

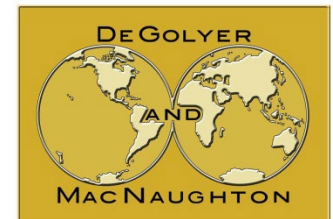
GEO INDIA 2022

Economic Evaluation

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October 2022

Jaipur, Rajasthan, India



Worldwide Petroleum Consulting

Presentation Outline

- ❑ Economics as a Critical Component of Assessment
- ❑ Common Economic Terminology
- ❑ Economic Sensibility Check
- ❑ PRMS Prices
- ❑ License Limits and Economic Limits
- ❑ PRMS General Reporting Guidelines
- ❑ Fiscal Systems Diagram
- ❑ Types of Fiscal Systems (SPE 37959)
- ❑ Concessionary Systems
- ❑ Contractual Systems
 - Production Sharing Contracts
 - Service Contracts
 - ❑ Risk Service Contracts
 - ❑ Pure Service Contracts

Executive Summary

Purposes of Economic Evaluation

■ Reserves Evaluation

- ❑ Reserves are defined as economic
- ❑ (A) Production to the economic limit
- ❑ (B) Validation of reserves cases

■ Asset Valuation

- ❑ Bottom-up approach
 - Based on reserves / reflects development plans
- ❑ Market applications
 - Mergers and acquisitions
 - Project financing
 - Stock exchange listing
- ❑ Management applications
 - Tracking of development projects
 - Project prioritization

Terms and Concepts

The following terms and concepts are common in economic analyses

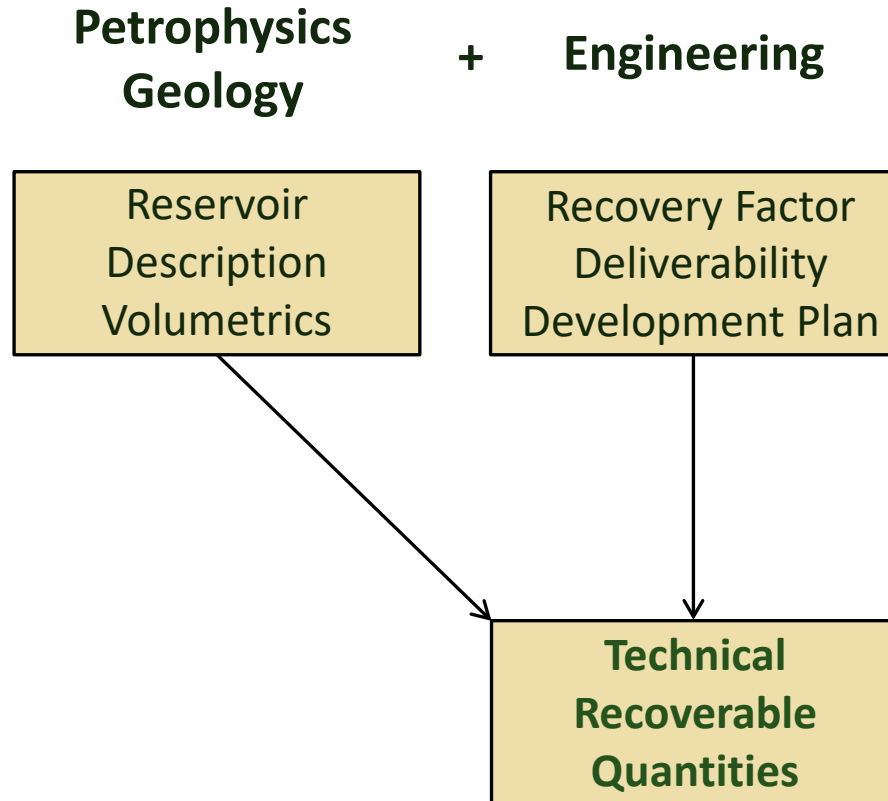
- Throughout the discussion, you will gain a better understanding of the following major terms in petroleum economics:

Abandonment	Net Present Value
Capital Costs	Netback Price
Contractor Entitlement	Operating Expenses
Cost of Capital	Present Worth
Cost Recovery	Production Sharing
Development Plan	Profit Sharing
Discount Rate	Royalty
Economic Limit	Taxable Income
Fiscal Regime	Unrecovered Costs
Future Net Revenue	

Economics in Reserves Evaluations

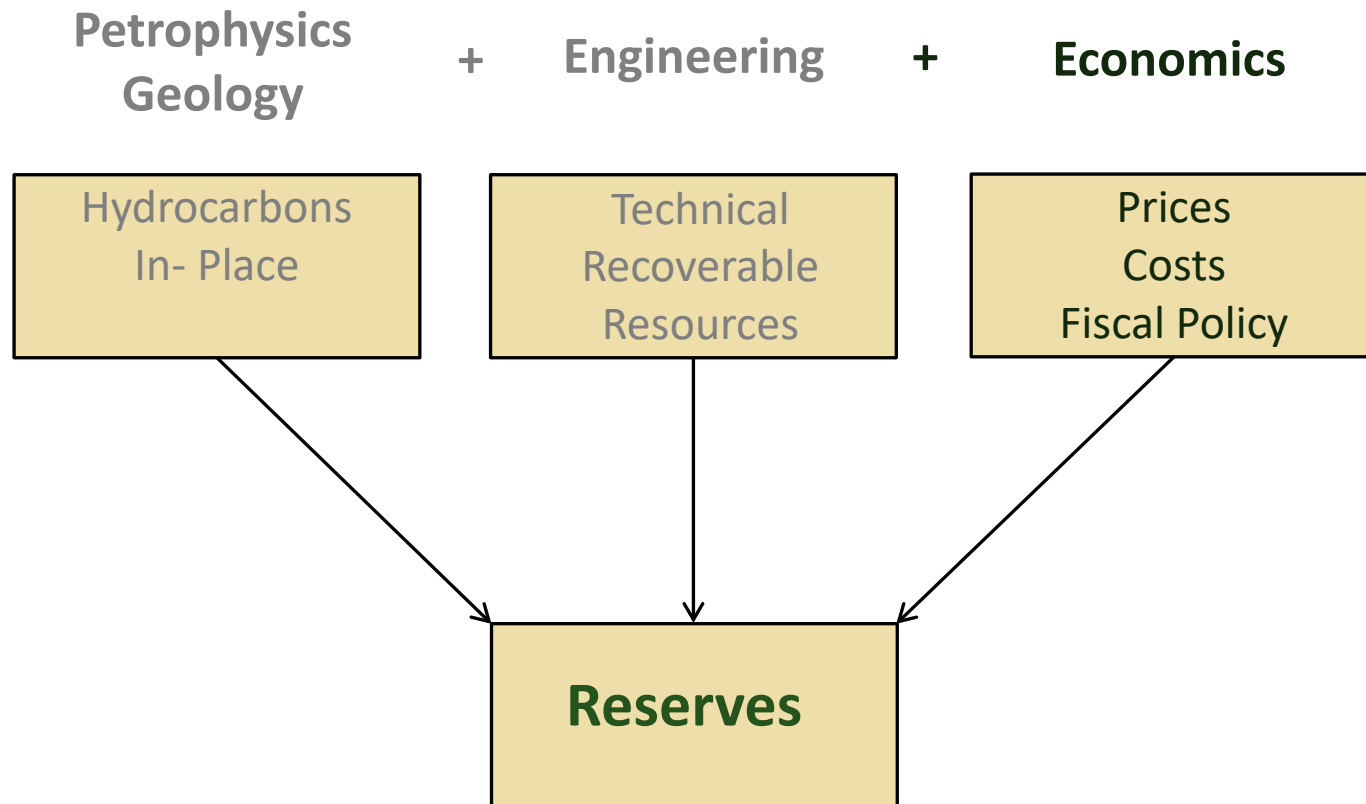
Economics in Reserves Evaluations

Economic analysis is used to determine reserves



Economics in Reserves Evaluations

Economic analysis is used to determine reserves



Common Economic Terminology

Key economic terms are defined below

- **Future Gross Revenue** – Revenue realized from the sale of the net reserves (products * prices)
- **Operating Costs** – Costs necessary to operate the field. Includes variable costs and fixed costs.
 - ❑ Variable costs dependent on production
 - ❑ Fixed well and facility dependent costs
 - ❑ Recurring costs
 - ❑ Offshore-high fixed costs, 70% fixed 30% variable
 - ❑ Onshore-30-40% fixed and 60-70% variable
- **Capital Expenses** – Funds used by a company to upgrade assets such as facilities and equipment.
 - ❑ Drilling costs
 - ❑ Facility costs
 - ❑ Major workover costs
 - ❑ Abandonment and reclamation cost
 - ❑ One time costs
- **Taxes** – Payments (usually in cash) to host governments, (local and federal) by companies involved in the extraction of hydrocarbons from the subsurface
- **Future Net Revenue** – Remaining revenue of the future gross revenue after deducting operating expenses, capital costs and taxes
- **Net Present Value** – Future net revenue discounted at a specific arbitrary rate over the life of the projection.

PRMS Prices

The following criteria are used when selecting and applying prices.

- Any price that is judged to be reasonable and supportable
- Examples:
 - ❑ Historical price using the SEC rule (annual average)
 - ❑ Recent historical price (i.e. sales price recent to the evaluation)
 - ❑ Forecasted prices from a credible source: internal plans, ministry forecast, consultant forecast, etc.
- Escalation
 - ❑ If price escalated, then operating costs should be escalated but not required
- Contracting
 - ❑ Sometimes prices are contracted into the future (sales agreements, etc.)

License Limits and Economic Limits

Just How Limiting are They for Reserves and Resources Reporting?

■ Economic Limit

- ❑ The End of Economic Life Based on Stated Conditions
- ❑ Reflective of Current Expectations
- ❑ Anything After the Limit Implies Another Class of Resources

■ License Limit

- ❑ End of a Contract or Agreement
- ❑ May be Negotiable
- ❑ While Not an Economic Limit, It May be the End of Commerciality



License Limits and Economic Limits

The economic limit is the production rate at which a project, field, reservoir, or well is uneconomic to produce.

- Operating Cost + Taxes (income taxes excluded) exceed revenues (FNR is negative)
- May be estimated on a daily, monthly, or annual basis
- Reserves may not be estimated for production below the economic limit
- Abandonment costs are a consideration when a project is undeveloped
- Following development, abandonment costs are included in economics but future net revenue going forward does **not** have to be greater than abandonment costs.

License Limits and Economic Limits

The undeveloped project economic forecast below gives a visualization of cash flow components.

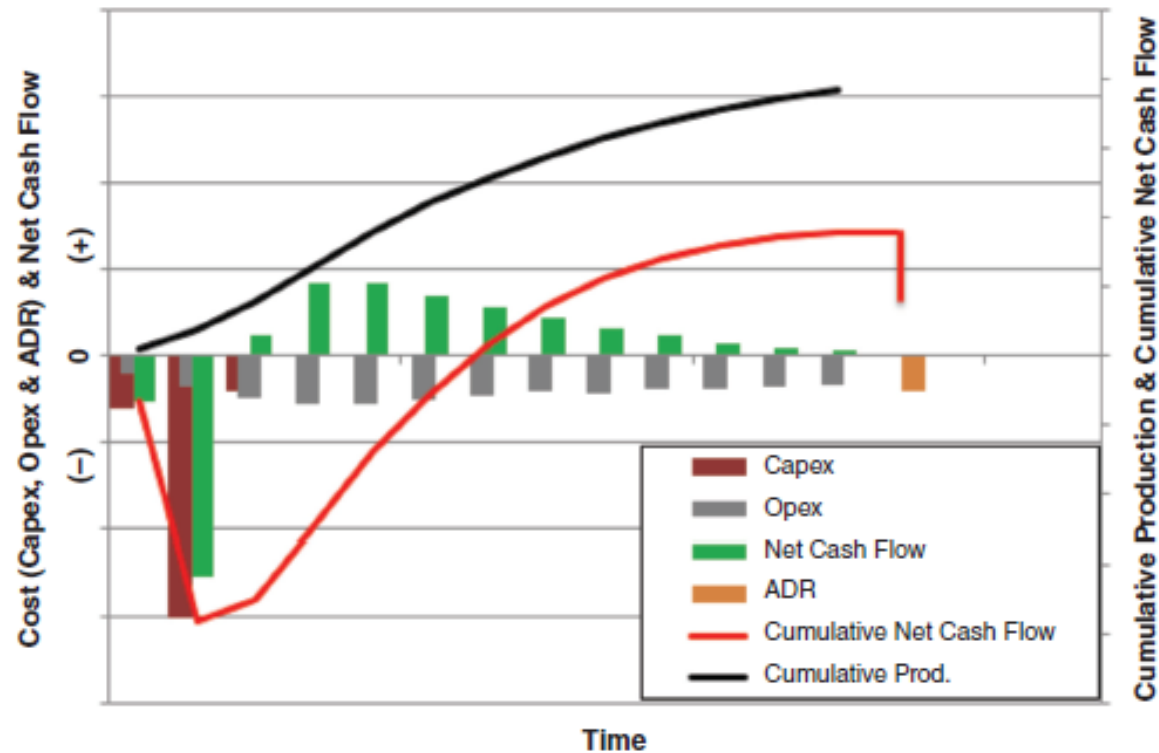


Figure 3.1—Undeveloped project economic forecast

License Limits and Economic Limits

Just How Limiting are They for Reserves and Resources Reporting?

