AZERBAIJAN AHEF116
WHITE PAPER
Description
Roadmap (strategic whitepaper) on the Development of District Heating in Azerbaijan until 2020
Roadmap developed for the national heating company Azeristiliktechizat
AHEF.116.AZ - the INOGATE Programme
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1. INTRODUCTION

1.1 Purpose of the White Paper
The aim of this White Paper is to provide assistance in development of District Heating (DH) in Azerbaijan. It shows clear and solid DH system route where all impediments could be avoided, stable heat and hot water supply is established, the old equipment replaced, rebuilt, or modified, and new technology implemented.

1.2 Addressing 2020 Targets
One of the main objectives of the White Paper is to provide the state owned national heating company Azeristiliktechizat with guidance and assistance in meeting 2020 Targets of a more economically sustainable DH system and growing demand for a higher comfort level of the local inhabitants as wealth increases.

Modern equipment will contribute to increase the energy efficiency further in the Azeri district heating systems, and new methodologies will contribute to prolong the technical lifetime, and thereby saving investments in the long term. The national district heating company is already working on these approaches.

The modernization speed and modernization direction will depend on the available money, the development of the energy prices, the national legislation, institutional structures, knowhow about international best practise, and long-term objectives for district heating as formulated in this White Paper.

Thus the White Paper also describe the recommended long term development targets beyond 2020 towards modern DH systems according to best practices developed in leading European cities.

For the Azeri a basic approach to district heating is to set the framework for a fruitful cooperation between the state, investors, operating companies, and apartment residents in order to achieve the vision of a reliable, efficient, competitive, and environmentally friendly district heating system.

One of the first proposed steps of an updated strategy is to implement a pilot project as a showcase of mature international district heating technology and best practice, including pre-insulated pipes, surveillance systems, sophisticated controls, and control by the customers and heat meters. It can work as reference for further approaches in the district heating sector in order to meet the 2020 Targets.
2. UNDERSTANDING THE ENERGY AGENDA

2.1 The International Agenda

Half the world's population now lives in urban areas, and the proportion will continue to grow in the future. Development of urban sustainability is one of the biggest challenges of our time and a top item on the international agenda.

The rapidly growing cities are at the forefront of global socio-economic change, but are facing challenges such as inefficient utilization of resources, air pollution and waste accumulation. At the same time, the urban population has increasing demands for improved living conditions and comfort, including requirements for good and stable heat supply for space heating and production of hot tap water.

In order to solve these challenges, increasing attention is directed to the potential of district heating as the ‘hidden backbone’ for urban environment, economic development, energy security and comfort. This applies particularly to cities with sufficiently cold winters. Thus, district heating is on the international agenda due to:

- District heating can be environmentally friendly when well-managed
- District heating can guarantee stable and reliable heat source and hot water supply for residential, public and commercial buildings. People will benefit the most from such comfort level
- District heating can improve energy security. Its higher potential efficiency means that less energy is needed. It tends to use local sources or sources that would be wasted otherwise.

However, to maximize the benefits of district heating, attraction of massive investments and a secure customer base are required. That means government challenges to implement an effective policy for ensuring the maximum output of developing district heating.

2.2 Azerbaijan

Securing a reliable and affordable heat supply for the population is a widely recognized issue in Azerbaijan, as it is in many other countries around the world. District heating plays an important role in addressing this in Azerbaijan, especially in Baku - the fast growing capital and largest city of Azerbaijan.

In some parts of Azerbaijan, the existing district heating infrastructure is old and outdated and does not provide a stable heat and hot water supply to consumers. Increased growth of urban areas cities has seen additional strain being placed on the existing heating infrastructure as demand for heat and hot tap water increases.

The Azerbaijani government intends to continue the present modernization process. Activities are dedicated to the improvement of heat supply in Azerbaijan as the continuation of measures taken during previous years. In recent years, there have been the state programs and development concepts, which identified specific measures in heating systems maintenance, restoration and development: State Program on socio-economic development, "City of Baku and its settlements in 2014-2016, was approved on 17th January 2014, "the State Program on socio-economic development of regions between 2014-2018", approved 27th February 2014, "Azerbaijan 2020: Vision for the Future" Development concept was approved in 29th December 2012.

In addition, the Azerbaijani government intends to develop renewable energy considerably, in particular solar and wind energy. Integration of renewable energy may have significant impact on the heat supply sector to be more environmentally friendly.
3. THE ROLE OF DISTRICT HEATING AS PART OF THE ENERGY AGENDA

3.1 The International Stage
District heating systems provide large buildings, industry and dwellings with heat and hot water from central heat sources. As a result there are numerous advantages generated for the consumer and the cities where such networks are installed, when compared to individual heat only boiler supply systems.

Recognition of the benefits of District Heating is growing internationally with increased cases of system installation throughout Europe. Additionally, under the EU Energy Efficiency Directive, assessments are currently underway to determine the potential for installation of further networks throughout the EU28.

The main benefits of well-planned and well-operated District Heating can be identified as follows:

**Lower Energy Cost**: Due to centralised heat generation, heat can be produced at a lower cost by utilising efficient plant or waste heat sources. Thus, district heating can contribute to the goal of reducing fuel poverty.

**Instantaneous hot water generation**: A variety of domestic hot water technologies for district heating are available, including instantaneous hot water generation units: Hot tap water can be generated by efficient heat substations at each building, or by small compact so-called flat stations placed in each flat (similar to instantaneous gas fired or electric water heaters), equipped with modern electronically controller that contributes to improve efficiency and comfort and eliminate the risk of bacteria ( legionella) growth.

**Increased Energy Efficiency**: Connection to modern district heating systems provides substantial energy savings for consumers and Cities when compared to alternatives, as the user pays only for the heat that is actually used. This is a result of the fact that no hot water is generated which is not used, which saves energy for the consumer and City.

**Increased Security of Supply and Supply Flexibility**: Numerous energy sources can connect and supply heat to a district heating network including biomass, geothermal heat, energy from waste, solar systems, heat pumps, waste heat from industrial processes, in addition to conventional boilers and cogeneration. This allows numerous alternative fuel sources to supply a district heating network, should one heat supply source be interrupted.

These benefits clearly outline the motivation for operating, maintaining, investing and improving district heating networks to facilitate the development of cities in a sustainable and energy efficient manner.

**Lower Carbon Footprint**: District heating can supply heat independent of fossil fuels to homes and industry, meaning significantly lower carbon footprint than conventional gas driven heat supply system. By utilising surplus heat, from renewable energy sources and Combined Heat and Power (CHP) technology, district heating can improve the efficiency of resource utilisation for a city, thus lowering a city’s carbon footprint.

**Reliability**: District heating systems are built with stand-by heating capacity or in connection to numerous heat sources to ensure that heat is always available. This means high heat supply reliability.
**Increased comfort**: Modern district heating provides even heating that is always on and is easily controlled, particularly when compared to older heating systems. This ensures domestic dwellings are always comfortable.

**Reduced Investment for the Individual**: Connection to a district heating network means there is no need for building owners to invest in individual building boilers, to maintain boilers, or invest in and maintain a chimney.

