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# *Maximizing the value of every molecule*

# A new approach to optimizing national oil company value chains

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# *Executive summary*

**National oil companies (NOCs) in resource-rich countries** should take a holistic approach to the management of activities across the oil and gas value chain. Whether they are emerging players developing the oil and gas sector based on newly discovered resources, or long-established companies managing mature and complex oil and gas operations, they have a common challenge: to maximize the overall benefit of hydrocarbon resources to the national economy.

Typically, NOCs have developed their oil and gas production, refining, and petrochemicals portfolios as a series of semiautonomous assets and companies. They tasked each asset with maximizing value within its own separate area of operations. Now, an increasingly volatile market outlook, growing complexity, and interdependent operations across the value chain, along with the requirement to manage multiple, potentially conflicting objectives make this a questionable approach.

Irrespective of their level of maturity, NOCs must respond by being more proactive in the management of their portfolio of operations. To do so, NOCs must standardize and align operational plans, address issues of fragmented and inconsistent data, develop new portfolio management tools and capabilities, and establish a culture of transparency and collaboration.

As an initial step, NOCs must develop an integrated approach to planning, linked firmly to national objectives and corporate strategies, and based on consistent and comprehensive data that provide the basis for the allocation of capital and resources across the portfolio. In addition, NOCs need new models of the end-to-end oil and gas value chain to identify bottlenecks and areas of misalignment, and to assess and quantify strategic options and trade-offs for the allocation of oil and gas to competing end-uses. The benefits of optimizing value chains are substantial for the financial performance of NOCs, and the achievement of broader national objectives.

# *Portfolio management challenges for NOCs*

NOCs play a central role in the development of the economies of resource-rich countries, which presents them with a specific set of portfolio management challenges. Resource-rich NOC portfolios are focused almost exclusively within their home countries, where they often manage assets across the value chain, linked by the physical flow of hydrocarbons from one asset to another. The challenge for NOCs is to maximize the overall value of the integrated portfolio rather than any single element. In addition, NOCs increasingly have a mandate that goes beyond profitability, to support the broader development of the non-oil economy and job creation.

NOCs at different stages of maturity face portfolio management challenges that demand that they adopt an integrated approach to the management of portfolios (*see Exhibit 1*).

*Exhibit 1*

**NOCs at different levels of maturity face a range of portfolio management challenges**

| | Maturity | | | |
|---|---|---|---|---|
| | **Emerging players** | **Sector developers** | **Resource custodians** | **National champions** |
| **Description** | NOCs in countries with recent discoveries under development | NOCs with growing production and nascent downstream | NOCs managing mature operations across the value chain | NOCs with a remit that extends beyond the oil and gas sector |
| **Examples** | Senegal – Petrosen<br>Mozambique - Empresa Nacional de Hidrocarbonetos<br>Tanzania – Tanzania Petroleum Development Corporation<br>Guyana – Guyana Oil Company | Iraq – North Oil Company, South Oil Company<br>Ghana – Ghana National Petroleum Corporation<br>Uganda – Uganda National Oil Company | Abu Dhabi – ADNOC<br>Kuwait – Kuwait Petroleum Corporation<br>Brazil – Petrobras<br>Mexico – Pemex<br>Indonesia – Pertamina<br>Malaysia – Petronas | Saudi Arabia – Saudi Aramco<br>Algeria – Sonatrach<br>Egypt – Egyptian General Petroleum Corporation<br>Angola – Sonangol |
| **Portfolio management challenges** | Developing plans for the longer-term development of the oil and gas sector | Executing projects and constructing infrastructure to develop the sector | Optimizing operations to maximize hydrocarbon recovery and portfolio value | Supporting national development objectives and economic diversification |

Source: Strategy& analysis

*Emerging players*
For countries at an early stage of development of the oil and gas sector, the key focus is on establishing production from newly discovered resources. This means ensuring that the capabilities for technical and regulatory oversight are in place, and that the contractual and legal environment is stable in order to attract investment.