■ Economic Limit

- ❑ After the Limit=Contingent Resource
- ❑ Economically Not Viable
- ❑ Where is the Cutoff for CR?

■ License Limit

- ❑ What You Do is Informed by Three Main Criteria
 - Is the License Extendable (within the Agreement)?
 - Is there a Track Record of Extensions?
 - Are Terms Fixed?

License Limits and Economic Limits

The following questions can help establish how to correctly apply license limits.

■ License is Extendable On Its Own Terms

- ❑ Is it Automatic, Administrative, Negotiated
- ❑ Reserves Can Include Consideration of That Term

■ Track Record?

- ❑ Established History

■ Terms

- ❑ Should You Use Current Terms? How Long?

■ Separate 'Project'?

- ❑ Perhaps an Extension is Its Own Project
- ❑ Contingent Resources Separate from Reserves



PRMS General Reporting Guidelines

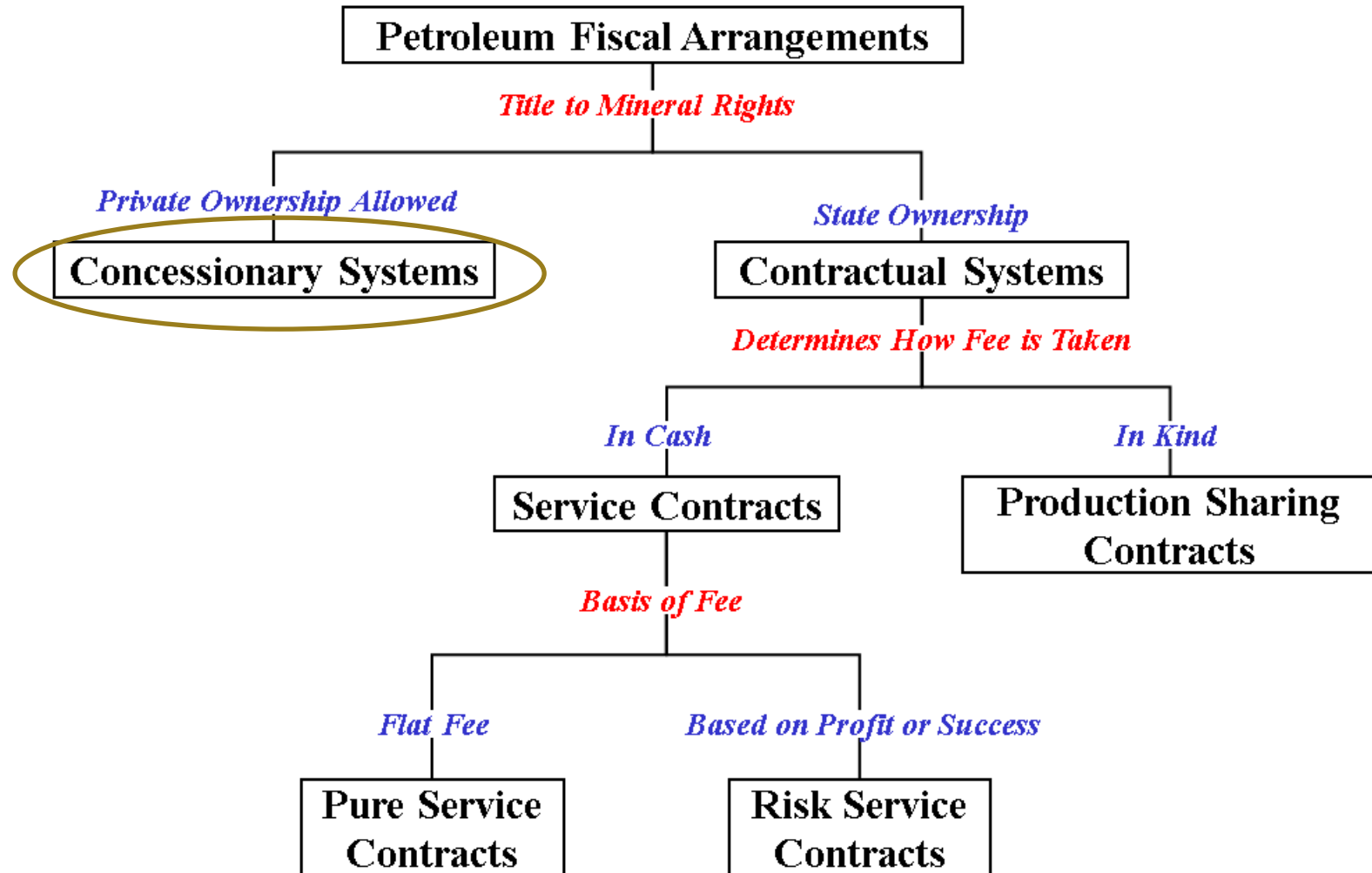
The PRMS states the following in terms of units, present worth, and costs applied to valuation.

■ PRMS

- ❑ Units – not specified
- ❑ Present worth – at any selected rate of return
- ❑ Escalated costs – If prices are escalated, then costs should be escalated. Otherwise, to escalate costs is a decision for the company.
- ❑ Overhead costs – Only those costs that can be directly attributable to field activities should be included

Fiscal Systems Diagram

The following fiscal arrangements can be applied when performing resources evaluations.



Concession Agreements

The main features below apply to Concessionary Systems.

- ❑ Contractor owns production
- ❑ Reserve entitlement based on agreements
- ❑ Contractor pays taxes on profits
- ❑ Contractor owns the equipment and may be responsible for cost of abandonment

Concession Agreements

The common elements of concessionary systems are listed below.

- ❑ Modern agreements
- ❑ The concession area is limited
- ❑ Provides for progressive relinquishment
- ❑ Duration is limited
 - Exploration usually 6 to 12 years
 - Exploitation usually 20 to 50 years
- ❑ Employment of nationals is encouraged and expatriates limited
- ❑ Host country receives reports and participates in decision-making process
- ❑ Contains work obligations
- ❑ Host country participation

Concession Agreements

The principal international oil producing provinces where concession agreements are in effect.

- ❑ North Sea (Norway, Netherlands, Denmark, United Kingdom)
- ❑ Europe
- ❑ Australia
- ❑ Russia
- ❑ Argentina
- ❑ Colombia
- ❑ Brazil

Concession Agreements

Basic economic elements of concession agreements are listed below.

❑ Basic economic elements of concession agreements

■ Royalty

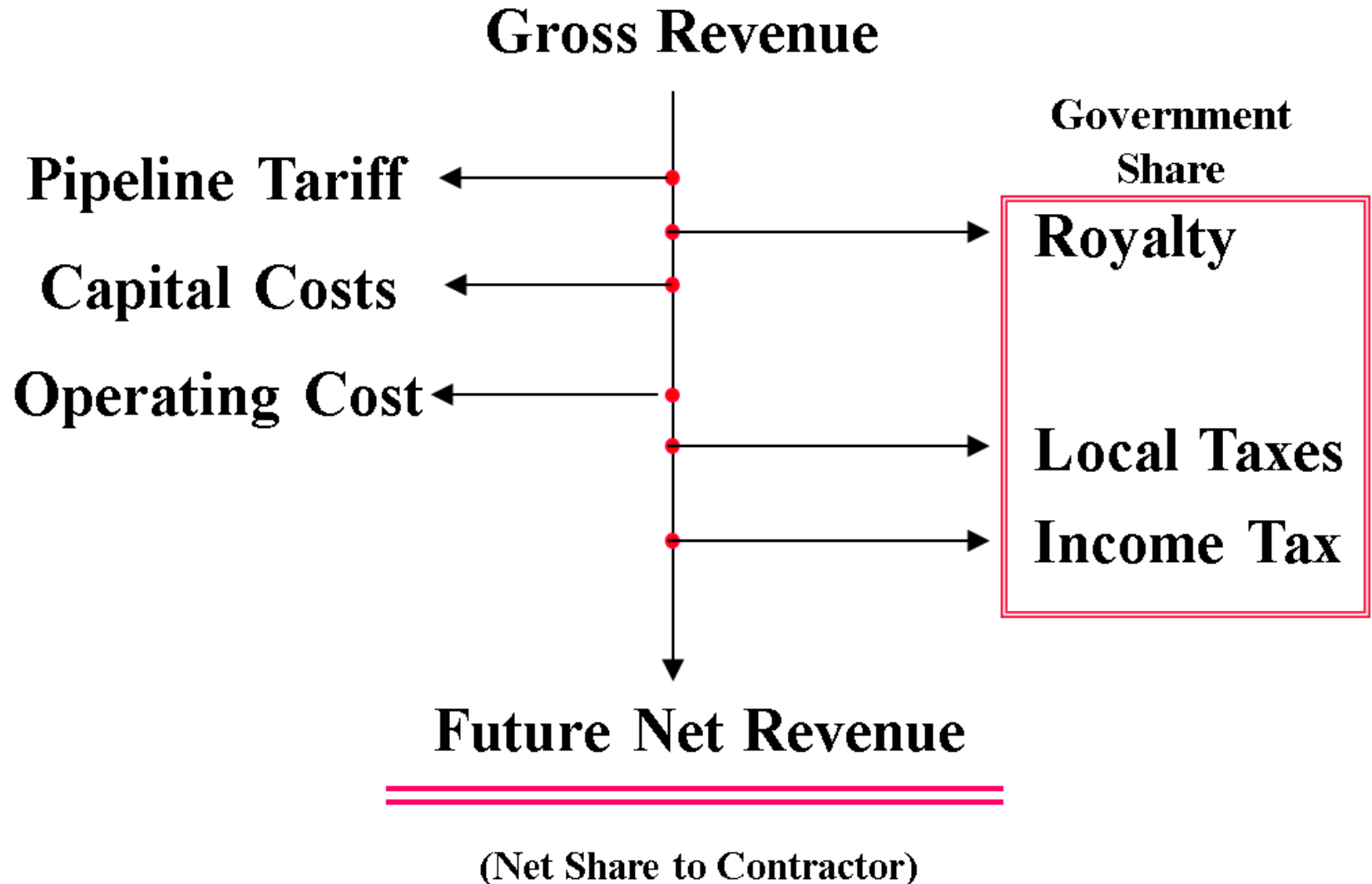
- ❑ Share of petroleum belonging to the holder of the mineral rights
- ❑ Not included in some PSA contracts
- ❑ If taken in kind – reserves are reduced (U.S. and Columbia)
- ❑ If taken as cash – treated as expense (Austria and Brazil)
- ❑ $\text{Royalty} = \text{Production} \times \text{Wellhead Price} \times \text{Royalty \%}$

■ Tax

- ❑ Production tax
- ❑ Income tax

Concession Agreements

The flow chart below describes the cash flow elements of a concession agreement.



Concession Agreements

The equation of a concession agreement is represented below.

