

# 16<sup>TH</sup> ANNUAL RYDER SCOTT RESERVES CONFERENCE



**Numbers to Count On. Experts to Trust.**

## PRACTICAL APPLICATIONS OF TECHNICALLY RECOVERABLE RESOURCES

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SEPTEMBER 2020

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# WHAT IS TRR?

- A new term in PRMS 2018.
- **1.1.0.8.B Technically Recoverable Resources (TRR)** are those quantities of petroleum producible using currently available technology and industry practices, regardless of commercial considerations. *TRR may be used for specific Projects or for groups of Projects, or, can be an undifferentiated estimate within an area (often basin-wide) of recovery potential.*

# TECHNICAL FORECAST



- **Glossary:** *The forecast of produced resources quantities that is defined by applying only technical limitations (i.e., well-flow-loading conditions, well life, production facility life, flow-limit constraints, facility uptime, and the facility's operating design parameters). Technical limitations do not take into account the application of either an economic or license cutoff. (See also Technically Recoverable Resources).*

# IN SIMPLE TERMS

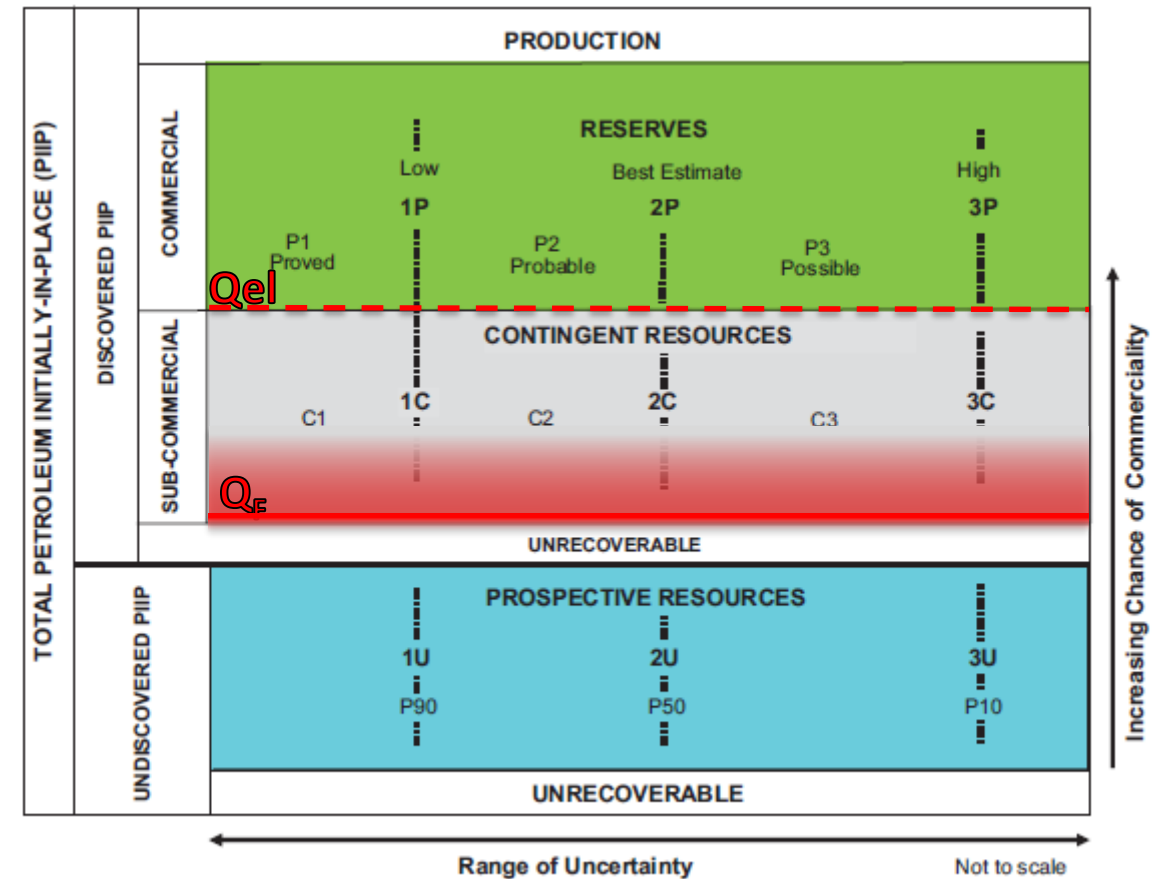


- Determine a production forecast representing the expected production over time.
- Simple production profile is described by a  $Q_i$ , type of decline (exponential, hyperbolic, etc.), rate of decline (%d, b), and a final production rate ( $Q_f$ ).
- This is necessary to model the expected cash flow and determine the economics of the forecast.
- Multiple forecasts are acceptable: low, best, or high, sensitivity, etc.



# WHAT IS THE ENDING RATE?

- The  $Q_f$  for a reserves projection will be the economic limit ( $Q_{el}$ ), unless overridden by a concession expiration or similar imposed termination prior to  $Q_{el}$ .
- What should we use for a  $Q_f$  for a resources projection? We don't have a  $Q_{el}$  yet because the economics have not yet been calculated...