However, even at this early stage, emerging NOCs also need to develop strategies and "road maps" for the development of the sector, which take into account future oil and gas supplies, along with potential end-uses. At this early stage, uncertainties in future production levels are high, and there are multiple options for meeting local demand and supporting broader economic development. Consequently, emerging NOCs need to develop and evaluate a wide range of future portfolio scenarios that take into account both profitability and the broader economic benefit of different options. For example, under certain assumptions, the profitability of an offshore oil discovery may be maximized by exporting all the oil. Conversely, national development objectives and the need to ensure security of supply may take priority and support a strategy of bringing oil onshore to feed a domestic refining operation. Such decisions, although seemingly simple, are dependent upon a wide range of uncertain variables, including production and demand outlook, product prices, and infrastructure development costs.

*Sector developers*
NOCs in the next stage of maturity have to focus on ensuring the portfolio is developed in line with the road map to meet key strategic objectives. As the oil and gas resource base becomes better defined, NOCs play a key role in developing the physical infrastructure, either directly or through their international partners. At this stage of their development, the portfolio management challenge for NOCs is the sizing and construction of key infrastructure. Typical portfolio questions might include the capacity of gas processing infrastructure, or the production capacity of refining and petrochemical facilities that they will develop. Although there may be less uncertainty at this stage, making the most efficient decisions will again require the evaluation of a range of possible infrastructure investments. For example, the strategy to export gas may be clear, yet the final investment in liquefied natural gas or pipeline export capacity requires further investigation of factors such as target markets, investment requirements, and production uncertainties.

*The challenge for NOCs is to maximize the overall value of the integrated portfolio rather than any single element.*

*Resource custodians*

Many of the world's largest NOCs act as custodians of national hydrocarbon resources. They have developed mature oil and gas sectors over many decades. They often have a specific mandate to maximize the value of hydrocarbons for the national economy. For these companies, growth has been driven primarily by stand-alone mega-projects. In some cases, upstream fields have their own processing and export infrastructure, and are developed by separate joint ventures. As a consequence, many more mature NOCs have been run as a series of strong, semi-autonomous asset organizations, with the role of the NOC "corporate" function limited to providing strategic guidance.

Although this model has served NOCs well in the past, its disadvantage is that collaboration and coordination between assets, and the ability of the NOC to manage the portfolio as a single entity, is often limited. Now, the era of stand-alone, independent mega-projects is coming to an end. Future growth will come primarily from field redevelopments and expansions, development of smaller fields through existing infrastructure, and integration of refining and petrochemical operations to capture operational and cost synergies. This increasing interdependency between assets, sometimes with overlapping footprints, means that NOCs need to consider how resources and infrastructure should be managed between assets in order to optimize operations across the integrated portfolio.

Maximizing value therefore requires mature NOCs to evaluate existing oil and gas flows across the portfolio, and make explicit decisions on the allocation of products to competing end-uses. For many NOCs this is particularly valid for the allocation of gas supplies among reinjection to increase oil recovery, fuel for power generation, feedstock for petrochemical production, or export.

*National champions*

In addition to their role as custodian of national resources, and major contributors to national budgets, NOCs in many countries increasingly play a broader role in building national capabilities that extend beyond pure management of the oil and gas sector. NOCs commonly provide quality employment opportunities and non-core services, such as healthcare and education. More recently, NOCs have often been tasked with supporting the diversification of the economy through the development of local suppliers, and through investment in alternative sources of energy. For these NOCs, investment and portfolio management decisions need to balance pure profitability considerations with the impact on broader development objectives, and make the trade-offs between objectives clear.

# *Barriers to NOC integrated portfolio management*

Recent volatility in the oil price, coupled with an uncertain outlook for global oil and gas markets, has forced NOCs across the maturity spectrum to focus on greater integrated portfolio management. The model of semiautonomous operating assets and entities managed primarily to meet ambitious production and output targets has changed for good. Mature NOCs in Abu Dhabi and Qatar have embarked on the merger of previously stand-alone joint ventures, whilst the need to make better use of capital is one factor behind the partial privatization of non-core operations in Abu Dhabi and Saudi Arabia. Government decisions to allow increased participation of international companies in Brazil and Mexico also reflects the need for NOCs to change their traditional models for managing their portfolios.

