, this structure is recommended as the business model for an ESCO scheme in Ternopil.

## 3.2 The Proposed ESCO Scheme

Following the discussion with representatives of the City Administration, City Council and TESCO of pros & cons and practicable opportunities for application of the above three variants a decision was taken to follow through Variant C with Hybrid ESCO – combined EE service and heat supply. For this variant the following institutional structure with indicative financial flows was drawn.

**Figure 9: Structure of EE financing (Consultants Illustration)**



In this structure TESCO, being owned by TE, is operating as heat Supply Company for end users, through a heat supply department. The new field of operation within TESCO will be organized in a department for Energy performance contracting (EPC). The initial funding of the scheme by the city will be arranged through an Energy Efficiency Revolving Fund (EERF). This EERF will be a separate, fenced account in the city budget, which will be established to arrange investment contributions for the EE projects identified by the Energy Office of the City.

- TESCO will apply for tenders issued by the energy department of the City of Ternopil (Energy Office), which are financed by the EERF.
- EPC department will take care of implementation of EE project and will charge a fee for saved energy, paid by the Facility.
- The Facility will pay costs for consumed electricity to Elektroenergo power utility and for heat to heat supply department within TESCO. So finally both departments of TESCO will invoice their services: EPC department for energy cost savings and heat supply unit for consumed energy. However final payment for all services will be lower than before.
- TESCO will pay TE for heat supplied to municipal entities under EPC contracts. Sector departments of the city (education, health, etc.) cover the energy costs of municipal entities as per a pre-determined baseline consumption
- TESCO will finally repay initial investment contribution to EERF from energy cost saving after deduction of an EPC service costs.

This model is also open for private ESCO's who can also participate in tenders and compete with the EPC department.

### **3.3 Critical Issues in the Business Model**

#### **3.3.1 Conflicts of interest**

The objective for the whole EE business model is to save energy costs through EE measures, in particular on expenses for heat. TE, the owner of TESCO, is to operate a profitable business from selling heat. For TE there is consequently some potential for conflict of interest, as the less heat is consumed due to EE projects, the less heat is sold..

However, for the position of TE a peculiarity of the Ukrainian tariffing and collection system is of importance too. Out of heat tariffs paid by customers into a special collection account 80% are transferred directly to the national gas supplier NAFTOGAZ, with only the remainder going to TE. By establishing TESCO, turnover from heat cost savings (70% to 80%) would be channeled through the energy services business of TESCO/TE, leaving only the residual heat consumption to be paid through the tariff system, in which NAFTOGAZ is the main recipient. TE will therefore benefit from increasing EE revenues (cost savings) and hence has a commercial interest in increasing the EE business.

#### **3.3.2 Cooperation between TESCO and EERF**

The selection of priority EE investment projects for municipal buildings is charged to the Energy Department of the CA. Project investment and management costs are determined by the Energy Department and are therefore controlled directly by the city. Project management costs (outsourced services for energy audits and documentation, staff costs and office operation) of TESCO need to be thoroughly specified for coverage through the contract with the city as represented through the EERF to ensure the financial sustainability of TESCO.

#### **3.3.3 Cost efficiency of project pipeline**

With the relatively low returns from energy costs savings, as determined by the preliminary analysis of the project pipeline, only a limited number of projects passes a threshold of 10 years for the Simple Payback Time (static PBT). While the static calculation from present cost savings shows only 1 project at less than 10 years Simple PBT, the consideration of estimated tariff increases (refer to section 4.1.2 for details of the assumption) over the medium term (dynamic discounted return analyses) result in a number of projects in the category of projects below 10 years PBT based on escalated tariffs.

### **3.4 Services Provided by TESCO**

TESCO will be contracted by the Municipality Department of Education (for kindergartens) or by the school (as individual legal entity) under a fixed term public management contract to be responsible for the management and maintenance of the public buildings operation, as well as for the payment of the utility bills under an Energy Performance Contract (EPC). The contract will:

- Provide TESCO with the mandate to manage the public buildings in the city of Ternopil.
- Oblige the Municipality and the EERF respectively to fulfill its financial obligations to TESCO.
- Oblige TESCO to manage selected public buildings
- Oblige TESCO to reach certain EE targets.

- Oblige TESCO to achieve and maintain certain comfort levels in the public buildings under its management.

The management activities of TESCO will aim to:

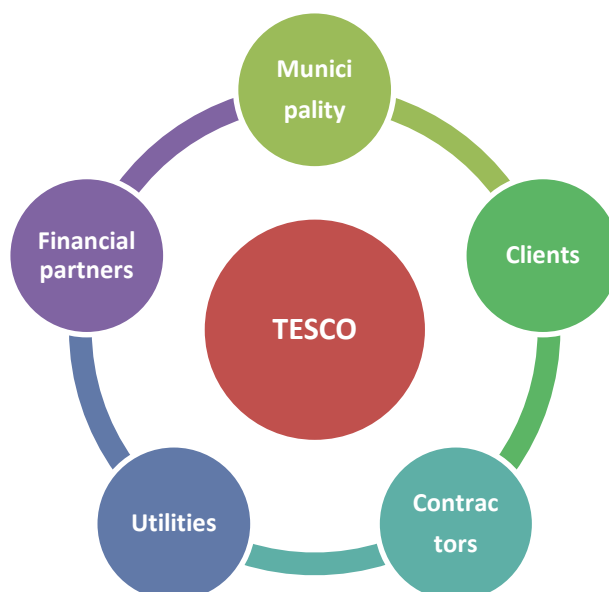
- Maintain, operate and service the public buildings (including reactive and proactive maintenance).
- Improve EE performance of the public housing stock and service EE related installations.
- Achieve and maintain pre-set comfort levels.

TESCO will have to develop, implement and manage energy savings opportunities, realizing the following activities:

- Identifying the Energy Efficiency Potential.
- Calculating the cost of implementation.
- Calculating the potential energy and utility savings.
- Performing cash flow analysis.
- Calculating the payback period and all the financial indicators.
- Presenting and selling the project to the municipal executives.
- Securing the project funding source from the lender.
- Defining the technical scope of work.
- Preparing tendering documents.
- Assigning the contracts to the winning contractors.
- Managing and supervising the implementation of the construction contract.
- Providing training to the different experts to be involved in the energy management activities in each building.
- Implementing awareness campaigns at the end users level in order to optimize the potential energy savings to be generated in each building.
- Measuring current thermal comfort levels (under/over heated) and comparing to desired comfort level

### 3.5 TESCO Stakeholder Relations

Figure 10: TESCO in the context of relevant stakeholders (Consultants Illustration)





TESCO will enter into a relationship with a number of stakeholders:

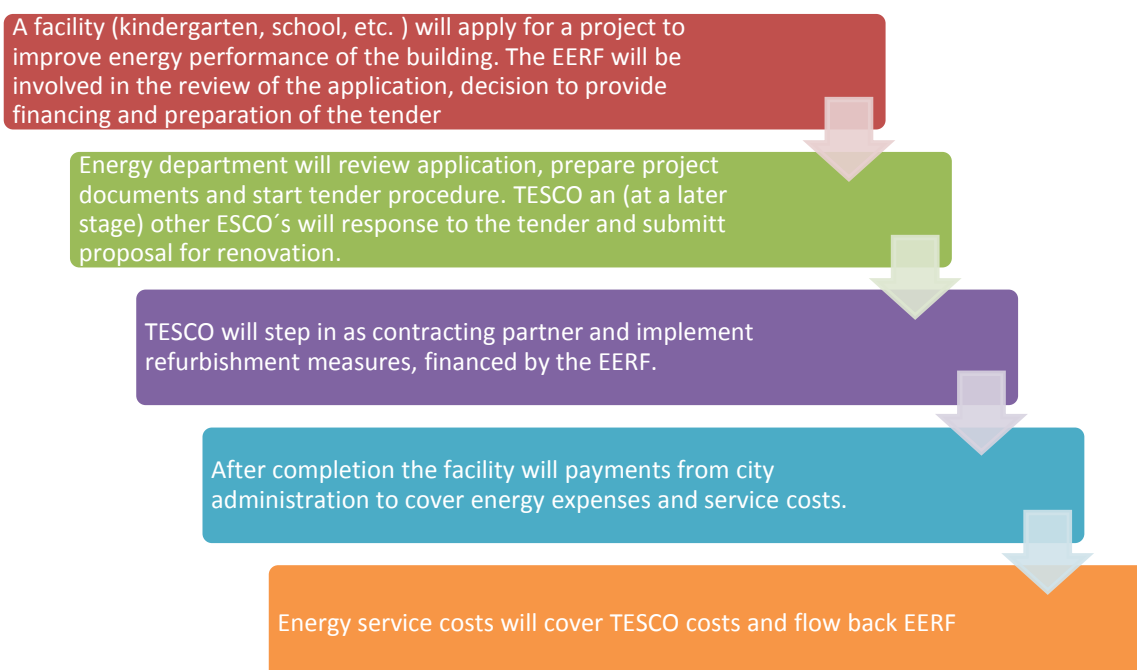
1. **Municipality:** TESCO is owned by the municipal enterprise TE and will be mandated by the Municipality to carry out certain functions which are described in more detail in paragraph below. To accomplish this, TESCO will enter into a public building management contract with the Municipality or legal entities for the respective municipal building.
2. **Clients:** The client of TESCO will informally be the Municipality, but functionally the client will be the school or the City Administration Department of Education buildings will be the end users of the services provided by TESCO. The terms of the service are fixed in the Energy Performance Contract.
3. **Utilities:** TESCO will become the contracting party and paying agent of the electricity, heat and gas utilities for as far as the supply of these utilities to the public buildings is concerned.
4. **Financial partners/IFIs:** In case IFI funding can be acquired to TESCO in order to realize the development and implementation of the project, mainly related to the needed investments for the implementation of the energy conservation measures. The Municipality will need to provide a municipal guarantee for the IFI loan in the name of TESCO.

IFIs may provide technical assistance funds to help the development of the ESCO business and to provide TESCO with essential tools and training needed.

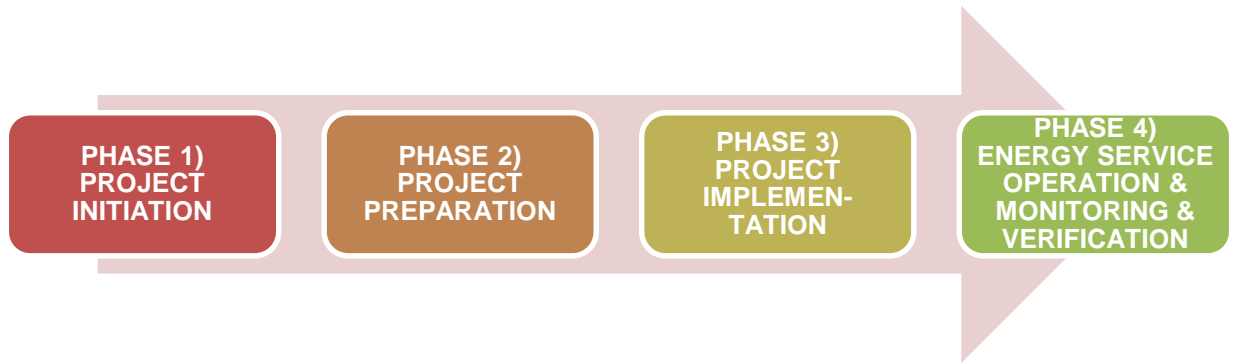
After the implementation of the energy conservation measures, TESCO will use the proceeds from energy savings and other generated savings to pay back the IFI loans. The periodic payments will be pre-defined and clearly stated in the loan agreement.

5. **Contractors:** TESCO will use local contractors to carry out energy audits, specific design building maintenance, the implementation of EE measures and the servicing of buildings and EE equipment.

### 3.6 Project implementation



In the following a brief outline of the work flow for the energy efficiency project is provided. The sequence of the activities follows the logic of 4 phases of the project on:

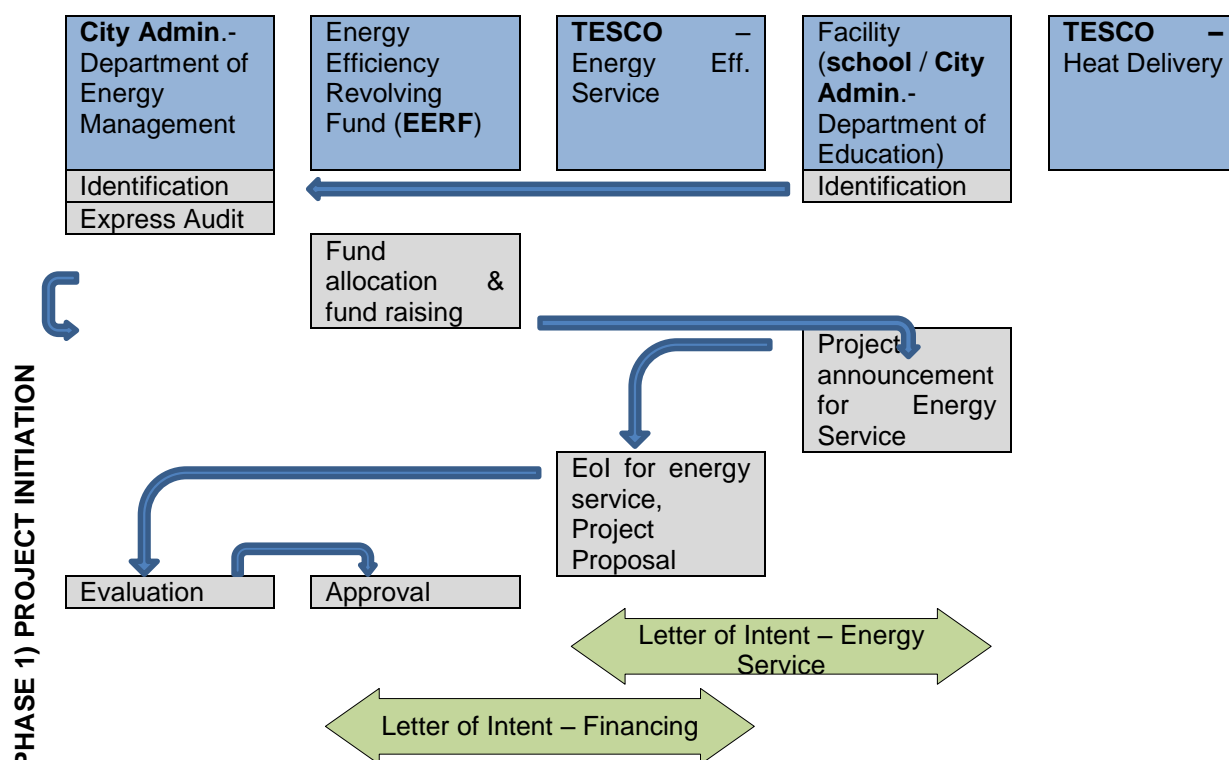


As mentioned above, the key stakeholders of the process are:

1. The **City Administration** - Department of Housing and Communal services, landscaping and ecology , sub-department **energy management**
2. The **EE Revolving Fund** – board of directors
3. **Ternolil ESCO** – Department for **Energy Efficiency Services** (contractor of energy services)
4. The **facility** for EE project implementation: a) the **School** as individual legal entity or b) for a Kindergarten the **City Administration, department for Education** and Science
5. **Ternopil ESCO** – Department for heat **energy delivery** services

The flow of activities within each phase is illustrated first by means of a summarizing diagram and explained thereafter.

### 3.6.1 PHASE 1) PROJECT INITIATION



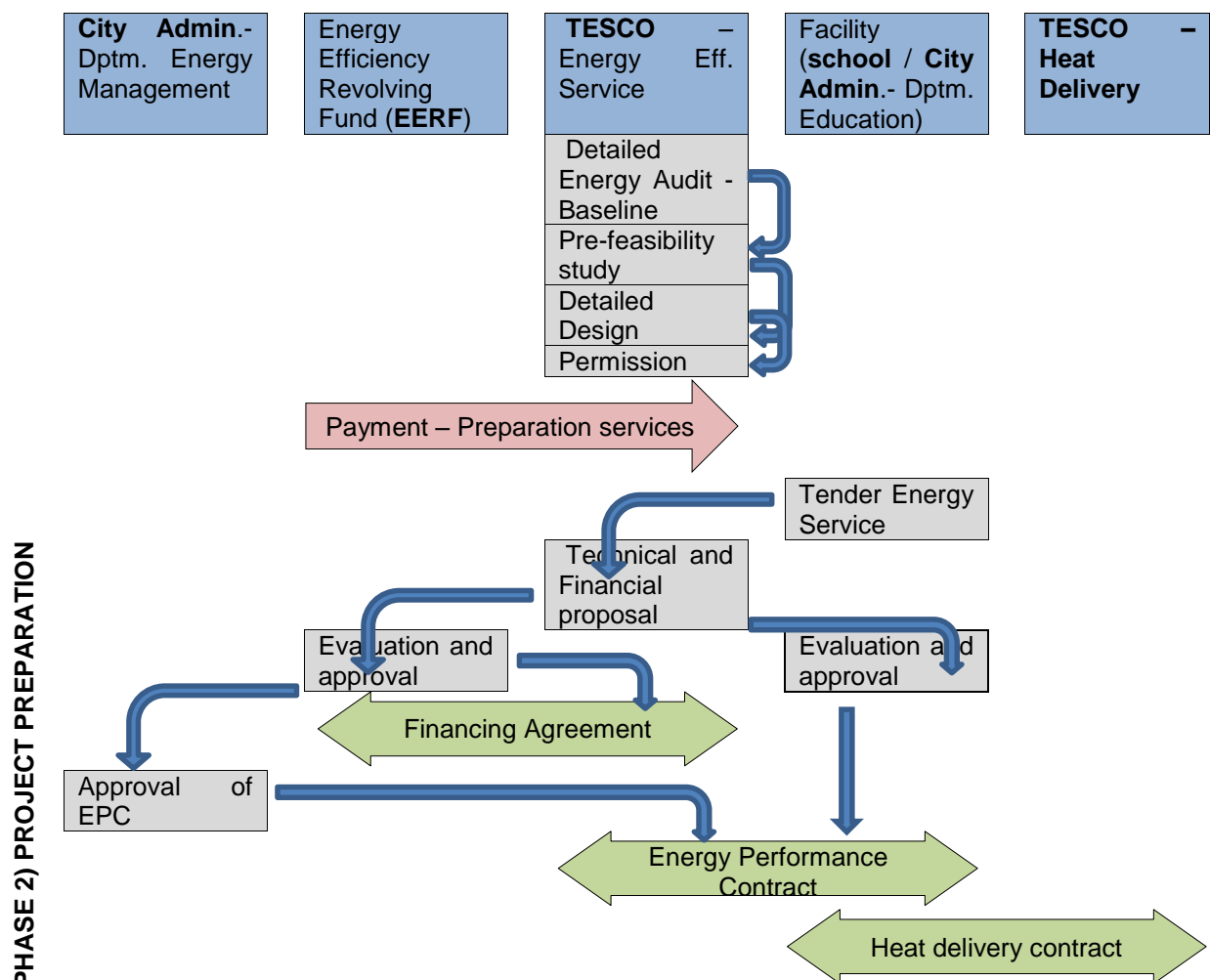
- The EE project can be **identified and initiated by the City Administration** sub-department *energy management* or the City Administration, Department for Education in coordination with the facility/school on the criteria of high specific energy consumption, level of the facilities' energy costs, energy saving potential and profitability. The instrument for identification of project will be the pool of preliminary assessed 46 municipal facilities (see Table 4).
- The **City Administration** will prepare an **express energy audit**<sup>12</sup> and project profile. In Annex 5 project profiles for 3 priority facilities are given as examples. The respective profiles need to be up-dated with energy consumption data for the calculation of the baseline.
- The City Administration – Department Energy management will inform the board of the EERF on regular basis about the status of the pool of projects, priority project and planned project initiations for the up-coming period.
- For each particular EE project in question the **EERF will need to allocate a) funds** to cover up-front costs for the project preparation and b) for the EE projects' investment cost or c) develop a strategy for acquisition of external financing or donation. The EERF in cooperation with the City Administration and Ternopil ESCO will make efforts to acquire external low-cost funding for the realization of the EE project pipeline from financial institutions (IFIs) for appropriate terms and conditions and preferably blended with grants. On demand of borrowing from IFI, the EERF will acquire financial guarantees from the City of Ternopil.
- The institution or legal entity responsible for **the facility will announce the initiated project to Ternopil ESCO** (or at a later stage to other ESCOs).