Concession Agreement

Net

$$\begin{aligned} \text{Production} \times \text{Price} = & \text{Gross Revenue} \\ & - \text{Royalty} \\ & - \text{Operating} + \text{Capital Costs} \\ & - \text{Production Taxes} \\ & - \text{Income Taxes} \end{aligned}$$

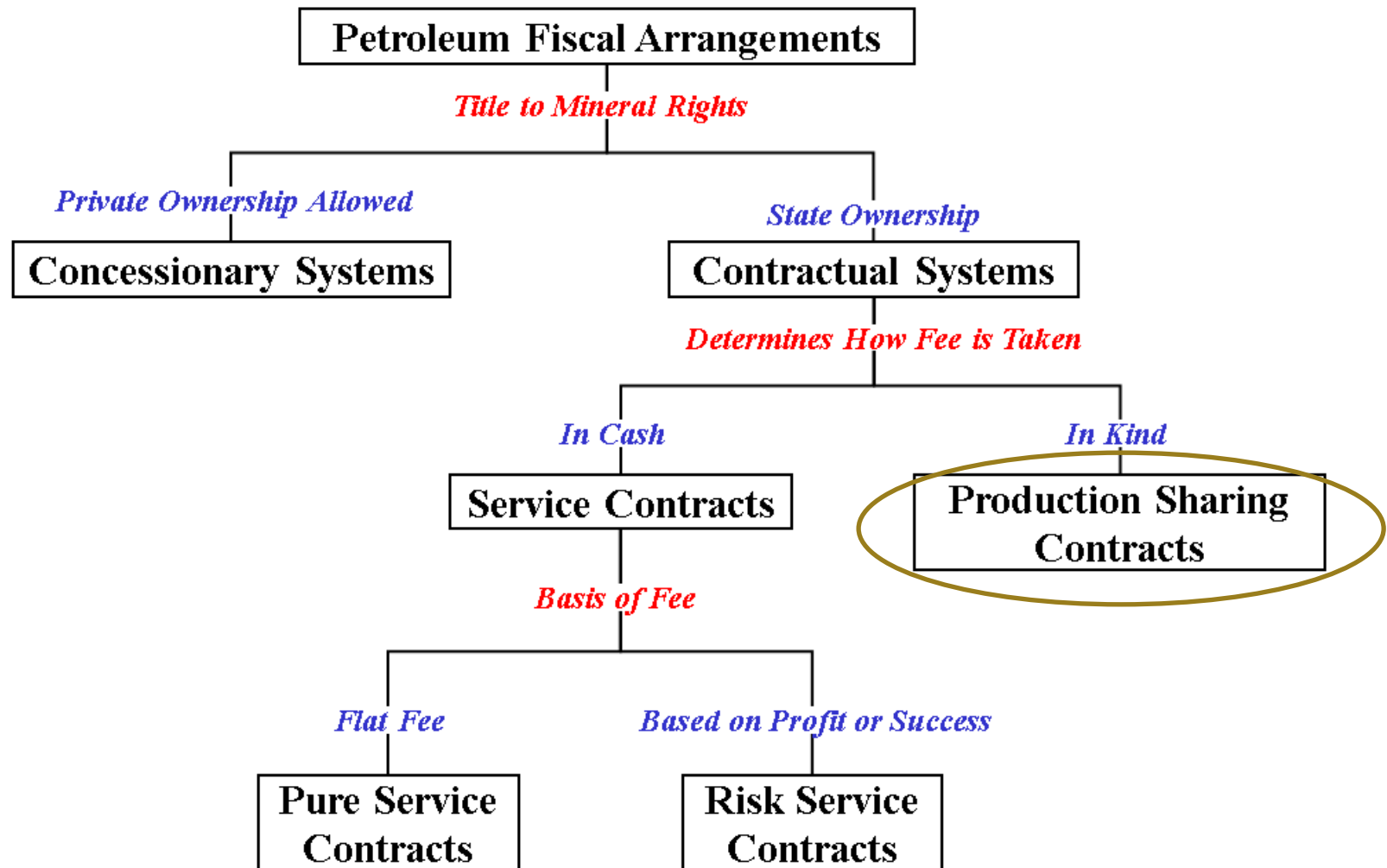
Net Cash Flow

less 10% discount

NPV @ 10% or SMV

Production Sharing Contracts (PSC)

A PSC is an “In Kind” contractual fiscal arrangement.



Production Sharing Contracts

The main features below apply to a PSC.

- ❑ Contractor operates at sole risk and expense
- ❑ Contractor is entitled to recover costs
- ❑ Balance of production is shared on a predetermined basis
- ❑ Contractor's share is liable for taxation

Production Sharing Contracts

The principal international oil producing provinces where PSA's are in effect.

- Africa-Angola, Algeria, Egypt, Nigeria, Mozambique
- Middle East/Asia – Uzbekistan, Yemen, Oman, Thailand, Malaysia, Vietnam

Production Sharing Contracts

The following significant features apply to PSC's.

- ❑ Cost recovery
 - Costs recovered from annual production
 - Capital costs generally amortized for cost recovery
 - Un-recovered balance can be carried forward sometimes with interest
- ❑ Profit Share
 - Compensates contractor for services provided and risks assumed
 - Compensates government in lieu of production taxes
 - Production remaining after cost recovery and is shared using any of several different schemes
 - ❑ Straight percentage
 - ❑ Based on contractor's cumulative cash flow
 - ❑ Based on an "R" factor table

Production Sharing Contracts

The key terms listed below are unique to PSC's.

■ Cost Oil

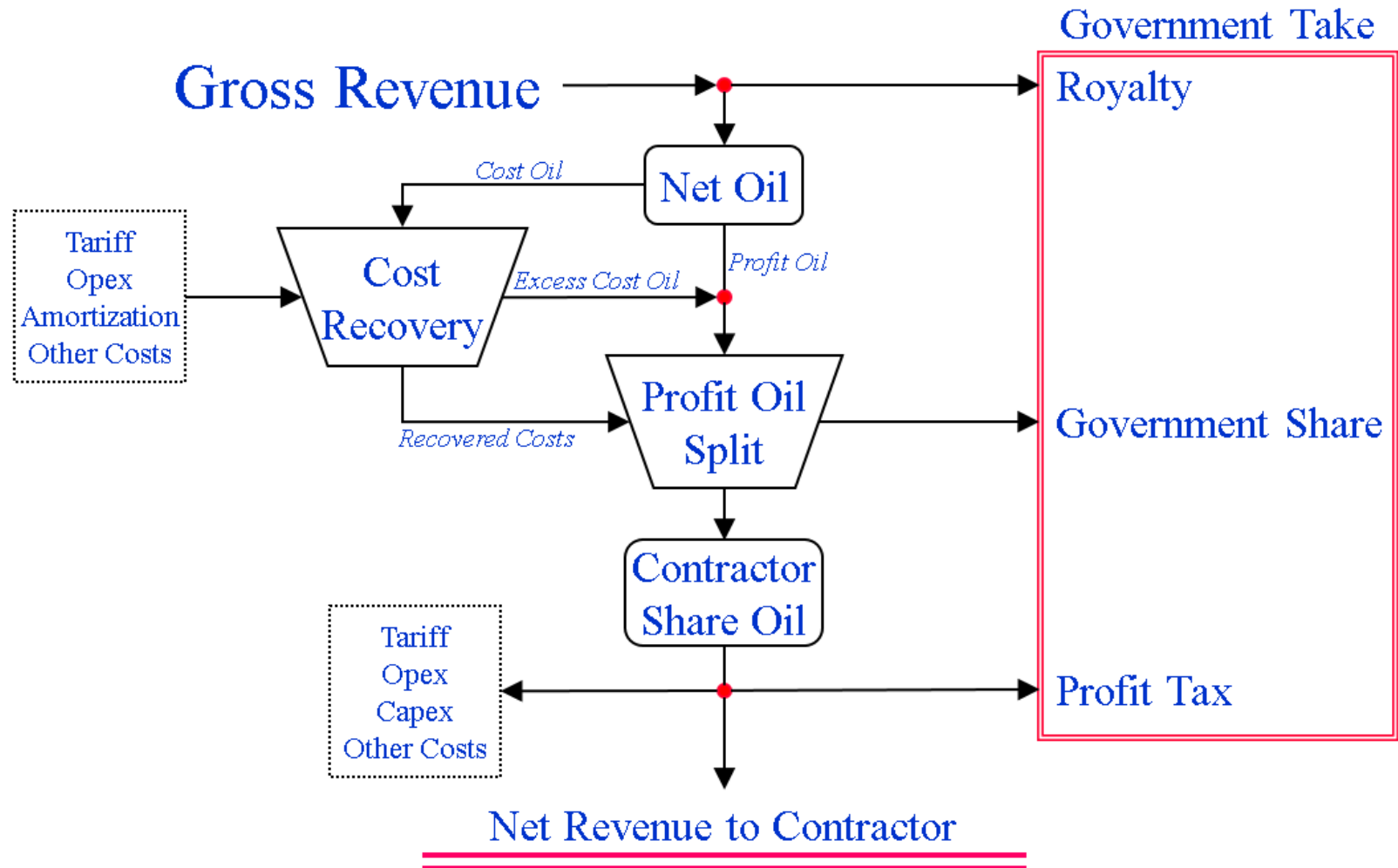
- Oil or revenues used to reimburse the contractor for exploration capital costs, development capex, and operating expenses (most PSC's have a limit on the percent of revenue that can be used as cost oil each year, the balance can be carried forward).

■ Profit Oil

- Revenue remaining after royalty and cost oil have been removed which is split between the contractors and government based on the PSC terms, the contractors portion will usually be taxed.

Production Sharing Contracts

The flow chart below describes the cash flow elements of a PSC.



Production Sharing Contracts

The equations below are unique to a PSC.

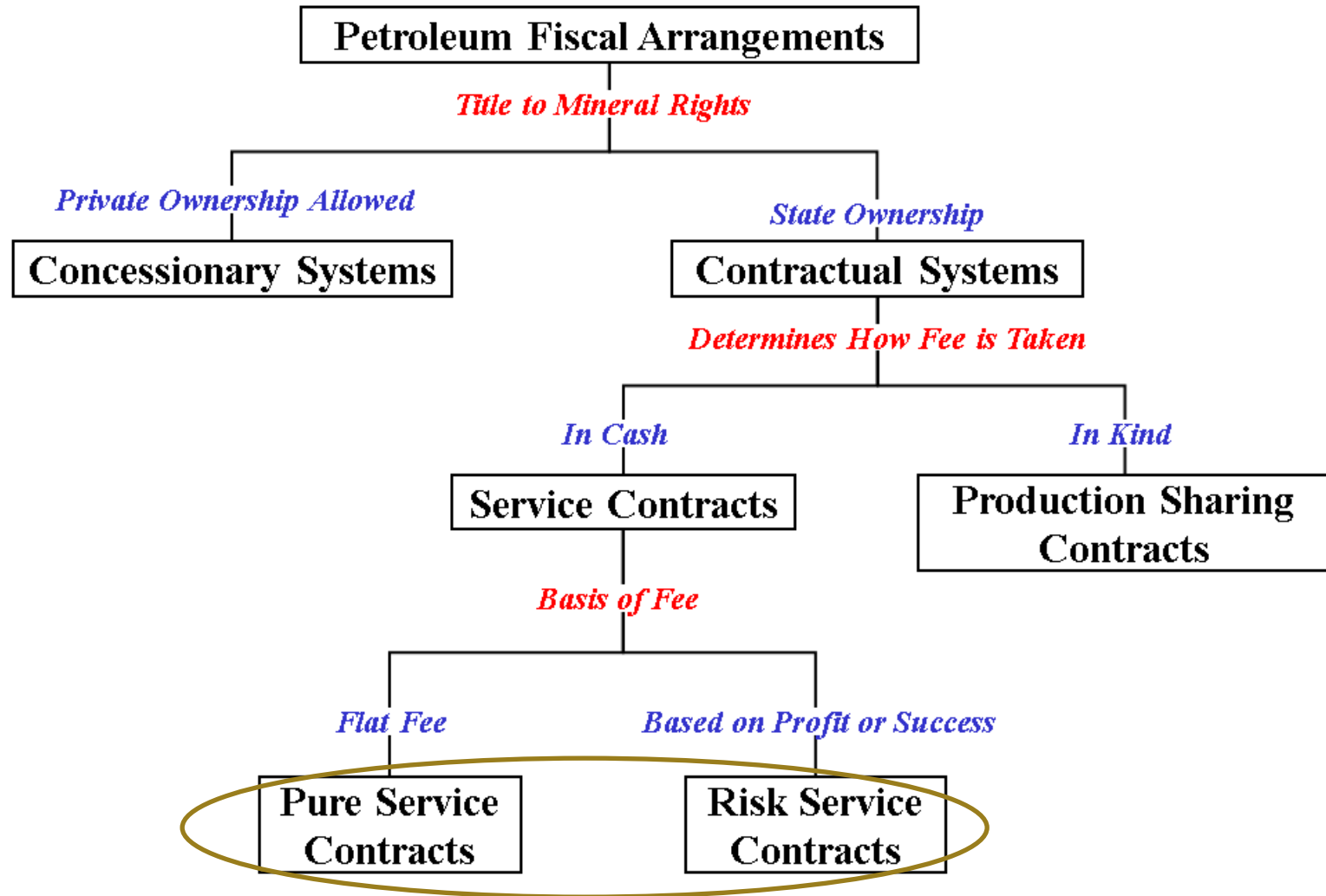
PSC ***Revenue or Net Interest***

Net Revenue Interest = Net Entitlement Share

$$\frac{\text{Cost Oil} + \text{Profit Oil}}{\text{Oil Price}}$$

Service Contracts

Service Contracts are “in cash” contractual fiscal arrangement.



