# Shale Gas

Collaboration and technical innovation are key to minimizing industry's cumulative footprint in the Horn River Basin.



Nexen is promoting greater understanding of the Horn River Basin's watershed through a multi-year hydrometric assessment and monitoring program. Its intent is to manage our use of water based on a thorough understanding of the watershed.

## SHALE GAS IN NORTHEAST BC

## Trillions of cubic feet of contingent recoverable resource.

## STRATEGIC RESOURCE VALUE

Enormous volumes of natural gas are concentrated inside the tightly bound shale rock formations found near Fort Nelson in northeast British Columbia. This unconventional resource is plentiful, but until the last decade, has been challenging to extract due to the low permeability of the rocks.

Today, with significant technological steps forward, the Horn River Basin, Canada's most prolific shale gas play, is a new and important resource for BC. Natural gas is a lower emission fuel and future demand and markets for this resource are positioned for growth.

Natural gas is also an important component of Nexen's long-term growth strategy. Since 2006, Nexen has acquired the rights to more than 300,000 acres in the Horn River, Cordova and Liard basins. Our contingent recoverable resource and prospective resource in the Horn River, Cordova and Liard basins is estimated at between 9 and



Nexen's shale gas resource plays in northeast British Columbia are focused in the Horn River, Liard and Cordova basins.

38 trillion cubic feet (tcf). Please refer to our press release dated November 15, 2010 for more information on these estimates.

As an early entrant to this rugged, remote region, Nexen has successfully translated these significant resource opportunities into tangible value. In the coming years, shale gas could represent as much as 20% of Nexen's total production and potentially double our proved reserves. Realizing these opportunities requires Nexen to contribute to the development of a sensible and responsible framework for shale gas development—one that addresses the current regulatory uncertainty concerning carbon taxes, as well as issues such as how and where to add pipeline infrastructure and facilitate export of liquefied natural gas to expanding overseas markets. We will continue to work with the provincial and federal governments as they address future GHG issues that may result from shale gas development.

We also continue to develop and improve technologies like multi-stage hydraulic fracturing and horizontal drilling and introduce innovations to minimize their potential impacts. And, as the foundation to all of our activity, we seek the best ways to inform and engage with local stakeholders.

## SHALE GAS CHALLENGES

Water use, hydraulic fracturing and minimizing the overall development footprint are the key shale gas challenges Nexen and other producers are working to address.

#### **Operational Infrastructure**

The Horn River Basin is the most active of the three shale gas basins Nexen operates within, however the entire region remains largely undeveloped. Shale gas production requires construction of roadways to provide access for the equipment and people that are involved—from initial seismic exploration through well site clearing and construction, drilling and completion and ongoing production. Additional activities include the installation of pipeline corridors, gas gathering and processing facilities and other associated infrastructure. In June 2010, Nexen hosted an open house at Fort Nelson First Nation (FNFN) Chalo School, where we shared our winter 2011 development plans with the community. More than 200 people attended the meeting.



### Surface Water Use

Water use is another central challenge in responsible shale gas development. Shale gas producers require water during drilling and completion activities, which is derived largely from surface water sources, including rivers, lakes and streams. The resulting produced water also requires safe disposal.

In BC, the use of surface water must be approved under the *Water Act* and is regulated by the British Columbia Ministry of the Environment. Water source wells and disposal well activity for oil and gas producers are legislated through the *Oil and Gas Activities Act* and regulated by the British Columbia Oil and Gas Commission.

Nexen is working to better understand the impacts of surface water use in this region and find alternatives, such as the use of underground saline aquifers to supplement surface water withdrawals.

#### **Hydraulic Fracturing**

Hydraulic fracturing is the process of injecting high-pressure water and sand into reservoirs through a secured well bore to crack the rock, creating pathways for the gas to flow. The sand is used

#### **Understanding Hydraulic Fracturing Fluids**



Over 99% of the fracturing fluids used in Nexen's Horn River operations are water and sand. Small amounts of additives are mixed with the water and sand to enhance the effectiveness of the fracturing process and are customized for each well. to prop open the rock, and the injected water is produced first, followed by the gas. Our industry has been using fracturing technologies for more than 50 years. Concerns about the potential for groundwater contamination and questions about the safety of chemicals used in fracturing fluid mixtures have been raised in shale gas producing jurisdictions. Regulations in BC and Alberta are in place and are stringent. They call for well set backs from water sources and a combination of both surface and production casing, which are fully cemented, providing protective, impermeable barriers from water sources.