<sup>12</sup> An express energy audit comprise a walk though audit to verify the conditions of the building data. An express energy audit does not replace the demand for a full energy audit and investment grade feasibility study.

- **TESCO** will review the feasibility of the announced project and, if suitable, **express interest for energy services** to the school or City Administration by means of a preliminary project proposal which specifies the needs and costs for preparation activities (audit, feasibility study, design and permission) and preliminary list of ECM, investment costs and expected results. At this stage the project shall comply with the key indicators as set by the EPC on 20-years NPV as well as a viability as requested by potential financiers ( e.g. payback time within loan term).
- The **City Administration – Department Energy Management** will **evaluate** and negotiate the **Expression of Interest** by the ESCO, consult with the EERF on preliminary availability of funds.
- The EERF will be involved in the review of the application, decision to provide financing and preparation of the tender. Following the **approval by EERF**, a **“Letter of Intent for Energy Services”** will be signed by the **ESCO and the City Administration or legal entity** responsible for the facility.
- In parallel a **“Letter of Intent for project preparation and financing”** will be signed between the **EERF and the ESCO**. By that the EERF commits to cover expenses for preparation services. Both documents will specify the scope of the project, necessary preparation activities, planned schedule and coverage of respective costs.

It shall be possible to complete the activities of the project initiation phase within one month.

### 3.6.2 PHASE 2) PROJECT PREPARATION

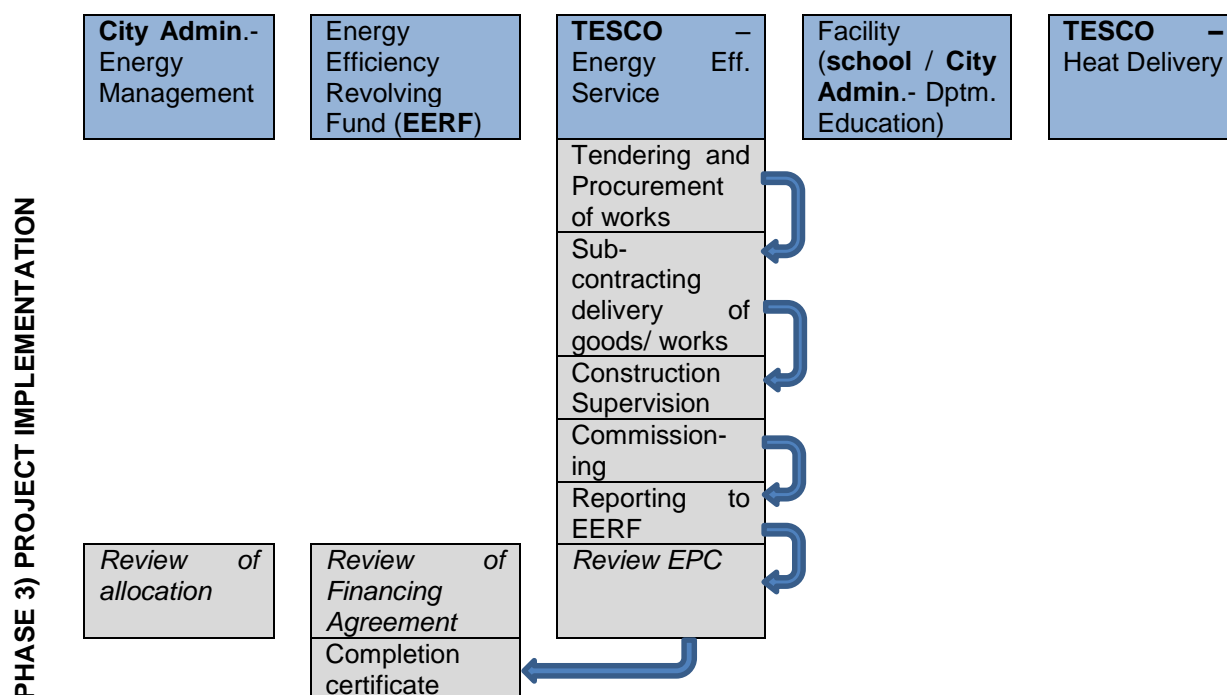


- Ternopil ESCO will commence the project preparation with a detailed Energy Audit to establish, calculate and validate the energy consumption baseline, identify and analyze energy saving measures, investment and operation costs as well as expected project results/benefits. The energy consumption baseline will be primarily established on real, metered energy supply to the building over the last 3 years, balanced on weather influences (according to Schedule 3 of the EPC). For buildings without heat metering the baseline will be calculated on the basis supply norms (area and type of building) and verified by a heat energy demand analysis, as a task of the energy audit.
- The Energy Audit will be implemented by specialized and certified energy auditors of TESCO. External technical or specialized assistance or qualified sub-contractors should be involved, if possible, supported by international donor / financing programs.
- The results of the energy audit, in particular the ECM investment strategy combined in a pre-feasibility study will be communicated by TESCO to the facility and the City Administration. Following agreement on that a detailed design and construction permission design will be elaborated by TESCO, respectively specialized and certified design companies as sub-contractors.
- The design documents will be the basis for the application of construction permissions, which will be prepared and submitted by TESCO. City Administration, Department of Housing and Communal services will grant support to apply and get timely the necessary construction permissions.
- After delivery of the preparatory analysis EERF will pay the agreed amount for the preparation services to TESCO.
- City Administration - Department Energy Management will apply the results of the above analysis (audit, feasibility study, design) to prepare and launch a tender for Energy Services / ESCO services.
- Ternopil ESCO (and at a later stage competitive ESCOs) will take part in the (“competitive”) tender and prepare technical and financial a proposal for Energy Services.
- The City Administration - Department Energy Management will form a tender evaluation committee which includes also representatives of the EERF board. The committee will evaluate the energy service proposal along pre-defined criteria and will start contract negotiation with the awarded ESCO and preparation of the Energy Performance Contract (EPC). The EPC will need to be validated and approved by the City Administration. The EPC will be concluded between the ESCO and the institution or legal entity responsible for the facility (school or City Administration - Education) while the terms of the energy service (price, payment) are governed in the contract and will be supported by the Schedule 1: energy service measures, terms and conditions; Schedule 2: specification of the object; Schedule 3: Baseline consumption; Schedule 4/ 5: expected reduced energy and energy costs.
- In parallel with the EPC a Financing Agreement between the EERF and the ESCO will concluded over the amount of financial contribution to the project, the scope and involved ECM and energy services. The financial contribution by the EERF to the project will be without interest rate. The terms of repayment are agreed in the Financing agreement. In case of external financing (IFI loan/ grant) the specific financing conditions, reporting and repayment terms will be considered in the Financing agreement.
- Since the EPC does not cover the subject of heat delivery a heat delivery contract for the buildings’ conditions after EE project will be concluded between Ternopil ESCO

and department of heat delivery services. The key features of the delivery contract are a) provision of heat energy to reach the comfort level in rooms (defined norm temperatures) and b) metering and respective billing of the heat according to real consumption.

It shall be possible to complete the activities of the project preparation phase within 3 to 4 month, including construction permissions.

### 3.6.3 PHASE 3) PROJECT IMPLEMENTATION



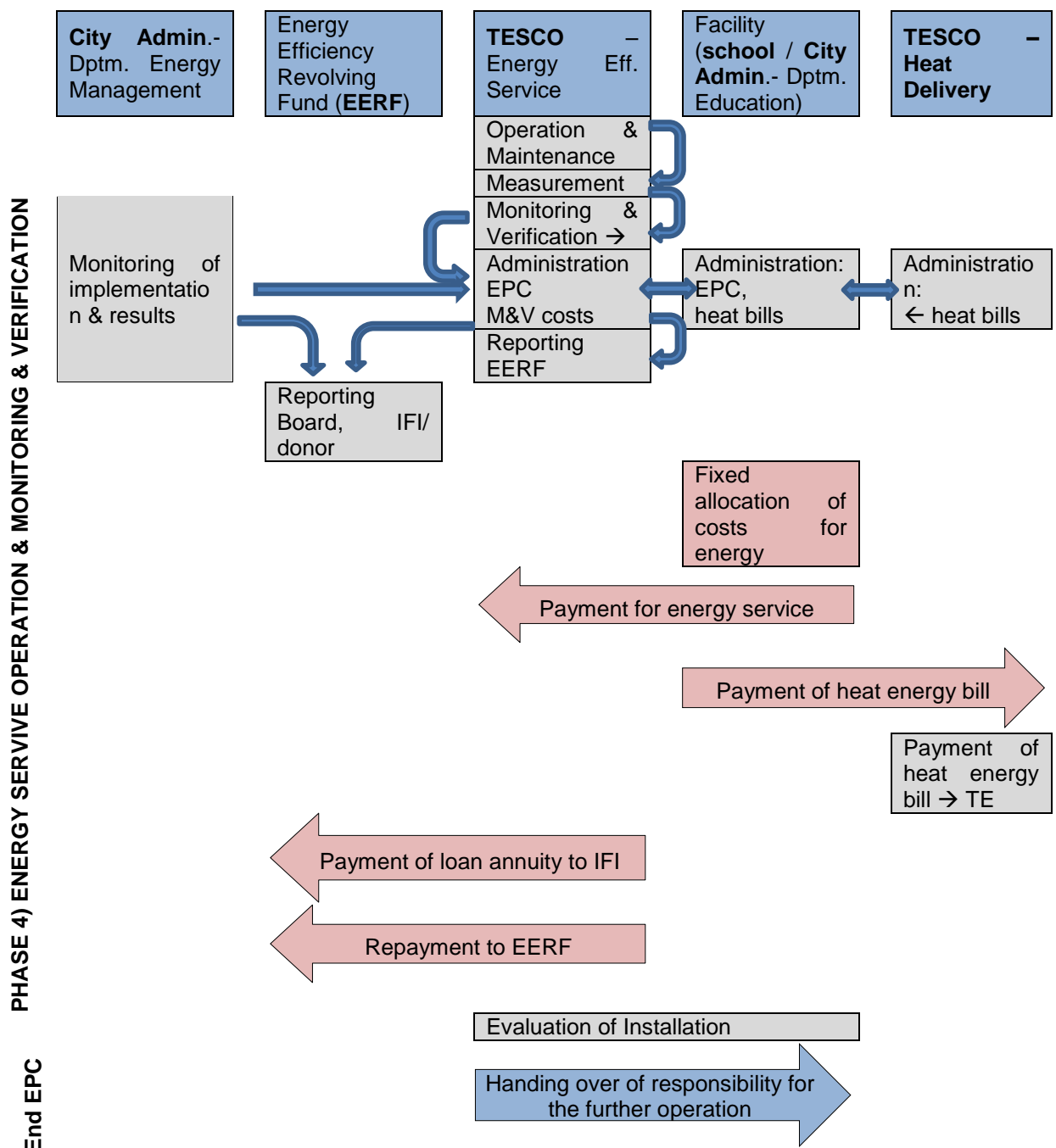
- After completed project preparation, construction permission and the contractual settlement of Financing, Energy Service and heat delivery the **ESCO can commence** the project implementation. In a first step the **equipment, materials and required works** (civil and installation works) for the ECM will be **tendered** according to the public procurement rules of Ukraine and – in case of involvement of IFI funding - under consideration of IFI tender procedures. The key criteria for the evaluation of bids from suppliers will be energy performance of the material/ equipment, costs and quality of equipment and services. After tender evaluation delivery contract negotiations with the awarded suppliers will commence and result into respective sub-contracts of **procurement of good and works**.
- At this stage the time frame for works must be defined with the target to minimize needs and efforts for resettlement of the occupants of the facility. For example, in schools indoor ECM shall be implemented during the 3-months summer vacation period or evening/ weekend times outside of school operation, while outside ECM (facade, roof insulation) can be implemented during school occupation. The sub-contracted **construction companies will implement the ECM** under the **construction supervision by the ESCO**. Again, special attention needs to be paid on quality of installation to achieve the high energy performance.
- The **commissioning of equipment** (e.g. building heating or ventilation system) will be documented and reported (according to Schedule 1 of the EPC) to the institution

or legal entity responsible for the facility and the City Administration- Energy management department.

- Any deviation from the plan on costs of equipment/ works or energy performance needs to be justified and reported. On demand the City Administration – Energy management department need to review the allocated financial contribution from EERF and apply at EERF for additional funding, if justified. In the case of deviation of expected energy savings, **the EPC as well as the Financing Agreement with the EERF need to be adjusted** on demand.

The implementation phase can have a schedule of 3 to 5 months, depending on the facility and complexity of ECM, and will end with a **completion certificate** (Schedule 6 of EPC), which will be retorted to the EERF.

### 3.6.4 PHASE 4) ENERGY SERVICE OPERATION & MONITORING & VERIFICATION





- The Energy Performance Contract (EPC) defines the continuous tasks and duties of TESCO, in particular a) **operation and maintenance** of proper functioning of the heating system, b) **monitoring** c) **verification and reporting**.
- Means of measurement are: heat meter protocols, metered room temperatures.
- Means of verification are: metered energy supply, compliance with set indoor-room comfort levels (temperate),
- Means of monitoring are: monthly and annual evaluation of a) reduction level of consumption (according to Schedule 4 of the EPC), b) Energy saving ratio by comparison with the baseline comfort level, c) reduction level of energy costs (according to Schedule 5 of the EPC) by comparison with the baseline. The **City Administration- Department of Energy management will monitor the implementation** of the EE projects and the EPC and verify the results in terms of energy and cost saving ratios. TESCO has the rights to apply "Procedures for the adjustment of determination and calculation of the results of implementation of energy service in the event of any changes in the structure, area or operating mode of the object - Adjustment of determination of the level of thermal energy consumption for the calculation of the results of implementation of energy service", according to Schedule 7 of the EPC.
- Further guidance on the monitoring and verification process is provided in Annex 6: IPMVP- International Performance Measurement and Verification protocol. TESCO must keep transparent and justified record of expenditures on operation, monitoring and verification (staff, equipment, external services). During the operation phase a continuous administration of the contracts and financial flows is required.
- The annual **financial flows** during the operation period are:
  - a) Fixed allocation of costs for energy for the baseline consumption (with energy cost adjustment factor in case of tariff increase):  
For the school: Share of lump-sum subsidy by Ministry of Education → (via) the City Administration, department for Education and Science → School as separate legal entity  
For a Kindergarten: energy costs fund allocation by the City Administration, department for Education and Science
  - b) Institution or legal entity responsible for the facility (school or City Administration- Education) → Ternopil ESCO-ES department: **Payment for energy service** based on the price agreed in the EPC (up-to 90% of reduced energy costs) and at a stage of project completion the remaining, hold-back 10% of the reduced energy costs
  - c) Institution or legal entity responsible for the facility → Ternopil ESCO-Heat delivery department: **payment of heat energy bill** according to metered supply.
  - d) Ternopil ESCO-Heat delivery department → JSC "Ternopiloblenergo": **payment of heat energy bill** according to metered supply.
  - e) In case of external IFI funding (loan and grants) involved. Ternopil ESCO-ES department → Financing Institution: **payment of annuity of loan** according the terms of the loan agreement.
  - f) Ternopil ESCO-ES department → EERF: **Repayment of Financial Contribution to EERF**, which results as the difference between the ES Payment minus verified costs of operation/monitoring/ verification (which is assumed at this stage at annual 5% of the ES payment) minus (if involved) financial obligations to FIs for loan refinancing.

- In case of external IFI (loan and grants) funding involved, the EERF in cooperation with the ESCO will comply with the regular reporting and repayment liabilities. The duration of the operation period is determined in the EPC, usually up-to 10 years.
- At the point of termination of the EPC - after 10 years – the building installations and performance included in the **EPC will be evaluated** and the responsibility for the further operation will be **handed over** from the ESCO to the Institution or legal entity responsible for the facility.

## 4. Financial Assessment

### 4.1 Economic assumptions

For the financial evaluation of the EE financing scheme and in particular the ESCO operations a number of assumptions have been elaborated, which are to provide a common basis for the overall business framework of the ESCO.

#### 4.1.1 Economic indicators

Estimated projections on general inflation have been applied based on the most recent country report of IMF13. Inflation was forecast to show a rapid decline from a high level of 27.6% in 2015 to 10.6% in 2016 and further to 6% in 2019. The latter rate was applied continuously from 2019 onwards.

The exchange rate was set to 27 UAH per 1 USD. In the base case this exchange rate was kept constant throughout the evaluation period.

#### 4.1.2 Energy tariff development

In the course of economic and financial evaluations for the Energy Transformation Programme, a series of tariff escalation scenarios<sup>14</sup> was developed in cooperation with local energy experts. These escalation scenarios have been applied with the respective energy types applicable with the various projects in the priority list.

**Table 7: Energy tariff escalation scenarios**

	2015	2016	2017	2018	2019	2020
Electricity - public institutions	10%	10%	10%	10%	10%	6%
Heat	200%	0%	10%	10%	10%	6%
Gas	51%	20%	10%	5%	4%	4%

The key item of energy savings is with heat supplied from TE. The projected tariff increase for 2016 has been set to 0% corresponding with the expectation that heat tariffs will be kept at least constant throughout the year. This expectation on the tariff for heat is based on cooperation with a private heat supply project using peat. Considering this facility, the proportion of fuel in the production costs is estimated to decrease from 94% in gas based operations to 72%.

#### 4.1.3 Priority projects

The projects screened as per the criteria specified in section 3.4 have been ranked to provide the most favorable measures and are therefore to be implemented in the starting phase of Ternopil ESCO.

The following list of the top ranked 10 projects shows key parameters of investment costs and energy savings, whereby the ranking criterion was the static payback period, as expressed by the annual energy cost savings compared to the total investment of the project.

<sup>13</sup> IMF Country Report No. 15/69, March 2015, Request for extended arrangement under the extended fund facility and cancellation of stand-by arrangement

<sup>14</sup> ESMAP/World Bank, Energy Efficiency Transformation Program City of Ternopil, August 2015, Annex 1: Municipal energy baseline and development scenario

**Table 8: Priority list of projects (Consultants Illustration)**

Description	Equipment Costs		Heat Savings		Heat cost Savings 1 <sup>st</sup> year
	UAH	USD	%	kWh/year	UAH/year
Kindergarten № 13	2.974.367	110.200	78%	231.387	305,790
School № 2 (high)	6.023.588	223.100	71%	403.855	533,715
KINDERGARTEN № 38	4.019.786	148.900	74%	262.529	346,946
Ukrainian gymnasium	5.445.278	201.700	69%	337.347	445,821
KINDERGARTEN № 31	5.672.481	210.100	74%	366.537	484,398
technical liceum	5.640.861	209.000	78%	380.232	502,497
KINDERGARTEN № 30	5.694.115	210.900	74%	351.034	463,910
KINDERGARTEN № 19	5.046.749	187.000	74%	315.165	416,506
SCHOOL-KINDERGARTEN № 28	5.589.985	207.100	73%	340.672	450,216
KINDERGARTEN № 2	4.679.678	173.400	74%	288.592	381,389
Total/Average	50.786.889	1.881.400	74%	327.735	4,331,188

#### 4.1.4 Cost assumptions

For the evaluation of the implementation of these projects the Ternopil ESCO a number of assumptions has been applied regarding operating cost items.