Service Contracts

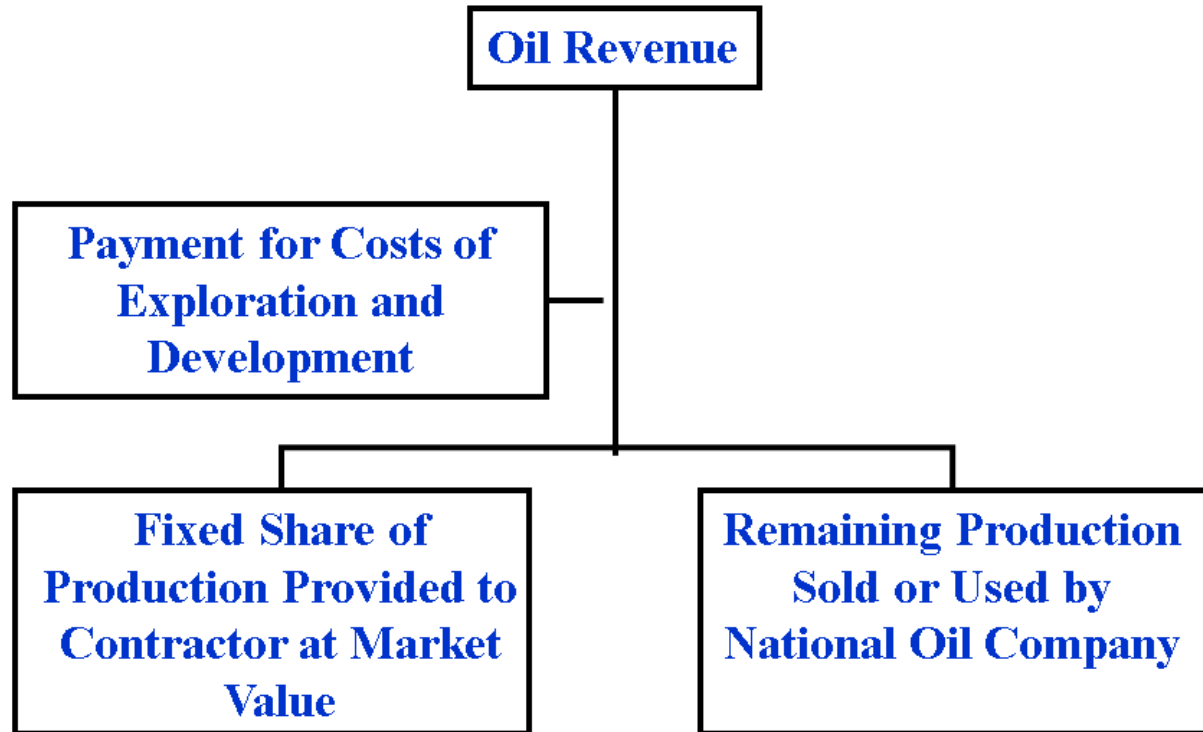
The main features below apply to a Risk Service Contract.

- ❑ Cost recovery and remuneration made in cash
- ❑ Contractor may purchase production at a discounted price
- ❑ National oil company is sole owner
- ❑ Contractor provides technical and financial services
- ❑ Work program is carried out at sole cost and risk of the contractor
- ❑ Generally the contractor operates the field
- ❑ Funds provided by the contractor are reimbursed over a specified period
- ❑ Sometimes termed Latin America PSC

Service Contracts

The flow chart below describes the distribution of revenue within a Risk Service Contract.

Risk Service Contract



Service Contracts

The main features below apply to a Pure Service Contract.

- ❑ Contractor provides technical skills and finances development phases.
- ❑ Contractor hands over operations to NIOC after development phase.
- ❑ Contractor reimbursement
 - Development and Operating Costs
 - Bank Charges
 - Cost reimbursement value defined by contract
 - Remuneration value defined by contract
 - Reimbursements in kind

Production Measurement

The reference point is a key decision criterion for estimating resources.

- May Seem Simple
- Not Directly Prescribed in Most Definitions
- Potential Reference Points
 - ❑ Sales Point
 - ❑ Custody Transfer
 - ❑ Property Boundary
 - ❑ Wellhead, Plant Outlet, or Other
- Important Ramifications

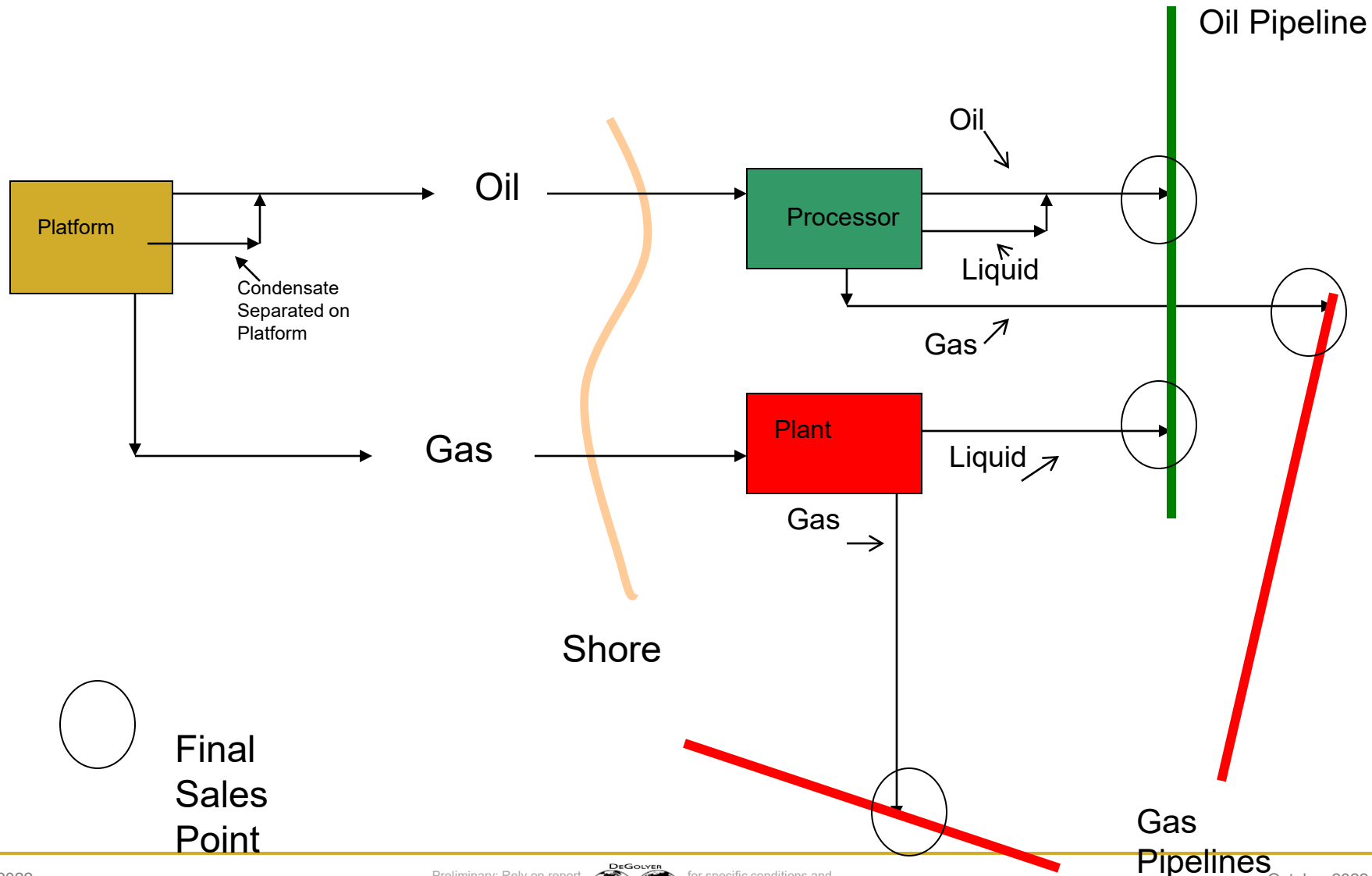
Production Measurement

The following considerations must be addressed when deciding a reference point.

- Match Between Accounting and Engineering
 - ❑ Desirable but Not Necessarily Optimal
 - ❑ May Not be Possible
- Limited to Actual Points of Measurement
- Can Influence Reported Volumes
 - ❑ Wet Gas versus Dry Gas
 - ❑ Competitive Situation
 - ❑ Several Approaches Considered Reasonable
- Important Ramifications

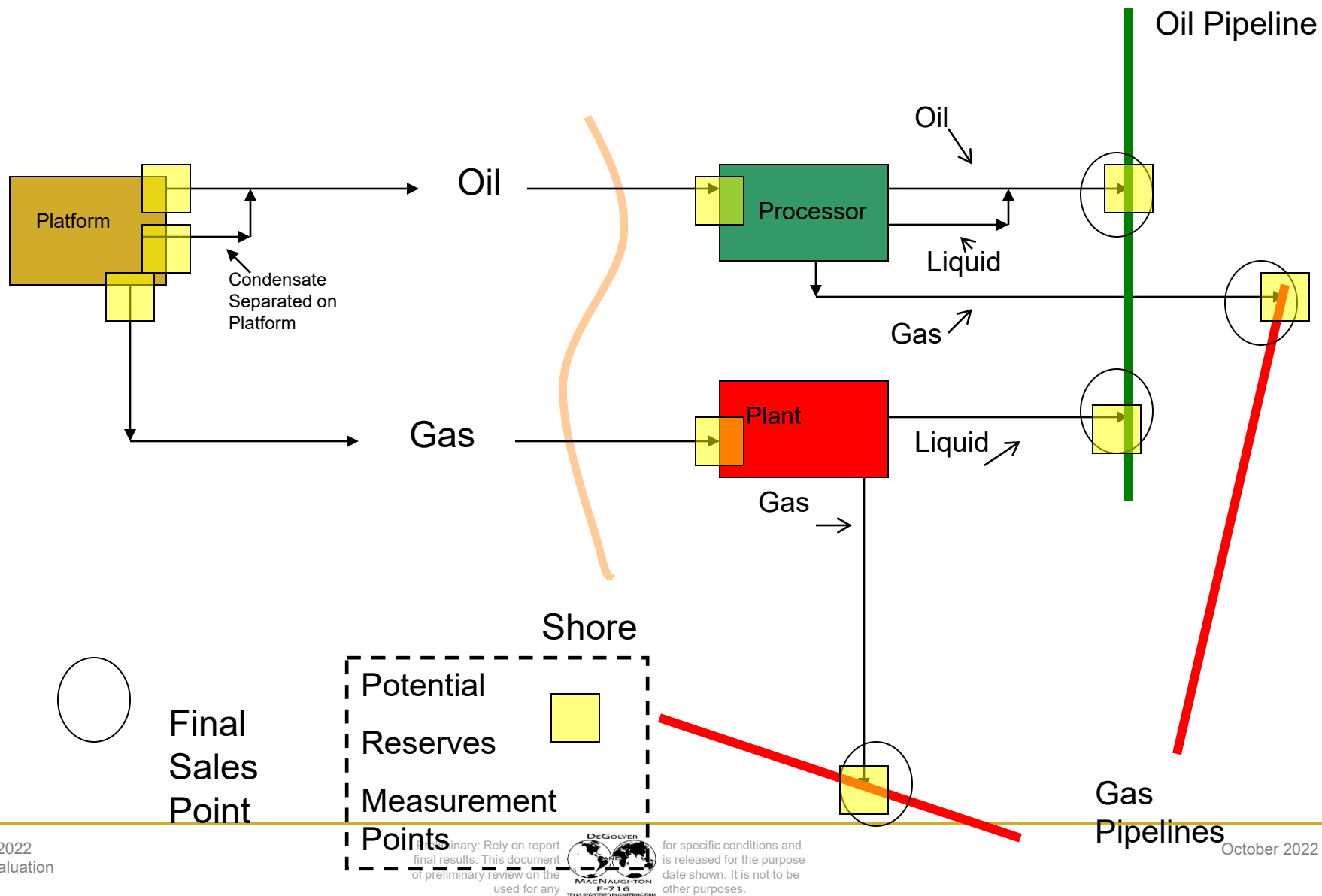
Production Measurement

The graphic below shows example reference points.