#### **Biodiversity**

Minimizing impacts to the rich biodiversity found in the northern boreal region also continues to be an important focus. The woodland caribou is an endangered species that has been impacted by forestry, mining and oil and gas industry encroachment on the boreal forest habitat in this region, resulting in their increased vulnerability. Nexen is conducting research and contributing to a provincial plan addressing caribou concerns.

#### Consultation

Fort Nelson First Nation (FNFN) and the Town of Fort Nelson are the communities in closest proximity to shale gas activity in the Horn River Basin. We consult on an open and timely basis about development plans, their potential impacts and employment and business opportunities.

### **RESPONSIBLE SHALE GAS DEVELOPMENT**

#### Horn River Basin Producers Group

Nexen is a founding member of the Horn River Basin Producers Group, created in 2007 to promote a coordinated approach to the region's shale gas activities. The 11 member companies pool information at the early stages of development to avoid overbuilding and reduce environmental disturbance. For example, Nexen and other producers partnered on the Komie Road, a shared access road, instead of building three separate roadways. Companies also build pipeline corridors alongside roadways to reduce forest clearing and consolidate infrastructure.



Horn River Shale Gas Formation
Potable Water
Cretaceous Shale
Saline Aquifer
Mississippian/Devonian Shale

#### **Footprint Management**

Nexen has incorporated a variety of footprint mitigation strategies into our shale gas development plans. Enhanced environmental constraints mapping is used to identify potentially sensitive areas so that they are avoided from the outset. Low-impact seismic practices and reduced right of way widths are other ways we strive to take only what is needed from the forest floor.

#### **Horizontal Drilling & Multi-Well Pads**

The use of horizontal drilling from multi-well pads concentrates our drilling activities in fewer, more centralized locations and improves the overall efficiency of our operations. By drilling from a single pad, the number of access roads and other physical impacts to land are greatly reduced. Prior to single pad drilling, each well site needed its own access road and land clearance. Consolidating activity in fewer locations also boosts efficiency and ultimately enables producers to extract larger hydrocarbon volumes with less overall impact.

#### Water Monitoring

Nexen is contributing to better understanding of surface water, shallow groundwater and deep saline water sources in northeast BC's shale gas producing regions. Since 2008, in support of our application for a long-term water allocation license, Nexen has been working on a water monitoring research initiative in the Horn River Basin, in cooperation with provincial and federal regulators. Ultimately, our water research efforts are expected to strengthen a regional database for the watershed that will enhance existing modeling and provide the basis for better decision-making when it comes to licensing and managing of water resources for industrial users.

In addition, Nexen has invited the Fort Nelson First Nation (FNFN) to subject our water study to an independent, third-party scientific review and is planning to provide training so FNFN members can become involved in ongoing water monitoring initiatives.

#### **Groundwater Resources**

Shale Gas Reservoir

In 2010, Nexen advanced testing of a groundwater aquifer as a potential alternative to fresh surface water use. The aquifer was identified as part of a collaborative research effort through GeoscienceBC, supported by the Horn River Basin Producers Group and the BC Government.

Nexen is also leading a regional groundwater monitoring initiative in partnership with the Ministry of Environment to monitor both the quality and quantity of shallow groundwater in the Horn River Basin.

#### **Caribou Study**

Since 2008, Nexen has participated in a baseline caribou habitat study in the Horn River area to enlarge our understanding of their habitat use patterns, which we apply to our resource development plans. In addition, we are contributing to the development of the BC Government's Boreal Caribou Management Plan.

#### **Economic Opportunities**

Providing economic opportunities to people and businesses in the Horn River area is a priority for Nexen. Through the Horn River Basin Producers Group, Nexen participates in annual trade shows and Energy Expos that bring together producers, vendors and potential employees. We also stage workshops for local contractors, and provide funding for relevant industry-related training that will open doors to employment and business contracts.

For more information on Nexen's shale gas operations, please visit www.nexeninc.com/operations.