**Outsourced Services:** The cost of various preparatory task are assumed to be managed by the ESCO through outsourcing of services. Thereby both flexibility and an independent view can be ensured. These services include

- the energy auditing of facilities
- the design of works
- the preparation of documentation for approvals

The cost estimated<sup>15</sup> for a project of 4 million UAH are as follows

- energy audit 40,000 UAH
- design work and documentation 80,000 UAH
- permissions 30,000 UAH

This cost item was therefore estimated at 4% of investment costs, reflecting the variable cost of such fees based on project size.

**Staff costs:** Capacities to be established include engineering, financial and legal know-how. The work load for managing the project implementation has been estimated at 7 man/months with a further 2 man/months per year for operation of the project over its contractual life. Further administrative tasks encompass billing, accounting, reporting and contract management. Staff costs have been estimated based on the salary level for engineering staff presently applied with the parent company of the Ternopil ESCO at 3,900 UAH per month. Upon addition of 30% for benefits and 22% for social insurance and taxes, the annual salary arrives at 74,225 UAH. Staffing level are adapted based on the project flow.

Due to the low level of project activity, i.e. 1 project per year during the first five years of operation, in the scenario of an only city financed start up, initially there will be only on full time expert. This person will also be engaged in the other functions of the ESCO, viz.

<sup>15</sup> Estimates by the study team of this report, based on current market prices.

preparatory tasks, training of city staff involved in energy management or awareness campaign work.

**Office and supplies:** For office costs and supplies a proportion of 8% of staff costs is applied in the analyses.

**Amortization:** The amounts attributable to repayments for loans to the EERF are considered as tax deductible payments. If the repayment component would be treated as a standard revenue resulting in an income tax liability of funds, which are essentially channeled through from the entity receiving the EE project via TESCO to the EERF, the tax liability would remain as a cash expense with TESCO.

**Income tax:** The rate of income tax applied for the Ternopil ESCO is 18%.

## 4.2 Funding Sources and Instruments

### 4.2.1 Financing from the city budget

Initial financing is assumed to be provided by the City of Ternopil through an Energy Efficiency Revolving Fund (EERF) to be developed under the auspices of the city's financial department. This EERF will provide both funding related to energy facilities in municipal entities as well as the cost of preparation of these investments. Currently the financing of building retrofit and EE measures is arranged through the Municipal development fund. The EERF thus represents a new facility to be established by the city.

The projects identified in the assessment on the market potential are planned to be funded at an initial rate of one project per year. A sequence of projects financed from own sources would thus develop as presented in the following table.

**Table 9: Financing of EE investment projects from city budget through EERF**

	2016	2017	2018	2019	2020
Kindergarten № 13	2.974.367	-	-	-	-
School № 2 (high)	-	6.565.711	-	-	-
KINDERGARTEN № 38	-	-	4.697.040	-	-
Ukrainian gymnasium	-	-	-	6.744.461	-
KINDERGARTEN № 31	-	-	-	-	7.447.423

Additional financing has been assumed to be provided by the city for the preparatory costs of the projects. This funding is estimated at 6% of the project investment costs. These amounts need to be considered in the project budgeting.

In order to leverage additional funding for the EE investment initiative of the City of Ternopil, financial support is sought from international sources. Targeted potential financing relates to both loan and grant funding. Regarding loans, the creditworthiness of the scheme for EE investment projects through the EERF will ultimately depend on the City of Ternopil.

The Development Budget Revenues form the basis for the determination the city's annual loan and loan guarantee limits as defined by Ukrainian law. Following the Ukrainian Budget Code, the city could provide loan principal repayment and loan repayment guarantees for up to 300 million UAH (12,9 million USD) in 2015. However, based on the City Council's decision, the limit on loan guarantees was set to 100 million UAH (4.8 million USD) for 2015.

Yet, according to item 3 of Article 18 of the Ukrainian Budget Code, for the maximum municipal loan guarantees, guarantees for loans from international financial institutions are

not considered. Therefore the loan interest payment to EBRD does not affect the Municipality's capacity to provide loan guarantees for further funding. For a comparison to the year 2016 the following debt related amounts are valid:

**Table 10: City of Ternopil – Debt parameters – in million UAH (Consultants Illustration)**

	2015	2016
Municipal Development Budget Revenues	150.0	176.8
Loan Repayment and Loan Repayment Guarantee Limit by Law	300.0	353.6
Outstanding Debt Limit (Decision of City Council on Budget)	300.0	200.0
Loan Guarantees Limit (Decision of City Council on Budget)	100.0	100.0
Debt Service/Loan Guarantees to EBRD	13.5	25.0

**Financing terms:** Regarding financing terms from the municipal budget and the related EERF interest free loans to the ESCO are assumed.

#### 4.2.2 National Banking Finance

Commercial financing from the banking sector is not deemed a realistic option by the city. Domestic interest rates are considered unrealistic to be earned from energy efficiency projects.

#### 4.2.3 International financing

As an option international financing is considered from an International Financing Institution (IFI), such as European Investment Bank (EIB) or Nordic Environment Finance Corporation (NEFCO), with possible grant funding from sources such as the Eastern Europe Energy Efficiency and Environmental Partnership (E5P) facility of the European Union and other IFIs operating in the region. Ternopil city and municipal utilities have received financing from international sources (EBRD, IBRD, USAID) in the past and has experience in dealing with respective obligations. Subsequently possible IFI sources are described.

##### EIB - Municipal Infrastructure Facility

A first possible source of international financing to be approached by the City of Ternopil is the Municipal Infrastructure Facility of EIB. Favourable terms targeted from this source are

- 20 years term
- EURIBOR + 1% interest
- Minimum tranche 10 mln. EUR
- Grace period 6 years

The facility is managed through the Ministry of Finance (MinFin). Initial discussions between the vice mayor and the ministry have been held. Funds would be directed from EIB to the MinFin with an on-lending arrangement. The ultimate borrower of the funds would need to be a utility, i.e. TE. The loan would be a EUR denominated funding to the ultimate borrower thus still entailing the exchange risk. Ternopil would have to pass an examination and approval on its creditworthiness from both the Ministry of Finance and the Ministry of Regional Development. Ternopil currently sustains three loans, all through TE.

##### NEFCO - Facility for Energy Saving Credits

The facility is directed towards municipalities or municipally-owned companies in Ukraine. The targeted investment projects are related to energy saving technologies in social facilities such as schools and hospitals. The maximum loan amount is at the equivalent of 400,000

EUR, whereby the loan is denominated in UAH with a financing share per project of up to 90%. Interest rates are fixed at 3% pa throughout the duration of the loan with no commissions or fees charged. A municipal guarantee is required for the application of the facility. Disbursements are made directly to the borrower.

Energy audits and business plans are required and to be provided at the borrower's expense. Project performances of up to 5 years payback period are expected.

In general NEFCO can accept maturities up to 10 years.

## E5P

The Eastern Europe Energy Efficiency and Environment Partnership (E5P) is structured to provide grant funding from the European Union, donor governments and IFIs to leverage loan financing from IFIs for the implementation of EE projects.

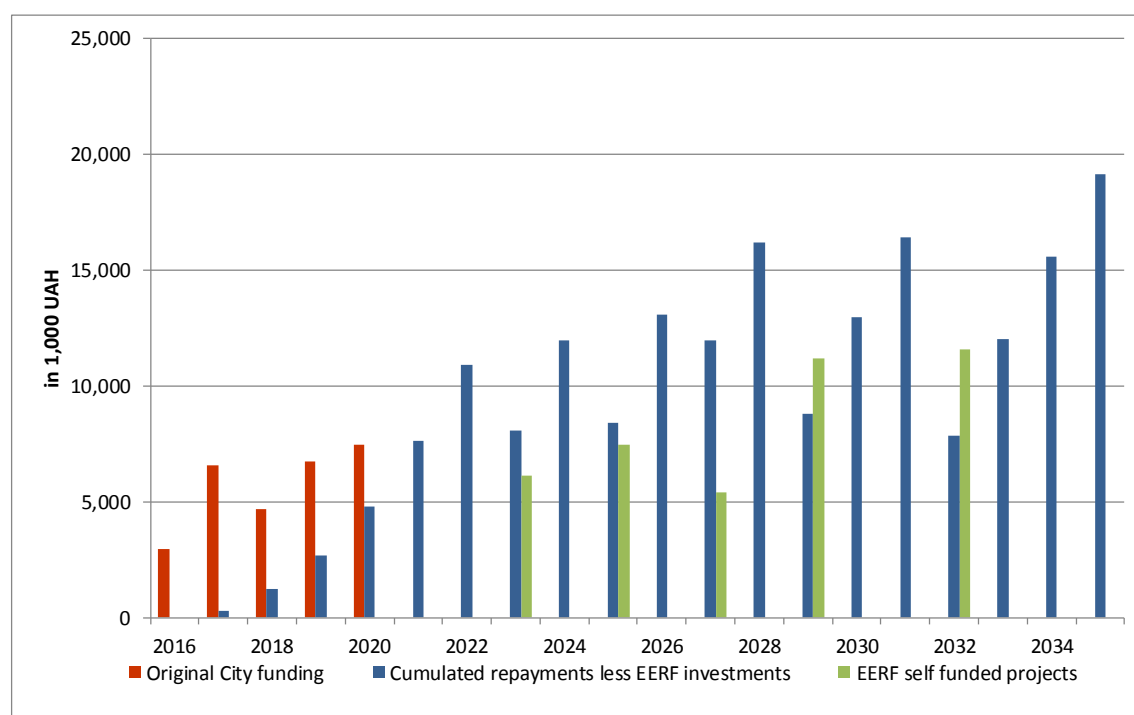
## 4.3 Financial Flows/ Projections of Stakeholders

### 4.3.1 EERF

Based on the economic assumptions and the financing options ultimately available the financial flows have been projected for the main actors of the EE financing scheme.

For a scenario with funding from the City of Ternopil only, Figure 7 provides both financing commitments to the EERF and the repayment flows from the Ternopil ESCO, which are subsequently used for further project funding. The following diagram distinguishes between projects funded by the original financing provided by the City of Ternopil and the projects subsequently funded from repayments replenishing the EERF.

**Figure 11: Financial flows with EERF – City financing only – in UAH (Consultants Illustration)**





### 4.3.2 Municipal Entities

Out of the total budget allocations for energy costs in municipal entities a total of some 13.5 million UAH will be covered by TESCO up to the 20 year horizon. The average share of energy costs saved is projected be above 70%. During the assumed contract period for ESCO services of 10 years in each project, fee payments serve to replenish the EERF and thus enable further EE investments. During the contract period the municipal entities retain the legal 10% of energy savings. After the ESC period all energy savings remain with the municipal entity. During a 20 year horizon the the ESCO scheme builds up a total asset value of some 74.6 million UAH from an initial capital outlay of some 30.4 million UAH, which ultimately represents one key benefit of the dedicated EE funding mechanism. The assets created under this scenario are projected to enable energy cost savings of some 121.3 million UAH (4.5 million USD)

**Table 11: Economic benefits to municipal entities – City financing only – in UAH**

	Year	2016	2017	2018	2019	2020	2025	2030	2035
Total budget allocation for energy cost	-	432,116	1,379,696	2,138,405	3,181,425	7,004,891	12,637,162	18,509,784	
Total saving from project(s)	-	336,369	1,015,801	1,579,166	2,302,908	5,125,373	9,232,590	13,519,421	
Share of energy costs saved		78%	74%	74%	72%	73%	73%	73%	73%
Total fees to ESCO	-	-302,732	-914,221	-1,421,250	-2,072,617	-4,612,836	-4,597,590	-3,906,593	
Energy cost savings retained	-	33,637	101,580	157,917	230,291	512,537	4,635,001	9,612,828	
Asset Value obtained		2,974,367	9,540,078	14,237,118	20,981,579	28,429,002	46,390,192	62,989,289	74,584,034

### 4.3.3 ESCO

During an initial period of 5 year the continuous flow of projects is assumed in the scenario of funding from the City of Ternopil only.

**Table 12: Project investment schedule – City financing only – in UAH**

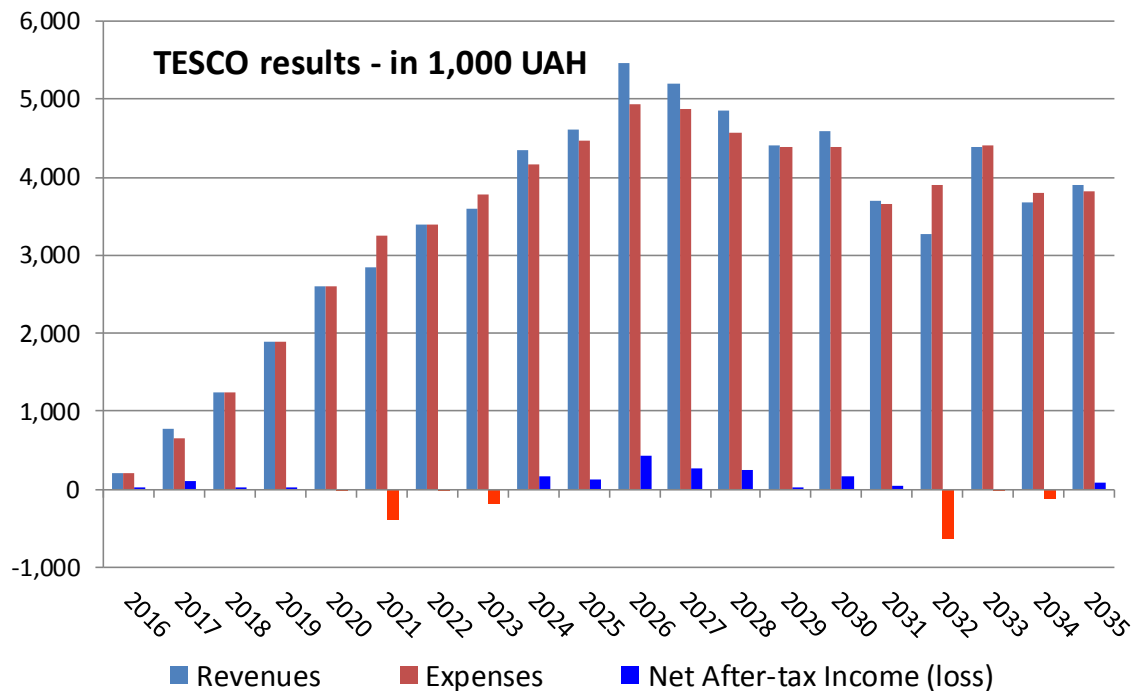
	2016	2017	2018	2019	2020
Kindergarten № 13	2.974.367	-	-	-	-
School № 2 (high)	-	6.565.711	-	-	-
KINDERGARTEN № 38	-	-	4.697.040	-	-
Ukrainian gymnasium	-	-	-	6.744.461	-
KINDERGARTEN № 31	-	-	-	-	7.447.423

Financial projections for the TESCO are shown in Figure 8. It presents the development of revenues from payments of municipal entities based on energy cost savings, expenses due to planning and monitoring and net income throughout the first 10 years of operation.

This evaluation of costs and benefits demonstrates the results of a satisfactory profitability in terms of After Tax Income and the financial sustainability through positive cumulated cash flows.

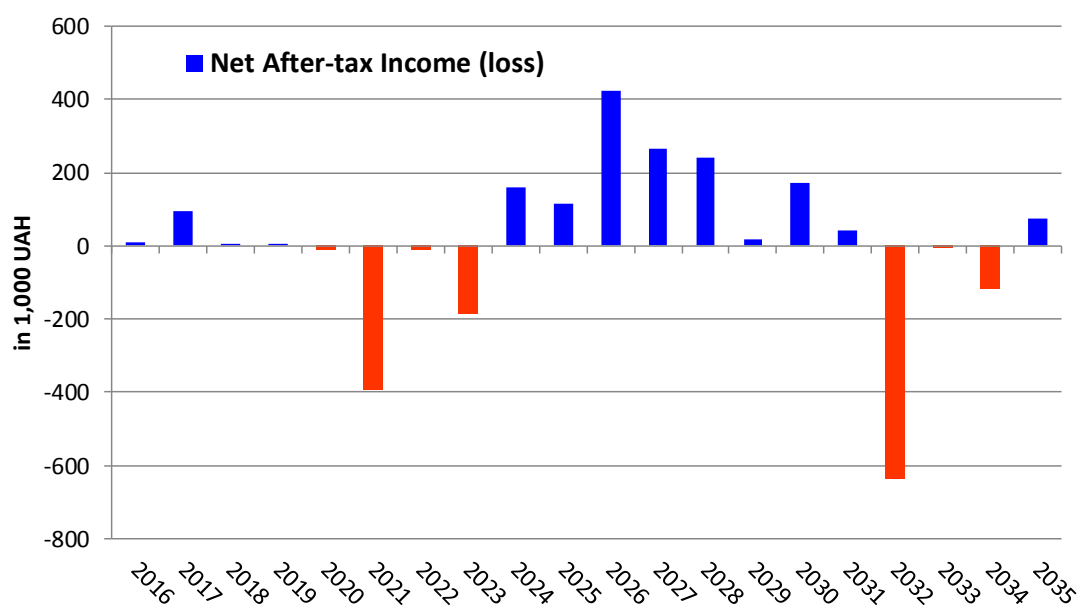
The respective financial projection tables are provided in Annex 7.

**Figure 12: Financial projection of Ternopil ESCO – with City financing only – in 1,000 UAH (Consultants Illustration)**



The development of Income for TESCO is dependent on the timing of planning costs and returns from energy cost savings. Losses occur after the coverage of project planning costs ends after 5 years. In later years, losses can occur when project planning costs coincide with low levels of returns from energy cost savings.