Production Measurement

The graphic below shows alternate reference points.



Production Measurement

The following are considered during production measurement.

- Allowed to Include Volumes on an “As Sold” Basis
 - ❑ Deliberate Overstatement Not Allowed
 - ❑ Prefer Impurities to be Small Part of Total
 - ❑ BTU Basis Handled in Multiple Ways
- Contractual Preferred (not experiential)
- Can be Reasons to Report Downstream of Sale Condition
 - ❑ Alignment with Other Properties
 - ❑ Concern with Overstatement
 - Heavy Oil/Synthetic Oil
 - High CO₂ Gas

Production Measurement

Consumed in Operations is that portion of petroleum consumed as fuel before the reference point.

■ Fuel

- ❑ Can be Included in Reserves or Resources
 - Not Preferred in PRMS but Allowed
- ❑ Should be Clearly Denoted or Footnoted

■ Flare

- ❑ Cannot be Reported as a Reserves Volume
- ❑ Included in produced quantities to account for total reservoir voidage.

Production Measurement

Special Situations to consider when deciding how to measure production.

■ Overlift/Underlift

- ❑ Typically Not Reflected in Net Reserves
- ❑ Balance Sheet
- ❑ Acquisition, Settlement, Similar

■ Gas Storage

■ Purchased Crude or Gas

- ❑ Must be included as operating expense

■ In Kind or In Cash?

- ❑ Royalties and Other Payments/Receipts
- ❑ Net Profits

Commerciality and the Ability to Market

In some instances, commerciality is blocked due to lack of a market outlet.

■ Examples:

- ❑ Gas Projects with No Buyers: Australia, Indonesia, Canada, Africa
- ❑ Proposed Processing Plants with No Transportation or Purchasers: Tanzania, Egypt, Algeria, South America
- ❑ Oil Projects without Pipeline to a Sales Point: Kazakhstan, Venezuela, Peru, Canada

■ What is Required to Establish a Commercial Market*?



Commerciality and the Ability to Market

What are the Requirements?

- A Commercial Market is Established by Multiple Factors
 - ❑ Buyer and a Known Price
 - ❑ Transportation and Associated Costs
 - ❑ Infrastructure to Facilitate Transport/Purchase/Disruptions
 - ❑ All Must Conspire to Create an Economic Viability
- Establishing Buyers
 - ❑ Gas Contracts and Liquids Purchase Agreements
 - Duration, Pricing, Stipulations (Minimum Take, Take or Pay, etc.)
 - Longevity/Dependability/Arms-Length
- Establishing Transportation to Create an Outlet
 - ❑ Physical Capacity
 - ❑ Dedicated Volume
 - ❑ Tariffs, Capital Provision, etc.
- Infrastructure

The Buyers

Assuming You are Willing to Sell...

■ Contracts to Purchase

- ❑ Most Direct but There are Details to be Worked Out
- ❑ Price
- ❑ Duration
- ❑ Stability

■ Ongoing Demand Market

- ❑ Spot Markets
 - Depth and Breadth
 - Longevity
 - Buyer Stability
 - North America Gas, North Sea Gas, North Africa to Europe, Indian Ocean LNG, European Spot, Australasia Buyers Market
- ❑ Multi-Party Markets
 - What is the Critical Mass?
 - Is It Reliable Enough for Forecasting
 - ❑ Reasonable?
 - ❑ With or Without Risk?



Transportation

Can't Sell It if You Can't Get it to the Buyer

- Can be a Non-Issue but Particularly Important in Remote Venues
- Seller or Buyer Responsibility
 - ❑ Both Ways Can Work if Economics Support It
 - ❑ Often Can Involve a Third Party
- Design
 - ❑ Fit for Purpose or Existing or Broader Mid-Stream Vendor
 - ❑ Capacity Impacts Field Development and Production Rates
 - Does Seller Have a Dedicated Volume (Min, Max, Fixed?)
 - ❑ Downtime Should be Expected and Built Into Analysis
- Cost
 - ❑ Per-Unit Tariffs
 - ❑ Capital Arrangements without Ownership-Imputed Cost Per Unit
 - ❑ Outright Lump Sum Capacity Capture (Duration? Volume? Open?)

Economics in Reserves Evaluations

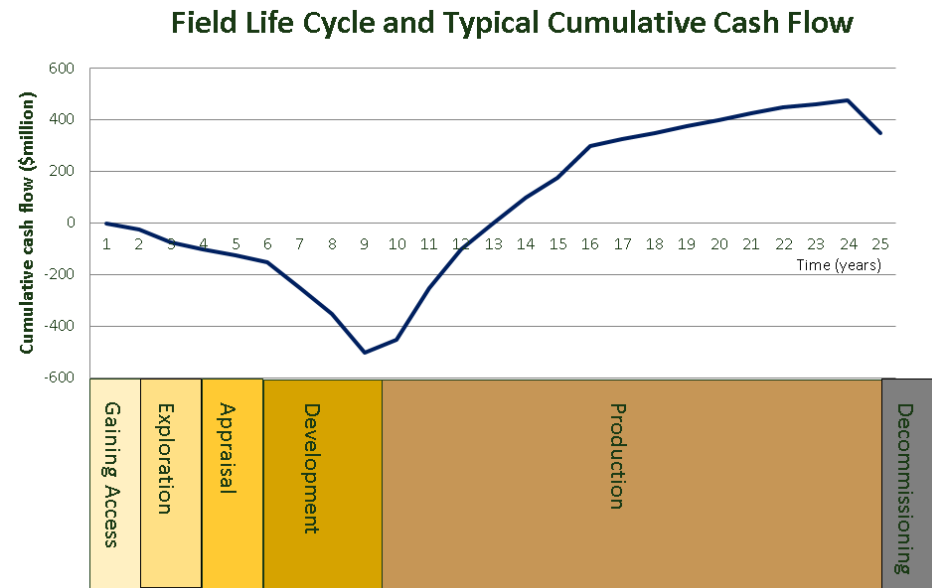
Revenues, Costs, and Taxes are calculated using varying inputs depending on the field

- Each input must be forecasted into the future to evaluate economics in each year of technical projections
- Economic forecast streams can be generally categorized as:
 - Revenues, considering:
 - Production profiles, current prices and price forecasts
 - Entitlement calculations
 - Costs, considering:
 - Development plans
 - Operating budget
 - Inflation and future conditions
 - Taxes, considering:
 - Production tax
 - Export tariffs
 - Income: depreciation and deductions

Economics in Reserves Evaluations

Reserves are determined by commercial and economic criteria

- Reserves are commercially and economically viable
 - Commercially: through existing or planned infrastructure and sales routes
 - Economically: all costs are lower than production revenues
 - (A) Life of the field: economic limit
 - (B) Undeveloped projects: economic cases
- Relevance of economic limit and economic cases depends on stage in the field's life cycle (brownfield vs. greenfield)



Economics in Reserves Evaluations

Economic analysis is used to determine reserves (first aspect: economic limit)

- Reserves are commercially and economically viable
 - Commercially: through existing or planned infrastructure and sales routes
 - Economically: all costs are lower than production revenues
 - (A) **Life of the field: economic limit**
 - (B) Undeveloped projects: economic cases
-

■ Economic limit

- Future Net Revenue = (annual gross revenue) – (annual operating costs/taxes)
 - Operating costs (“OPEX”), plus taxes, maintenance, fees, etc.
- Production is economic in all periods when FNR is positive
 - Fields are shut in when FNR becomes negative, so **forecasted production with negative FNR is excluded from reserves**

Economics in Reserves Evaluations

Economic limit: annual profitability

■ Basic formulaic estimation approach:

Exercise

- Price: \$70/bbl
- OPEX: 7.83 \$/bbl variable plus \$1,428,571 fixed
- Taxes (generalized): 50% of operating profit
- What annual volume is required for production to be economic (breakeven)?

Economics in Reserves Evaluations

Economic limit: annual profitability

■ Basic formulaic estimation approach:

Exercise

- Price: \$70/bbl
- OPEX: 7.83 \$/bbl variable plus \$1,428,571 fixed
- Taxes (generalized): 50% of operating profit
- What annual volume is required for production to be economic?

$$\frac{\text{Direct Field Annual Fixed Operating Costs}}{(\text{Oil price} - \text{variable costs}) \times (1 - \text{Tax})}$$

- $1,428,571 / ((70.00 - 7.83) \times (1 - 0.5)) = 45,955 \text{ bbl or } 126 \text{ bbl/day}$
- Production below this level should be uneconomic
- This is an **approximate** guide to field economics
- For reserves, economic limit must be considered in each forecast year, considering all dynamics (taxes, CAPEX, cash flow timing, etc.)