### 3.2 Azerbaijan

Through the presidential decree on “Improvement of the Management in the district heating sector in the Republic of Azerbaijan” in 2005 the state company Azeristiliktechizat was founded as the national operator of heat supply systems of Azerbaijan. The purpose of the governmental initiative was to improve heat supply which was practically destructed in the first national reform period after the independence in 1991. The company is formed as a state-owned open joint stock company, and refers to the Cabinet of Ministers.

The strategy that the national district heating operator Azeristiliktechizat still is using, is the "Strategy of Heating Supply of the Republic of Azerbaijan", which originally was developed by USAID as a recommendation within the project "Provision of technical assistance to the energy sector of Azerbaijan" in September 2004. However, it is not an official document and was not approved as an official strategy for the district heating sector in Azerbaijan.

The strategy includes to abandon large outdated centralized systems from the Soviet era and to establish smaller boilers in individual urban quarters. These smaller boilers are equipped with modern units with high automation to increase their efficiency and to decrease the need for permanent presence of working staff. The capacity of the new boiler houses depends on the construction planned for the area and the amount of currently connected buildings; however these smaller boilers will not normally supply heat to more than 10-15 apartment blocks.

According to Azeristiliktechizat, the structure in the heating season 2015/16 is: 335 Baku boilers are supplying heat to 3,035 residential apartment buildings, 184 schools, 123 kindergartens, 102 health facilities and 460 other objects. By regions respectively there are the following numbers: 191, 415, 103, 38, 55, and 93.

This network configuration helps to minimize heat distribution losses, and if there is a leakage of water, the problem is easy to identify and eliminate. Additionally, Azeristiliktechizat prefers individual quarter heat supply systems with its present conditions, as the company faces difficulties in effectively expanding its district heating network by constructing heating mains under the new streets, avenues and private plots. However, Azeristiliktechizat does not in general support proposals for significant decentralization into patchy (spot) heating.

The 2004 DH strategy is still in force, despite many changes have taken place in the last decade in the operating environment of the district heating business. Changes are also expected to continue in the future in the heating market.

The strategy is recommended to be recognized officially as a fait accompli and the basis for further state initiatives within the overall national strategy for development and modernization of the national infrastructures in accordance with the targets envisaged in the Concept "Azerbaijan 2020: Vision for the Future", approved by the Decree of the President of the Republic of Azerbaijan dated 29.12.2012:

"During the period covered by the concept, comprehensive reforms will be carried out in the housing sphere, the access of the country’s population to enhanced water supply services and sewer system will be improved, cities and villages will be provided with purifying installations and"
the system of monitoring in this sphere will be improved. A new heating system will be installed, the zone of heating supplies will be expanded, new heating sources will be built and economically ineffective boiler houses will be closed."

The new agenda and challenge for district heating business is to be ‘greener’, as the alternative and renewable energy sector has received increased attention in Azerbaijan. With the adoption in 2013 of the plan "National Strategy for the Development of Alternative and Renewable Energy Sources in 2012-2020" the Azerbaijani government has made renewables a priority, in particular solar and wind energy. The objectives are to accelerate the deployment of renewables and attract private and foreign investment in the renewables sector through supportive policies and incentives.

With the development of fluctuating solar and wind energy the need for flexible energy consumption will rise. It may provide a unique opportunity for district heating in Azerbaijan to take advantage of periodic cheap surplus production of renewable energy by supplementing the existing gas boilers with new big heat pumps and heat storages.
4. **DISTRICT HEATING IN AZERBAIJAN – IDENTIFYING THE CHALLENGES**

In order to determine the most effective way forward, it is first necessary to determine the impact national and international trends have on the urban development in Azerbaijan in general and the heating supply and its customers in particular. The impact areas are divided into the following groups:

1. Heat Consumers
2. District Heating Networks

### 4.1 Heat Consumers

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| Maintenance of in-house heat systems has been downsized for years, and is in general in a bad shape. | DH system blamed for issues which can be addressed within consumer buildings, but also by low cost network solutions. | - Consumer piping systems need hydraulic balancing in order to operate properly  
- Consumer’s misconception as to why their radiators are cold: need for hydraulic balancing  
- Consumer side valves for regulation of space heating needed to address over-heating  
- Meters to be installed for consumption-based billing. |
| Some heat consumers are asking for reconnection to District Heating. | Restoration of proper consumer side system operation following reconnection requires sufficient competent, resources to be provided to facilitate this. | - Provide and train housing department staff to be competent in consumer side operation of DH systems  
- Provide knowledge about modern regulation equipment to housing department staff  
- Mutual agreements to be reached among the apartment owners in the respective buildings  
- Cooperation required between the housing department staff and the district heating company. |
| Many heat consumers are switching to electricity or natural gas. | - Only 8.8% of urban apartments receive hot tap water supply  
- District heating supply is available for only 64.8% of the urban apartments  
- 92.1% of housing stock is connected to natural gas. | Need to increase availability of district heating and hot tap water supply to consumers to provide an equivalent and competitive service to natural gas or electricity-based heat supply. |
Lack of functioning condominium corporations creates a barrier for Azeristiliktechizat to cooperate with the building or flat owners about proper heat supply services

District heating services suffer from the absence of condominium corporations, and it creates bad reputation amongst heat consumers.

- Need to create functioning condominiums or similar organizational structures that can ensure proper heat supply services
- Need to rebuild heat consumer confidence in district heating as the future heat supply system in urban areas.

## 4.2 Networks

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<tr>
<td>Restoration of district heating by the establishment of smaller boilers and networks in individual quarters of Baku which supply heat to no more than 10-15 apartment blocks</td>
<td>On one side Azeristiliktechizat does not support significant decentralization and on the other side Azeristiliktechizat meets barriers against increased centralization.</td>
<td>Need to identify the optimum solution for enhancing the efficiency of the future district heating system. Measures to realize this include better planning basis for the development of district heating and strengthened knowledge of modern best practice and technology</td>
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<td>Modern pre-insulated pipeline systems makes it easier to expand district heating and to establish larger networks</td>
<td>Difficult to get permission to expand district heating networks in urban areas due to ownership of land, traffic problems, and the presence of other pipelines and wires.</td>
<td>Adoption of international best management procedures that makes it easier to get permission to put new district heating pipelines in urban areas</td>
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## 4.3 Heat generation

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| Heat generation is provided exclusively through natural gas fueled heat-only boilers | Combustion of natural gas contributes to air pollution in local urban areas and to greenhouse gas emissions. Natural gas dependence links heat costs. | Need to utilise flexibility of district heating systems to use any heat source as a heat supplier:
- Combined heat and power plants need to be considered when replacing or installing new heat sources for the district heating network
- Alternative heat sources such as renewables and industrial waste heat need to be used for district heating supply where possible. |
5. **DISTRICT HEATING IN AZERBAIJAN ROADMAP – STRATEGIC ACTIONS**

In order to address the issues and challenges that district heating in Azerbaijan is facing, a coherent approach in the form of a District Heating Roadmap is proposed.

Economic growth, environmental protection and social progress are established as the three pillars of sustainable development:

![Sustainable development diagram]

In summary the proposed Roadmap involves the following groups of strategic actions:

1. **Development of the Political Framework for District Heating**
   - Implementation of government level policy on district heating (because Azeristiliktechizat was created to implement heat supply policy at the state level)
   - Heat Master Planning for all cities
   - Tariff reform process.