However, establishing integrated portfolio management capabilities requires companies to address a number of barriers that are common to many NOCs. These barriers often reflect legacy ways of working and include:

1. Fragmented, incomplete, or inconsistent data due to different data definitions, standards, and reporting procedures in the companies or assets within the portfolio
2. Diverse, non-standardized planning and portfolio management tools and systems, with inefficient links to technical systems, incompatible software platforms, and business planning schedules
3. Rigid organizational silos that encourage focus on optimization of business results for the individual organization entity, rather than the NOC as a whole
4. Key performance metrics that incentivize activities and operations within one organizational entity, but may be counterproductive for other organizational entities
5. Limited individual and organizational capabilities to identify, evaluate, and resolve critical cross-organizational and cross-functional issues
6. Culture and behaviors that discourage collaboration and the active sharing of data, insights, and pursuit of business improvement opportunities, across the NOC portfolio

# *A new approach to integrated portfolio management*

To overcome these barriers to integrated portfolio management, NOCs should take two complementary measures:

1. Establish an integrated planning and capital allocation capability
2. Develop new models to evaluate options for optimizing operations across the value chain

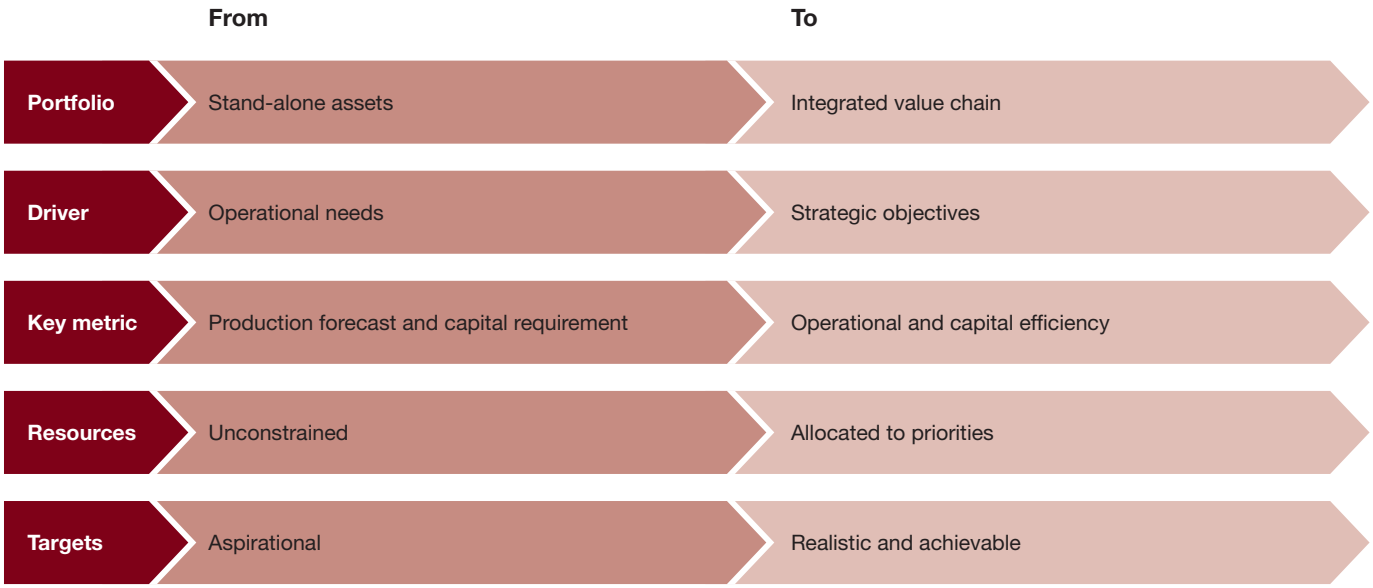
*Integrated planning and capital allocation*
NOCs first need to change their approach to planning and capital allocation to reflect the change from managing the portfolio as a series of stand-alone assets to a more integrated value chain (*see Exhibit 2, page 10*).