Economics in Reserves Evaluations

Economic limit represents the end of economic production

■ Generalized example of economic limit:

<div><div>*excluded from cutoff FNR</div><div>*included in final FNR</div></div>											
Year	Production Rate (103mt)	Oil Price (U.S.\$/bbl)	Total Revenue (103US\$)	Total OPEX (103US\$)	Total Taxes (103US\$)	CAPEX + Aband		Forecasted FNR (103US\$)	FNR Used to Determine Cutoff (w/o CAPEX+Aband) (103US\$)	Aband Cost Moved Up To Cutoff Year (103US\$)	Final Economic FNR (103US\$)
						Total CAPEX (103US\$)	Forecasted Aband (103US\$)				
2012	157	45	52,176	6,201	6,346	61,268		-21,640	39,629		-21,640
2013	247	45	82,002	7,583	13,891	33,518		27,011	60,529		27,011
2014	244	45	80,884	7,503	11,450	78,515		-16,585	61,930		-16,585
2015	540	45	179,400	16,614	12,345	576,814		-426,373	150,441		-426,373
2016	1,076	45	357,045	33,065	64,310	105,335		154,335	259,670		154,335
2017	1,760	45	584,128	54,134	105,114	134,735		290,145	424,880		290,145
2018	2,854	45	947,520	87,856	170,304	185,039		504,322	689,361		504,322
2019	4,120	45	1,367,685	126,940	247,497	208,383		784,865	993,248		784,865
(intermediate normal production)											
2045	1,512	45	502,074	67,033	280,096	15,233		139,712	154,945		139,712
2046	1,045	45	346,833	49,943	192,532	10,523		93,835	104,358		93,835
2047	710	45	235,625	36,665	132,782	7,149		59,029	66,178	35,995	23,034
2048	465	45	154,523	25,768	88,768	4,688		35,298	39,986	35,995	-697
2049	282	45	93,602	16,315	55,375	2,840		19,072	21,912	35,995	-16,923
2050	158	45	52,499	9,293	32,451	1,593		9,163	10,756	35,995	-26,832
economic limit!	2051	93	30,870	6,201	19,854	937		3,878	4,814	35,995	-32,117
2052	51	45	17,038	6,201	11,522	517		-1,202	-685	59,992	-59,992

negative FNR is allowed when solely caused by abandonment

negative FNR
is allowed
when solely
caused by
abandonment

Economics in Reserves Evaluations

Economic limit represents the end of economic production

- Considerations in determining economic limit
 - ❑ Determined at the project level
 - ❑ Capex and Abandonment costs should not cause the economic limit
 - ❑ Temporary periods of negative FNR

Economics in Reserves Evaluations

Economic analysis is used to determine reserves (second aspect: case profitability)

- Reserves are commercially and economically viable
 - Commercially: through existing or planned infrastructure and sales routes
 - Economically: all costs are lower than production revenues
 - (A) Life of the field: economic limit
 - **(B) Undeveloped projects: economic cases**
-
- Economic case/project profitability
 - $\text{Future Net Revenue} = (\text{TOTAL gross revenue}) - (\text{TOTAL operating costs/taxes}) - \underline{\text{TOTAL CAPEX (drilling/infrastructure/abandonment)}}$
 - Cases are economic when total FNR is positive
 - Cases with negative FNR will not be developed, so they are **excluded from reserves**
 - What is a case – doing nothing is one case, and development actions are cases

Economics in Reserves Evaluations

Economic analysis is used to determine reserves (second aspect: case profitability)

- Reserves are commercially and economically viable
 - Commercially: through existing or planned infrastructure and sales routes
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 - (A) Life of the field: economic limit
 - **(B) Undeveloped projects: economic cases**
-
- Economic case profitability: PDP case and development
 - FNR must be positive **compared to** non-development
 - PDP Case - If PDP production provides negative total FNR, that is worse than shutting in the field which provides zero future FNR; the field should be shut in
 - Development Cases - If 2P development total FNR is positive, but 1P plan provides more FNR, the Probable project should not be developed

Economics in Reserves Evaluations

Case profitability addresses Yes/No determination of profitability

- Considerations in determining case profitability
 - ❑ Determined at the project level
 - ❑ Abandonment costs may cause an uneconomic case if undeveloped
 - ❑ Determination is made based on case FNR; PW may be lower

Economics in Reserves Evaluations

Case Profitability Exercise – Remove Uneconomic Cases from Reserves

Exercise

- Which cases should not be called reserves?
- Adjustments are made to reserves and economic forecasts, to reflect that economic case profitability was considered

	Oil Reserves (M Tons)					CAPEX (M\$)					Abandonment Cost (M\$)					(Gross) Future Net Revenue (M\$)					
	SPE-PD	SPE-TP	SPE-2P	SPE-3P		SPE-PD	SPE-TP	SPE-2P	SPE-3P		SPE-PD	SPE-TP	SPE-2P	SPE-3P		SPE-PD	SPE-TP	SPE-2P	SPE-3P		
Field 1	1,565	3,130	6,260	12,520	ok	0	209,103	662,710	3,393,217	ok	38	38	59	63	ok	752,771	677,494	609,745	426,821	check	
Field 2	66,995	133,990	133,990	535,960	ok	0	8,587,348	8,587,348	13,738,597	ok	330	1,388	1,388	1,388	ok	30,914,451	34,349,390	34,349,390	24,044,573	check	
Field 3	321	642	1,284	2,568	ok	0	13,101	91,816	709,260	ok	500	1,933	2,974	2,974	ok	47,162	52,403	49,782	2,837,039	check	
Field 4	66	132	264	528	ok	0	17,573	26,959	38,262	ok	38	38	59	63	ok	63,262	70,291	107,838	153,048	ok	
Field 5	330	660	660	2,640	ok	0	13,494	13,494	25,980	ok	38	38	59	63	ok	48,578	43,720	43,720	103,921	check	
Field 6	564	1,128	2,256	4,512	ok	0	44,002	403,946	3,021,997	ok	553	553	1,789	2,043	ok	158,408	176,009	1,615,784	12,087,988	ok	
Field 7	148	296	296	296	ok	0	1,846	1,846	1,846	ok	711	711	812	925	ok	6,647	7,386	7,386	7,386	ok	
Field 8	514	1,028	2,056	4,112	ok	0	72,290	415,558	3,531,028	ok	1,070	1,070	1,641	2,005	ok	260,243	289,159	1,662,230	1,163,561	check	
Field 9	2,570	5,140	10,280	20,560	ok	0	95,756	618,851	3,043,838	ok	508	635	912	1,105	ok	344,722	383,024	2,475,404	12,175,352	ok	
Field 10	12,850	25,700	25,700	25,700	ok	0	709,260	709,260	709,260	ok	712	712	712	712	ok	2,553,335	2,298,001	2,837,039	2,837,039	check	
Field 11	973	1,946	3,892	7,784	ok	0	96,176	364,242	661,918	ok	4,115	4,115	4,188	4,259	ok	346,235	384,705	1,456,968	2,647,673	ok	
Field 12	639	1,278	2,556	5,112	ok	0	109,501	593,249	5,524,425	ok	538	538	1,432	1,543	ok	394,202	438,002	2,372,995	1,661,096	check	
Field 13	762	1,524	3,048	6,096	ok	0	46,929	142,331	1,002,360	ok	2,413	2,413	2,756	3,080	ok	168,945	187,717	569,323	4,009,439	ok	
Field 14	379	758	1,516	3,032	ok	0	104,543	313,629	940,888	ok	590	590	598	608	ok	376,355	418,173	398,787	418,173	check	
Field 15	369	738	1,476	2,952	ok	0	99,504	866,983	2,366,901	ok	1,033	1,055	2,752	2,752	ok	358,216	398,018	3,467,930	9,467,603	ok	

Asset Valuation

Asset Valuation

Purposes of Asset Valuation

■ Asset Valuation

❑ Bottom-up approach

- Based on reserves / reflects development plans

❑ Market applications

- Mergers and acquisitions
- Project financing
- Stock exchange listing

❑ Management applications

- Tracking of development projects
- Project prioritization

Asset Valuation

Field value is determined by forecasted cash flow

- Financial community uses many methods to estimate value
 - ❑ Cost approach (accounting focused, replacement value)
 - ❑ Multiples approach – Similar assets similar prices
 - ❑ Comparable company analysis – Value based on metrics of businesses of similar size in same industry
 - ❑ Precedent transactions – Price paid for similar companies in the past considered as an indicator of company's value
 - ❑ Discounted future cash flow – Used to estimate the value of an investment based on expected future cash flow
- Discounted Cash Flow Model is used for reserves
 - ❑ Consistent with the “bottom-up” approach
- Terms used in the final calculation sequence:
 - ❑ Future Net Revenue (FNR)
 - ❑ Cost of Capital and Discount Rate
 - ❑ Annual Present Worth (PW) and Net Present Value (NPV)

Asset Valuation

Valuation Illustration

- Generalized illustration for a field:
 - Revenue (prices * production)
 - Costs
 - Operating costs (OPEX)
 - Capital costs (CAPEX)
 - Local country taxes/bonuses, any other cash flows
 - Abandonment
 - Future Net Revenue = revenues minus all costs
 - Discount Factor
 - Cost of capital: rate of return required by the company's stakeholders
 - Discount factor = $1 / (1+r)^n$
 - Present Worth = FNR * discount factor
 - Net Present Value = sum of PW

Asset Valuation

Valuation Implications and Warnings

- **Field valuations are not Company valuations**
 - ❑ A company's fields cannot be aggregated to calculate Company value
 - ❑ Company-level revenues and costs exist unrelated to field operations
 - ❑ Financing (debt vs. equity) is not addressed in the field evaluation
- **2P valuation is not directly comparable to 1P valuation, etc**
 - ❑ Each has a separate likelihood and confidence level, just like volumes
- **Reserves Valuation is not the same as Market Value**
 - ❑ The real value of any asset is what the highest bidder pays in the market
 - ❑ There may be strategic benefits to owning the assets (control, market share)
 - ❑ Management has its own reasoning behind transactions, not only calculations
- **Finance professionals combine multiple valuation methods**
 - ❑ Discounted Cash Flow results are compared to market-based estimates
- **Bottom-up approach makes the most sense to technical team**
 - ❑ It is widely understood and can be discussed using technical reasoning

Calculation Methodologies

Calculation Methodologies

Revenues, Costs, and Taxes are calculated using varying inputs depending on the field

- In this section we will review aspects of calculating the inputs that give us the Revenues, Costs, and Taxes
- Recall the generalized categorization:
 - Revenues, considering:
 - Production profiles, current prices and price forecasts
 - Entitlement calculations
 - Costs, considering:
 - Development plans
 - Operating budget
 - Inflation and future conditions
 - Taxes, considering:
 - Production tax
 - Export tariffs
 - Income: depreciation and deductions

Calculation Methodologies

Focus Area : Revenue

Calculation Methodologies

Revenue calculations

- Revenue is the result of:
 - Sales forecasts
 - Oil is normally sold when produced, by pipeline or road
 - Oil can be exported, or sold domestically
 - In gas fields sales often differs from production forecasts (gas flaring, shrinkage during processing, fuel usage in the field, re-injection or storage, etc)
 - For these technical reasons, and market demand, gas sales are managed by sales contracts
 - Price forecasts
 - For PRMS, several forecasts allowed – should reflect current or expected conditions
 - Netback price concept

Calculation Methodologies

Revenue calculations: netback price concept

- The point of measurement for production and pricing must be clearly defined and applied consistently
 - Typically the sales point or where custody transfer of the product occurs
 - Netback price is “net of” any costs paid to get the product to market

