At OAO Koks, as at other industrial enterprises where steam is used in the production process, the production buildings were also heated by steam at first. This was simple and quick to organize in the early stage of plant development.

However, the deficiencies of steam heating are so significant that its use has now been severely restricted. Deficiencies include the following:

1. On account of the high and constant steam temperature, the heat transfer in the heating devices cannot be reliably or flexibly regulated. Consequently, the temperature in the heated buildings cannot be appropriately adjusted, which can result in considerable discomfort.

2. The constant high temperature at the surface of the pipes and heating devices results in scorched dust and creates unhealthy conditions of the building. Even in industrial buildings, according to building standards, steam heating is only permitted in special conditions—for example, with an excess of steam from the production process. In that case, the temperature must not exceed 130°C. (At OAO Koks, the steam temperature is 180–290°C, depending on the location.)

3. Steam heating is associated with elevated heat losses from the steam lines, evaporation, and entrainment with the condensate.

4. Operation of the system is associated with noise (knocking and banging), as a result of partial condensation with local heat loss through the wall of the pipe, especially when the steam is moving upward and when the system is switched back on after an interruption.

5. Steam systems are more complex in design and require condensate traps. In winter, the risk of condensate freezing in the pipes is a real concern.

6. Steam systems are less reliable, primarily because of the short working life of the steam lines (<10 yr) and condensate lines (<4 yr), since the corrosion at the inner walls of the pipe in the steam–condensate mixture is greater than in water. In addition, considerable thermal stress and deformation is created in the steam system, especially when it is turned on.

Subsequently, in reconstruction of shops and production departments so as to permit expanded production, provision was made for local heating boilers based on the steam–water principle and for regulation of individual groups of heat consumers with water heating. Each such boiler system required at least two heat exchangers, two network pumps, an expansion volume, two condensate pumps, a condensate collector, pipelines, control valves, electrical equipment, and monitoring and measuring instruments. In addition, the operating staff needed to constantly track the operation of this equipment.

At the end of the century, such boiler systems had been in operation for more than ten years. At the same time, with expansion of production at the plant, there was a shortage of thermal energy; in winter, steam had to be imported from the Kemerovo cogeneration plant. The switch from steam to water heating was adopted as a means of economizing on energy expenditures.

The switch began in 2005. It is a considerable task, which involves reconstructing the heating systems in the whole plant.

The starting point for the project was the construction of coke battery 3, in which the central boiler and part of the major thermal lines were built by the major-construction department, with the participation of specialized shop 1 for the repair of coke-production equipment. In the design, all the new heating components were based on hot water. To eliminate the shortage of thermal energy, work on the switch from steam to water heating proceeded continuously. All the installation work for conversion of the heating systems in the buildings, within thermal groups, and in the intrashop thermal networks was performed by shop personnel, with the assistance of specialized shop 1.

The progress of the transition over the years is illustrated in the table and in Fig. 1.

The main benefit of switching from steam heating to water heating by means of a central boiler is the increased efficiency thanks to the significant reduction in heat losses with the steam condensate and the energy
consumed for its collection and transportation. For comparison, heat losses through the insulation of water lines in a normal state is 3–5%, while the heat losses with condensate in a steam system are 30%, on average, depending on the design and state of the equipment.

The switch from steam to water heating also entails organization of centralized heat regulation and distribution. Classical centralized systems represent a well-established approach to heating. Their efficiency may be seen historically in the smoothness and stability of heat supply, not only in the socialist era but in the extremely difficult economic conditions of the 1990s.

The heat-supply system selected at OAO Koks is characterized as dependent and conditionally closed. This means that the pressure of the heat carrier—in other words, the hot water circulating in the system and heated at the central boiler in the immediate vicinity of the heat source (steam boiler 3)—at the consumers depends directly on the pressure of the heat carrier at other points of the system, with no hot-water supply outside the system.

The cost of the thermal equipment and the internal water systems is considerably less than the cost of the equipment for the steam system, since there is no need for steam–water heat exchangers, expansion tanks, top-up pumps, and other components whose function is centralized in the central boiler.

The basic steam–water heaters at the central boiler are two compact plate-type heat exchangers produced by OAO Al’fa-Laval Potok, which are unmatched in parameters, size, and reliability.

The water temperature is regulated at the central boiler on the basis of a 130/70 temperature graph, where 130 and 70°C are the maximum temperatures at the boiler in the supply and return network, respectively, with a theoretical ambient temperature of –39°C. However, as experience shows, it is not necessary to raise the water temperature to this level. (Even in the coldest weather, at –39°C, the temperature of the supply line is actually only raised to 110°C.)

In addition, provision is made for regulation of the water flow rate and temperature at thermal groups according to a 95/70 temperature graph. The thermal-group equipment is selected so that, although simple, it ensures automatic and precise regulation. The regulation is based on control valves, automatic instruments, and a mixing pump that commingles some of the cooler water in the return line with the high-temperature supply water, so as to automatically maintain the required temperature in the heating systems as a function of the outdoor temperature (in accordance with the graph) and maintain effective water flow with the required pressure difference between the supply and return lines. When individual heating units are connected directly to the main network, regulation may be ensured by means of simple choke disks.

Of course, in switching shop and building networks from steam to water, their equipment was also upgraded and reorganized.

In the 2008–2009 heating season, all the major thermal networks went into operation, and ~88% of the planned conversion was complete. Note also that all the new construction was designed for water heating. From the beginning of the switch in 2005 to the 2009–2010 heating season (including the planned load for the new coal store), new construction amounted to 24.7% of the plant’s total theoretical thermal load for heating and hot water (Fig. 1).

The total costs for the switch since 2005 have been ~57 million rub, including 19 million rub for the construction of the central boiler, 18 million rub for the distribution networks, and ~20 million rub for the conver-