Adaptive COMPUTING

ADAPTIVE COMPUTING INDUSTRY SOLUTIONS

HPC FOR OIL & GAS

With escalating energy costs, there is an urgent need to improve hydrocarbon exploration and recovery especially in environmentally hostile deep water and wide basins with salt mounds and complex geology. To maximize the probability of finding and recovering oil and gas, it is critical to predict the nature of oil fields, rapidly bridge the gap between technical and business decision making, and eliminate delays and guesswork.

Sophisticated multi-dimensional seismic imaging and very accurate multi-component, multi-scale reservoir simulation help engineers better optimize the location and number of wells in a reservoir or on an entire basin without expensive drilling. This requires considerable high performance computing (HPC) capability.

HPC improves the efficiency and economics in several areas of Oil & Gas from data acquisition to seismic imaging to reservoir simulation, and to downstream applications. To get an immediate and significant return on investment, the HPC solution must support and integrate a very broad set of industry applications with diverse processing needs from interactive visual applications for seismic data interpretation to petaflop-sized systems for state-of-the-art computations for basin-wide optimization.

### Overcoming HPC Challenges in Oil & Gas

The biggest challenge to the use of HPC in Oil & Gas is that enterprise users – typically engineers and not IT experts – are not trained in HPC technologies. This makes it difficult to submit and run applications in an HPC environment and to collaborate across teams and locations. The result? Non-optimal HPC workloads, delays and failures to achieve compute SLAs, wasted compute capacity

and power usage, and increased costs. It is complex and expensive to manage workloads across heterogeneous cluster systems – you need to unify workload management across clusters with mixed processors, memory, GPGPUs, operating systems, and middleware.

Adaptive Computing is leading the HPC revolution in Oil & Gas with a modular end-to-end solution set that addresses the entire range of oil and gas industry computing challenges. Users submit data for analysis through their familiar industry application-based templates using an easy-to-use application portal that removes all the complexity of accessing HPC resources. The user can obtain the detailed simulations and rich visualization they need for analysis and decision making, without having to learn any of the complex HPC technologies. We do this through a suite of products that each address different parts of the problem and combine seamlessly to optimize delivery of the final results. And since all the products are vertically integrated, users get integrated support for the entire solution.

The Adaptive Computing End-to-End Solution Set for Oil & Gas includes:

- **Moab® HPC Suite - Application Portal Edition** makes it simple for industry end users to adapt their commonly used applications and workloads to HPC using intuitive templates. No special HPC training is required to use and leverage the competitive advantage of the HPC resources, users just need to know their application(s). Workload processing is optimized for speed, SLAs and priorities with Moab policies.

- **Moab HPC Suite - Remote Visualization Edition** optimizes 2D and 3D visualization techniques to interpret data and results more cost effectively and productively. By transferring only pixels instead of data, users can collaborate on simulations and analysis across locations without any data transfer time lags or security issues. This also means that the business gets the innovation and competitive advantage from the analysis at a significantly reduced cost for the required technical compute resources.