2. **Definition of the Desired Technical World-Class DH system**
   - Pilot projects as model for modernized district heating systems all over the country
   - Change from fixed to variable flow regime
   - Introduce modern building heat substations
   - Increasing the heat production efficiency
   - Decrease the heat distribution losses
   - Automation and computerization.

3. **Technical, Economic and institutional developments**
   - Priority Investments Programs
   - Institutional Strengthening Plan.

4. **Market and service developments**
   - Customer Relationship Management
   - Wholesale Competition
   - Increased market share of HTW supply coverage.

The strategic actions of the roadmap can also be illustrated by the figure below. The strategic actions are described further in the chapters below.
5.1 **Development of the Political Framework for District Heating**

The energy sector in Azerbaijan is predominantly state-owned. Thus, the state and the municipalities have a key role for the development of the Azerbaijani heat supply sector, and they may influence by a number of means. In the district heating sector, development of the political framework depends on defining clear, long-term political goals to reach economic, social and environmental sustainability.

Framework policies and energy planning processes allow national decision makers to proactively decide on what should be served by district heating, and how to provide this at least cost. When defining the framework, the benefits of district heating should be taken into account:

- District heating is not a fuel but a flexible system that can provide an opportunity to address strategic priorities and socio-economic and environmental objectives.
- District heating is in the long term a precondition for cost effective use of surplus heat and renewable energy on a large scale, thereby reducing fossil fuel combustion and greenhouse gas emissions and make more efficient use of resources.
- By using district heating the air pollution from fuel combustion can be concentrated at a few high chimneys, where it is efficient and affordable to reduce harmful flue gas emissions by using modern combustion techniques or highly efficient equipment for flue gas cleaning.
- The expertise to keep the heat supply system operating efficiently can be concentrated with a few experts in the district heating company. This can ensure high supply reliability and increased safety and comfort for the customers. At the same time Azerbaijan will benefit from the creation of jobs for specialists and technicians.

For maximum exploitation of these benefits, district heating should be the backbone of energy supply in densely populated areas.

5.1.1 **Review of national policies**

Review of the national policies includes review of the role of the state and state institutions as:

- Decision-maker of legislation, standards and norms
- Creator of political visions
- Investor and provider of subsidies
- Regulator of heat supply market.
A review also includes in deep analyses by experts in order to be able to address in an efficient way the barriers and problems that district heating faces:

- Quality of the heat and hot tap water services
- Actual technical problems
- Actual economic challenges.
- Environmental objectives to make district heating greener.

5.1.2 Well-balanced and integrated energy policy
Planning the development of district heating cannot be regarded as isolated investments and technology improvements without considering broader policies. The energy sectors - electricity, heat, gas, and oil - are undergoing reforms that are parallel with housing sector reforms. But reforms, liberalisation and subsidies in one sector inevitably have major impacts on the other sectors, for example, on district heating.

Therefore review of the coordinated national policy is recommended to ensure that political instruments and measures are well balanced to develop the long-term sustainability goals of the heat supply sector. In any reform, a combination of regulation, subsidies and marked forces are recommended as a means to reach the long-term political goal.

Thus, it is important to ensure that district heating in the reform process is integrated with the other parts of the energy sector and gets fair development conditions. With the national plan to support the development of in particular solar and wind energy, increasing fluctuating solar and wind energy in the power sector requires the development of flexible energy consumption. By means of heat pumps and heat storages, district heating systems – especially bigger district heating systems - have the opportunity to exploit periodic cheap surplus electricity production from solar cells and windmills, and thereby decrease to use of gas boilers.

Development of cogeneration (combined heat and power production) and exploitation of surplus heat from the industrial sector is also highly recommended to increase the energy efficiency and to decrease air pollution and greenhouse gas emissions.

5.1.3 Determination of common rules
Common rules and procedures on district heating development that addresses all key aspects and applying across the country is highly recommended. Overlapping and unclear rights and responsibilities of the district heating stakeholders may hamper both investments and optimal operation.

Therefore it is recommended to adopt a legislation that define and establish a comprehensive set of common rules inclusive rights and responsibilities for each party of district heating.

Common rules will - among others - determine the institutional responsibilities and competences (including supervisory) in the district heating sector in order to create full transparency for the district heating stakeholders, inclusive the customers and potential investors.

Azeristiliktechizat refers to Azerbaijan’s Cabinet of Ministers, and is dependent on financial support from the state, as the actual heat tariffs do not provide full cost recovery. It is recommended to start a process towards more economic independence from the state. For example, Azeristiliktechizat should have mandate to contract directly with construction contractors in order to realise investments plans adopted by the authorities.

It is also recommended to adopt a set of common, binding contractual guidelines on minimum aspects to be addressed by any contract that is concluded in the district heating business.
In case disputes between the district heating operator and consumers are not solved on a negotiated base, a legal system for investigation and resolution is recommended. International best practise shows that the general court system is not suitable for specific energy sector issues, so a special system is usually set up for such purposes. Thus an independent national board of appeal in accordance with international best practise is proposed to handle disputes arising from the contractual relationships, and to determine appeals about decisions made by the district heating operator or authorities.

5.1.4 Transitional arrangements due to shortages of condominium corporations
Modernization of the district heating system may include installation of modern heat substations at private premises, typically in the basements of privatized multi-storey, residential buildings.

But due to the current shortages of functioning condominium corporations, the national heating operator Azeristiliktechizat should in a transitional period have legal mandate to cooperate directly with the building or flat owners, inclusive legal allowance to install, own, operate and maintain new heat substations at private premises.

In case of failure to reach a negotiated solution with building owners about heat substations, piping and auxiliary equipment, the dispute would need to be subjected to proceedings at the proposed independent national board of appeal that will weigh the public interest in modernizing a district heating systems against the private interest to refuse a system modernization.

For the building owners heat supply problems often include malfunctioning radiators or imbalance in the in-house heat distribution system beyond the responsibility of Azeristiliktechizat. In case of non-functioning condominium corporations, in-house technical problems Azeristiliktechizat should have the mandate to register and report the problems to the customers and the authorities, and this work should be a separate cost item in the financial statements of Azeristiliktechizat.

5.1.5 Heat Master Planning for all cities
Heat master planning - inclusive assessment of district heating - is recommended to be compulsory in city planning. This includes statutory representation of Azeristiliktechizat in the city planning committees and strengthening and clarification of the city planning obligations.

Heat Master Planning is a recommended element of the roadmap because it creates the basis for a least-cost approach and the long term sustainability of the urban Azerbaijani heat supply sector. Heat planning is essential to realise the full potential of district heating, as district heating is often not beneficial, if it is only fragmentised into smaller areas and not included in a comprehensive urban development plan. Thus the benefits of heat planning includes:

- Balance of heat supply and demand in an optimal way
- Balance the interests of the stakeholders (the government, the heat supply company, heat consumers, the public)
- Help ensure that investments in developing district heating are optimized and justified.