A typical NOC planning approach often considers the operational needs of the assets, particularly capital investment and resource requirements, to be the key drivers for the overall plan. Plans consolidate operational needs, such as funding requirements, with little consideration of interdependencies and trade-offs. The resultant NOC plan and targets are expressed primarily through key metrics of production forecasts and capital requirements. In many cases, production forecasts reflect aspirational targets, unconstrained by capital or capability limitations.

In contrast, an integrated planning and capital allocation approach starts with the strategic objectives of the NOC as the key driver along with an explicit consideration of how each element of the value chain will support these objectives. NOC strategies involve balancing multiple objectives and trade-offs, particularly between growth and profitability. Consequently, key metrics under an integrated planning approach are often based on operational and capital efficiency, rather than expressed primarily as top-down production or capacity targets. Financial and operational resources are allocated on the basis of priority, rather than bottom-up operational need, to those assets and activities that best support fulfilment of strategic objectives. Finally, a more integrated approach to planning and capital allocation, which incorporates constraints and reflects interdependencies, results in targets that are realistic and achievable, and forms a firm basis for the monitoring of corporate performance.

*Exhibit 2*

**NOCs first need to change their approach to planning and capital allocation**




Source: Strategy&

Putting this change of approach into action requires the implementation of six key planning elements:

1. *Strategic guidelines*: Articulation of strategic guidelines for each asset, function, or portfolio company that go beyond the simple cascading of corporate production targets to each entity. Such guidance may include, for example, expectations on the alignment of maintenance and shut-down programs, principles for the allocation of oil and gas across the value chain, or targets for the use and development of local service contractors in support of the local content agenda.
2. *Portfolio segmentation*: Definition of a consistent portfolio hierarchy, and segmentation of the portfolio at a level that is specific enough to link all capital and operating expenditures to the resultant production and financial outcomes. Resultant portfolio segmentation reflects the core building blocks of the portfolio, and acts as a basis for performance management.
3. *Data consistency and transparency*: Development of aligned definitions for key metrics across the portfolio, and the comprehensive capture of data in consistent formats that allow direct comparison between assets and portfolio companies.

4. *Portfolio review and challenge*: Implementation of a series of reviews of planning inputs. These ensure completeness of data input and, more important, act as a forum to review and challenge forecasts and key assumptions in the context of past performance.
5. *Project ranking and capital allocation*: Establishment of transparent procedures for the ranking of projects with respect to operational, financial, and other strategic targets, as a basis for the allocation of capital and resources.
6. *Planning governance*: Establishment of a body to govern the planning process, which includes representatives from across the organization to oversee the development of the plan, and drive collaboration and alignment between elements of the portfolio.

*Value chain optimization models*

Many of the most pressing strategic questions for NOCs cut across organizational divides, and involve decisions and trade-offs across the value chain that cannot be evaluated using a traditional approach to planning. NOCs therefore need to augment integrated planning, with new models to provide insights and support decision making that optimize activities across the value chain.