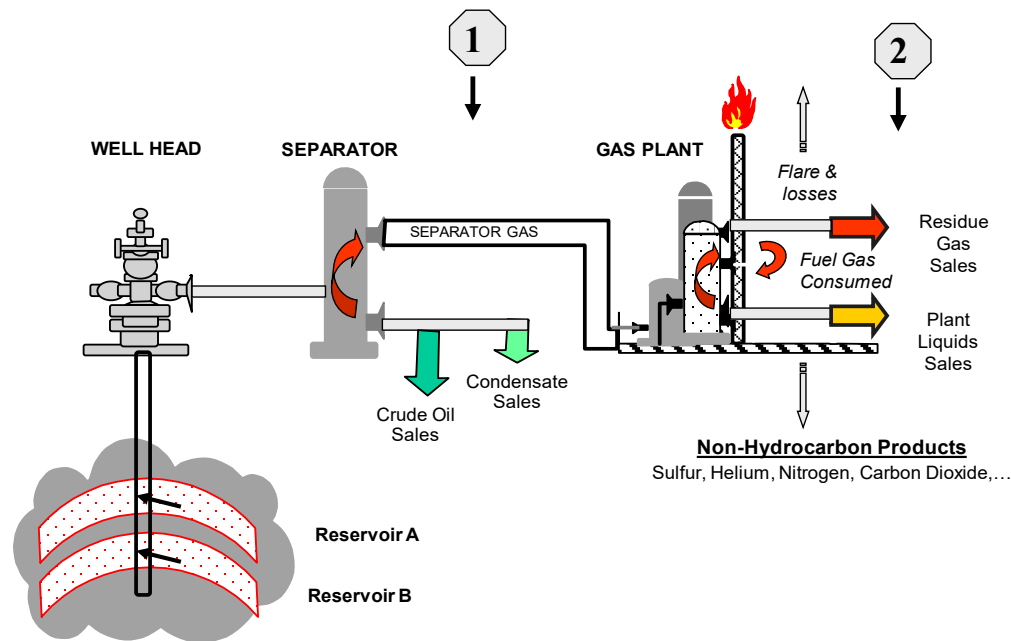
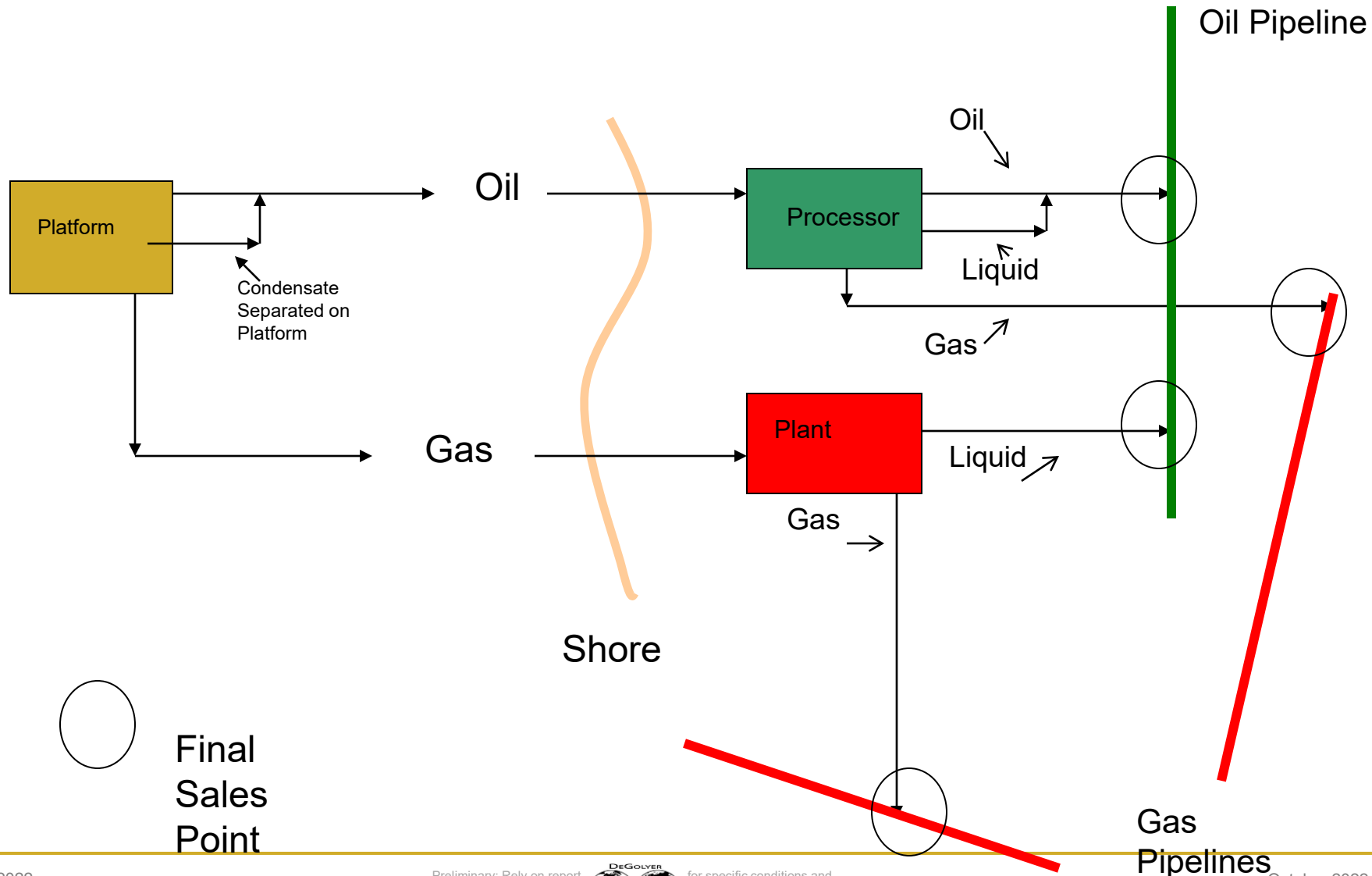


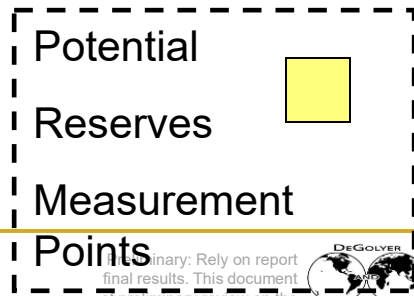
Figure: SPE, Guidelines for Application of the Petroleum Resources Management System, November 2011

Production Measurement

The graphic below shows a common example reference points.



The graphic below shows alternate reference points.



Example Cash Flow

Year	Total Future Gross Revenue (10 ³ US\$)	Operating Expenses (10 ³ US\$)	Other Capital (10 ³ US\$)	Abandonment Costs (10 ³ US\$)	Total Production Taxes (10 ³ US\$)	Income and Excess Income Tax (10 ³ US\$)	Future Net Revenue (10 ³ US\$)	Present Worth 10% (10 ³ US\$)
	7100001300	5000101300	5500301300	4000101300	3000201300	3000301300	7200001300	6101001300
2018	8,989,628	504,378	4,058,952	0	346,095	2,609,848	1,470,355	1,393,714
2019	9,023,032	506,564	3,392,142	0	347,194	2,542,622	2,234,510	1,917,274
2020	8,961,886	504,210	2,958,331	0	461,229	2,428,260	2,609,856	2,027,071
2021	8,868,200	499,616	1,889,368	0	516,382	2,357,097	3,605,737	2,535,110
2022	9,009,354	506,361	2,020,495	0	667,451	2,334,210	3,480,837	2,215,323
2023	12,891,078	697,457	1,117,805	0	696,490	3,427,689	6,951,637	4,004,894
2024	13,148,499	710,373	1,902,147	0	1,220,339	3,319,697	5,995,943	3,126,886
2025	13,103,249	707,529	1,106,822	0	1,076,274	3,357,817	6,854,807	3,235,938
2026	12,974,912	701,237	885,376	0	1,203,530	3,288,589	6,896,180	2,946,891
2027	12,240,664	655,356	618,903	0	1,198,266	3,094,342	6,673,797	2,581,540
2028	11,166,871	592,614	487,662	0	1,149,223	2,819,729	6,117,643	2,142,104
2029	10,271,654	548,326	491,654	5,147	1,054,728	2,604,383	5,567,416	1,764,659
2030	9,413,557	496,376	495,684	5,147	959,081	2,402,526	5,054,743	1,450,296
2031	8,588,469	438,239	0	5,147	867,714	2,221,260	5,056,109	1,313,180
2032	8,021,936	402,827	0	5,147	859,132	2,080,103	4,674,727	1,099,043
2033	7,235,747	364,366	0	5,147	792,356	1,890,685	4,183,193	890,260
2034	0	0	0	0	0	0	0	0
2035	0	0	0	0	0	0	0	0
2036	0	0	0	0	0	0	0	0
2037	0	0	0	0	0	0	0	0
2038	0	0	0	0	0	0	0	0
2039	0	0	0	0	0	0	0	0
2040	0	0	0	0	0	0	0	0
2041	0	0	0	0	0	0	0	0
2042	0	0	0	0	0	0	0	0
Total	163,908,736	8,835,829	21,425,341	25,735	13,415,484	42,778,857	77,427,490	34,644,183