**Figure 13: Projection of TESCO Income – with City financing only – in 1,000 UAH (Consultants Illustration)**



## 4.4 Sensitivity Analysis

In order to calculate an overall profitability of the funds invested into the ESCO scheme a time series of Net Cash Flows (NCF) can be derived from data shown in Figure 8. The NCF time series draws values from the Cash Flow from Operations and the Project Investment for the first 5 years representing the actual capital injections of the city. From these NCF series a dynamic profitability analysis reveals an Internal Rate of Return (IRR) calculated for the base case of a financing from the City of Ternopil only as

$$\text{IRR} = 9.9\%$$

The discounting of Net Cash Flows from all project operations through TESCO returns a Net Present Value using a discount rate of 3.0% at

$$\text{NPV} = 17.05 \text{ million UAH}$$

**corresponding to 631,390 USD**

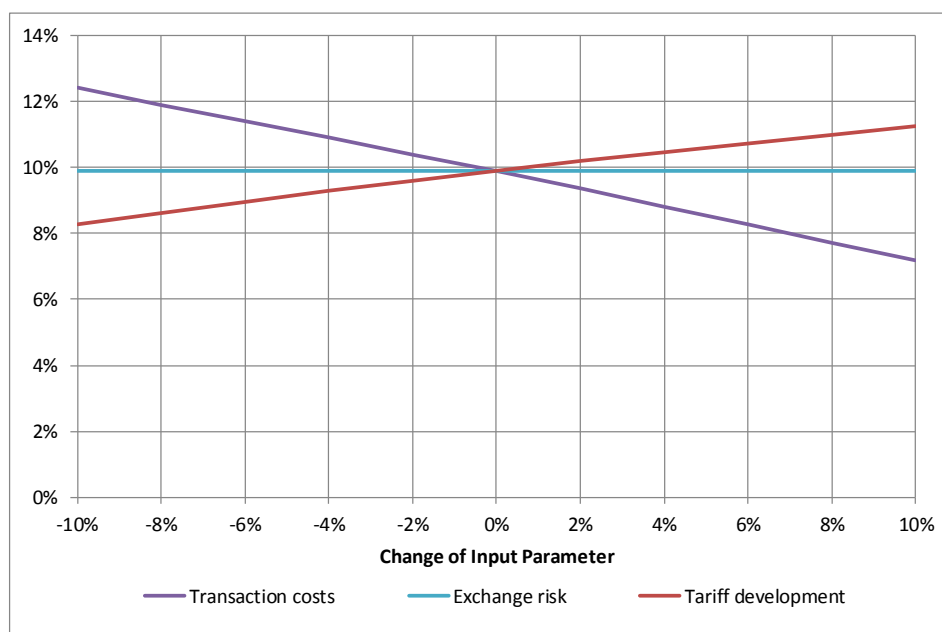
Focusing the financial performance of the Ternopil ESCO into one specific indicator enables the elaboration of a sensitivity and risk analysis pinpointing to variability of profitability to changes in key economic parameters.

For the sensitivity analysis of the ESCO's IRR the following parameters have been tested for changes from base case assumptions by variations from -10% to +10%. The chosen parameters and their effect are

- Transaction costs: Percentage changes affect the level of costs from outsourced services, staff costs and office expenses.
- Exchange risk: In the base case no effect from exchange rate fluctuations can be observed as all financing, costs and returns are denominated in domestic currency.
- Tariff development: The changes are considered with the initial price increase in 2016 thus raising (or decreasing) the level of tariffs throughout the projection period by the chosen percentage.

Using the changes to operating parameters the resulting profitability is depicted as a sensitivity graph. It demonstrates the relatively stronger impact of deviations from assumed transaction costs and tariff development, while, with financing and revenues denominated in UAH, the foreign exchange risk can be neglected in the basecase of a financing provided only by the city.

**Figure 14: Sensitivity of IRR (Consultants Illustration)**



## 4.5 Financing Option - IFI funding

In order to evaluate the effects of possible sources of finance for EE scheme of Ternopil a financing structure has been assumed and applied to the base case model. This scenario uses exemplary terms of financing from the possible sources described in section 4.2.3.

### Financing terms

#### IFI Loan:

An loan from an IFI operating in Ukraine (example NEFCO, for details see section 4.2.3) has been assumed at a maximum available tranche per year of some 400,000 EUR. The actual amount is to be scaled by project investment costs available from the priority list. The funding is assumed to be applied for 2 consecutive years. The applicable terms of financing are assumed to be at

- interest rate 3.0% pa fixed
- grace period 2 years
- repayment period 10 years

The loan is assumed to be disbursed to the City of Ternopil for application in the EERF. The loan is assumed to be denominated in local currency. Therefore foreign exchange risk can be considered not applicable.

#### IFI Grant:

In addition a grant financing is assumed to be available also to the EERF at a proportion of 50% of the IFI financing.

#### Technical Assistance (TA):

For the coverage of project preparation of the EE investment projects an additional 7% of the total of loan and grant funding per year has been assumed to be available from the IFI. This

project related financial support is assumed to be disbursed by the EERF to TESCO as extraordinary income.

The results of the quoted financing structure and terms are shown in Table 11 through Figure 12.

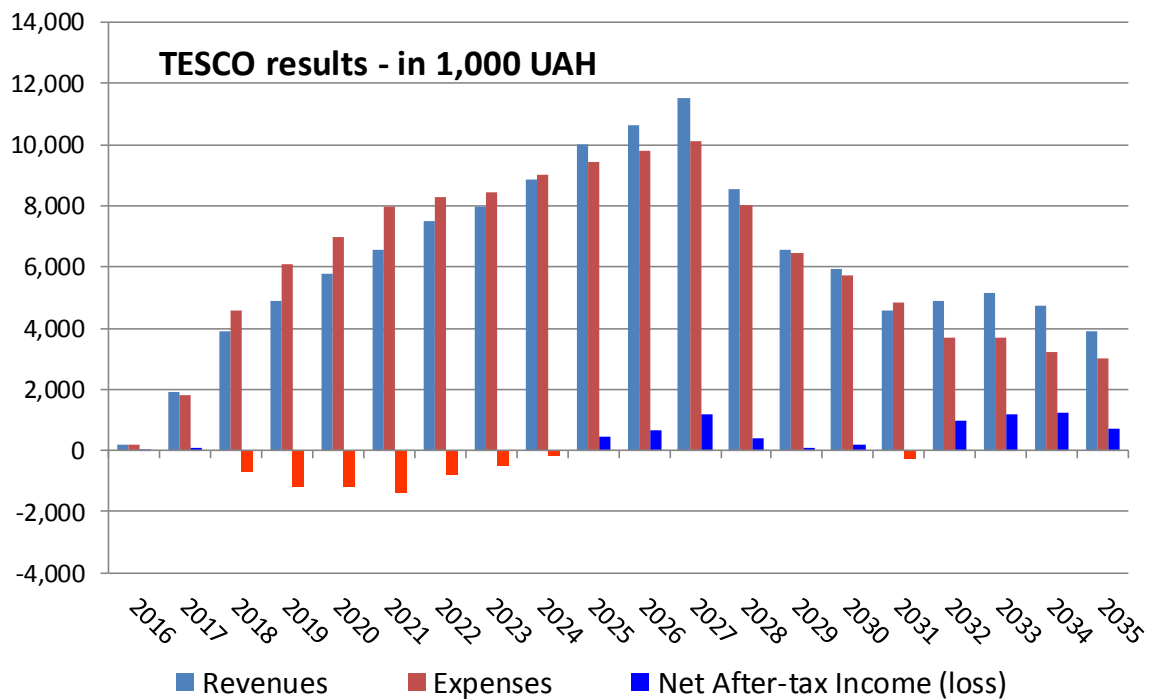
From the income and cash flow projection of TESCO it becomes evident, that the cost savings from the project pipeline are not sufficient to cover the financial commitments as per the financing terms assumed. Consequently loss/cash coverage arrangement has to be stipulated in the contractual arrangements of TESCO.

Under the assumption of the participation of an IFI (e.g. NEFCO) including the opportunity for grant provision the indicative financial projections will be as follows. Assumption: IFI financing of 1.36 M USD, of which 62% loan, 31% grant and 7% TA for project preparation. This total amount of 63 mln UAH will enable the realisation of 11 EE projects within the first 5 years.

**Table 13: Project investment schedule – with IFI funding – in UAH**

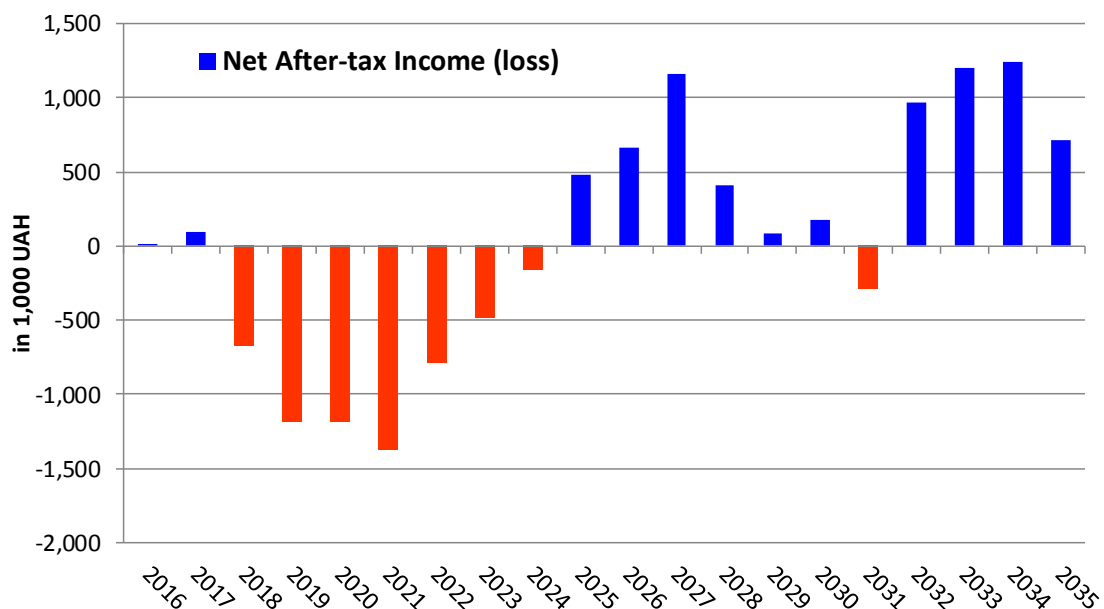
	2016	2017	2018	2019	2020
Kindergarten № 13	2,974,367	-	-	-	-
School № 2 (high)	-	6,565,711	-	-	-
KINDERGARTEN № 38	-	4,381,567	-	-	-
Ukrainian gymnasium	-	5,935,353	-	-	-
KINDERGARTEN № 31	-	6,183,004	-	-	-
technical liceum	-	-	6,591,234	-	-
KINDERGARTEN № 30	-	-	6,653,460	-	-
KINDERGARTEN № 19	-	-	5,897,025	-	-
SCHOOL-KINDERGARTEN № 28	-	-	-	6,923,693	-
KINDERGARTEN № 2	-	-	-	-	6,143,968
KINDERGARTEN № 10	-	-	-	-	5,123,303

**Figure 15: Project investment schedule – with IFI funding – in UAH (Consultants Illustration)**



Data from the scenario with IFI funding shows, that income of TESCO requires loss coverage up to 50,000 USD per year during the initial years of operation with profits emerging, once energy cost savings increase due to higher tariffs.

**Figure 16: Projection of TESCO Income – with IFI funding – in 1,000 UAH (Consultants Illustration)**



Since the co-operation with IFI might be an important added value for Ternopil the City already started some activities in this area:

- E5P: The City of Ternopil has signed an agreement with E5P for DH modernization (HIS installation in residential buildings). At the moment the project is at procurement procedure stage.
- NEFCO: The City of Ternopil had not any experience with NEFCO in the energy sector in the past but now they are concluding the agreement also for DH project. The agreement is under negotiation, but not signed yet.
- EIB: The City of Ternopil applied for an EIB loan and has submitted a letter of interest and is going to cooperate with EIB in future, However, by now (March 2016) there has been no decision on a loan agreement. It would be the first co-operation with EIB.
- USAID: Ternopil applied for technical assistance funding for up to 90 energy audits for their schools and kindergartens. The procurement process is ongoing, implementation is planned for Q2 and Q3 2016.



## 5. The Energy Efficiency Revolving Fund (EERF)

### 5.1 Governance and Management of the EERF

Under a typical EERF targeting the public sector, loans are provided to public agencies to cover the initial investment costs of EE projects; some of the resulting savings are then used to repay the EERF until the original investment is recovered, plus interest and service charges. The repayments can then be used to finance additional projects, thereby allowing the capital to revolve creating a sustainable financing mechanism.

The Fund for Energy Efficiency (further – the Fund) is created in order to identify, develop and finance projects in the area of energy efficiency contribute to the streamlining of energy consumption and influence the reduction of greenhouse gas emissions.

The target of the revolving fund is to a) ensure the coordination and provision of funds for dedicated EE projects, b) capture financial savings resulting from the ECM and re-invest them in further EE improvements and c) to enable a transparent scheme of decisions for project selection and implementation which complies with procurement rules and is applicable for participation of commercial/ private sector participants.

An EERF shall be set-up as separate institutional structure as interface between the city administration and TESCO or private ESCOs with sovereign and transparent decision power on projects and financial flows. The fund shall be authorized and established by City council of Ternopil, 100% owned by municipality, coordination by City council and work under the umbrella of the City Administration.

The Fund's main object of activity is the managing of the financial resources in order to finance the projects in the area of energy efficiency in accordance with the strategies and programs elaborated by the City Council of Ternopil.

The Fund will realize its scope by providing financing to financially profitable projects that may assure sustainability and energy savings. The municipal EERF could provide direct financing for EE projects, sometimes requiring co-financing from commercial banks or IFI. The EERF is structured to aggressively seek out municipal EE projects; market EE loans; work closely with potential borrowers; and perform loan intake, supervision, and collection services.

The EERF can offer financial instruments such as grants and loans for direct EE investment projects as well as for services for capacity building and project preparation and implementation. The key element will direct investment through energy performance contracts (EPCs) with municipal beneficiaries, such as municipal enterprises, especially those lacking the ability to borrow funds.

The role and function of the EERF is summarized to:

- Support and facilitate the development of energy service contract model
- Catalyze EE as commercial business
- Complement the process with expertise and facilitation among stakeholders
- Raise and facilitate funding and donation dedicated to concrete EE projects
- *Help to mobilize commercial co-financing*
- Facilitation of financial guarantees to increase borrowing capacity of municipal project implementation partners
- Acquisition and mobilization of funds for technical assistance for project preparation and dissemination

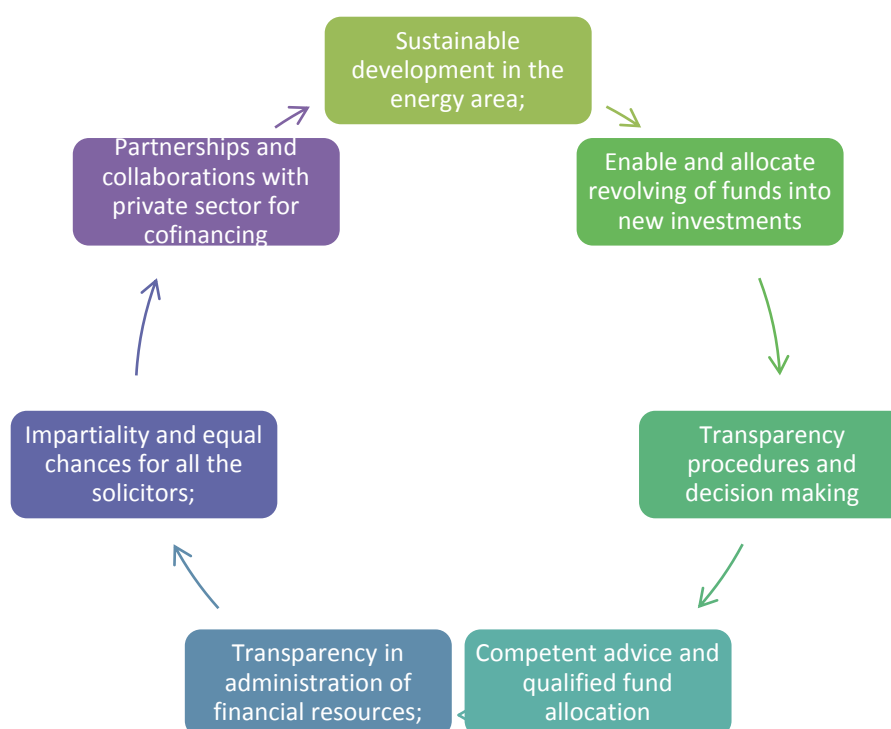
- Leverage external financing by IFI/ donors by allocation of city budget grant support
- Secure and fence financial returns by energy costs reduction
- Ensure utilization of returned funds will be reinvested in EE investments, and reduce the risk that municipal or central government subsidies for schools will be cut, if they pay less for energy
- Initiate and select projects for the EPC business with high energy and energy costs saving potential to enable quick returns
- Promote Energy conservation benefits and solutions among the municipal stakeholders
- profitable Monitoring of performance and achievement of targets
- Demonstrate EE Revolving as functioning and profitable model to attract private participation
- Contribute to the achievements of the set EE targets of the Strategic Development Plan of Ternopil until 2025
- Disseminate information on EE subproject performance

The Fund exercises the following attributions:

- draws up, through its governing bodies, a set of evaluation and selection criteria, as well as procedures for operating in accordance with internationally accepted standards, in order to establish methods for the identification, evaluation, selection and financing of projects in the area of energy efficiency;
- promotes and disseminates to potential beneficiaries information about its own activity and about the types of projects that it can finance;
- provides assistance to the eligible project beneficiaries in accordance with the evaluation and selection criteria approved by the Fund's Board of Administration;
- finances projects that meet the eligibility criteria;

While conducting its activity, the Fund guides itself after the following principles:

**Figure 17: Principles of the EERF (Consultants Illustration)**



The Fund's governing body is the Board of Administration, made up of 5 or 7 members, representatives of the public and the private sector, as follows:

- 1) a representative of the City Council;
- 2) a representative of the City Administration - Financial department; for control of budget flows for municipal services,
- 3) a representative of the City Administration - Energy management department; for technical advice
- 4) a representative of the City Administration - Education department; for facility selection and advice
- 5) a representative of the City Administration - Strategy department; for structure approval, development funds and investment allocation
- 6) – on appropriateness- an independent technical advisor from outside the administration




The board of the fund will be shared by President of the Fund's Board and will have the authority to:

- Select the projects
- Conclude of the financial agreement
- Finance of the ESCO activities for particular selected and prepared projects
- Control of the financial flows of the implementing ESCO

The Fund functions in accordance with the provisions of legislative and normative acts that are in force, as well as with other internal regulations approved by the Fund's Board of Administration.

A simplified fund management structure comprises:

**Table 14: EERF Management Structure**

Board of Administration	President of the Fund's Board of Administration	Fund Manager <sup>16</sup>
		
<i>Decision making on project funding</i>	<i>Ensuring transparent operation according to rules and provisions</i>	<i>Preparation and evaluation of project documentation for decision making</i>  <i>Fund operation and project implementation</i>
<b>Means of the fund are</b>		
Board of Administration <b>meetings</b>	Investment Committee <b>meetings</b>	Project preparation and monitoring <b>team</b>
<b>Required main provisions and instruments of the Fund management are</b>		
<ul style="list-style-type: none"> <li>List of eligible EE measures / projects</li> <li>Sources of Funding</li> <li>structured to address financing needs and evolving capacity of the municipality</li> </ul>	<ul style="list-style-type: none"> <li>a pre-prepared EE project pipeline</li> <li>Procedure of the ESCO Ternopil financing providing as well as cost refunding.</li> <li>a simple and consistent project evaluation scheme</li> <li>Control of the target financing use</li> <li>Reliable partners and communication culture</li> </ul>	<ul style="list-style-type: none"> <li>The Fund's Administrator is the City Administration</li> <li>professional, well-incentivized Fund Management Team</li> <li>strong and capable fund manager or management team</li> <li>A clear contract structure</li> <li>Fund administration support by the city administration</li> </ul>

## 5.2 Coexistence and Interaction of EERF and TESCO

The tasks of the EERF arise from the defined role and can be summarized as follows:

- Providing project dedicated funding to the ESCO with revenue streams independent of the state budget, and energy performance contracts to schools and other public facilities
- Providing grants for project preparation and justified expenses for monitoring and verification
- Ensuring the utilization of funds dedicated for EE investments,
- Securing and fencing the financial returns by reduced energy costs through EPC
- Enabling and allocating the revolved funds into new investments
- Facilitating and raising funding and donation
- Catalyzing Energy Efficiency as a business model and facilitating Energy Performance contracts
- Contribution to the strategic development targets of the city of Ternopil

The activities of the ESCO arise from the EPC business model and can be summarized as follows:

<sup>16</sup> In the first phase of operation Fund manager position will be hold by Energy department or Financial department of CA.

