



### Which raw materials will be particularly important over the next 20 years?

**Troyan:** Petroleum and natural gas will remain the most important raw materials. However, gas hydrates — flammable ice-like compounds of water and gas — could greatly increase in importance, as they bind the largest deposits of methane gas worldwide. Because gas hydrates only remain stable at high pressures or low temperatures, they are only to be found deep in the oceans or in permafrost regions. The tundra, for example, harbors huge deposits of gas hydrates — but their extraction is very costly. Before we do anything, however, we need to obtain detailed information on their formation, extent, and decomposition if

flected by the boundaries of the geological strata. The time it takes for them to return provides information on the subsurface composition. The technology thus significantly reduces the risk of drilling in the wrong place.

### How does Russia view its current and future role as a raw materials supplier?

**Troyan:** Russia is rich in natural resources, and it's still sitting on a large number of undeveloped petroleum and gas deposits. We know, for example, that there are huge reserves in places like eastern Siberia, the Barents Sea, the island of Sakhalin, and the northern Arctic Ocean. Extraction under Arctic conditions will be very difficult and expensive, however, and

## Tapping New Technologies for Tomorrow's Fuel

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we are to realistically assess potential dangers and the impact extraction would have on the global climate. In any case, methane needs to be extracted with the lowest possible losses because it's a very powerful greenhouse gas that should not be released into the atmosphere in large amounts. Methane has been extracted from hydrates for 30 years in the Messoyakha gas field in western Siberia. Nevertheless, truly optimal extraction technologies probably won't be available until the second half of the 21st century.

### Which technologies will have to be further developed if raw materials are to remain affordable in the future?

**Troyan:** Exploiting fossil deposits in the northern seas will require an infrastructure that functions perfectly — and economically — even under the extreme geological and climatic conditions that prevail in those areas. This will cost a lot of money, which is why the price of gas and oil will remain high in the future. New technologies currently being tested in Russia could help increase the oil production yield, however, as they allow for things like horizontal drilling, the construction of multiple-chamber shafts, and maximizing pressure in the stratum. Nanotechnology is also opening up new opportunities that range from nanocatalysts for oil refineries to "intelligent" liquids that facilitate drilling processes, and special nanofoils that improve the frictional properties of oil and gas pipelines. Seismics can also help locate new deposits by generating shock waves that travel thousands of meters under the ground at intervals of just a few seconds. These waves propagate and are re-

will also require new technologies and international partners. And that's exactly what's happening now with the Total oil company's involvement at the Stockman gas field in the Barents Sea. The Baltic Sea gas pipeline is also very important for ensuring reliable gas deliveries in the future, which is why the project is a major priority for both Germany and Russia.

### To what extent will environmental protection play a role in Russia?

**Troyan:** The exploitation of natural resources always leads to major landscape changes. Open pit mining results in pits and spoil heaps that are often used as garbage dumps, for example, and this can lead to landslides, a lower water table, parched vegetation, and so on. Attitudes in Russia toward nature have changed over the last few years. Instead of viewing the environment as something to be consumed without consequences, the country is now taking a more conservationist approach. Put simply, in Russia we need to think about future generations, and we need to treat nature and our natural resources accordingly. Russia is part of the UN's Global Environment Monitoring System project and has also signed the Kyoto Protocol. Back in 1993, our country introduced a government system for environmental monitoring to ensure adherence to standards. The increasing use of new technologies is now benefiting the environment because they make raw material extraction more efficient and reliable. So, while environmental damage resulting from the exploitation of natural resources remains a critical issue, we are nevertheless making progress.

■ Interview conducted by Thomas Vesper.