Moab HPC Suite End-to-End Solution Set for Oil & Gas Industry
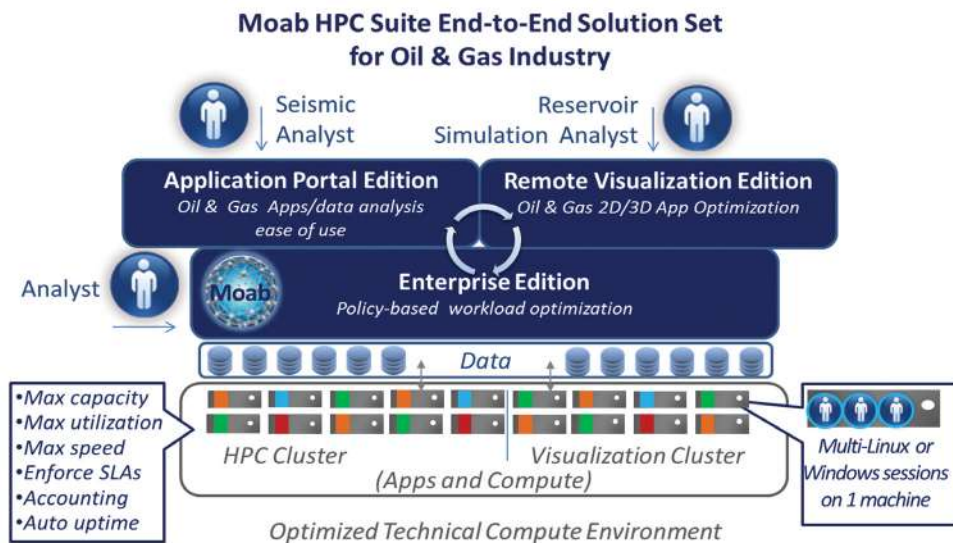
■ **Moab HPC Suite - Enterprise Edition** lets organizations focus on just optimizing and accelerating HPC workloads to get faster results, higher utilization and balance competing workload priorities. It provides intelligent workload management with policies that dynamically adapt the resources to the requirements of user workloads, streamline processes, enforce SLAs and achieve organizational objectives. Edition to Moab HPC Suite - Enterprise Edition is a foundational component of the Application Portal and Remote Visualization Editions, but can also be purchased as a workload management product to work with existing customer portals.

Moab HPC Suite - Application Portal Edition
Moab HPC Suite - Application Portal Edition is the gateway to the core HPC engine and provides end users single-point access to their applications, data, resources, and job submissions across the analysis and interpretation process. No special HPC training is required. Moab HPC Suite - Application Portal Edition simplifies the specification and running of jobs on HPC resources to a few simple clicks on an application specific **template** with key capabilities that include:

■ **Application-centric job submission templates** enable users to submit complete HPC jobs by just filling in the blanks, with parameters specific to their application, and their job is submitted from virtually any location, internet connection or any browser-enabled device. They can also easily monitor their job and retrieve their results. For Oil & Gas, the templates cover commonly used applications such as SLB Reservoir Simulator suite, Schlumberger Eclipse, CMG solvers (STARS, IMEX, GEM), Matlab and others. Standard web services integration, tested for both .NET and Java interoperability, also enables immediate integration with your custom applications.

■ **Support for batch and interactive applications,** such as simulations or analysis sessions, to accelerate the full project or exploration and production cycle.

■ **Distributed data management** to eliminate unnecessary remote file transfers for users, to store data optimally on the network for easy access and protection, and to optimize file transfer to and from user desktops.

Moab HPC Suite - Remote Visualization Edition
The final goal of any simulation, including the most complex HPC simulation, is visualization of data for analysis and decision-making. Most current technical computing methods do this inefficiently -- slow transfers of large data sets limit the access to the visualized data and clog up network bandwidth, user productivity, and team collaboration while increasing data and security risks. The high-cost individual workstations and and their software are under utilized by the limited user(s) that have access to them. They are costly to manage and often have gaps in meeting changing workload technology requirements.

Moab HPC Suite - Remote Visualization Edition significantly reduces the hardware, network and management costs of visualization in technical computing. It enables end users easy, centralized access to shared visualization compute, application, and data resources. These compute, application, and data resources reside in a technical compute cloud or grid in your data center and not in expensive and underutilized individual workstations. Key benefits include:

■ **Lower hardware costs** by consolidating individual workstations into centralized visualization and thus reducing specialty hardware purchases, such as GPUs, for individual users.

■ **Improved workforce collaboration and productivity** as multiple users can access and collaborate on the same visualization data at the same time from almost any location or device with little or no data transfer lag times and no data transfer security risks.

■ **Reduced management costs** by moving from remote user workstations to centrally managed visualization servers that require significantly less administration overhead.