- offering a complete range of implementation services, including design, engineering, construction, commissioning, and maintenance of EE measures, and monitoring and verification of the resulting energy and cost savings.
- providing or arranging financing
- undertaking energy performance contracts under which specific performance guarantees for the entire project and generally guarantee a level of energy and/or cost savings.
- TESCOs offer a full package of services to identify, implement, and monitor EE projects. The beneficiary ESCO will be required to pay some or all of the reduced energy costs into an EERF-established escrow account to cover the investment cost and associated fees during the ESA contract period.
- To support the build-up of an ESCO business, simplified ESCO contracts are used to shift some performance risks to private construction firms/contractors.

As a principle, the activities of the EERF and ESCO must not overlap, instead complementing each other within as interface within the project steps as follows:

EERF activities		Means of interaction		TESCO Activities
<b>PHASE 1) PROJECT INITIATION</b>				
Project identification Project profile/ brief	➡	Cooperation	⬅	Project identification Project Proposal
Fund allocation & fund raising				
Evaluation & Approval	➡	Letter of Intent for project preparation and financing	⬅	Eol for energy service and project preparation
<b>PHASE 2) PROJECT PREPARATION</b>				
	➡	Payment for completion of preparation services	➡	Detailed Energy Audit - Baseline Pre-feasibility study Detailed Design Permission planning
Evaluation and approval by tender evaluation committee	➡	Financing Agreement over the amount of financial contribution to the project, scope and involved ECM and energy services	⬅	Technical and Financial proposal for energy service
<b>PHASE 3) PROJECT IMPLEMENTATION</b>				
Review of allocation and of Financing Agreement on demand	➡	Completion certificate		Tendering and Procurement of goods/ works Sub-contracting delivery Construction Supervision Commissioning
<b>PHASE 4) ENERGY SERVICE OPERATION &amp; MONITORING &amp; VERIFICATION</b>				
				Operation & Maintenance Measurement Monitoring & Verification Receipt of payments from energy service, reporting of M&V costs Payment of loan annuity to IFI
Reporting Board, IFI/ donor		Repayment to EERF	⬅	Reporting EERF

### 5.3 Recommended steps of implementation of the EERF

1) Decision of the Ternopil city council to establish EERF	April 2016
2) Development of the provisions for EERF operation / fund rules	May 2016
3) Determine the Board members(head of the EE department, head of the Financial department, deputy mayor etc).	May 2016
4) Development of the provision for Board and tender committee of the EERF.	June 2016
5) Allocation of start-up financing for prioritized EE projects (of approx. announced 5 M UAH)	June 2016

## **6. Risk Management**

A characteristic feature of a traditional performance contract between an ESCO and the Customer is that the ESCO undertakes all risks related to the achievement of certain energy saving parameters stated in the contract.

Under the contract for the proposed scheme for the implementation of this particular energy savings project, TESCO not only commits itself to certain energy saving, but is also obliged to maintain the building in proper condition and to ensure a certain level of comfort. Unlike traditional performance contracts concluded by ESCOs, such a contract carries a great variety of risks.

In the scheme under consideration TESCO undertakes to perform the entire range of building management functions including energy savings responsibilities. TESCO will enter into contracts with resource and equipment supply companies to achieve the set objectives.

Furthermore, TESCO invests funds of the EERF and/or IFI funding in ECMs in order to achieve the required energy savings. The risks of these funds' non-return and the maintenance of sufficient returns on investment are the main but not the only risks that TESCO faces.

A review of the risks of TESCO during the implementation of the performance contracts is given below. The review takes into account the entire scheme of contractual relations including that TESCO will sign

- contracts with the municipal government or the school as independent legal entity for the building management including the building maintenance, assurance of comfortable conditions therein and achievement of energy savings.
- Contracts with resource supply companies (heat networks) for the delivery of the required resources to achieve comfortable conditions.
- Contracts with suppliers of energy saving equipment used for the implementation of energy saving activities.
- Contracts with construction companies for the construction and/or repair activities related to the energy saving activities.

The TESCO risks may be divided into internal, i.e., those that may affect the parties involved in contractual relations, and external, i.e. those that cannot be regulated by contracts. It is evident that major material risks should be internal and regulated by contracts. Furthermore, it is important that internal risks should be taken on by the project participant who can control them best and reduce their impact on the project implementation and its cost. While doing so, the following should be taken into consideration:

- The ability to assess the risk.
- The ability to control and manage the risk.
- The risk impact on the cost of the TESCO services.

Internal risks are minimized by incorporating special provisions into the agreement by and between the building owner (or its representative) and TESCO and also by a complex of contractual provisions taking into consideration possible risks and hedging against them (utility resources supply agreements, equipment supply agreements, meter maintenance agreements, etc.). The main idea of performance contracts is that TESCO handles the main internal risks.

External risks related to the contract implementation should be to a greater extent handled by the customer of the TESCO services.



While managing risks it should be also noted that the more risks TESCO undertakes, the higher price the Customer shall pay for the services of the TESCO. Therefore, the most important objective of the project efficient implementation is to define the maximum number of internal risks and to minimize them in the format of the performance contract.

The interrelations between the client/municipal government and TESCO are one of the main sources of risks in ESCO projects. In addition, the complex of TESCO relations with other organizations involved in implementation of the main contract is also a source of risks. This complex includes:

- TESCO relations with resource supply organizations / utilities.
- TESCO cooperation with contractors performing the supply, installation, adjustment and maintenance of the required equipment and the maintenance of the building.

## 6.1 TESCO Risks

### 6.1.1 An Insufficient Level of Utility Tariffs

TESCO develops its business plan for project implementation including the calculations of the project payback period. The project payback period shall not exceed the contract validity. The savings gained from the reduced consumption of resources is determined by their tariff. Currently tariffs for utility resources in Ukraine are set for a year, while it is practically not feasible to accurately forecast the future tariff rate.

Also, the setting of heat and gas tariffs is within the competence of the National Energy and Utility Regulatory Commission of Ukraine (NERC) and not of the city (which is one of the contract parties). Therefore, the contract parties cannot influence the level of energy tariffs. TESCO risks to fall short of funds for investment payback and loan payments if tariffs for utility resources (heat) are set at a level below the one projected in the business plan.

**Risk mitigation options:** In most cases, the risk is external that any agreement cannot hedge. The business plan of TESCO is based on rather conservative estimates of tariff changes for utility resources to at least partly hedge against this risk. In order to reduce this risk during the implementation of the pilot project the contract between the municipal government and TESCO shall provide for budget subsidies to be provided to TESCO if the tariff changes at a lower rate than the minimum rates stated in the contract.

Procedures are proposed which may only minimize this risk, not to entirely avoid it. This needs to be added in the edition of the Contract.

### 6.1.2 Risks related to the building

If the City is not insured for the building in case of fire, destruction, etc., (as it is often the case for government entities), how will it be possible to reimburse ESCO in such cases?

**Risk mitigation options:** The risk mitigation could be that TESCO goes for such insurance or requires that building owner takes this risk. In any case, this issue will have to be discussed within contract negotiations since whoever is a finally responsible need to have full access and power to implement mitigation interventions<sup>17</sup>

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<sup>17</sup> For example if TESCO insists to install fire detectors, the client must give full access for maintenance purposes. This needs to be regulated in contract

### 6.1.3 Insufficient Funding for Building Maintenance

In accordance with the Ukrainian laws on the government procurement, the contract price for the maintenance for the buildings cannot be changed during its implementation except for some exceptional cases such as a change in utility tariffs. However, a rise in the costs of building maintenance is not considered in such a case. The building maintenance costs may be included in a long-term agreement between the municipal government and TESCO with consideration of forecasted inflation rates for the whole term of the agreement. The TESCO risk is that the actual inflation rate will be higher than the forecasted value and, consequently, there will be insufficient funds for the maintenance of the buildings.

**Risk mitigation options:** It is expedient for the pilot project to be guided by a pessimistic forecast of future inflation rates, i.e., its considerable growth. This will reduce TESCO risks, while budget expenses will grow, though such growth will be rather limited as the current building maintenance costs are considerably below the costs of utility services (provision of comfort). The best way to mitigate such risk, which is to build the cost of the contract under the most pessimistic conditions and to increase the level of profits to assume such risk if it cannot be better managed under the current Ukrainian system.

### 6.1.4 The Early Termination of the Contract by the Municipal Government

The municipal government may terminate the contract during the implementation of the project due to, for example, a change in the political situation in the city or the region. At the same time, TESCO may have incurred considerable costs on the procurement, installation and adjustment of energy saving equipment. Thus, TESCO risks not receiving the required funds to repay its investments and loans.

**Risk mitigation options:** This risk is an external one. However, it may be hedged by incorporating certain provisions into the contract in the event of early unilateral contract termination initiated by the municipal government. In the absence of any violations on the part of TESCO the municipal government shall reimburse TESCO for incurred losses and loss of profit. It is necessary to agree on the mechanism of defining the amount of compensation due by the municipal government to TESCO for the early termination of the contract.

### 6.1.5 Payment Delays by the Municipal Government or the EERF

An ESCO usually has no considerable funds of its own, making it dependent on the timely payments by the municipal government agreed under the contract. A delay in payment by the municipal government or the EERF may cause losses and also lead to violations of commitments to loan holders and contract parties of TESCO such as resource supply organizations, equipment vendors, services providers and contractors.

**Risk mitigation options:** This risk is partly hedged against by the adoption of the municipal long-term energy saving targeted program.<sup>18</sup>

In accordance with the Budget Code it is not possible to enter into a long-term contract by and between the municipal government and TESCO without approval of the long-term targeted program. This program includes payments under the said contract from the municipal budget for the whole period of the program validity. It is necessary to include into the contract between the city and TESCO provisions on obligations of the municipal

<sup>18</sup> Please refer to section 1 with reference to this report of the long-term program.

government or EERF to pay considerable penalties in the event of non-compliance to the payment schedule.

Furthermore, it is crucially important that the TESCO penalties for untimely payments for goods and services to its contract parties do not exceed the municipal government's penalties under the performance contract.

#### **6.1.6 A Lack of Complete Information on the Condition of the Public Sector Buildings**

TESCO will manage municipal public buildings such as schools and kindergartens. It should possess detailed information about these buildings to adequately plan its energy savings activities. The selection of energy saving activities depends to a great extent on the condition of the buildings transferred to TESCO for management. Lack or incomplete information may considerably increase the expenses of TESCO.

**Risk mitigation options:** This risk is an internal one and it is borne by TESCO. At the same time this risk is also a risk for the municipal government/or the school client as it may lead to not achieving energy saving targets during the implementation of the performance contract. The issue of its hedging is dependent on the way the municipal government prepares for the contract conclusion.

The city government should conduct energy audits of the public sector buildings that are included in the contract and obtain information on their condition prior to entering into the contract. It is not feasible to conduct an energy audit of all the buildings transferred for management due to time and economic constraints (currently the municipal government has 122 sites under its control). The city has to define parameters based on which the public sector buildings will be classified and to select sites for an energy audit. Independent experts shall be involved in such audits in order to reduce the chance of possible mistakes.

#### **6.1.7 An Increase in Energy Consumption**

TESCO is paid based on the fixed initial consumption of energy resources by the public sector buildings under its management and the results of its energy saving activities. The energy consumptions of the buildings will drop as a result of these activities. There is, however, a risk of an increase in energy consumption for the following two reasons:

- The consumption of heat increases in order to provide comfortable conditions in bad weather (low outdoor temperature).
- The energy consumption of the building increases due to objective changes in its use (installation of new energy-intensive equipment, changes in building operational target, etc.).

**Risk mitigation options:** The following actions should be considered to address each of these two causes in order to hedge the risk:

- In the contract between the client / municipal government and TESCO the heat consumption volume shall be defined for fixed weather conditions. In addition, the contract should contain a procedure for recalculating the heat volume based on actual weather conditions. This is necessary to prevent losses of TESCO in case of cold weather, but also to prevent unjustified revenues of TESCO in case of warm weather.

- The contract between the municipal government and TESCO should incorporate the city's commitment to inform TESCO on all planned changes in energy equipment and/or use of the building and also a procedure to review the volumes of initial energy consumption.

The City Administration - Department for Education and Energy management in cooperation with TESCO shall undertake accompanying measures to motivate and instruct the occupants of the facilities to enable the energy savings by change of behavior and operation practice. This will include: provision of information, guidance for operation and training of facility managers/ care takers. A Lack of Sufficient Resources to Assure Comfortable Conditions

TESCO bears the responsibility for providing comfortable conditions in public buildings under its management. TESCO concludes resource supply agreements with resource supply organizations in order to fulfill this task. Under such agreements heat energy is supplied to buildings. If resource suppliers fail to honor their commitments under such agreements TESCO bears the risk of not providing comfortable conditions in the buildings. This may cause TESCO losses due to violations of its commitments under its contract with the municipal government.

**Risk mitigation options:** This risk is an internal one and it is borne by TESCO. For its hedging it is necessary to define in the agreement between TESCO and the heat utility commitments of the resource supplier in relation to the quality of supplied resources, their key properties and requirements to continuity of supplies, and also to provide for sanctions against the resource supplier in the event of its failure to perform contractual commitments. The system of agreements between the client/municipal government and TESCO and TESCO and the heat utility should be built so that financial consequences for non-provision of comfortable conditions in buildings in the event of non-supply or supply of low-quality resources should be borne not by TESCO but by the respective resource supplying organization.

### **6.1.8 Overruns of Planned TESCO Payments under Heat Supply Agreements**

TESCO concludes heat supply agreements to maintain set temperature parameters in buildings under its management. The cost of heat supplied by the centralized heat supply system is regulated in accordance with the Ukrainian laws. However, it frequently happens that heat supply organizations include other payments not regulated by the state in heat supply contracts. For example, it may be that the price of the heat carrier discharged from the heat supply system during repairs or lost in the building as a result of some failure/emergency is charged to TESCO.

**Risk mitigation options:** TESCO should determine the average amount of such unplanned payments and their causes based on the analysis of the implementation of resource supply agreements to hedge this risk. The average amount of such expenses including inflation expectations should be included in the contract between the municipal government and TESCO. In addition, the contract between TESCO and the resource supply organization should contain a procedure for defining and calculating possible additional payments. These extra payments should be made only if extra expenses were incurred through the fault of TESCO. For example, in the case of a discharge of a heat carrier through the failure of the internal building heat supply system due to the fault of the municipal network, such costs should not be covered by TESCO.

### 6.1.9 A Failure to Achieve the Expected Reduction of Energy Consumption

The reduction of energy consumption is the main goal of the contracts between the Client/municipal government and TESCO. It is assumed that the municipal government fixes only targeted values of energy consumption reduction while TESCO bears the risk of choosing the way to reach these values. The failure to achieve such energy savings as per the contract leads to serious financial consequences for TESCO.

To settle the issue of energy savings, TESCO prepares an action plan, concludes agreements for the procurement, delivery, installation and adjustment of energy saving equipment. If the selected technical solutions do not allow TESCO to reach the set targets of energy saving, TESCO will not comply with key contract provisions.

**Risk mitigation options:** This risk mitigation may include two moments to be addressed in the contract.

- Firstly, it is important to fix in the contract TESCO’s commitment to have the energy saving enhancement plan and its implementation timeline endorsed by representatives of the municipal government. It will help not only to have an additional review of the action plan but to impose certain obligations on the municipal government to provide for the implementation of certain actions in buildings stated in the plan as per the defined schedule.
- Secondly, the contract with the client/municipal government should contain the provision that TESCO undertakes to use tender procedures for all purchases.

### 6.1.10 The Transfer of the Commitments of a Contractor to Third Parties

If contractors are mobilized for building maintenance or enhancement of its energy savings within the framework of TESCO’s implementation of its commitments under the contract, the achievement of main contract objectives greatly depends on the competence of contractors. Therefore, the shifting of contractor commitments to third parties without prior agreement with TESCO may cause non-performance of TESCO’s commitments and lead to its losses.

**Risk mitigation options:** This risk is an internal one and it is fully borne by the TESCO. To hedge this risk the contract between TESCO and the client/municipal government shall contain a complete ban to mobilize third parties for the implementation of commitments under contracts between TESCO and its contractors without TESCO agreeing.

### 6.1.11 The Exchange Rate and Loan Interest Rate Variation

TESCO should use loans if it does not have sufficient own funds or EERF funds to finance its energy saving actions. Currently, the conditions of commercial banks are not ready to give credits at an interest rate acceptable for borrowers. Therefore, TESCO might have to attract loans in foreign currency, while for its services under the contract between the municipal government and TESCO the latter receives payments in UAH. Loans will be returned at the exchange rate for the loan currency as of the date of payment. Thus, TESCO may incur considerable losses due to the currency rate drop vs. the loan currency. The last year showed that great attention should be paid to the exchange rate risk due to possible continuation of the currency devaluation.

Based on the above logic it is recommended to take loans in UAH in order to prevent exchange rate risks. But in this case there is a risk relating to the variation of the loan interest rate. The setting of the loan interest rate depends on the reservation rate of the NBU that



affects the interest on deposits of commercial banks. The growth of the loan interest rate will increase the project payback period that may lead to TESCO's losses.

**Risk mitigation options:** It will be the IFI task to minimize all of the above risks.

## **6.2 Risks of the Municipal Government**

### **6.2.1 The Poor Quality of TESCO Services**

The municipal government transfers the management of the public sector buildings to TESCO. The quality of services rendered by TESCO has an impact on the level of comfort in the said buildings. The use of the buildings may be restricted or become impossible if the quality of services rendered by TESCO is poor.

**Risk mitigation options:** The contract between the municipal government and TESCO shall include provisions containing detailed requirements of the quality of services rendered by TESCO and also a quality tracking system to hedge this risk. Certain penalties for TESCO shall be specified in the contract if it fails to achieve the set quality parameters. The contract should contain a system of penalties for TESCO in the form of the cumulative score system where failure to achieve a set quality parameter corresponds to a specific score. The penalty will be determined based on the sum of these scores.

### **6.2.2 A Failure to Achieve the Expected Reduction of Energy Consumption**

One of main objectives of the contract between the client/municipal government and TESCO is to reduce the consumption of utility resources by public sector buildings by a minimum value stated in the contract. The budget for energy costs will be reduced upon expiry of the contract between the client/municipal government and TESCO due to the reduction of energy consumption by the public sector buildings. The released funds can then be used for other means. If the expected reduction of energy consumption is not achieved, the budget expenses may not be reduced to the planned level.

**Risk mitigation options:** The contract between the municipal government and TESCO shall incorporate not only provisions containing energy saving improvement targets for public sector buildings but also the dynamics of such parameters' variation (milestones) during the project implementation to minimize this risk. The monitoring of milestone achievements will help to obtain exact information on the contract performance status. Besides, the failure to achieve energy saving milestones should entail penalties for TESCO.

### **6.2.3 A Failure to Reach an Agreement on the Proprietary Right of the Equipment Installed by TESCO**

The energy saving activities performed by TESCO are implemented as building permanent improvements. The owner of the public sector building should become the ownership of the owner of these improvements. However, TESCO has to install equipment in public sector buildings, which it will purchase at its own expense (frequently financed by EERF grants or loans received under loan agreements). Thus, the lack of a provision on the ownership to the said equipment in the contract may lead to the situation when TESCO will consider the installed equipment its own property during the contract validity and, more importantly, after the contract expiry.