Heat master planning focusses on capturing the benefits that district heating has to offer compared to other heat supply solutions. To ensure proper realisation of the heat master plans it is essential to have a political and legal framework that ensure fair conditions for district heating. By heat planning technical-economic analyses will clarify that district heating is not inherently the best option in all cases, but in some cases it will also be clarified that district heating should not be cut back because the evaluation procedures will identify a modern district heating system as the absolute best solution.
Steps in the Heat Master Planning Process
By heat master planning the city planning bodies can in cooperation with Ministry of Energy create the basis for optimal exploitation of available heat sources, inclusive surplus industrial heat, cogeneration and renewable energy.

Heat master planning is - among others - used to identify opportunities for new DH networks in a specific area, and to set out a long-term vision for DH development. The steps in the process are:

- Mapping energy demands, considering ownership and control of the demands
- Mapping energy supplies in the specific area, including all kinds of energy sources
- Mapping existing and planned district heating schemes
- Mapping possible new development in the specific area
- Identifying suitable locations for new heat production centres, and
- Identifying routes for potential district heating networks.

Once a heat master plan is developed, it will be clear where the heat sources and heat demand centres are located in the city. From the heat map it will be possible to set out initial proposals for developing district heating, inclusive new pipe routes and plant locations, as well as assessment of economic and environmental impacts of their implementation.

Heat master planning is a dynamic process and should be active and continuous from year to year for a City in coordination with other urban planning.

Heat Planning Use in Future Development of City
Heat master planning, and thereby planning of district heating, must be included early in the decision processes when modernizing urban areas.

A heat master plan should outline existing, planned, and proposed developments that may be of potential interest for future interconnection. This plan will therefore play a key role in the consideration of network development design, such as location of heat production centres and the capacity of pipes to interconnect with other heat loads.

Zoning in urban planning
The idea of zoning is to specify urban areas where district heating is economic or required by environmental considerations, or less densely-populated areas where gas or other heat sources offer the lowest cost. By zoning, geographic boundaries are established within which virtually all buildings must be connected to, in this case, the district heating system.

In accordance with the plans, legislation and rules shall ensure that district heating can expand in the urban zones through pipeline declarations and land acquisition.

Principle for master plan zoning of district heating and with time schedule for realisation
5.1.6 Tariff reform process

Azeristiliktechizat suffer from financial problems due to obvious low heat tariffs and has appealed to the government to increase the tariffs. In 2015/16 households pay 0.15 manat per square meter of living space per month. Non-residential customers (public organizations and private business entities) without meters pay 0.25 manat for 1 cubic meter heated volume. For comparison, the cost of heating of 1 square meter of residential apartments is around 5 times higher in comparable countries like Ukraine and Russia. However, unlike Russian and Ukrainian district heating companies, Azeristiliktechizat receives financial support from the state allocated to reconstruct and modernize the heat supply facilities. In Kazakhstan, where district heating companies also receive investment subsidies to supplement its own funds, the same household tariff is at least twice that at Azeristiliktechizat.

As a part of the national reform process, a tariff reform is recommended. As all energy sold in Azerbaijan is regulated by the Tariff Council, their involvement is required to pave the way for an adequate tariff reform. Furthermore, the overall political framework conditions are important; the recommended tariff reform will require a coordinated national policy to ensure both social protection of vulnerable groups and fair development conditions for district heating.

In the actual situation where Azeristiliktechizat prepares the shift to consumption-based billing, they – as well as the Tariff Council - should consider how to develop the most reasonable and adequate tariffs, also taking into account that the tariffs should not undermine the economy of the district heating company in the transition period.

Thus, social protection should not be provided through low tariffs. Social protection measures linked with heating and other housing communal services should be targeted at low income households and only those – in order to ensure that they can afford the cost of heat and other housing communal services. The present social safety net should be assessed in detail, whether it will be capable of compensating fully the additional costs that would stem from heat tariff increases.

The long-term objective is economic sustainability, defined as bringing the tariff towards full cost-recovery inclusive sufficient profitability that makes it possible for Azeristiliktechizat to continuously modernize the DH system in the future by own means. During a transitional period direct financial state aid may be required.

Competition from other heat sources, like gas or electricity, can have an impact on the district heating tariffs. It is recommended to ensure that there is both fair competition together with an effective regulation, taking various factors such as safety, environmental issues, health and social protection into account. For example, free heat source competition would not be fair to that part of the population, which due to limited means would not be able to exercise an investment choice.

A value-for-money strategy is proposed, which includes that an increase of the heat tariffs towards cost recovery can only follow after realization of significant improvement of the district heating services to the customers.

As the retail heat tariffs today are uniform for all district heating systems across the country, a tariff reform should include the possibility of setting differentiated retail tariffs that reflect the local costs for heat production and distribution.

In addition, the recommended reformed heat tariff structure should reflect that some costs – as administration, asset depreciation and fixed maintenance costs – are fixed annual costs, while
other costs, such as energy costs, are dependent on the heat consumption. Thus, the tariff structure should be divided into a fixed part, and a variable consumption-dependent part, the latter connected to readings of the heat meters. This will ensure stable company finances, specifically directed to warm winters, where the sale of heat is low.

The current heat tariffs are far from being cost-recovering. Although a priority investment program will imply high investment cost, the savings in operation and maintenance cost will contribute to keep the necessary tariff increases within a reasonable order of magnitude. Any other alternative without prioritised investments will require much higher tariff increases to achieve full cost-recovery.

5.2 Defining the Desired Technical World-Class DH System

The Desired Technical World Class District Heating System is recommended to be based on the solid Azerbaijani tradition of international cooperation.

The Clean Development Mechanism (CDM) in the framework of the Kyoto Protocol has been used in the power sector to support the implementation of modern equipment and technology. However, the price of carbon is today relatively low with a general pessimistic forecast, and is deemed insufficient to warrant a CDM project, especially taking into consideration the cost of project development. But there are still plenty of opportunities for cooperation with international organizations without the use of financing tools and respective procedures developed under the Kyoto Protocol.

The Desired Technical World Class District Heating System should be defined as the technical goal based on parameters such as the use of meters, automation and control, demand side management, supply side management, heat production diversity, energy efficiency and green energy sources.

The very first key step to define the desired technical system is to implement a pilot project as a showcase of mature international district heating technology and best practice, including pre-insulated pipes, surveillance systems, sophisticated controls, and control by the customers and heat meters. The pilot project will reveal the need for national reforms, new standards, investments etc., as it can work as reference for further approaches in the district heating sector as a whole.

The pilot project - as well as future feasible district heating projects - is expected to be based on international grants, and to be realized within the framework of the national district heating operator Azeristiliktechizat.

With the pilot project as a reference, any direction towards the Desired World Class DH System should be promoted through national energy policy and reforms and supported through investments. It includes review and revision of norms and standards that may act as barriers to the realization of the Desired World Class DH System.

In addition, it is necessary to develop technical expertise to facilitate the desired modern technology and methodologies. It is recommended to develop a strong research environment that can translate research into practical technical solutions adapted to the national context and where technicians can get training to ensure the optimal implementation, operation and maintenance of the required modern equipment.

Proposed elements of the Desired Technical World-Class DH System are shown in Appendix 1.
5.3  **Technical, economic and institutional developments**

5.3.1  **Priority Investment Programs**

District heating can use energy sources in an efficient, environmentally-friendly way to supply heat to customers. The challenge is that district heating requires massive investments, and therefore requires development of the institutional framework in order to minimize the investment risk, the cost of capital, and to strengthen the confidence of national or international investors.