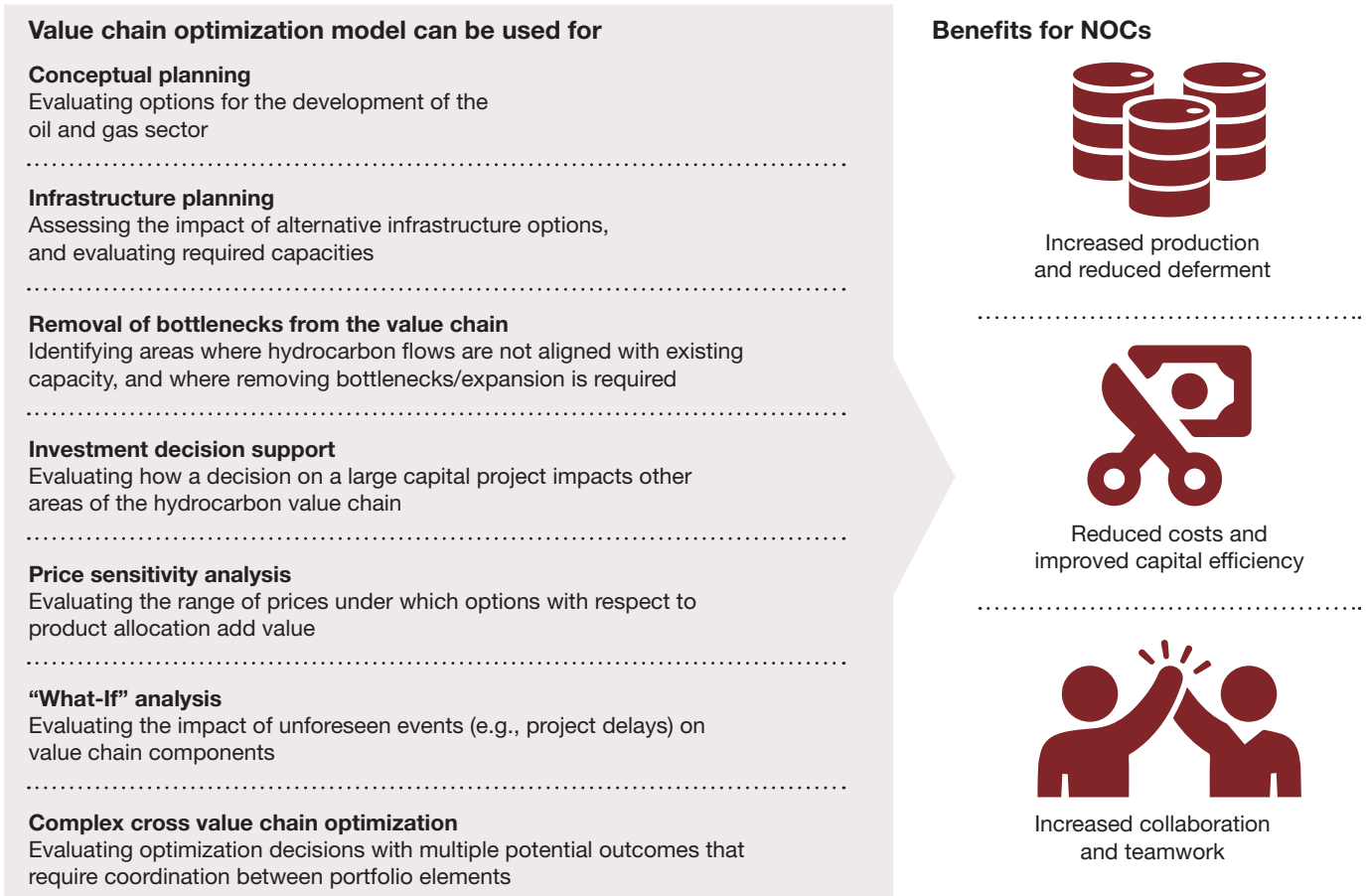
*NOC strategies involve balancing multiple objectives and trade-offs, particularly between growth and profitability.*

An illustration of the challenges involved in optimizing NOC portfolios is the dilemma that many NOCs face in the allocation of gas resources. Stakeholders in the gas value chain typically include upstream entities that produce and consume gas for pressure support in oil fields; gas-processing entities mandated to produce processed gas for domestic power and industrial consumers and meet gas export commitments; and downstream entities seeking to expand gas-based petrochemical production. Maximizing the value of gas resources requires the NOC to determine which of multiple options best meets profitability and non-financial strategic objectives, under a range of supply, demand, and price assumptions. However, under a typical NOC approach, each entity would have its own demands on gas supply that maximize the returns on its particular operations. Whereas all entities have the capabilities required to optimize *within* their own operations, the tools and processes to allocate *between* operations do not exist. The result is that the allocation of gas between entities is often ad hoc. Such an approach does not allocate gas according to priorities, and does not quantify the required trade-offs. Consequently, the overall profitability and non-financial benefits to the NOC and the national economy are not maximized.

Value chain models provide a range of clear and tangible benefits for NOCs (*see Exhibit 3*). At the early stage of NOC development, value chain models can be used to plan the conceptual development of the sector, and the planning and sizing of strategic infrastructure. The process of building a model is a powerful way of highlighting potential bottlenecks and areas of misalignment in plans for interdependent entities across the sector. With increasing interconnectedness of assets, value chain models highlight previously unidentified impacts of major planned investments across the value chain. The impact of product price and cost variations on the portfolio can be rapidly assessed without the need to evaluate each element of the portfolio separately. Furthermore, the impact of unforeseen events (for example, an unplanned shutdown of transportation or processing infrastructure) can be quickly understood, and mitigation plans developed. Finally, value chain optimization models are increasingly required to identify and evaluate complex cross value chain optimization opportunities as NOC portfolios mature and become more interconnected.