**Risk mitigation options:** The contract between the client/municipal government and TESCO shall state that all the installed equipment in the public sector buildings shall be the property of the municipal government under such contract to hedge this risk.

#### **6.2.4 A Sharp Decline of the Building Quality after the Contract Expiry**

There is a chance that TESCO will focus on the maintenance of the building in a proper condition during the contract validity without assuring its proper reliability after the contract expiry.

**Risk mitigation options:** The contract between TESCO and the municipal government should include quality parameters that each building should meet when the responsibility of maintaining the building is transferred from TESCO to the city upon the expiry of the contract. In addition, TESCO shall provide a 2 to 3 year warranty on all installed equipment and all capital construction activities conducted over the last years of contract implementation.

### **6.3 Other Risks**

#### **6.3.1 Technical risks**

The implementation of new technologies or equipment goes along with the technical risk of poor quality of the equipment, with wrong installation of new advanced equipment and lack of appropriate maintenance and operation. All that might result in under performance or in worst case in total break down of the equipment. If such case happens it might happen the neither the expected saving can be realized nor the demanded level of comfort will be achieved.

**Risk mitigation options:** It is highly recommended to define within procurement process clearly all technical minimum parameter and to put focus not only on lowest price but also on high quality. The same is true for implementing company that should have a strong record of similar works and well educated and trained staff as well as sufficient capacity to install all equipment. In addition supervision of implementing works is highly recommended

#### **6.3.2 Performance risk**

There is also a risk that even though all equipment is properly installed the realized savings are far beyond expectation. This might happen due to unexpected failures in planning/implementation/metering or operation

**Risk mitigation options:** Contract shall have a performance clause stating that final 10 or 15% will be based on satisfying performance results. In addition user need to be trained in how to use new equipment and finally permanent metering of temperature and additional indicators need to be ensured to verify performance and to immediately identify any deviation.

#### **6.3.3 Cash flow Risk**

The cash flow risk is linked with the performance risk, in case of lower verified energy savings than expected. Another factor is development of the heat energy tariff. The latter is an external risk and respective mitigation strategies are provided in above section 6.1.



#### **6.3.4 Delayed Payments or Non-payment by TESCO for the Supplied Utility Resources**

TESCO enters into agreements with resource supply organizations for the supply of the required utility resources to assure comfortable conditions in public sector buildings. Under such agreements TESCO pays for the resources based on the credit scheme envisaging that the resource supply organization supplies resources and TESCO subsequently pays for these resources. The supplier of a utility resource may incur losses in the event of delayed payments or non-payments by TESCO.

##### **Risk mitigation options:**

The agreement between TESCO and the resource supplier shall envisage penalties for delayed or non-payments for utility resources to minimize this risk.

#### **6.3.5 Changes in Effective Laws**

Any changes in civil, budget, state procurement laws of Ukraine may considerably affect the project implementation.

#### **6.3.6 Force-majeure**

Force-majeure circumstances are acts of God that cannot be foreseen, and which presence does not depend on any actions or omissions on the part of both the municipal government and TESCO. In the event of force majeure the party affected by such event shall be relieved from the implementation of its commitments under the contract except for the obligations which performance was not affected by force majeure.

## 7. Conclusions & Next steps

The City of Ternopil shows strong efforts to improve the energy performance in public buildings. In addition the CA committed to undertake additional steps to set-up effective organization for fast and efficient implementation. The CA will take advantage of the new legislation on EPC will act as a front runner in making a municipal ESCO operational.

The business model as outlined in this report is tailored to the specific needs of Ternopil and shows the potential to realize financial benefits from retrofitting and use such benefits to finance additional investments. The Mayor of Ternopil confirmed that the developed strategy meets the expectations and will be followed by the City Administration.

The proposed model will use up front funding from City budgeted as starting investment for retrofitting of 5 public kindergarten and schools via a dedicated energy efficient revolving fund. Implementing body will be existing municipal ESCO which will establish a new department for Energy Performance business. These recommended institutional settings will ensure transparent procedures on the one side and use existing capacities on the other side. Both will reduce transaction and operational costs significant.

Once measures are implemented financial benefits will flow back to the EERF and hence provide new capital for EE investment in the next building.

Under this perspective the CEETI (implemented for Ternopil city during the period 11/2014 to 03/2016) project was fully successful since it delivered mechanisms, capacities and financing to realize municipal EE investments. As result Ternopil received confirmation for donor funding of technical assistance for 90 municipal buildings energy audits and applied for loan funding by the recently established EIB facility.

In addition, it shows that retrofitting can be also realized even without donor funding if the base work is done and the CA shows strong efforts to make it happen. However, one of the final recommendation is to approach international donor such EIB or NEFCO for financing the identified investment program.

### **Recommended next steps for the completion of the CEETI project are:**

- The final version of the business plan will be translated into Ukrainian and shared with City of Ternopil.
- The City of Ternopil will organize an event Mid of April where the consultant will present this business model to international donors.
- Confirmation that the drafted delivery mechanism shall be used as show case, demonstrating the functioning of the scheme to international donors/ banks (such as EIB)

### **During the final consultation workshop the following determining actions for operationalizing Ternopil EERF and Ternopil ESCO have been presented and preliminary agreed:**

- Take necessary legislation actions (acts) for creating the EERF
- Development of rules of the fund
- Establish the supervision board (or committee)
- Commit funding and funding schedule (e.g., x amount per year for 3 years)
- Appoint the fund manager and additional staff if necessary
- Authorization of the EM department of City Admin. to take over the function of the Fund Manager

- Develop and approve operation guidelines (e.g., project selection criteria, operating procedures and monitoring & evaluation)
- Further development of a project pipeline qualified by energy audits by autumn 2016
- Active fund raising
- Communication of the ESCO business plan
- Develop operational manual for ESCO
- Ensure Institutional development/ staff/ capacities of ESCO
- Institutional development/ staff/ capacities

Further practical recommendations to kick-off the scheme are:

- Make sure to have full commitment within all City departments and well informed motivated executing staff in place.
- Make sure to have well educated and trained staff on operational level.
- Be sure to have a solid and smart contract in place. Invest in good legal advice, which will pay pack..
- Communicate pro-active the benefits to attract publicity, business partners and donors.
- For the first projects invest in supervision of works to ensure meeting expected savings.
- Use performance indicators by contracting implementing companies.

## **Annexes**

## **Annex 1: Presentation of the results for the final workshop with City of Ternopil**

## Annex 2 – Legal aspects

Key issue	Addressed by law/ regulation	Related provisions by the law/regulation	Open and critical issues
<a href="#">Law of Ukraine No. 327-VIII "On the Implementation of New Investment Opportunities, Ensuring Rights and Legitimate Interests of Individual Entrepreneurs for the Performance of Large-Scale Energy Sector Modernisation"</a> dated 09 April 2015 provides a legal and an economic basis for energy service business under public procurement for state and municipally-owned buildings and facilities			
Terms and conditions for energy service agreement (ESA)	<u>The following terms are defined in Law:</u> <ul style="list-style-type: none"> <li>• The maximum contract period</li> <li>• Termination conditions</li> <li>• Payments</li> <li>• Adjustment of the results</li> </ul> Please refer to the Section 2.8 ESA for more details	Article 5 (paragraphs 1-13)	1. Assets transferring procedure 2. The separate contract needed for energy supplying. It is impossible to regulate the terms of the energy supply in the ESA.
Additional procurement rules to the <a href="#">Procurement Law of Ukraine</a>	<u>Specific requirements to be specified in application form:</u> <ul style="list-style-type: none"> <li>• basic level of energy consumption;</li> <li>• detail information about the facility;</li> <li>• annual cost reduction;</li> <li>• annual amount of payment;</li> <li>• contract period.</li> </ul>	Article 3 (paragraphs 1-13)	In some cases the public institutions are allowed to use negotiated procedure
Evaluation of the application by the local authority	<u>The main criteria for evaluation of the proposals is NPV.</u> In case the additional criteria used the ratio of NPV must be at least 75%. <u>NPV calculates</u> as a total amount of the discounted value differences between the annual customer cost reduction and annual payments to the participant for the 20-year period from the date of execution of the energy service agreement. <u>The tender committee shall reject the tender in following cases:</u> <ul style="list-style-type: none"> <li>• If the tender price for energy service &gt;1 000 000 UAH (for one lot, e.g. usually one building per lot, in particular for school which are separate legal entities) and less than 2 proposals are evaluated.</li> <li>• If all proposals exceed 1 000 000 UAH and less than 2 proposals are evaluated; &lt; 3 proposals for framework agreement with several participants.</li> </ul>	Article 4 (paragraphs 1-2) Article 7 (paragraphs 1-3)  The NPV is calculated by the tender committee members and used for evaluation of the proposals from ESCOs.	The tariff development scenario is not foreseen in criteria for tender evaluation.

Key issue	Addressed by law/ regulation	Related provisions by the law/regulation	Open and critical issues
Approval of the ESA	Procedure for approval: <ul style="list-style-type: none"> <li>The facility owner should submit the contract to the local authority for approval.</li> <li>Local financial authority approves the ESA within 3 working days</li> <li>Local authority has the obligation to approve the essential conditions within 10 working days</li> </ul>	Article 6 (paragraphs 1-4)	The approval procedure to be developed by the city council
<a href="#">Law of Ukraine № 328-VIII "On Amendments to the Budget Code of Ukraine on introduction of new investment opportunities, guaranteeing the rights and interests of businesses large scale energy modernization"</a> dated on 09 April 2015 updated the exist <a href="#">Budget Code of Ukraine</a> and introduces long-term budgetary repayment obligations under energy service contracts, regulates repayment basis and methodology			
Budget obligations	Local authorities(facilities) allowed: <ul style="list-style-type: none"> <li>to take the obligations concerning the energy service payments;</li> <li>to reallocate costs in case when the actual achieved reduction of energy expenditures is lower than amount specified in ESA, and visa versa.</li> </ul>	Articles 21, 22, 23, 35, 38, 48, 55, 76, 113	The authority must guarantee the funding of the facilities energy costs according to the baseline level from which the school can cover EE service + bills for heating
<a href="#">Resolution by the Ministry of Finance #333 13.03.2012 "Regulation for use of economic classification of the budget expenditures..."</a> aimed to clearly distinguish the expenditures of local authorities based on economic characteristics of the transactions			
Budget code	The municipal facilities financed from local budget are supposed to use new budget code in case of payments under energy service agreements This Law #327-18 allows to have long term commitments for public institutions (more than 1 year).	Articles 2 (Paragraph 2.2.7 Costs for utilities and energy) (KEKB – 2276 – Payments for energy service)	
<a href="#">Procedure and conditions for providing the educational subvention from the state to local budgets approved by the Resolution of the Cabinet of Ministers #6 dated 14 January 2015</a>			
Formula for calculating of the educational subvention from the state budget	It depends on the quantity of pupils, regional coefficient of economic factor and type of school. It includes energy costs, salary and social contributions as well as operational costs. $V = H \times U \times K$ , where U - quantity of pupils, H - financial norm of budgetary provision per pupil in thousands UAH. K - adjustment coefficient, depends of type of the school	The formula approved by Regulation of the Cabinet of Ministers #6 dated on 14 January 2015 Calculates by relevant department of the Regional State Administration	Educational subvention is a fixed amount per school. The schools are interested to consume less energy in order to save money for salary, that's why the school director may not be interested in fixing costs for energy.



## Energy service agreement (ESA)

Key issue	Principle and main requirements	Addressing in the recommended model	Critical aspects remaining
Price of ESA	The total price of the ESA is 100% of energy savings. Establishes in the tender application form along with other tender documents	Calculates by multiplying the economy in natural indicators on tariff for heating valid on date of tender announcement and determined in Article 2 of the ESA	Fixed amount
Baseline	The basic line is calculating in natural and financial indicators and specified in Annex 3.	The <u>baseline consumption</u> may be determined in two ways: <ul style="list-style-type: none"> <li>based on customer's actual average annual energy consumption over the last 3 years or (using real, metered energy consumption for or, in case of not metered heat supply, using the norm supply)</li> <li>in case of indoor climate conditions are not complied, using the <u>norms</u> for energy consumption in public sector approved on 25th October 2015 by resolution of the State Committee on Energy Efficiency №91</li> </ul> The ESCO is allowed to choose the variant for the baseline calculation.	1. The independent energy audit needed 2. Two different methods for baseline calculation
Level of energy costs reduction	To be developed in percentages and in monetary form for each year of the agreement based on proposed measures	Specified in Annex 4 and 5 of the ESA	-
Payments	Annual amount calculates by summing up of all amounts of billing period and limited to 80-90% of the annual cost reduction. Payments are to be made by monthly using formula $P_{tn} = \frac{B*(BLn - ALn)*Tn}{100\%},$	Article 13 of the ESA  Annual payments can not be more than 90% of the actual annual cost reduction. The remaining 10-20% are reserved as an additional guarantees for the facility in case the ESCO fail to achieve the stated level of savings. ESCO will receive this remaining 10% in final payments.	Not clear how payments will be done during the implementation of the technical measures, whether no energy savings achieved. In case the price/tariff for energy will increase, the payment to the ESCO increase compared with the calculated payments which are made using a current tariff.
Adjustment of the results	The adjustment factors are changes in climate conditions or in operational mode of the facility or changes in final purpose of the facility.	Adjustment methods described in Annex 7 of the ESA (heat energy, electricity, cold water, heat water) The adjustment is to be initiated by ESCO or facility and must be approved by parties.	May affect the annual amount within the ESA

### Annex 3: Building performance and Environmental requirements relevant for public buildings

According to the regulation of Ukraine "THERMAL INSULATION OF BUILDINGS" (ТЕПЛОВА ІЗОЛЯЦІЯ БУДІВЕЛЬ) by the ministry of Regional Development, Construction materials and equipment of retrofit measures of the building envelope must comply with the following performance standards.

For new buildings and/or complex retrofitting that falls under the building permit requirements, developers must comply with the following U values.

Those have been applied for the preliminary technical specification and cost estimation of ECM.

**Table 1 - The minimum requirements value of heat resistance (R) and U-Value of public buildings for climate zone I (Ternopil)**

Building structure	Norm Heat resistance Rq min, m <sup>2</sup> K/W	Heat transfer coefficient U-value, W/(m <sup>2</sup> .K)
External walls	3,3	0,303
Flat roof / roof ceiling	5,35	0,187
Floor Ceiling over unheated exterior	4,95	0,202
Floor Ceiling over heated basement	3,75	0,266
Windows (rooms of permanent occupation)	0,75	1,333
Doors with the entrance space	0,5	2,000

In addition that regulation defines that the minimal requirements for energy performance requirements of class 'B' must be met after complex retrofit, which are for climatic region I

Required specific Space Heating consumption limits per heated volume are for:

School buildings, etc. 18-31 kWh/m<sup>3</sup>/a

Kindergarten and nurseries 20-36 kWh/m<sup>3</sup>/a

According to the real room height the specific space heat energy consumption per heated area of the building must be in the range between 60 and 110 kWh/m<sup>2</sup> for kindergartens and schools. Those are the minimum target values to be reached after the implementation of the package of ECM.

The national regulations and standards provide environmental requirements relevant for public buildings:

The design indoor temperature is for the following building/ room category:

Education (schools) and health care institutions	20 °C
Kindergarten children rooms and nurseries	22 °C
Other heated space (Gym, corridors, WC, halls, staircases)	18 °C

The maximum Relative air humidity must not exceed 50%. The air change rate should be min 0.5 1/h

## Annex 4 - Typical characteristics of the pool of buildings for ESCO business

The existing public buildings have been mostly built in the Soviet Union era in 1950-1980. They have large heat losses through the building envelope and require a significant amount of heat energy for space heating. Most buildings have not received regular maintenance and repairs over 30 years.

In the following an overview of the average technical characteristics of the typical school or kindergarten buildings of the analyzed pool of 20 schools and 26 kindergartens for the ESCO business is given.

Building element/ component	School buildings	Kindergartens
Use and occupation time of the buildings	Schools are operated throughout the year Monday to Friday from 8 am to 6 pm with 3 months summer vacation period. The estimated annual operation time is 1,800 hours.	Kindergartens are operated throughout the year Monday to Friday from 7 am to 6 pm without vacation period. The estimated annual operation time is 2,640 hours.
Heating period	The average heating period in Ternopil has a duration of 6 months, total 182 days	
Typical Building geometry and structural elements		
Average share of heated area	90% of floor area is heated at typically 2.5 – 3 floors	80% of the floor area is heated at typically 2 floors
Heated area	in the range of 2,000 to 8,000 m², average 3,000 m²	in the range of 1,000 to 2,400 m², average 2,000 m²
Typical composition of rooms and use	Class rooms (up to 70% of the heated area), corridors, washing rooms/ WC, some teacher rooms Many schools accommodate: a theater room, a gym, a library and storage rooms Some schools accommodate a kitchen and a dining hall	Children rooms (up to 65% of the heated area), corridors with locker room, washing rooms/ WC Some accommodate a cultural room All kindergartens accommodate a central kitchen and decentral small kitchenettes
Average ratio of structural elements	Outside wall area: 50% of heated area Window area: 30% of heated area Door area: 1% of heated area Floor and roof area: 40% of heated area	Outside wall area: 70% of heated area Window area: 40% of heated area Door area: 2% of heated area Floor and roof area: 50% of heated area
Windows	In average some 60% of the windows of the building has been changed during the last decade (in some buildings up to 90%, mainly at class rooms)	In average some 50% of the windows of the building has been changed during the last decade.
Outside walls and facade	historical façade with limitations for outside wall insulation at Secondary school №3, School №4 and Secondary school № 5	historical façade with limitations for outside wall insulation at small Kindergarten № 24
Type of roof construction	40% sloped roof 60% flat roof Both with unheated space between ceiling and roof cover	50% sloped roof 50% flat roof
Underfloor/ basement construction	Most of the buildings have a basement floor which an area of 50-100% of the ground floor where the district heating sub-station is located. Heat distribution pipelines and the sub-station are usually not insulated	

Building element/ component	School buildings	Kindergartens
	so that the basement can be considered as heated.	
Typical Heat supply and domestic hot water		
Space heat supply	The majority of buildings is supplied with central heat by the district heating company “Ternopilniskteplokomunenergo”. In all buildings the heating sub-station was rehabilitated during the years 2011/12.	
	A few large facilities, (two, such as the lyceum) operate an individual gas boiler for heating of stand-alone building parts	2 kindergartens have no DH connection and operate an individual gas-fueled boilers.
Domestic hot water (DHW)	No hot water supply for washing/ WC by DH system supply Some small electric hot water boilers are installed	There is regular hot water supply for washing/ WC/ kitchen. Most kindergartens receive DHW by the DH system; only a few operate an individual gas boiler for DHW. Some small electric hot water boilers are installed.
Special energy consumption	In the School No 22 an indoor swimming pool is accommodated	In the Kindergarten No 35 comprise an indoor swimming pool
Ventilation system	The originally installed passive ventilation system is not working, ducts are existing but dirty and fans are not in operation	The originally installed passive ventilation system is working slightly due to poor maintenance, existing ducts dirty and fans are not in operation
	Ventilation system in kitchens is working slightly	
Metering of energy consumption	All buildings have separate electricity meter and – if gas supply – a gas meter. All DH supplied buildings have an individual heat meter in the rehabilitated heating sub-station. Meter reading and reporting is done by the school administration once per month.	
Lighting and electric devices		
Lighting	Most of class / children rooms are equipped with fluorescent tube T5 lamps of which most are without ballast and no/ damages reflector. At corridors, other rooms and outside lighting old lamps with incandescent bulbs.	
Kitchen equipment	Generally outworn ovens/ cookers and low performance electric devices, such as refrigerators	
Other electric devices	The schools are equipped with computer cabinet of old devices and low annual operation time.	Some electric heaters for up-heating of children rooms during cold winter days with low annual operation time.