The method to define and organize the necessary investments is described below as the priority investment programs:

Following the production of a heat master plan, a feasibility study is necessary to assess, in more detail, whether district heating or an alternative heat source -- such as natural gas -- should be selected to supply the area. The feasibility study may consider the specific requirements of individual connecting buildings, the phasing of the network, the route of the network. The proposed improvements can be divided into three groups:

- Short term urgent measures
- Medium term improvements until 2020
- Long term visions beyond 2020

The major effort will be to concentrate on identifying and evaluating available options and setting out a priority investment program. The program will include priority and time schedule of the proposed investments in the short and medium term, with the objective of creating the basis for the long-term visions. The long term technical vision is equal to the Desired Technical World-Class DH System. Pilot projects can provide an important method of testing new concepts prior to full-scale implementation.

The priority investment program based on a feasibility study will produce a robust conclusion on the economics and feasibility of the proposed network. It will provide all the technical information required to proceed with regulatory approval (i.e. hearing procedures, technical and environmental approvals and construction permits, etc. in accordance with national legislation) and proceed with the procurement process and implementation of the project.

For successful implementation the project and its strategic goals have to be accepted and supported by the stakeholders. Furthermore, the provision of financial means has to be agreed on by the relevant financing bodies. Attraction of international financial institutions is recommended in elaboration of feasibility studies and realisation of priority investment programs.

5.3.2  **Institutional Strengthening Plan**

The Institutional Strengthening Plan sets out Azeristiliktechizat’s strategic objectives for the next five years to 2020 and beyond with an accompanying budget for how much it is likely to cost.

It shall be emphasized that Azeristiliktechizat for years has been working on institutional strengthening and is today a well-operating company within the framework defined by the present regulations. Thus, the Institutional Strengthening Plan of the Roadmap is a continuation of the efforts that Azeristiliktechizat already are working on:

A. Provide Azeristiliktechizat’s customers (heat consumers) with services in the most efficient and sustainable manner.
B. Sustain a business where staff is motivated and skilled in system operation and customer relations.
C. Cooperate with government bodies and other service entities towards common goals.
D. Ensure that the business fulfils its responsibility in utilizing the energy efficiently and in an environmentally sound way.
E. Develop the business so that financial viability is strengthened.

The Institutional Strengthening Plan includes development of the institutional set-up and a financing strategy that sets out how the company improves the financial viability. The financial strategy is an integral part of deciding what opportunities and activities the company will pursue.

The Institutional Strengthening Plan is closely related to the Priority Investment Program to modernize the DH system. This plan shows investors that they can trust the company and its ability to ensure effective utilisation and return on investments.

An Institutional Strengthening Plan includes definition of the long-term objectives of the DH Company

For international financial institutions the present institutional set-up and financial situation of Azeristiliktechizat may imply considerable risks. Especially because the critical financial situation requires the development and implementation of debt restructuring plan to liquidate the accumulated deficit and to prevent future deficits by creating a solid financial basis.

Thus, it is, for international financial institutions, a precondition for investing in a project, that Azeristiliktechizat adopts an Institutional Strengthening Plan including institutional improvements and a financial strategy to help ensure sufficient security for the investment and maximum benefit from the investment in the long term.
5.4 Market and service developments

5.4.1 Customer Relationship Management
In the reform process policymakers and regulators as well as the district heating company should continue to prioritise the heat customer’s needs and the quality of all heat supply services.

Focus on the heat customer is a key political priority in order to ensure and develop the living conditions of the urban population in general. But customer satisfaction also has significant implications for the economic performance of Azeristiliktechizat. Customer satisfaction decreases frequency of complaints and has a positive impact on customer loyalty and willingness to pay the heat bill. Thus, an important side effect of realising the recommended priority investment programs with better performance and service will be a more satisfied and loyal customer base with higher overall willingness to pay.

Continued development of the Customer Relationship Management is recommended as an approach to managing Azeristiliktechizat’s interactions with current and future customers, the term demand-side management can also be used. The term customer relationship management signifies that the focus is on the interactions and relationship with customers.

5.4.2 Wholesale Competition
In general, competition will force district heating companies to minimise costs and prices which, in the end, will benefit everyone. The idea of wholesale competition is to use competition to lower the heat production costs. A competitive wholesale regime will include a framework regulation, which includes environmental and safety regulation.

The prerequisite for developing wholesale competition is that the district heating systems is centralised to greater operational units and are changed to a modern variable flow regime. The variable flow regime also gives higher flexibility through the ability to control, not only the temperature (as in the present fixed flow regime), but also the water flow with an upgrader or new circulation pumps.

Wholesale competition includes the simple setup, where the most efficient gas boiler among several boilers in a boiler house has first priority and is operating as base load.

Through mapping of heat sources there is also the potential to identify industrial and waste heat sources which could be utilised to provide a base load supply in the heating season and provide a possible HTW supply in the non-heating season. As the Azerbaijani government has made renewables a priority, the development of fluctuating solar and wind energy provides in the year to come a unique opportunity for Azeristiliktechizat to take advantage of periodic cheap surplus production of renewable energy by supplementing the existing gas boilers with new big heat pumps and heat storages. Increased utilisation of surplus heat will result in huge energy savings for society.

An excellent example to be inspired by is the Baku Thermal Power Centre (Baku TPC), situated at Garasheher in south-east Baku. Two gas turbine units operate with a capacity of 53,5 MW each and provide steam for the two oil refineries. But Baku TPC also delivers heat to the nearby residential neighbourhoods. Thus Baku TPC supplies heat to nearly 220 high-rise apartment buildings, 8 schools, 12 kindergartens, 7 health and 12 other social facilities.

Wholesale competition means the use of the load dispatch. Depending on the heat production price the plants will have different priority in the district heating system throughout the year. Cheap heat can be used a base load heat supply with first priority, while more expensive heat can be used as peak load in the winter period.
Where beneficial, and where possible to get permission, there is a huge economic and energy savings potential in the long term beyond year 2020 for establishing heat transmission pipelines from thermal-electric power plants or industrial complexes with surplus heat to the gas boiler houses of Azeristiliktechizat as a base load heat supply. It will require a strong long-term political commitment similar to what have been seen in many European cities that today harvest the benefits of large modern, efficient and environmentally friendly district heating systems, even in very dense urban areas with originally huge difficulties for developing modern infrastructures.

Heat losses from new pre-insulated heat transmission pipelines are considerably lower than would have been the case with the originally installed main lines. The installation of such transmission lines could create the basis for a district heating system to be operational in the summer period to provide an economically viable hot tap water supply.

**Competition will force companies to minimise costs and prices**

5.4.3 Increased market share of HTW coverage
Azeristiliktechizat should make a strategic plan for increasing the market share of HTW services.

To get the maximum benefits out of the recommended wholesale competition, it is recommended that the district heating systems provide both heat and HTW to the customers and operate the whole year.