■ **Decreased network access costs and congestion** significantly lowers the amount of visualized pixels that are transferred to users, and not full data sets.
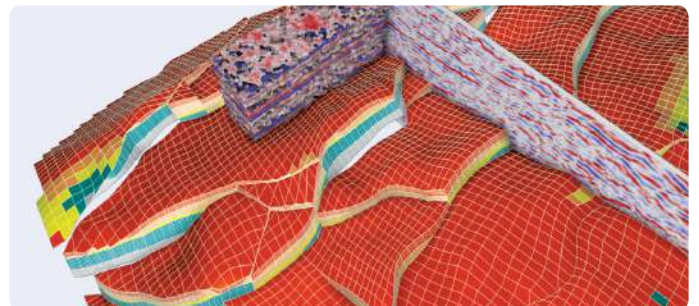
A Geologic model from Gullfaks visualized together with seismic data using Huespace. Image courtesy of HUE AS.

Moab HPC Suite - Enterprise Edition

Moab HPC Suite - Enterprise Edition is the core application that optimizes workload performance by dynamically adapting resources to requirements of users workloads, streamlining processes, enforcing SLAs, and achieving organizational objectives. At the core of the Moab technology is a patented policy engine and scheduler for scalable, large-enterprise computing facilities and utility-based computing environments. Moab's architecture enables policy-based optimization of infrastructure resources, software licenses, file spaces, and other devices.

Moab HPC Suite - Enterprise Edition provides enterprise-ready HPC workload management that brings together key enterprise HPC use cases and capabilities as well as implementation and 24x7 support services into a single integrated product to maximize the value from your HPC environment. Key benefits include:

- **Productivity acceleration** to deliver more results faster at lower cost with massive scalability, intelligent management to achieve 90-99% utilization with the lowest power and cooling costs, and fast and simple job submit and management.
- **Uptime automation** to ensure workloads complete successfully and reliably, avoiding failures and missed organizational opportunities and objectives.
- **Auto-SLA enforcement** to schedule and adjust workload to consistently meet service guarantees and business priorities so that the right workloads are completed at the optimal times while accounting for usage and enforcing usage budgets.
- **Grid- and Cloud-ready HPC** management to extend the benefits of traditional HPC environment to manage and share workload across multiple remote clusters to meet growing workload demand or surges.

The Adaptive Computing Advantage: One-Stop Solution for Oil & Gas

Adaptive Computing makes HPC simple and accessible for reservoir simulation and seismic processing. This eliminates duplication of data inputs across individual applications and solvers, eliminating errors, and improving the productivity and profitability of your oil and gas exploration and production. More importantly, it ensures integrated support for the entire solution. This one-stop solution for Oil & Gas includes a suite of integrated software products.

Moab HPC Suite - Application Portal provides a large, extensible set of industry specific application templates that make it simple for engineers to submit, run, and manage HPC workloads from almost any platform or device through a standard web browser.

Moab HPC Suite - Remote Visualization Edition improves visualization resource utilization by 50% by enabling shared visualization resources, reduces hardware costs by 45-50% through sharing of blades and GPUs, and improves staff productivity by 10-20% by eliminating data wait times for transfers.

The core Moab intelligence engine technology in Moab HPC Suite - Enterprise Edition has been patented and battle tested for over 10 years, making it uniquely able to mimic real-world decision-making. It can simultaneously factor and balance multiple dimensions such as current and future time and schedules, priorities and SLAs, workload requirements, and heterogeneous resources capabilities and current cluster events to make the most accurate and efficient scheduling and allocation decisions.

Adaptive Computing is the largest supplier of HPC job and workload management software today. 21% of HPC sites use our commercial and open source job and workload management software. Moab manages many of the Top 500 HPC systems in the world today, including the most powerful system (Titan), and at Fortune 500 companies. We make HPC work for end users.

For more information visit:
www.adaptivecomputing.com/products/hpc-products.

Contact a solutions advisor by phone or email, or visit our Web site today

North America, Latin America	+1 (801) 717.3700
Europe, Middle East, Africa	+44 (0) 1483 243578
Asia, Pacific, Japan, India	+65 6597-7053

Email: solutions@adaptivecomputing.com
www.adaptivecomputing.com

Corporate Headquarters
1712 S. East Bay Blvd. Suite 300 Provo, Utah 84606