## Annex 5 EE Packages

### EE Package A –Thermal modernization of the building envelop

Highest specific heat energy losses are identified at structural elements of outside walls, roof, floor, windows and doors.

The main purpose of this EE measure is the reduction of heat energy transmission losses.

Additional benefits of the EE measure are: the increases of the sealing of the building envelop, reduction of draught and mechanical ventilation losses, reduction of heat losses through thermal bridges, increase of indoor room conditions, extension of the life-time of the building.

The following table provides an overview on the conditions of main elements of the building envelop (for schools and kindergartens) and opportunities for reduction of heat transmission losses.

BASELINE		Energy conservation measure (ECM)		
Current condition	Current energy performance characteristics <sup>19</sup>	Recommended measures	Costs of ECM	Expected benefits of ECM
<b>Outside walls →</b>		<b>Wall insulation</b>		
Walls made of bricks with thickness of 0.6 – 1.0 m with inside and outside plaster	Responsible for 20 % of overall building heat losses U-value baseline: 0.7 – 1.0 W/m <sup>2</sup> ·K	Installation of stone wool insulation of 150 mm, new outside plaster and joints (windows, floor, roof) U-value after ECM of 0.2 W/m <sup>2</sup> ·K (requirement by standard is 0.3)	Specific investment costs of 35 USD per m <sup>2</sup> of wall area (950 UAH/m <sup>2</sup> ) including works	78 % reduction of transmission losses at site 16 % Energy saving of total building consumption Simple payback: 12 years Specific annual savings: 1.7 kWh/USD investment consumption
<b>Windows →</b>		<b>Window replacement</b>		
Old windows, wooden frame, partly single glass, broken	Responsible for 30 % of overall building heat losses U-value baseline: 2.8 W/m <sup>2</sup> ·K	Replacement by Plastic 4-5 chambers, double e-glass U-value after ECM of 1.3 W/m <sup>2</sup> ·K (requirement by standard is 1.33)	Specific investment costs of 110 USD per m <sup>2</sup> of window area (3,000 UAH/m <sup>2</sup> ) including works	30 % reduction of transmission losses at site (weighted: changed/ new) 10 % Energy saving of total building consumption Simple payback: 20 years Specific annual savings: 1.0 kWh/USD investment consumption
Changed windows (last 10 years) by plastic 3 chambers, double glass <sup>20</sup>	U-value baseline: 2.2 W/m <sup>2</sup> ·K	No replacement		
<b>Outside doors →</b>		<b>Door replacement</b>		
Wooden or poor	Responsible for 1%		Specific investment	40 % reduction of

<sup>19</sup> Based on values of energy audits, estimates, assumptions and calculation of building experts.

<sup>20</sup> The baseline U-value of the existing windows, which have been renewed within the last decade is estimated to be 2.2 W/m<sup>2</sup>·K. The existing windows are of low quality with a plastic 3-chamber frame and standard class.

BASELINE		Energy conservation measure (ECM)		
Current condition	Current energy performance characteristics <sup>19</sup>	Recommended measures	Costs of ECM	Expected benefits of ECM
insulated plastic frame doors	of overall building heat losses U-value baseline: 2.7 W/m <sup>2</sup> xK	Installation of new insulated/ new plastic doors with mechanical door closer U-value after ECM of 1.6 W//m <sup>2</sup> xK (requirement by standard is 2.0)	costs of 110 USD per m <sup>2</sup> of door area (3.000 UAH/m <sup>2</sup> ) including works	transmission losses at site 0.5 % Energy saving of total building consumption Simple payback: 25 years Specific annual savings: 0.7 kWh/USD investment consumption
<b>Floor/ floor ceiling →</b>		<b>Floor ceiling insulation</b>		
Floor ceiling over heated premises made of typically reinforced concrete plates of 0.22m with top wooden parquet/ planks, no insulation	Responsible for 20 % of overall building heat losses U-value baseline: 1.44 W/m <sup>2</sup> xK	Insulation under the floor ceiling with XPS plate of 100 mm U-value after ECM of 0.19 W//m <sup>2</sup> xK (requirement by standard is 0.2)	Specific investment costs of 26 USD per m <sup>2</sup> of floor ceiling area (700 UAH/m <sup>2</sup> ) including works	85 % reduction of transmission losses at site 22 % Energy saving of total building consumption Simple payback: 6 years Specific annual savings: 3.5 kWh/USD investment consumption
<b>Roof/ roof ceiling →</b>		<b>Roof ceiling insulation</b>		
Ceiling between upper floor and unheated attic is typical made of reinforced concrete plates of 0.28 m with top hydro insulation cover, no heat insulation, poor condition	Responsible for 15% of overall building heat losses U-value baseline: 0.94 W/m <sup>2</sup> xK	Installation of stone wool insulation of 150 mm U-value after ECM of 0.2 W//m <sup>2</sup> xK (requirement by standard is 0.2)	Specific investment costs of 30 USD per m <sup>2</sup> of roof ceiling area (810 UAH/m <sup>2</sup> ) including works	75 % reduction of transmission losses at site 13% Energy saving of total building consumption Simple payback: 11 years Specific annual savings: 1.8 kWh/USD investment consumption

An additional effect of retrofit of the building envelop (windows, walls, etc.) will be the reduction of losses through heat bridges (2%) and mechanical ventilation (3%) due to untight elements.



## EE Package B – Heating and ventilation system

The majority of buildings are supplied with central heat by the district heating company “Ternopilmiskteplokomunenergo”. The DH company rehabilitated the heating sub-stations in all municipal public buildings during the years 2011/12.

The building internal heating system has many problems and shortcomings:

- Heating hot water is delivered to the building through the municipal district heating network and is distributed to original cast iron radiators. The radiators are not controlled and are not fitted with thermostatically control valves. Overheating of rooms is regulated by window opening.
- The system is manually operated: all the operations (start, stop, adjusting the thermal power, etc.) of the system must be performed manually. Often during the heating season the temperature is not adjusted/reduced during nights, weekends and holidays. The system works on nominal load causing excessive energy use.
- The radiators. The radiators are designed to work on the nominal load and lack thermal valves.
- All the heat distribution pipes in the building are made of steel and are not insulated.
- Ventilation is provided by 100% outside air with no heat recovery capability.

The internal heat losses in the building through i) unbalanced heat distribution, ii) overheating of parts of the building and during times of non-occupation and iii) losses at not insulated pipelines in unheated premises are estimated at 12% of the delivered heat. The current ventilation losses are estimated at 5 kWh/m<sup>2</sup> x year.

With the following energy conservation measures (ECM) the internal heat losses can be minimized. The capacity of the heating and ventilation system need to be designed according to the space heat energy demand after the implementation of the EE package A. The installation of a ventilation system is a requirement to which derives from EE measures of the facade and openings (walls, floor and windows). Better tightness of the building envelop results in lower mechanical and free ventilation and by that to insufficient air exchange. As a consequence this results to humidity levels exceeding the standards of indoor climate and leads by high dew point temperatures to mildew at structural elements (window frames), reduction of their lifetime and health hazards for pupils.

This ECM package B for heating and ventilation include:

Heating system	Ventilation system
Recommended energy conservation measures	
<ul style="list-style-type: none"> <li>• <b>Re-Zone</b> and provide Direct Digital Control (DDC) based Automatic Control valve system to control different heating zones for buildings.</li> <li>• Reconstruction of internal heating system</li> <li>• Up-grading – on demand - of the Individual Heating Substations with automatic control for temperature setback at nights and weekends</li> <li>• Replacing all radiators with new cast iron radiators and retrofit radiators with thermostatic control valves</li> <li>• Pipe insulation in the basement and other unheated spaces</li> <li>• Balancing of heating system</li> </ul>	<ul style="list-style-type: none"> <li>• Reactivation of existing ventilations system</li> <li>• Convert constant volume air handling unit systems to variable air volume system. This ECM is realized by retrofitting the supply and return (or exhaust) fans with variable speed drives to modulate the amount of outside air introduced based on actual ventilation needs using carbon dioxide sensors installed in the return or exhaust ducts.</li> <li>• Provide tight control time schedule to air handling units.</li> <li>• Retrofit outside air ventilation system with heat recovery technology where applicable.</li> </ul>



Heating system	Ventilation system
<b>Applicability at</b>	
In all DH supplied buildings of the pool (95%)	In approx. 10% of the buildings, mainly at large facilities with kitchen <sup>21</sup>
<b>Specific investment costs</b>	
Specific investment costs of 17 USD per m <sup>2</sup> of floor area (500 UAH/m <sup>2</sup> ) including installation works	Specific investment costs of 2-4,000 USD per unit
Valves and temperature sensors: 4 valves per building; Cost \$20 sensor+\$75 Valve + Installation	Variable Speed Drives with controllers and pressure Sensors: Cost estimate \$1500 per unit in Schools
Controllers and outdoor temperature sensor: 1 controller per building; Cost \$20 sensor+ \$100 Controller + Installation	AHU controllers: Costing is for Implementing of ECM when not included in previous; Cost estimate \$350 per controller + installation
Radiator Thermostatically Control Valve: Radiators are installed on the perimeter of the buildings. one radiator for each 30 m <sup>2</sup> of building space: Cost \$7.5 Thermostatic Control Valve + installation	Retrofit outside air ventilation system with heat recovery: Cost for 2 coils @\$400 each+\$100 for piping+ \$200 cost small pump + installation
Reconstruction of internal heating system + Replacing all radiators + Pipe insulation in the basement and other unheated spaces + Balancing of heating system: 12-13 USD/m <sup>2</sup>	
<b>Expected benefits of ECM - Saving effect</b>	
100% reduction of internal heat losses 12% reduction of losses at site compared to the baseline Balanced room temperatures	Improved room climate Comfortable air humidity level Pre-heating of some rooms with recovered heat
<b>Profitability</b>	
Average specific energy savings of 1.25 kWh per USD investment Simple payback time 17 years	Very little energy saving because of the power consumption of fans No profitability, but a requirement for room condition

<sup>21</sup> With the reactivation and repair of the ventilation system a part of the energy of the aspirated air can be recovered by a heat exchanger. Since it is not planned to install new ventilation ducts to the class rooms one possibility is to use the recovered heat in the kitchen. The simplest solution for the heating by the ventilation system shall be identified in the frame of the energy audit analysis.

### **Other energy saving measures**

Certainly there are additional opportunities for energy saving or heating strategies comprising renewable energy (such as application of solar collectors or heat pumps).

For the ESCO business model only the simplest, easy and most profitable ECM shall be considered to generate quick energy cost savings with low technology performance or operation risks.

According to recommendations by representatives of the City Administration – Department of Education and Ternopil ESCO electric energy saving measures shall not be focus for the ESCO business due to following reasons:

- Electricity consumption makes amounts in average only to approx. 9% of the overall energy consumption of the facility.
- Due to unpredictable use of electric devices and lighting the ESCO has limited access and control to achieve EE targets.
- The annual time of use is low, while specific equipment costs are high, which reduces the profitability of replacement of electric devices.
- The determination of electric energy savings will require the metering of consumption at the related device for which additional expenses of meters and regular meter reading must be considered.
- It is expected, that lighting will be gradually renewed over the next years with efficient CFL or T8 fluorescent tube or even LED by individual parents donation or in the frame of repairs financed by the building operator (school/ kindergarten or City Administration).
- It is expected that other small electric devices and kitchen equipment will be gradually renewed over the next years by individual parents donation or governmental or international support programs or in the frame of repairs financed by the building operator (school/ kindergarten or City Administration).

For some facilities the use of renewable energies might be applicable, which needs to be analysis during the detailed energy audit.

- For buildings with individual gas fired boilers the fuel switch to biomass - with boiler replacement - might be an option, which seems economic due to the fuel price difference between gas and biomass. Certainly the ECM of a boiler replacement should be done after or in connection with thermal modernization of the building envelop and adjustment of the heating capacity.
- For facilities with a considerable demand of low temperature heat or DHW , such as large kindergartens or facilities with indoor pool - the application of solar collectors might be appropriate. Again, during the energy audit analysis this ECM will be determined.

## Annex 6 - Project profile of the prioritized facility for the Kick-off of the ESCO model

General information on the object			
Object	Kindergarten # 13	Contact:	Director
Address:	Ternopil, вул. Юності, 1	e-mail:	Phone
Year of construction	1954	Number of users:	279 children, Approx. 30 staff
Legal form:	... individual legal entity ...	Annual time of use/occupancy:	12 months, Monday-Friday, 2,400 hours/year
Building envelop and current conditions			
Total area	1,731 m <sup>2</sup>	Heated area:	1,251 m <sup>2</sup>
Area of windows (estimate)	375 m <sup>2</sup> , 50% changed over last decade	Area of outside doors:	12 m <sup>2</sup>
Area of outside walls:	626 m <sup>2</sup> , 60 cm bricks	Type and area of roof:	flat roof, ceiling/ attic area 626 m <sup>2</sup>
Area of heated ground floor	626 m <sup>2</sup> = ceiling to basement	Number of floors	2
Energy consumption and cost baseline (last 3 years average)			
Heat supply:	District heat, supplied by TE, metered	Annual space heat energy consumption	310,000 kWh/year, overheated! Calculated demand 300,000 kWh/yr
Domestic hot water	With individual gas boiler	Annual DHW energy consumption	53,000 kWh/year
Electricity supply:	JSC "Ternopiloblenergo", metered	Annual electricity consumption	18,000 kWh/year
Specific heat consumption	Real: 271 kWh/m <sup>2</sup> Calculated: 238 kWh/m <sup>2</sup>	Specific power consumption	15 kWh/m <sup>2</sup>
Energy costs in 2016	Heat: 396,000 UAH Gas: 50,000 UAH	Power: 35,000 UAH	Total: 482,000 UAH
Recommended Energy Conservation Measures (ECM)			
Building envelop - Component A		Heating system - Component B	
✓ Wall insulation, 150 mm		✓ Retrofit of Heat distribution system	
✓ Windows replacement, old windows		✓ Reactivation of ventilation system with heat recovery	
✓ Outside doors replacement			
✓ Floor ceiling insulation, 100 mm			
✓ Roof ceiling insulation, 150 mm			
Investment costs: Incl. 10% contingencies	2,975,000 UAH 110,100 USD	Specific costs per m <sup>2</sup> :	2,375 UAH/m <sup>2</sup> 88 USD/m <sup>2</sup> ,
Project results			
Heat energy savings	231,000 kWh/year	Energy saving compared to baseline	77 %, heat energy
Specific annual savings per investment	2,1 kWh per year per USD investment	80 kWh per year per '000 UAH investment/	15-years NPV: ... UAH 20-years NPV: .... UAH
Energy cost savings	At least 318,000 UAH in the 1 <sup>st</sup> year after EE	Specific cost savings for 1 <sup>st</sup> year: 0.11 UAH saving per UAH investment	Simple payback time: 9 years
Economic benefits	Sustainable, long-lasting Energy costs savings Extension of the lifetime of the building	Comfort and environmental benefits	improvement the indoor temperature at norm level, Reduction of CO <sub>2</sub> emissions for heat generation

General information on the object			
<b>Object</b>	<b>School #2</b>	Contact:	Director
Address:	Ternopil, вул. Новий Світ, 11	e-mail:	Phone
Year of construction	1954	Number of users:	632 pupils, Approx. 60 staff
Legal form:	... individual legal entity ...	Annual time of use/occupancy:	9 months, Monday-Friday, 1,800 hours/year
Building envelop and current conditions			
Total area	3,256 m <sup>2</sup>	Heated area:	3034 m <sup>2</sup>
Area of windows (estimate)	910 m <sup>2</sup> , 90% changed over last decade	Area of outside doors:	29 m <sup>2</sup>
Area of outside walls:	1,517 m <sup>2</sup> , 64 cm bricks	Type and area of roof:	Sloped roof, ceiling/attic area 1,517 m <sup>2</sup>
Area of heated ground floor	1,517 m <sup>2</sup> = ceiling to basement	Number of floors	2
Energy consumption and cost baseline (last 3 years average)			
Heat supply:	District heat, supplied by TE, metered	Annual space heat energy consumption	601,000 kWh/year, overheated! Calculated demand 530,000 kWh/yr
Electricity supply:	JSC "Ternopiloblenergo", metered	Annual electricity consumption	21,000 kWh/year
Specific heat consumption	Real: 198 kWh/m <sup>2</sup> Calculated: 186 kWh/m <sup>2</sup>	Specific power consumption	7 kWh/m <sup>2</sup>
Energy costs in 2016	Heat: 718,000 UAH	Power: 40,000 UAH	Total: 833,000 UAH
Recommended Energy Conservation Measures (ECM)			
Building envelop - Component A		Heating system - Component B	
✓ Wall insulation, 150 mm		✓ Retrofit of Heat distribution system	
✓ Windows replacement, old windows		✓ Reactivation of ventilation system with heat recovery	
✓ Outside doors replacement			
✓ Floor ceiling insulation, 100 mm			
✓ Roof ceiling insulation, 150 mm			
Investment costs: Incl. 10% contingencies	6,024,000 UAH 223,100 USD	Specific costs per m <sup>2</sup> :	2,000 UAH/m <sup>2</sup> 74 USD/m <sup>2</sup> ,
Project results			
Heat energy savings	404,000 kWh/year	Energy saving compared to baseline	69 %, heat energy
Specific annual savings per investment	1.81 kWh per year per USD investment	70 kWh per year per '000 UAH investment/	15-years NPV: ... UAH 20-years NPV: .... UAH
Energy cost savings	At least 564,000 UAH in the 1 <sup>st</sup> year after EE	Specific cost savings for 1 <sup>st</sup> year: 0.11 UAH saving per UAH investment	Simple payback time: 11 years
Economic benefits	Sustainable, long-lasting Energy costs savings Extension of the lifetime of the building	Comfort and environmental benefits	improvement the indoor temperature at norm level, Reduction of CO <sub>2</sub> emissions for heat generation

General information on the object			
Object	Ukrainian gymnasium	Contact:	Director
Address:	Ternopil, вул. Коперніка, 14	e-mail:	Phone
Year of construction	1910	Number of users:	659 pupils, Approx. 60 staff
Legal form:	... individual legal entity ...	Annual time of use/occupancy:	9 months, Monday-Friday, 1,800 hours/year
Building envelop and current conditions			
Total area	3.495 m <sup>2</sup>	Heated area:	3,188 m <sup>2</sup>
Area of windows (estimate)	956 m <sup>2</sup> , 90% changed over last decade	Area of outside doors:	30 m <sup>2</sup>
Area of outside walls:	1,594 m <sup>2</sup> , 80 cm bricks	Type and area of roof:	Sloped roof, ceiling/attic area 1,063 m <sup>2</sup>
Area of heated ground floor	1,063 m <sup>2</sup> = ceiling to basement	Number of floors	3
Energy consumption and cost baseline (last 3 years average)			
Heat supply:	District heat, supplied by TE, metered	Annual space heat energy consumption	545,000 kWh/year, overheated! Calculated demand 440,000 kWh/yr
Electricity supply:	JSC "Ternopiloblenergo", metered	Annual electricity consumption	22,000 kWh/year
Specific heat consumption	Real: 171 kWh/m <sup>2</sup> Calculated: 154 kWh/m <sup>2</sup>	Specific power consumption	7 kWh/m <sup>2</sup>
Energy costs in 2016	Heat: 718,000 UAH	Power: 43,000 UAH	Total: 761,000 UAH
Recommended Energy Conservation Measures (ECM)			
Building envelop - Component A		Heating system - Component B	
✓ Wall insulation, 150 mm		✓ Retrofit of Heat distribution system	
✓ Windows replacement, old windows		✓ Reactivation of ventilation system with heat recovery	
✓ Outside doors replacement			
✓ Floor ceiling insulation, 100 mm			
✓ Roof ceiling insulation, 150 mm			
Investment costs: Incl. 10% contingencies	5,445,000 UAH 201,677 USD	Specific costs per m <sup>2</sup> :	1,700 UAH/m <sup>2</sup> 63 USD/m <sup>2</sup> ,
Project results			
Heat energy savings	337,000 kWh/year	Energy saving compared to baseline	69 %, heat energy
Specific annual savings per investment	1.67 kWh per year per USD investment	60 kWh per year per '000 UAH investment/	15-years NPV: ... UAH 20-years NPV: .... UAH
Energy cost savings	At least 502,000 UAH in the 1 <sup>st</sup> year after EE	Specific cost savings for 1 <sup>st</sup> year: 0.09 UAH saving per UAH investment	Simple payback time: 11 years
Economic benefits	Sustainable, long-lasting Energy costs savings Extension of the lifetime of the building	Comfort and environmental benefits	improvement the indoor temperature at norm level, Reduction of CO <sub>2</sub> emissions for heat generation

## **Annex 7 International Performance Measurement and Verification protocol - Details of IPMVP Options**

### **INTRODUCTION**

The savings that result from Energy Efficiency (EE) projects cannot be directly measured, as they represent the absence of energy consumption that would have otherwise occurred. It is indeed impossible to measure something that by definition does not exist! As the common knowledge of “What can not be measured can not be managed” can not be truer than in the context of energy efficiency initiatives, there is an important need to “measure and verify” savings generated by a project. Without such Measurement and Verification (M&V):

- one will not be able to properly value the results of an action or investment in energy efficiency (and therefore not inviting recognition, duplication, continuous investments, etc)
- energy reductions achieved through the initiative/project will degrade in part or in totality over time

### **Measurement and Verification definition**

“M&V is the process of using measurement to reliably determine actual saving<sup>22</sup> created within an individual facility by an energy management, energy conservation or energy efficiency project or program. As savings cannot be directly measured, they can be determined by comparing measured use before and after implementation of a project, making appropriate adjustments for changes in conditions.