*Exhibit 3*

**Value chain optimization models have a range of uses and provide tangible benefits for NOCs**




Source: Strategy&

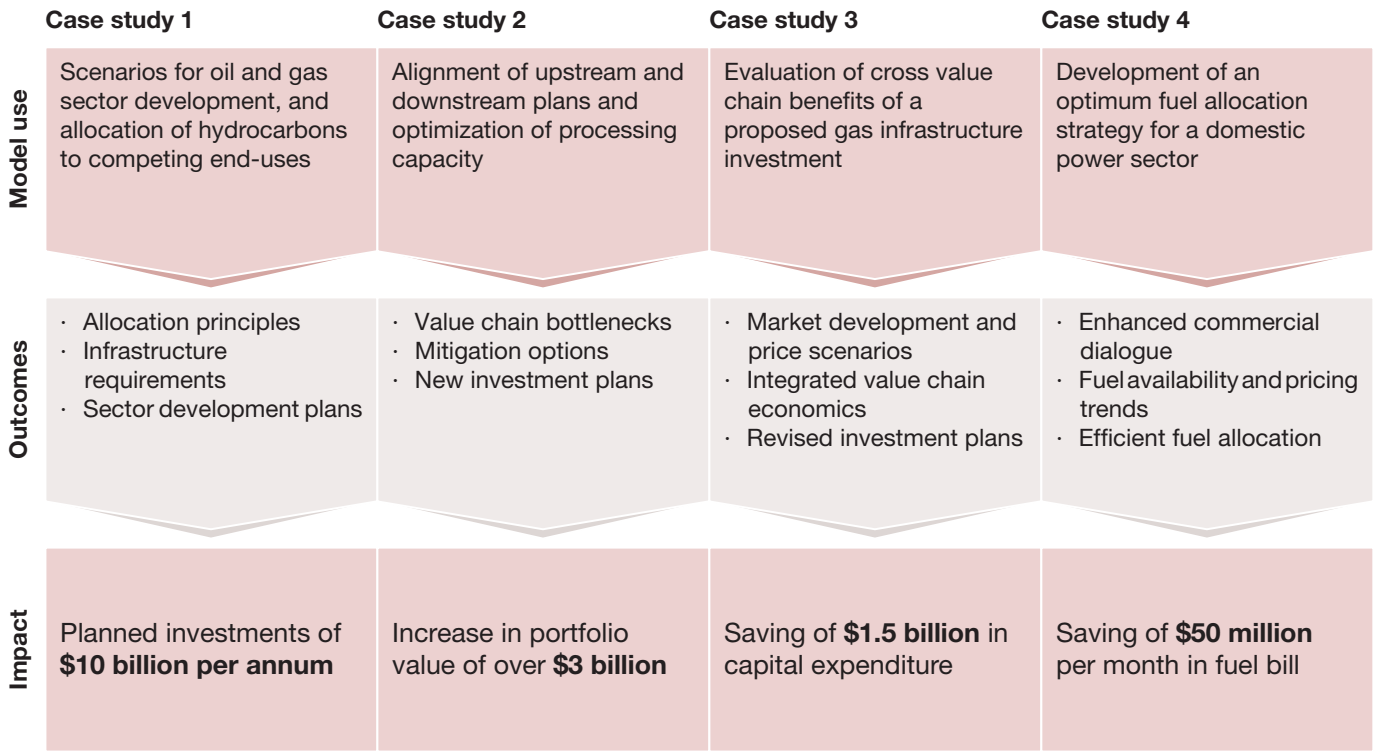
Specific improvements that result from taking a more holistic view of the portfolio include:

- Increased production through the identification and elimination of bottlenecks
- Reduction in costs, and improvement in capital efficiency, through alignment of plans between organizational entities, identification of synergies, and elimination of duplication
- Aligning behaviors in support of a more collaborative corporate culture through the establishment of a multi-disciplinary, cross-organizational team to develop the value chain optimization model

Recent experience demonstrates the strength and flexibility of value chain models in helping NOCs make sense of trade-offs and competing demands across the value chain, and the magnitude of the financial benefits (*see Exhibit 4*).