Following development of heat maps, Azeristiliktechizat should identify additional heat sources which can be utilised to provide supplementary heat to the DH network all year round and
thereby make year-round HTW services economic beneficial. Feasibility studies should be commissioned where deemed necessary and to assess the viability of providing heat for HTW service.

In a district heating system which provides both heating and hot tap water, the standard concept should be that hot tap water is produced at the building substation through a heat exchanger. Modern building heat substations with automatic control devices must be installed to ensure proper supply of heat both for heating and for hot tap water at the same time.
6. **FOCUS AND APPROACH**

6.1 **Key stakeholders and partners**

6.1.1 Institutional Framework

The Ministry of Energy of Azerbaijan Republic (MoE) is a governmental agency within the Cabinet of Azerbaijan in charge of regulating the activities in the energy sector of Azerbaijan Republic. MoE is the central executive body for formulating and providing the national policy of energy.

MoE is responsible for regulation, supervision and control of the efficient use of the fuel-energy complex inclusive development of renewable energy and the issuing of licenses for energy companies, if required by the legislation.

MoE established in 2014 a workgroup on fuel and energy complex (FEC) within the development of regions of Azerbaijan. The workgroup has started work on drafting an Action Plan on the reconstruction and development of energy supply systems of regions. The group includes representatives of the main stakeholders in the Azerbaijani energy sector.

The Ministry of Economic Development (MED) is responsible for the preparation and implementation of socio-economic development programs economic reforms and regulations. MED is the chairman of the Tariff Council, which approves wholesale and retail tariffs.

Like the state-owned national water operator Azersu OJSC, the state-owned national district heating Operator, Azeristiliktechizat OJSC refers to the Cabinet of Ministers. Various authorities also influence the operations of Azeristiliktechizat. In Baku, for example, Baku Executive Authorities have influence on the decision of starting the heating season.

6.1.2 Main Stakeholders in the Energy Sector

The energy sector in Azerbaijan is dominated by a number of state-owned monopolies, and the energy market is highly regulated with limited competition:

- The national district heating company Azeristiliktechizat
- State Oil Company of Azerbaijan Republic (SOCAR), known as one of the largest fossil fuel corporations in the world.
- SOCAR’s subsidiary Azerigaz Production Union. Virtually all district heating operating by Azeristiliktechizat is based on boilers fuelled by natural gas.
- Azerenergy OJSC, the biggest producer of electricity in the country and the second biggest corporation in Azerbaijan
- From 2015 the new company Azerishiq OJSC was created for distribution and sales of power and maintenance activities of small infrastructures.

The district heating sector in Azerbaijan is dominated by Azeristiliktechizat, which is the national operator of district heating (and block heating) systems of Azerbaijan. Azeristiliktechizat’s structure is an Open Joint Stock Company (OJSC) where the shares belong to the state.

Azeristiliktechizat was founded in 2005 in accordance with a decree from the President of the Azerbaijan Republic with the purpose of operating as a state monopoly on the production and sale of district heating and to implement heat supply policy at the state level.

The present business of Azeristiliktechizat includes the production, distribution and sale of heat for space heating in building. In addition also HTW is provided to a limited share of customers. Azeristiliktechizat supplies heat to apartment buildings, educational, health and other facilities predominantly in Baku, but also in other cities of the country.
According to Azeristiliktechizat, the structure in the heating season 2015/16 is: 335 Baku boilers are supplying heat to 3035 residential apartment buildings, 184 schools, 123 kindergartens, 102 health facilities and 460 other objects. By regions respectively there are the following numbers: 191, 415, 103, 38, 55, and 93.

Azeristiliktechizat is continuously expanding by the construction of new boiler houses and connection of new customers. For example in 2013 it has been reported that Baku city was numbering around 320 boiler houses, heating 2760 apartment buildings and 730 social, educational, and medical facilities. Among the eleven districts of Baku, Xatai district has been recognized as having the most district heating, in contrast there are districts in Baku with almost no centralized heating systems.

6.2 Strategic approach
Implementation of the proposed roadmap is a step-by-step process with a series of actions and milestones along the way towards the target. The realization will be done within the current technical-economic and legal and political opportunities.

When the decision is made to implement the roadmap, the stakeholders shall ensure the completion of the relevant processes that reliably lead the desirable outcomes. Collaboratively, the stakeholders shall agree on the actions to pursue.

*Implementation of the proposed roadmap with actions, opportunities and stakeholders*

The recommended approach is to start imagining a vision of five years out in 2020 and then beyond while, at the same time, downplaying the typical tend to look at the current reality and problems. Thus, despite faced with a challenging current reality, it is recommended to start with the mental image of the goal – a future world-class district heating system – and then sequentially work backwards in increments whilst always thinking about what needs to be done to move step by step towards this vision.

The options generated through working backwards from a desired vision are usually somewhat different from the options generated through considering the current reality facing the organization.

The work is executed through people: it requires skilled staff and a competent management that makes sure that the organization’s priorities are performed properly, so that the desired outcomes are achieved. And it requires helping heat customers through information and campaigns to understand how to move from their current situation to a desired future state.
### 6.3 Primary roles and responsibilities

#### 6.3.1 National authorities and city authorities

The Cabinet of Ministries will have the primary role to launch a coordinated national policy and to set the political and administrative framework for developing district heating in Azerbaijan and to launch the regulations inspired from the proposed roadmap.

The Cabinet of Ministries are assumed to be the national authority, which approves the feasibility studies and priority investment plans. Through the Cabinet of Ministries, the state will ensure the required funds for investments. Technical and financial assistance from international financial institutions is highly recommended. Furthermore, the Cabinet of Ministries shall ensure the necessary budget provision.

High priority at ministerial level is to introduce a requirement for the Tariff Council to instigate a study on the development of appropriate tariff system and restructuring to ensure cost of generation and supply are covered by the tariff and that an appropriate subsidy is provided accordingly. Following completion of the tariff study the Tariff Council should review and implement the recommendation of the study in accordance with best practice. Increased involvement of Azeristiliktechizat in heat tariff setting is high recommended. The recommended long term target is to transfer the power to set the heat tariffs fully to Azeristiliktechizat.

Development of district heating networks shall be coordinated with city planning authorities and the cadastral and land registry authorities. The development includes the options for expanding the district heating systems where technical-economic beneficial.

Pipe routes for interconnecting smaller systems into larger systems are recommended as long term targets beyond 2020. It requires a strong long-term political commitment, similar to what have been seen in many European cities that today are harvesting the benefits of large modern efficient and environmentally friendly district heating systems, even in dense urban areas with originally huge difficulties for developing modern infrastructures.

The rationale for larger district heating systems is to ease the exploitation of possible surplus heat and renewable energy sources, and there by fulfil the long term national objectives of making district heating ‘greener’.

The authorities will play a central role in the case of compensation to private landowners due to land and rights acquisitions.

#### 6.3.2 Responsible for the implementation of projects

The national operator of district heating, Azeristiliktechizat, should have a key role when developing city planning and heat master planning for the cities it provides district heating services for.

But as a heat supply operator and in accordance with antimonopoly regulations, Azeristiliktechizat could face legal barriers that have to be solved in order to contribute in city planning and heat master planning.