M&V techniques can be used by facility owners or energy efficiency project investors in order to mitigate the different risks after project completion. Indeed, EE practionners are using M&V for the following purposes:

- Increase energy savings

Accurate determination of energy savings gives facility owners and managers valuable feedback on their energy conservation measures (ECMs). This feedback helps them adjust ECM design or operations to improve savings, achieve greater persistence of savings over time, and lower variations in savings.

- Document financial transactions

For some projects, the energy efficiency savings are the basis for performance-based financial payments and/or a guarantee in a performance contract. A well-defined and implemented M&V Plan can be the basis for documenting performance in a transparent manner and be subjected to independent verification.

- Enhance financing for efficiency projects

A good M&V Plan increases the transparency and credibility of reports on the outcome of efficiency investments. It also increases the credibility of projections for the outcome of efficiency investments. This credibility can increase the confidence that investors and sponsors have in energy efficiency projects, enhancing their chances of being financed.

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<sup>22</sup> The reduction in *energy* use or cost. Physical savings may be expressed as *avoided energy use* or *normalized savings* (IPMVP Chapter 4.6.1 and 4.6.2, respectively). Monetary savings may be expressed analogously as “cost avoidance” or “normalized cost savings” (IPMVP Chapter 8.1). Savings, as used in IPMVP, are not the simple difference between baseline and reporting period utility bills or metered quantities.



- Improve engineering design and facility operations and maintenance

The preparation of a high-quality M&V Plan encourages comprehensive project design by including all M&V costs in the project's economics. High-quality M&V also helps managers discover and reduce maintenance and operating problems, so they can run facilities more effectively. High-quality M&V also provides feedback for future project designs.

- Manage energy budgets

Even where savings are not planned, M&V techniques help managers evaluate and manage energy usage to account for variances from budgets. M&V techniques are used to adjust for changing facility-operating conditions in order to set proper budgets and account for budget variances.

- Enhance the value of emission-reduction credits

Accounting for emission reductions provides additional value to efficiency projects. Use of an M&V Plan for determining energy savings improves emissions-reduction reports compared to reports with no M&V Plan.

- Support evaluation of regional efficiency programs

Utility or government programs for managing the usage of an energy supply system can use M&V techniques to evaluate the savings at selected energy user facilities. Using statistical techniques and other assumptions, the savings determined by M&V activities at selected individual facilities can help predict savings at unmeasured sites in order to report the performance of the entire program.

Increase public understanding of energy management as a public policy tool

By improving the credibility of energy management projects, M&V increases public acceptance of the related emission reduction. Such public acceptance encourages investment in energy-efficiency projects or the emission credits they may create. By enhancing savings, best-practice M&V highlights the public benefits provided by good energy management, such as improved community health, reduced environmental degradation, and increased employment.

### **Measurement and Verification, by WHOM?**

As M&V is now well recognized as one of the fundamental tools for the success of EE projects and programs, an emerging question is who should develop and implement an M&V protocol for a specific project. As should be noted, any of the parties involved in a project can design and implement an M&V protocol as long as it follows and implements IPMVP's recognized best practice concepts. In the specific case of a performance contracting project, the beneficiary of a project (the client), the project implementer (the ESCO), a combination of both of these parties, or a third party, are all proper and acceptable alternatives to implement and maintain the M&V protocol.

### **IPMVP, the principles**

M&V is a science that adheres to the following fundamental principles (presented in alphabetical order):

Accurate: M&V reports should be as accurate as the M&V budget will allow. M&V costs should normally be small relative to the monetary value of the savings being evaluated. M&V expenditures should also be consistent with the financial implications of over- or under-reporting of a project's performance. Accuracy tradeoffs should be accompanied by increased conservativeness in any estimates and judgments.



**Complete:** The reporting of energy savings should consider all effects of a project. M&V activities should use measurements to quantify the significant effects, while estimating all others.

**Conservative:** Where judgments are made about uncertain quantities, M&V procedures should be designed to under-estimate savings.

**Consistent:** The reporting of a project's energy effectiveness should be consistent between:

- different types of energy efficiency projects;
- different energy management professionals for any one project;
- different periods of time for the same project; and
- Energy Efficiency projects and new energy supply projects.

‘Consistent’ does not mean ‘identical,’ since it is recognized that any empirically derived report involves judgments which may not be made identically by all reporters. By identifying key areas of judgment, IPMVP helps to avoid inconsistencies arising from lack of consideration of important dimensions.

**Relevant:** The determination of savings should measure the performance parameters of concern, or least well known, while other less critical or predictable parameters may be estimated.

**Transparent:** All M&V activities should be clearly and fully disclosed. Full disclosure should include presentation of all of the elements defined in Chapters 5 and 6 for the contents of an M&V Plan and a savings report, respectively.

The balance of these principles enables an M&V expert to present a flexible framework of basic procedures for achieving M&V for EE projects.

Based on these principles, the most popular M&V protocol, the International Performance Measurement and Verification protocol (IPMVP) has developed four different acceptable approaches (called options) that are all using the following fundamental formula:

$$\text{Savings} = (\text{Baseline Energy} - \text{Reporting-Period Energy}) \\ \pm \text{Routine Adjustments} \pm \text{Non-Routine Adjustments}$$

#### **IPMVP, the different options**

IPMVP provides four Options for determining savings (A, B, C and D). The choice among the Options involves many considerations including the location of the measurement boundary (IPMVP Chapter 4.4). If it is decided to determine savings at the facility level, Option C or D may be favored. However if only the performance of the ECM itself is of concern, a retrofit-isolation technique may be more suitable (Option A, B or D).

OPTION A:	Stipulated consumption and measured capacity (Partially measured retrofit isolation)
Definition:	Option A is used for simple measures where the hours of operation are considered constant, or where an ESCO does not want to guarantee variation in operating hours that are under the control of customers. It is also used where the customer agrees with a simplified approach to reduce M&V cost. Only the power reduction is measured in Option A.
M&V Option applicable to:	Individual systems or equipment. One or several equipment's can be measured to obtain an average (sample size)
Duration of measurement:	Can be a one-time measurement or repeated at regular interval (months, year).
Typical applications:	<ol style="list-style-type: none"> <li>1. Short term guaranteed savings.</li> <li>2. Often used for simple measures (light replacement, etc.) where hours of operation are easily estimated.</li> </ol>
How savings can be calculated:	The savings are calculated by measuring the power of specific equipment before and after energy efficiency (EE) implementation. The hours of operation are estimated (agreed by contract for ESCO contract). The total energy consumption is calculated mathematically.
Advantage:	Low cost.
Disadvantage:	<ol style="list-style-type: none"> <li>1. Low accuracy.</li> <li>2. High uncertainties.</li> </ol>
The resulting savings can be affected by:	<ol style="list-style-type: none"> <li>1. Variation of equipment efficiency.</li> <li>2. Bad or non-functioning equipment.</li> </ol>
% of construction cost:	1-5%.
Accuracy:	± 20%.

OPTION B:	Measured capacity and consumption (Retrofit isolation)
Definition:	It is a measured demand and consumption approach. The demand and hours of operation are measured before implementation, and the demand and consumption are also measured after implementation.
M&V Option applicable to:	Individual systems or equipment. One or several equipments can be measured to obtain an average (sample size).
Duration of measurement:	Could be applied for short-term comparison (1 hour, 1 week, 1 month) or for long term (continuous with monthly evaluation of savings).
Typical applications:	<ol style="list-style-type: none"> <li>1. Long term guaranteed and shared savings.</li> <li>2. Remuneration based on savings.</li> <li>3. Applicable when the power varies (e.g. motors load variation in a variable speed system).</li> </ol>
How savings can be calculated:	Savings are calculated by comparing energy consumption of a given period (base year or reference period) before and after EE project implementation.
Advantage:	Results are more accurate than in option A because they consider: <ol style="list-style-type: none"> <li>1. Real hours of operation.</li> <li>2. Variation of demand.</li> </ol>
Disadvantage:	More difficult and more expensive than option A because it requires more equipment: kW meter, hour's meters or kWh loggers.
% of construction cost:	3-10%.
Accuracy:	± 10-20%.

<b>OPTION C:</b>	<b>Continuous measurement through the building (Whole Facility)</b>
Definition:	This approach is appropriate when all parameters are available before and after project implementation. This approach is also appropriate for large scale projects, projects with many ECMs, ECMs with savings interactions, and ECMs were energy savings >10% of facility total energy bill. Billing and adjustment factors are continually gathered for the baseline period and after implementation.
M&V Option applicable to:	Whole building/plant approach using utility meter data (billing follow-up).
Duration of measurement:	Long term (continuous with monthly or annually evaluation of savings).
Typical applications:	<ol style="list-style-type: none"> <li>1. Shared savings and where remuneration is based on savings.</li> <li>2. Appropriate for large-scale projects.</li> <li>3. Appropriate to calculate the cumulative impact of projects in which components cannot be isolated.</li> <li>4. If individual measure saving evaluation is not required.</li> <li>5. Often the only approach to measure soft savings (training, awareness).</li> </ol>
How savings can be calculated:	Savings are calculated by comparing energy consumption of a given period (base year or reference period) before and after EE project implementation.
Advantage:	Option C takes into account: <ol style="list-style-type: none"> <li>1. The entire installation.</li> <li>2. The interactive effects between EE measures.</li> </ol>
Disadvantage:	<ol style="list-style-type: none"> <li>1. More expensive than option A or B.</li> <li>2. Require monthly calculation.</li> </ol>
% of construction cost:	5-15%
Accuracy:	± 5-10% (annual), ± 20% (monthly)

<b>OPTION D:</b>	<b>Computerized building/process energy simulation (Calibrated Simulation)</b>
Definition:	This Option uses a calibrated simulation approach to calculate the savings on a computer model. The project is simulated before and after the EE implementations.
M&V Option applicable to:	It is applicable for whole building or plant or for the only system where an ECM is implemented.
Typical applications:	<ol style="list-style-type: none"> <li>1. This approach is appropriate for certain large scale and complex projects.</li> <li>2. It is also appropriate for new construction, when the baseline cannot be measured.</li> <li>3. When energy savings for each measure are required.</li> <li>4. When option C is too expensive or difficult to apply because adjustment factors are non linear or there is too many changes to allow tracking</li> </ol>
How savings can be calculated:	Savings are determined by the energy use simulation, before and after the measures implementation.
Advantage:	<ol style="list-style-type: none"> <li>1. Does not require field survey.</li> <li>2. Including interactive effects of individual EE measures.</li> </ol>
Disadvantage:	<ol style="list-style-type: none"> <li>1. Expensive if a detailed analysis is required.</li> <li>2. Simulation skills needed</li> <li>3.</li> </ol>
% of construction cost:	3-10%
Accuracy:	± 10%

## Annex 8: Financial Assessment Charts

**Table 15: Financial flows with EERF – City financing only – in UAH**

	Year	2016	2017	2018	2019	2020	2025	2030	2035
<b>Funding Sources</b>									
City of Ternopil (excl. project preparation)		2,974,400	6,565,724	4,697,056	6,744,488	7,447,449	-	-	-
<b>Total</b>		<b>2,974,400</b>	<b>6,565,724</b>	<b>4,697,056</b>	<b>6,744,488</b>	<b>7,447,449</b>	<b>-</b>	<b>-</b>	<b>-</b>
Disbursements to projects/measures		-2,974,367	-6,565,711	-4,697,040	-6,744,461	-7,447,423	-7,455,535	-	-
Fund repayment		-	297,437	954,008	1,423,712	2,098,158	3,893,466	4,200,771	3,564,938
Cumulated repayments less EERF investments	33	297,483	1,251,506	2,675,245	4,773,428	4,008,614	8,572,165	14,754,112	

**Table 16: Project investment schedule – City financing only – in UAH**

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Kindergarten № 13	2,974,367	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
School № 2 (high)	-	6,565,711	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 38	-	-	4,697,040	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ukrainian gymnasium	-	-	-	6,744,461	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 31	-	-	-	-	7,447,423	-	-	-	-	-	-	-	-	-	-	-	-
technical liceum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 19	-	-	-	-	-	-	-	-	-	-	-	-	-	11,194,314	-	-	-
SCHOOL-KINDERGARTEN № 28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 10	-	-	-	-	-	-	-	6,101,936	-	-	-	-	-	-	-	-	-
Special general-education school	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCHOOL-KINDERGARTEN № 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCHOOL-KINDERGARTEN № 32	-	-	-	-	-	4,403,718	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SCHOOL-KINDERGARTEN № 35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Secondary school № 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,594,745
Secondary school № 7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Classical gymnasium(foreign lang)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
School № 12 "Йосифа Сліпного"	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
KINDERGARTEN № 34	-	-	-	-	-	-	-	-	-	7,455,535	-	-	-	-	-	-	-
KINDERGARTEN № 16	-	-	-	-	-	-	-	-	-	-	-	5,404,784	-	-	-	-	-

**Table 17: Financial projection of Ternopil ESCO – City financing only – in UAH unless otherwise indicated**

Year	2016	2017	2018	2019	2020	2025	2030	2035
<b>Revenues</b>								
Payment from Customers - Energy Savings	-	302,732	914,221	1,421,250	2,072,617	4,612,836	4,597,590	3,906,593
Other	208,208	459,601	328,794	472,114	521,321	-	-	-
<b>Total Revenues</b>	<b>208,208</b>	<b>762,332</b>	<b>1,243,015</b>	<b>1,893,364</b>	<b>2,593,939</b>	<b>4,612,836</b>	<b>4,597,590</b>	<b>3,906,593</b>
<b>Expenses</b>								
Outsourced Services	-118,975	-262,628	-187,882	-269,778	-297,897	-298,221	-	-
Staff costs	-74,225	-80,905	-86,730	-183,868	-194,900	-260,820	-174,518	-233,545
Office and supplies	-5,938	-6,472	-6,938	-14,709	-15,592	-20,866	-13,961	-18,684
Interest on Debt	-	-	-	-	-	-	-	-
Cost of Guarantee	-	-	-	-	-	-	-	-
Amortization	-	-297,437	-954,008	-1,423,712	-2,098,158	-3,893,466	-4,200,771	-3,564,938
<b>Total Expenses</b>	<b>-199,137</b>	<b>-647,443</b>	<b>-1,235,558</b>	<b>-1,892,068</b>	<b>-2,606,547</b>	<b>-4,473,373</b>	<b>-4,389,251</b>	<b>-3,817,166</b>
<b>Taxable Income</b>	<b>9,071</b>	<b>114,890</b>	<b>7,457</b>	<b>1,296</b>	<b>-12,608</b>	<b>139,463</b>	<b>208,339</b>	<b>89,427</b>
Income Tax	1,633	20,680	1,342	233	-	25,103	37,501	16,097
<b>Net After-tax Income (loss)</b>	<b>7,438</b>	<b>94,210</b>	<b>6,115</b>	<b>1,063</b>	<b>-12,608</b>	<b>114,359</b>	<b>170,838</b>	<b>73,330</b>
<b>in USD</b>	<b>275</b>	<b>3,489</b>	<b>226</b>	<b>39</b>	<b>-467</b>	<b>4,236</b>	<b>6,327</b>	<b>2,716</b>
<b>ESCO Cash Flow</b>								
ESCO Cash Flow from Operations	7,438	391,646	960,122	1,424,775	2,085,549	4,007,825	4,371,609	3,638,268
<b>Cash Flow from Investing</b>								
Project Investments	-2,974,367	-6,565,711	-4,697,040	-6,744,461	-7,447,423	-7,455,535	-	-
Other	-	-	-	-	-	-	-	-
<b>Subtotal</b>	<b>-2,974,367</b>	<b>-6,565,711</b>	<b>-4,697,040</b>	<b>-6,744,461</b>	<b>-7,447,423</b>	<b>-7,455,535</b>	<b>-</b>	<b>-</b>
<b>Cash Flow from Financing</b>								
Proceeds from Loans	2,974,367	6,565,711	4,697,040	6,744,461	7,447,423	7,455,535	-	-
Total repayments	-	-297,437	-954,008	-1,423,712	-2,098,158	-3,893,466	-4,200,771	-3,564,938
<b>Subtotal from financing</b>	<b>2,974,367</b>	<b>6,268,274</b>	<b>3,743,032</b>	<b>5,320,749</b>	<b>5,349,266</b>	<b>3,562,070</b>	<b>-4,200,771</b>	<b>-3,564,938</b>
<b>Increase / (Decrease) in Cash</b>	<b>7,438</b>	<b>94,210</b>	<b>6,115</b>	<b>1,063</b>	<b>-12,608</b>	<b>114,359</b>	<b>170,838</b>	<b>73,330</b>
Cumulative	7,438	101,647	107,762	108,825	96,217	-220,464	892,169	244,798
<b>Cumulative in USD</b>	<b>275</b>	<b>3,765</b>	<b>3,991</b>	<b>4,031</b>	<b>3,564</b>	<b>-8,165</b>	<b>33,043</b>	<b>9,067</b>
<b>Net Cash Flows on city funding</b>	<b>-2,966,930</b>	<b>-6,174,064</b>	<b>-3,736,918</b>	<b>-5,319,686</b>	<b>-5,361,874</b>	<b>4,007,825</b>	<b>4,371,609</b>	<b>3,638,268</b>