*Exhibit 4*

**Value chain optimization models have material and immediate benefits for NOCs**



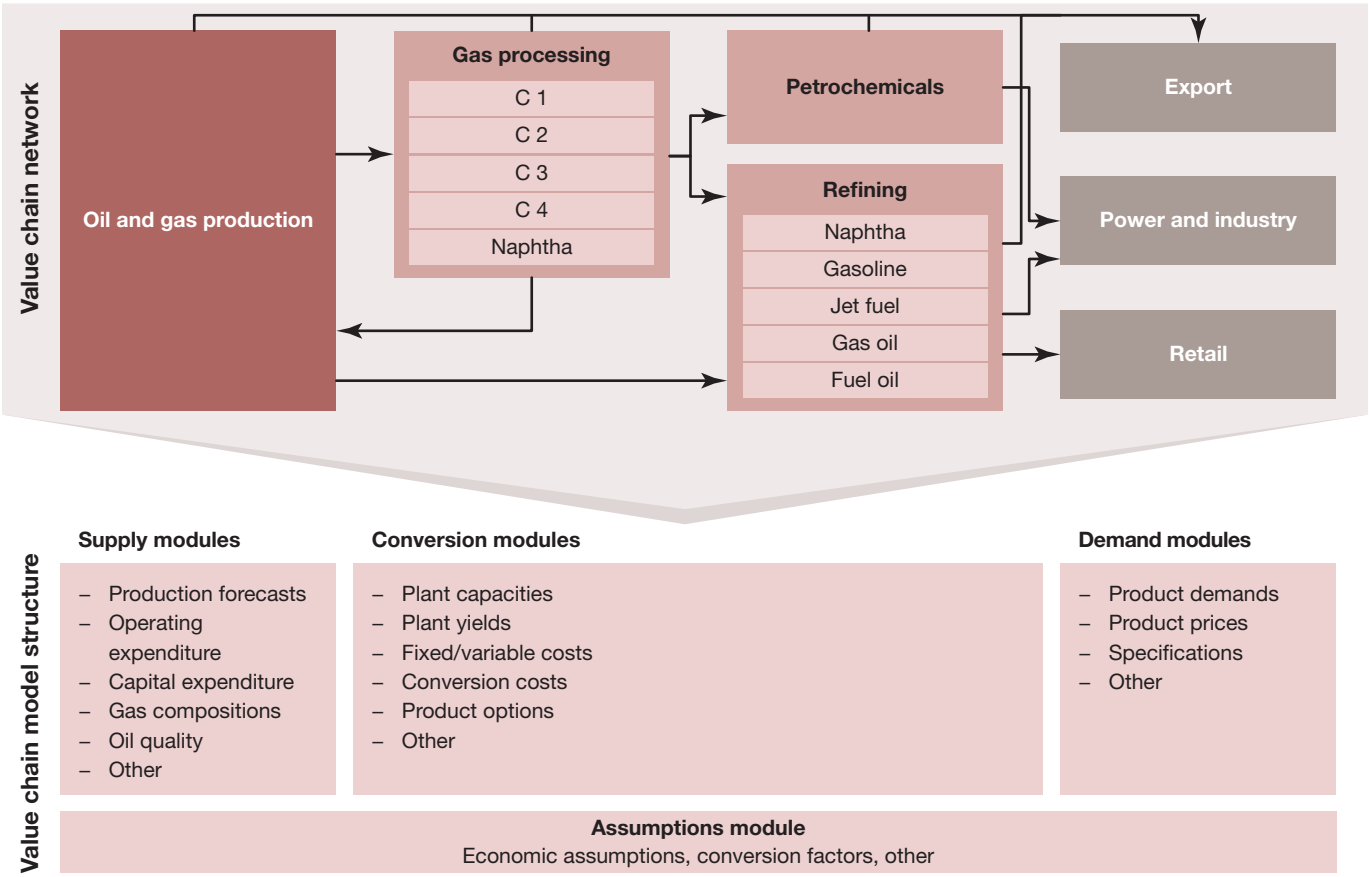

Source: Strategy&

Each value chain optimization model is unique and specifically tailored to each NOC's key challenges and objectives. However, in most cases, the development of a value chain optimization model starts with the mapping of the physical network of infrastructure and the actual and planned flows of oil, gas, and other products across the network. The second step is to identify the key nodes where alternative options for the allocation of hydrocarbons exist, or are feasible, for example in the allocation of crude oil to domestic refining or to export (*see Exhibit 5*). The third step involves converting the network into a numerical model that includes all key information required to develop scenarios and test the impact of different scenarios on the portfolio.

Much of the data required to populate the model, such as upstream production and operating cost forecasts, is derived from the integrated planning process. Additional information such as macroeconomic assumptions, plant capacities, plant yields, and conversion costs is added to allow the model to be able to calculate the value of each element of the portfolio in each scenario.

*Exhibit 5*

**Schematic oil and gas value chain network and optimization model structure**

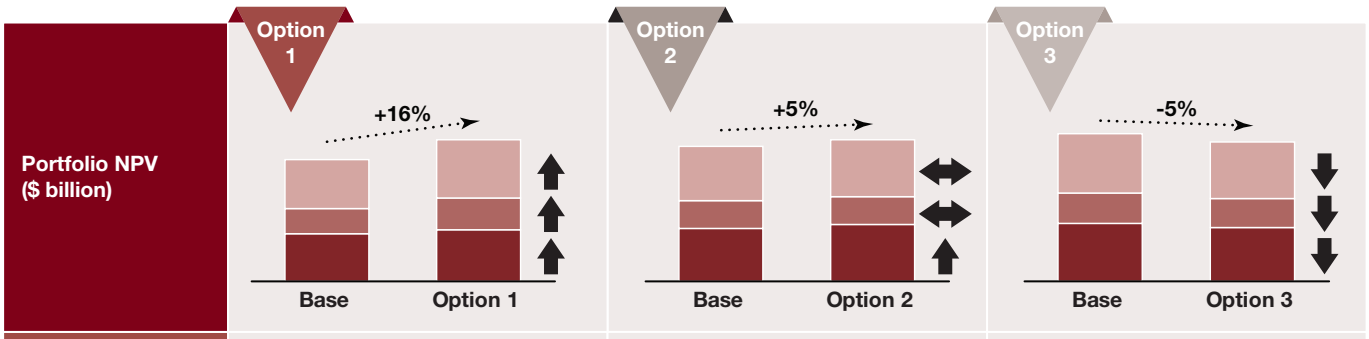



Source: Strategy&

Typically, the value chain optimization model will provide a "base" net present value (NPV) of the portfolio and each of its components, based on the latest integrated planning input data. The impact of potential alternative options on the portfolio's NPV can be assessed with reference to the base NPV, and each option characterized in terms of capital investment requirement and ease of implementation (*see Exhibit 6*). The most common approach is to optimize based on portfolio value. However, models are highly flexible and can be customized to investigate a wide range of parameters, for example, employment generation, power requirements, or greenhouse gas emissions.

*Exhibit 6*

**Value chain optimization models typically show the impact of options on base portfolio value**




Note: NPV = Net present value

Source: Strategy&

# *Conclusion*

The benefits of implementing an integrated planning process and developing a value chain optimization model can be immediate and tangible. Prioritizing projects and investments, and identifying and addressing bottlenecks, results in more efficient use of resources to maximize production and reduced deferment of production. This comes hand-in-hand with the increased ability to benchmark and optimize costs across the portfolio, and to direct capital toward the highest-performing assets. Finally, an important additional benefit to NOCs is the increased collaboration and teamwork that comes as a consequence of treating planning as an integrated exercise, and emphasizing the NOC portfolio as an integrated, interconnected set of assets that act together to maximize the value of every molecule of oil and gas resources.

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