Assistance from national and international experts is recommended. Following development of heat plans, the responsibility of the assigned heat planning bodies includes:

- To define the desired technical world-class district heating system that can be approved by the national authorities.
- To elaborate feasibility studies and define the priority investment plans inclusive to identify additional heat sources which can be utilised to provide supplementary heat to the DH
network, and to identify preferred options for system expansion and possible pipe routes for interconnecting decentralised district heating networks.

- To define training needs for technical and administrative staff

6.3.3 Other stakeholders

One of the first proposed steps of an updated strategy is to implement pilot projects as a showcase of mature international district heating technology and best practice. It can work as reference for further approaches in the district heating sector in order to meet the 2020 Targets. Such project requires cooperation with local partners and international financial institutions or other international institutions. In order to facilitate project management, administration, coordination, and monitoring, a national project management unit has to be constituted.

The heat customers and the housing departments are key stakeholders, who need information and training to ensure their competence in modern regulation and consumer side operation of DH systems. However, there is currently shortage of functioning condominium corporations. Therefore in a transitional period national heating operator Azeristiliktechizat have to legally to cooperate directly with the building or flat owners, inclusive legal allowance to install, own, operate and maintain modern heat substations at private premises.

As the new agenda and challenge for district heating business is to be ‘greener’ in the future, exploitation of alternative and renewable energy heat sources requires cooperation with the owners of alternative and renewable energy sources. That can be:

- Power companies producing CO2 neutral electricity for solar cells and wind mills,
- Power production companies in order to increase the share of combined heat and power production
- Various industrial companies producing surplus heat from industrial processes.

Thus other stakeholders in energy sector of Azerbaijan can play a key role to realise economic and environmental beneficial exploitation of additional heat production sources.
### 7. ROADMAP – KEY ACTION 2016 – 2020

#### Key Action Plan 2016 - 2020

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<th>Action</th>
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<th>Expected Result</th>
<th>Timing</th>
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<td></td>
<td></td>
<td><strong>1. Development of the political framework for district heating</strong></td>
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<tr>
<td>1.1</td>
<td>Formation of inter-ministerial coordination body under the Cabinet of Ministries.</td>
<td>To create the national political, legal and administrative basis for reforms</td>
<td>• A new state body with the executive power to settle legal, economic and institutional issues, to define and administrate common rules in the heat supply sector.</td>
<td>2016</td>
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<td>1.2</td>
<td>Study to reform heating tariff based on metering and subsidy restructure.</td>
<td>A study to develop appropriate tariff system and that appropriate subsidies are provided accordingly for vulnerable customers</td>
<td>• Recommendation to heating tariff and subsidy restructure in accordance with best practice. &lt;br&gt;• Attraction of international institutions for investment in the DH sector</td>
<td>2017-2018</td>
</tr>
<tr>
<td>1.3</td>
<td>Develop/adopt common rules and procedures on district heating development..</td>
<td>To establishing a set of clear and coherent framework rules that uniformly apply to any district heating project</td>
<td>• Determine the scope of regulatory control in the DH sector. &lt;br&gt;• Define or confirm decision making competences in the DH sector. &lt;br&gt;• Establish common standards for consumer contracts. &lt;br&gt;• Establish common framework conditions for heat metering. &lt;br&gt;• Establish of common mandatory guidelines for tariffs. &lt;br&gt;• Provide framework conditions on protection of vulnerable customers.</td>
<td>2018-2019</td>
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<td>1.4</td>
<td>Budget Provision for Heat Map Preparation</td>
<td>To introduce a requirement to develop heat master planning for all cities, and provide funding for their development.</td>
<td>• Provide the basis for heat master planning</td>
<td>2017-2018</td>
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<tr>
<td>No.</td>
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| 1.5 | Heat master plans to be implemented for all cities except for parts of Baku etc. (Based on 1.4) | Realise the full potential of district heating in the long term | • Provide a plans to balance heat supply and demand in an optimal way  
• Assessment of the required investments in the future | 2018-2019         |
| 1.6 | Implementation of the recommendations of the tariff study (base on 1.2 and 1.3) | Following completion of the tariff study the Tariff Council should review and implement the recommendation of the study in accordance with best practice. | • Development of a long-term economically sustainable district heating industry without impairing the responsibility for socially vulnerable groups. | 2018-2020         |

### 2. Defining the Desired Technical Modern DH system on National Level

**2.1** Definition/determination of the desired technical modern DH System – the first step is by the implementation of a pilot project.

To formulate the desired technical modern DH system on national level for Azerbaijan

- A pilot project as a showcase for further modernization of the country’s other DH systems.
- Creation of technical and political consensus about the Desired Technical DH System
- Mitigation of barriers, including norms and standards that stand in the way of realizing the desired long term technical targets.

**2.2** Developing expertise to facilitate the desired modern technology and methodologies in accordance with 2.1

In order to support the modernization process, it is necessary at the national level to develop the necessary expertise and the associated education in technical education centres

- A strong research environment that can translate research into practical technical solutions adapted to the national context.
- Trained technicians who can ensure the implementation, operation and maintenance of the required modern equipment.

### 3. Technical, Economic and Institutional Development of DH Companies

**3.1** Development and approval of feasible technical improvements (e.g. flue gas analysers, speed control on pumps, water treatment measures)

Assess opportunities identified by the heat plans for investment in the DH network

- Clearly defined investment packages for DH optimization and rehabilitation
- Investment packages are agreed and supported by stakeholders

2017-2020
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<tr>
<td>3.2</td>
<td>Implementation of priority investment programs in accordance with 3.1</td>
<td>Assessment, design, procurement, installation and commissioning of new technology</td>
<td>• Approved the plans in relation to e.g. environmental issues, land acquisition for pipe routes and additional heat sources.</td>
<td>2018-2020 and beyond</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>• Realization of the desired modern DH system through prioritized investments</td>
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| 3.3 | Development of plans for institutional strengthening | Provide guidance for Azeristiliktechizat’s on how to improve its operation for both consumers and staff | • Define strategic 2020 plan  
• Provide budget and financing strategy to implement plans  
• Outline strategy for Azeristiliktechizat organisation improvements | 2017-2018 |
| 3.4 | Training and Development in accordance with 3.3 | Implementations of the institutional strengthening plans and training of relevant staff to ensure their competence in modern system regulation and consumer side operation. | • Implementation of the strategic 2020 plan  
• Skilled internal staff  
• Skilled relevant housing department staff | 2017-2020 |

4. **Market and service development**

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| 4.1 | Strengthening customer relationships by a new customer relationship management plan inclusive a new meter-based billing system. | Continued development of the quality of the heat supply services. | • Satisfied and loyal customers with higher willingness to pay for service provided  
• Attract new customers and make it easier to realise approved heat master plan  
• Secure investments in DH system modernization. | 2016-2017 |
| 4.2 | Strategic plan to increase Azeristiliktechizat’s market share of HTW services | To plan maximum benefit from recommended wholesale competition and to operate the whole year, providing an improved service to consumers. | • Year round HTW supply where feasible  
• Increased connections to DH network  
• Improve economy of DH network operation | 2017-2020 |
| 4.3 | Introduce wholesale heat supply competition to the DH network and integrate alternative and renewable energy sources. | To use competition to lower heat supply costs and lower carbon footprint of DH. | • Introduce a competitive wholesale regime which will include a framework for its regulation. | From 2020 |
Recommended Short term Actions for the national district heating operator “Azeristiliktechizat”:

**Azeristiliktechizat**
National DH operator

**Recommended Short-term actions**

**Technical**
- Flue gas analysers
  - Portable/stationary
- Speed control on pumps
- Network balancing
- Supply temperature control with weather compensator
- New gas boilers, inclusive condensing gas boilers
- Shunts (min. 46°C) or heat exchangers for old boilers
- Water treatment measures
- New preinsulated pipes
- Hot tap water service via heat exchanger managed by company
- Systematic metering
- Leak surveillance

**Institutional (external)**
- Metering and billing system strengthening
- Full reference to Ministry of Energy (performance supervision, budget and accounts)
- Seat in cooperation bodies - city planning bodies - inter-ministerial committee

**Legal**
- Legal permission to contract with contractors
- Legal permission to own and operate new heat substations at private premises
- Legal registration service of in-house problems

**Capacity building**
- Staff training through international programs
- International company twinning

**Market development**
- Market development of hot tap water services from modern substations
- Market development of central cooling services
APPENDIX 1
ELEMENTS OF THE DESIRED TECHNICAL WORLD-CLASS DH SYSTEM
This appendix highlights and describes short and medium term key measures towards the desired world class district heating system:

- Change from fixed to variable flow regime
- Introduce modern building heat substations
- Increasing the heat production efficiency
- Decrease the heat distribution losses
- Automation and computerization.

**Change from fixed to variable flow regime**
The present standard concept for district heating system in Azerbaijan is to operate one boiler house per system. In case of integrating new heat production sources, the heat must be delivered through a transmission pipeline to the existing boiler house to operate together with the existing boilers or the new heat production sources must be installed at the existing boiler house. In that way, hydraulic balancing can ensure that the existing fixed flow regime can be maintained as an optimisation of the existing constant flow regime.

However, in case of the installation of modern equipment for individual control of the heat and hot tap water demand at the building substations, the present fixed flow regime will not be able to operate properly as hydraulic problems will arise. It will be necessary to change to variable flow regime.

The variable flow regime gives higher flexibility through the ability to control not only the temperature (as in the fixed flow regime) but also the water flow by new variable speed pumps - or by installation of frequency converters on the existing pumps. In that way the pumps will not run at unnecessary high and constant speed – the speed can be controlled by “cells” at critical pressure points in the district heating network.

*Frequency converters at the circulation pumps to obtain variable flow regime*

Implementation of variable flow regime includes installation of:

- Modern building heat substations
- Differential pressure control at (some of) the building heat substations;
- Variable speed driver at the pumps with manual or automatic regulation of the pressure at the most remote customers, where the difference pressure in the network is lowest.
The benefits are considerable electricity savings when operating the pumps and, at the same time, a higher quality heat supply with very short system response time. Variable flow regime also allows load dispatch with more than one heat producer, which also develops wholesale competition.

Frequency converters can be installed at the largest existing pumps, where technical conditions allow, which will immediately result in considerable electricity savings.

**Modern building heat substations**
The prerequisite for installation and operation of modern building heat substations is an institutional and legal framework that allows Azeristiliktechizat to invest in modern building heat substations and be responsible for keeping the performance of the new heat substations.

As a part of the roadmap, it is recommended to begin the installation of a modern building heat substation in accordance with the demand of the building owners or users, including modern equipment for individual control of heat and hot tap water at the building level. Elaboration of a priority list is recommended to identify where modern building heat substations can easily be installed in available and safe space facilities – for example in the building basement - and where there is clear legal and ownership conditions. But the priority list will also reflect different barriers against installation of modern building heat substations that have to be analysed and solved.

**Modern building heat substation**

Maintenance and control of a modern heat substation’s performance is enabled through heat meters and regulators installed in each substation. District Heating suppliers achieve efficient operation of the system through permanent control and optimization of all elements, among which heat substations have the highest priority. Thus customers receive fast and reliable information about the quality of their building’s installations.

The in-house heat distribution systems also need hydraulic balancing and control equipment inclusive thermostatic valves on the radiators. In many cases it will also be necessary to wash scale and dirt out of the in-house distribution pipes or to replace pipes where the scale is too heavy. These improvements are outside the responsibility of Azeristiliktechizat but are recommended in parallel in order to obtain full benefits of the modernisation of the district heating system.

**Increasing the heat production efficiency**
Increasing the heat production efficiency includes:
Installation of more efficient gas boilers
New better burners
Exploitation of flue gas condensation by new condensing gas boilers
Automatic supply temperature control

Interconnection of networks and introduction of variable flow regime with load dispatch will make it possible to increase the utilisation of the most efficient boilers by exploiting them as base load in the centralized DH system.

Through load dispatch, optimization of overall system efficiency can also be realised by utilization of surplus heat from industry, from power production (i.e. combined heat and power), and by installation of new technology that can be used for heat production: e.g. Heat pumps, waste incineration etc.

**Decrease the heat distribution losses**
In order to decrease heat distribution losses the following measures are recommended:

- Replacement of worn-out pipelines with modern pre-insulated pipelines. This can also reduce water losses in case old pipelines are leaking.
- Decreasing the heat supply temperature where possible without causing a negative impact on heat supply to consumers.

Along with modernisation of the DH system, quality of the circulating water becomes important to ensure long technical lifetime of the new pipelines. This is crucial when existing worn-out pipelines are replaced with new pipes and when the DH system is expanding in order to realise the adopted heat plans.

*Replacement of worn-out pipelines with modern pre-insulated pipelines*

To ensure high quality of the circulating water, a pH-adjustment plant and part stream filter is additionally recommended. The pH-adjustment plant consists of a dosing pump for sodium lye, and an agitator. A part stream filter is a fine strainer continuously filtering a certain part flow of the circulating DH water. A part stream filter is recommended for larger systems.

**Automation and computerization**
For maximum utilization of new equipment the modernization process must be followed up with increased automation and computerization. Two main computerized systems are recommended to install in parallel with, or as an integrated part of, the priority investment program:
Computerised monitoring and control system (SCADA)  
Computerised technical administrative system (TAS).

*Computerised central control room for SCADA and TAS*

The proposed SCADA system consists of:

- A central application server acquiring data status and process data from field devices on a real-time base, and making this information accessible to other systems on a real time basis;
- Monitoring screens through which the operators in a central control room monitor and control the district heating system;
- Remote programmable logic controllers (PLCs) operating as terminal units that are connected to sensors at field devices for status and meter readings, converting the sensor signals to digital data and sending the digital data to the central application server;
- Wireless (could be internet or radio) communication infrastructure connecting the central supervisory system to the PLCs.

Where SCADA is used to establish efficient remote control and management and continuous optimization of district heating systems in real time, TAS will have easy access to comprehensive and consistent data from SCADA, and will be used for:

- Statistics and billing
- Management of maintenance procedures
- Analyses of different operation situations

Azeristiliktechizat existing management and administration system should be integrated with the modern TAS.

All data on the district heating network should be gathered in one common Inventory Database which is accessible by all employees.

The Inventory Database can among others be used for the management of spare parts and for maintenance.
Functionality options for TAS