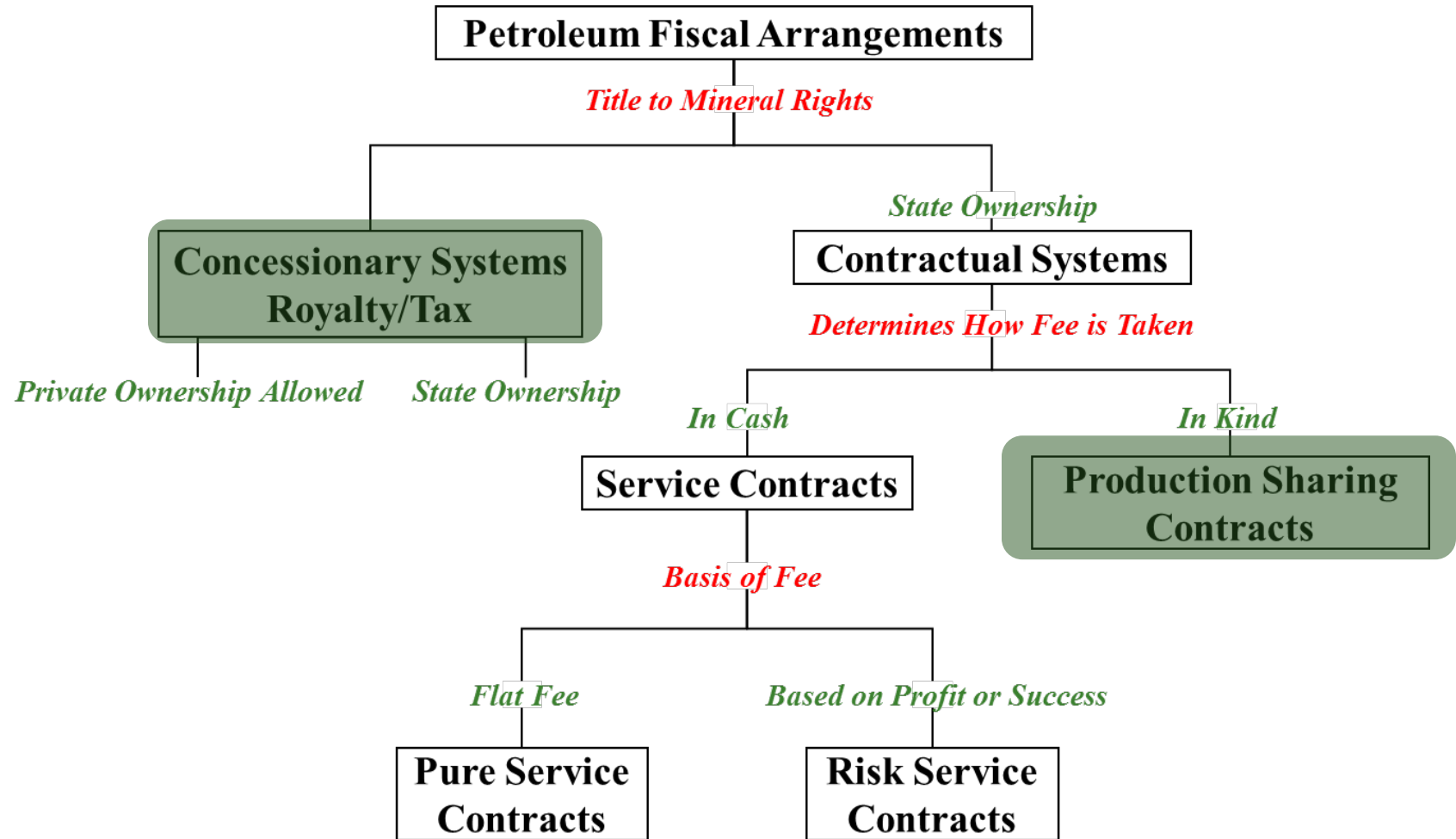
Calculation Methodologies

Focus Area: Revenue

Special Topic: Production Sharing Contracts

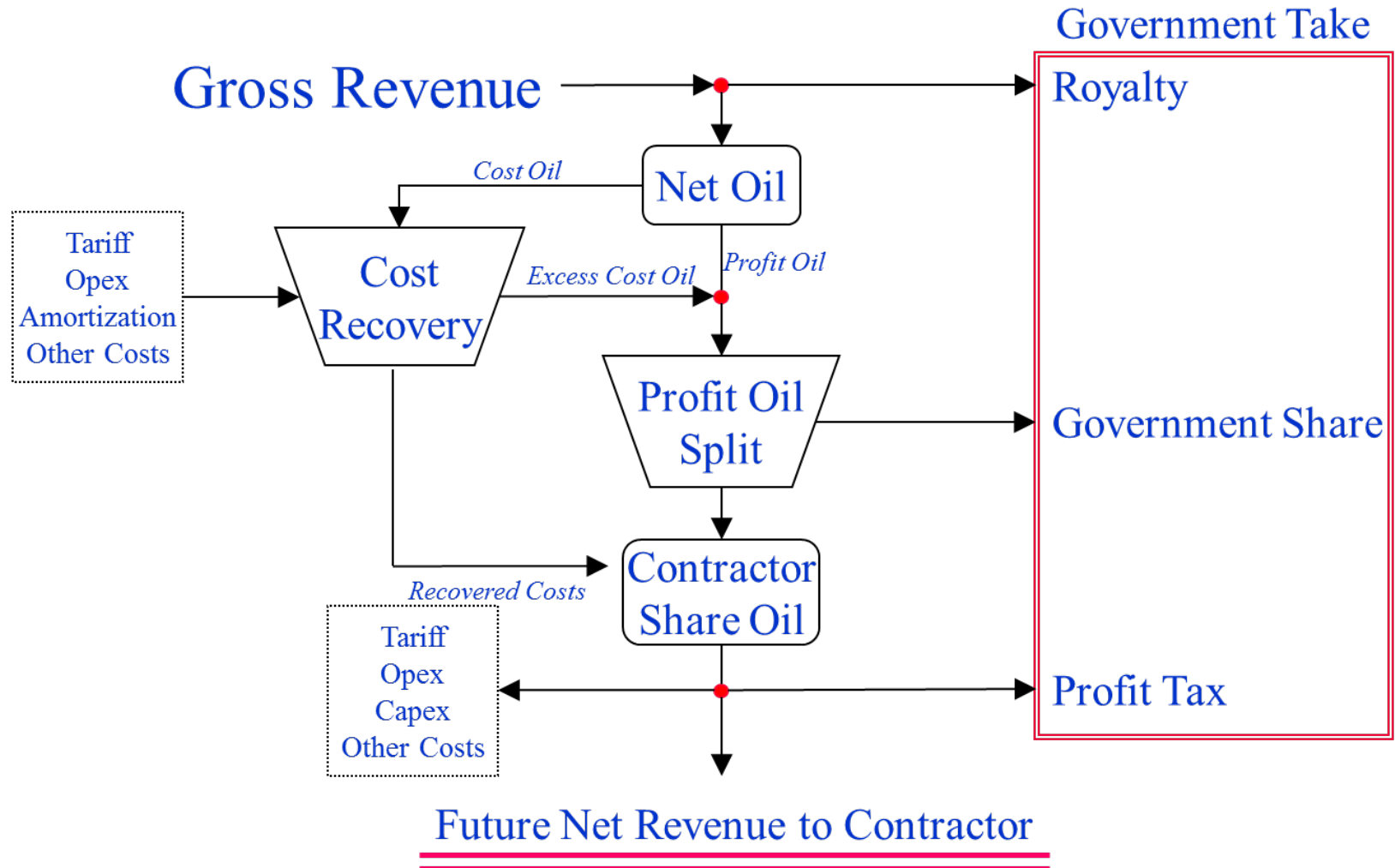
Calculation Methodologies

Revenue calculations depend on the fiscal regime governing the field



Calculation Methodologies

In a PSC, Revenue depends on agreed calculations considering Cost and Profit



Calculation Methodologies

Sample PSC Calculation with effect on reserves

- Reserves and revenue are calculated in this sequence:
 - ❑ Gross Field Revenue
 - Gross Field Revenue Available for Cost Recovery
 - ❑ Cost Recovery Value to Contractor
 - Remaining Profit
 - ❑ Profit Share Value to Contractor
 - ❑ Production Volumes Representing Value to Contractor
 - Calculated as Value divided by product Prices
 - ❑ Contractor Revenue: Volumes * Prices (same as total Value to Contractor)
 - ❑ Company Revenue: Contractor Revenue * Company Working Interest
 - ❑ Company Reserves: Contractor Volumes * Company Working Interest

Calculation Methodologies

Sample PSC Calculation with effect on reserves

■ Calculate Net Company Reserves for Field A to be produced in 2021:

Exercise

- ❑ Oil production: 90 million barrels
- ❑ Price: \$53/bbl
- ❑ Historical unrecovered costs = \$60 billion
- ❑ Royalty = 3.5%
- ❑ New costs = \$3.6 billion
- ❑ Cost Recovery Limit: 76.5%
- ❑ Contractor Profit Share: 90%
- ❑ Company Working Interest: 8.44%

Calculation Methodologies

Sample PSC Calculation with effect on reserves

■ Calculate Net Company Reserves for Field A to be produced in 2021:

Exercise

- Revenue = 90 million bbl * \$53/bbl = \$4.770 billion
- Royalty = 3.5% = \$167 million
- Available for Recovery = 76.5% = \$3.521 billion
- Recoverable = Historical + Current = \$63.6 billion
- Recovered = Min of Available and Recoverable = \$3.521 billion
- Profit = Revenue - Royalty – Cost Recovery = \$1.082 billion
- Contractor Profit Share = 90% = \$973 million
- Contractor Entitlement \$ = Recovery + Profit Share = \$4.495 billion
- Contractor Entitlement Barrels = \$/Price ~ 85 million barrels
- Company Entitlement Barrels (Reserves) ~ 7 million barrels
- Company Revenue in 2021 ~ \$4.495 billion

Calculation Methodologies

Focus Area: Costs

Calculation Methodologies

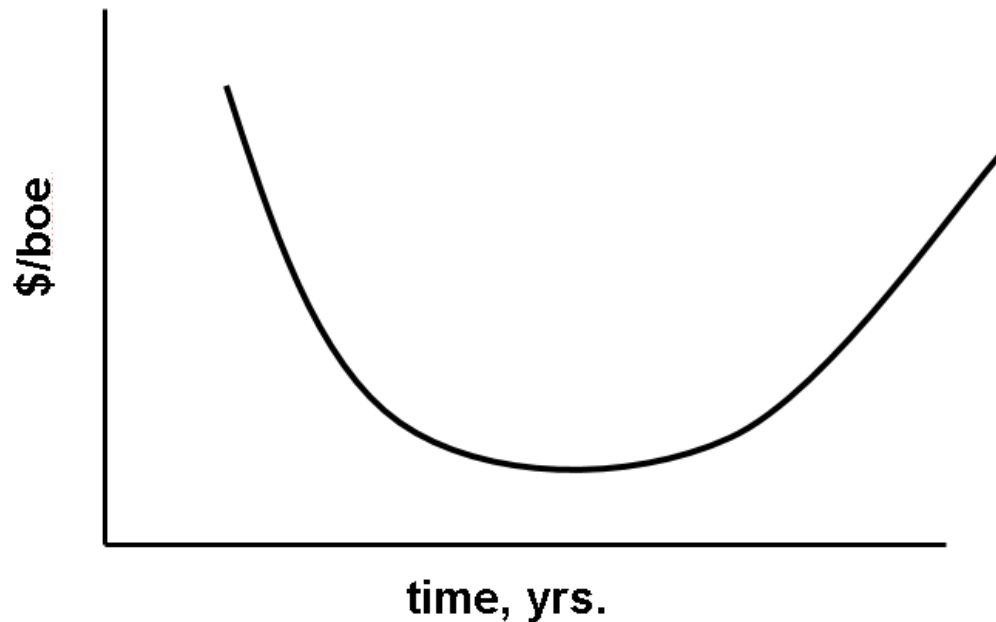
Cost calculations

- “Costs” exclude:
 - ❑ Taxes – although they are negative to FNR, they are usually not called “costs”
 - ❑ Overhead and administrative – these are not directly required for production
 - ❑ Exploration – it has no consistent link to production of reserves
- “Costs” include:
 - ❑ All payments directly related to producing the hydrocarbons and getting them to the sales point
 - ❑ Matches netback price concept – costs get the product to the netback point
- All costs are exclusively separated into:
 - ❑ Expensed costs (OPEX)
 - ❑ Capitalized costs (CAPEX)
 - ❑ Also used for organizing and identifying data to be considered OPEX or CAPEX
 - ❑ Generally, OPEX: repeated costs used to maintain production and operations
 - ❑ Generally, CAPEX: one-time costs used to increase/enable future profits

Operating Expenses Sensibility Checks

Average total costs tend to be higher at the beginning and end of a project.

Average Total Cost



Calculation Methodologies

Cost calculations

■ OPEX or CAPEX?

Exercise

- ❑ Electricity for wells
- ❑ Drilling cost
- ❑ Employee salaries
- ❑ Gas processing
- ❑ Power line installment
- ❑ Road construction
- ❑ Upgrade of computer equipment
- ❑ Purchase of trucks
- ❑ Flow lines hookup
- ❑ Compressor station construction
- ❑ Platform repairs
- ❑ Sidetrack operation
- ❑ Replacement of gathering lines
- ❑ Safety training

Calculation Methodologies

Cost calculations

■ OPEX or CAPEX?

Exercise

- ❑ Electricity for wells - OPEX
 - ❑ Drilling cost - CAPEX
 - ❑ Employee salaries - OPEX
 - ❑ Gas processing - OPEX
 - ❑ Power line installment - CAPEX
 - ❑ Road construction - CAPEX
 - ❑ Upgrade of computer equipment - CAPEX
 - ❑ Purchase of trucks - CAPEX
 - ❑ Flow lines hookup - CAPEX
 - ❑ Compressor station construction - CAPEX
 - ❑ Platform repairs - OPEX
 - ❑ Sidetrack operation - CAPEX
 - ❑ Replacement of gathering lines - CAPEX
 - ❑ Safety training - OPEX
-
- ❑ Much of this is debatable. It depends on the amount of the cost, the specific government guidelines for the cost category, etc. These are specific accounting issues. When appropriate, reserves specialists defer to the expertise of the production company's accountants.

Calculation Methodologies

Cost calculations

Calculation Methodologies

Focus Area : Taxes

Calculation Methodologies

Concession system is based on taxation

- Example concessionary taxes:
 - Production Tax (depends on production and import/export)
 - Export Rental Tax (depends on reference oil price)
 - Income Tax (20% on Income)
 - Excess Income Tax (depends on Income/Expenses)
 - Others
 - Social contributions
 - VAT (reflected in prices)
 - Asset Tax
 - Smaller regional taxes

Calculation Methodologies

Concession system is based on taxation

■ Income Tax

- For concessions and also applied in some PSCs
 - The only “Tax” in PSCs
 - Different rates for each PSC
- Taxable Income
 - Revenue
 - - OPEX
 - - Depreciation (instead of CAPEX)
 - - Other Taxes
 - Taxable Income

Commerciality and the Ability to Market

What are the Requirements?

- A Commercial Market is Established by Multiple Factors
 - ❑ Buyer and a Known Price
 - ❑ Transportation and Associated Costs
 - ❑ Infrastructure to Facilitate Transport/Purchase/Disruptions
 - ❑ All Must Conspire to Create an Economic Viability
- Establishing Buyers
 - ❑ Gas Contracts and Liquids Purchase Agreements
 - Duration, Pricing, Stipulations (Minimum Take, Take or Pay, etc.)
 - Longevity/Dependability/Arms-Length
- Establishing Transportation to Create an Outlet
 - ❑ Physical Capacity
 - ❑ Dedicated Volume
 - ❑ Tariffs, Capital Provision, etc.
- Infrastructure

Transportation

Can't Sell It if You Can't Get it to the Buyer

- Can be a Non-Issue but Particularly Important in Remote Venues
- Seller or Buyer Responsibility
 - ❑ Both Ways Can Work if Economics Support It
 - ❑ Often Can Involve a Third Party
- Design
 - ❑ Fit for Purpose or Existing or Broader Mid-Stream Vendor
 - ❑ Capacity Impacts Field Development and Production Rates
 - Does Seller Have a Dedicated Volume (Min, Max, Fixed?)
 - ❑ Downtime Should be Expected and Built Into Analysis
- Cost
 - ❑ Per-Unit Tariffs
 - ❑ Capital Arrangements without Ownership-Imputed Cost Per Unit
 - ❑ Outright Lump Sum Capacity Capture (Duration? Volume? Open?)

Infrastructure

What Does This Mean in Terms of a Commercial Market?

- **Infrastructure is Not an Issue in Established Venues**
 - ❑ Service Companies and Manpower Availability
 - ❑ Power Sources
 - ❑ Supply Lines and Accessibility
- **In Frontier Area There Will be Challenges**
 - ❑ Remote Locations May Preclude Fast Mitigation Turnarounds
 - ❑ Security of Measurement and Delivery
 - ❑ Marketability of Facility if Owned by Seller