Modified PRMS Figure 1.1

# RESOURCES $Q_f$ CHOICES

1/2



- We should choose a  $Q_f$  that is less than the expected  $Q_{el}$ . If we were to pick a  $Q_f$  that turned out to be higher than the  $Q_{el}$ , we would be understating the potential reserves of the project when we calculate the economics.
- We could arbitrarily pick a very low  $Q_f$  (1 barrel or 1 mcf per month), but that could overstate the resources in both volumes and time. Many wells will not produce at low rates due to liquid loading, low wellhead pressures, etc. This could overstate the resources volumes, particularly in offshore or frontier areas.

# RESOURCES $Q_f$ CHOICES

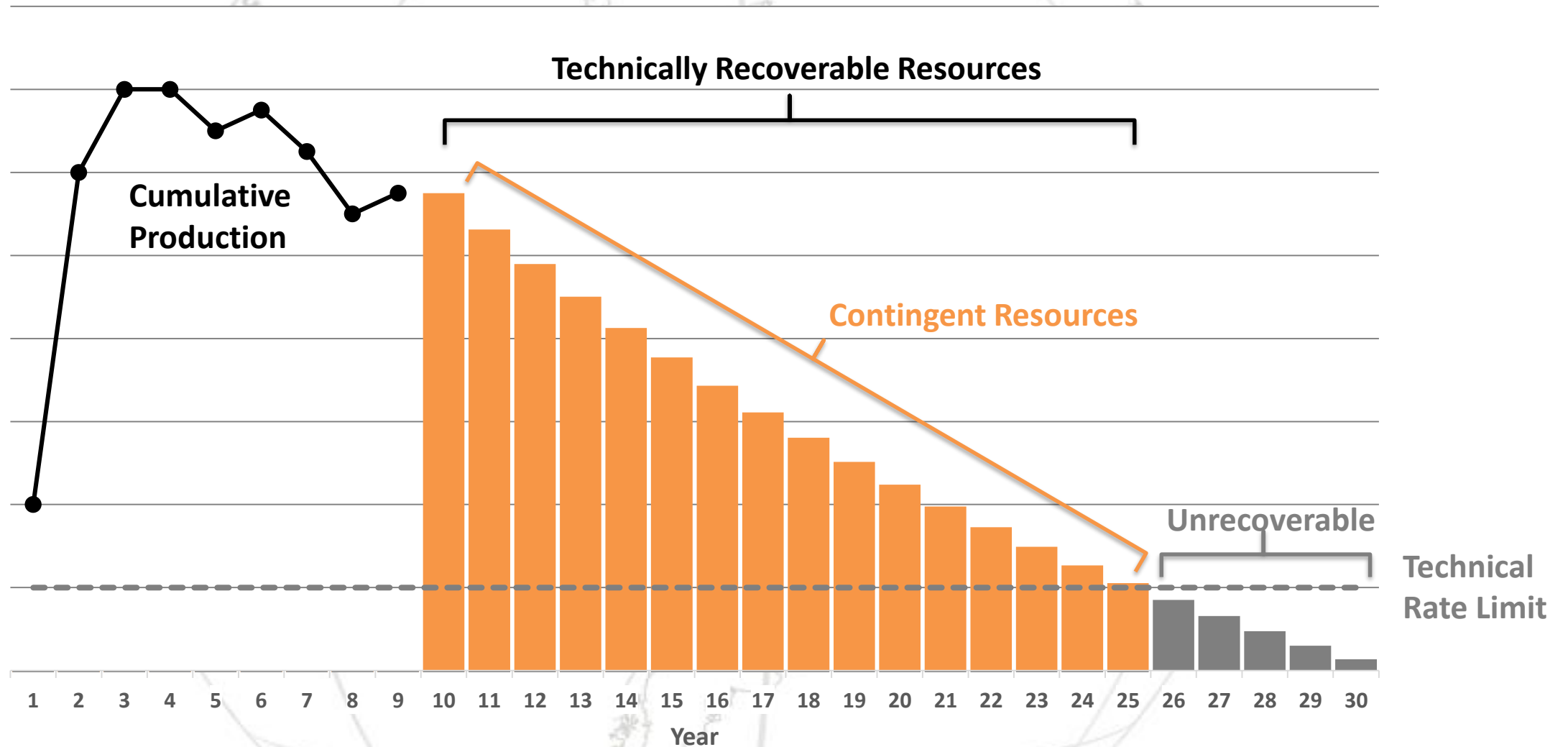
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- Select a  $Q_f$  that represents a reasonable technical producing limit for the particular area.
- Consider reservoir characteristics, well construction, and facilities:
  - Drive mechanism (i.e. water or depletion drive)
  - Wellbore construction
  - Lift type
  - Gathering system / line pressure
- It is not intended that a great deal of work should be done to justify a technical  $Q_f$ , but it should be reasonable for the situation at hand.



# TRR SIMPLE EXAMPLE



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# THE NAME IMPLIES ONLY RESOURCES



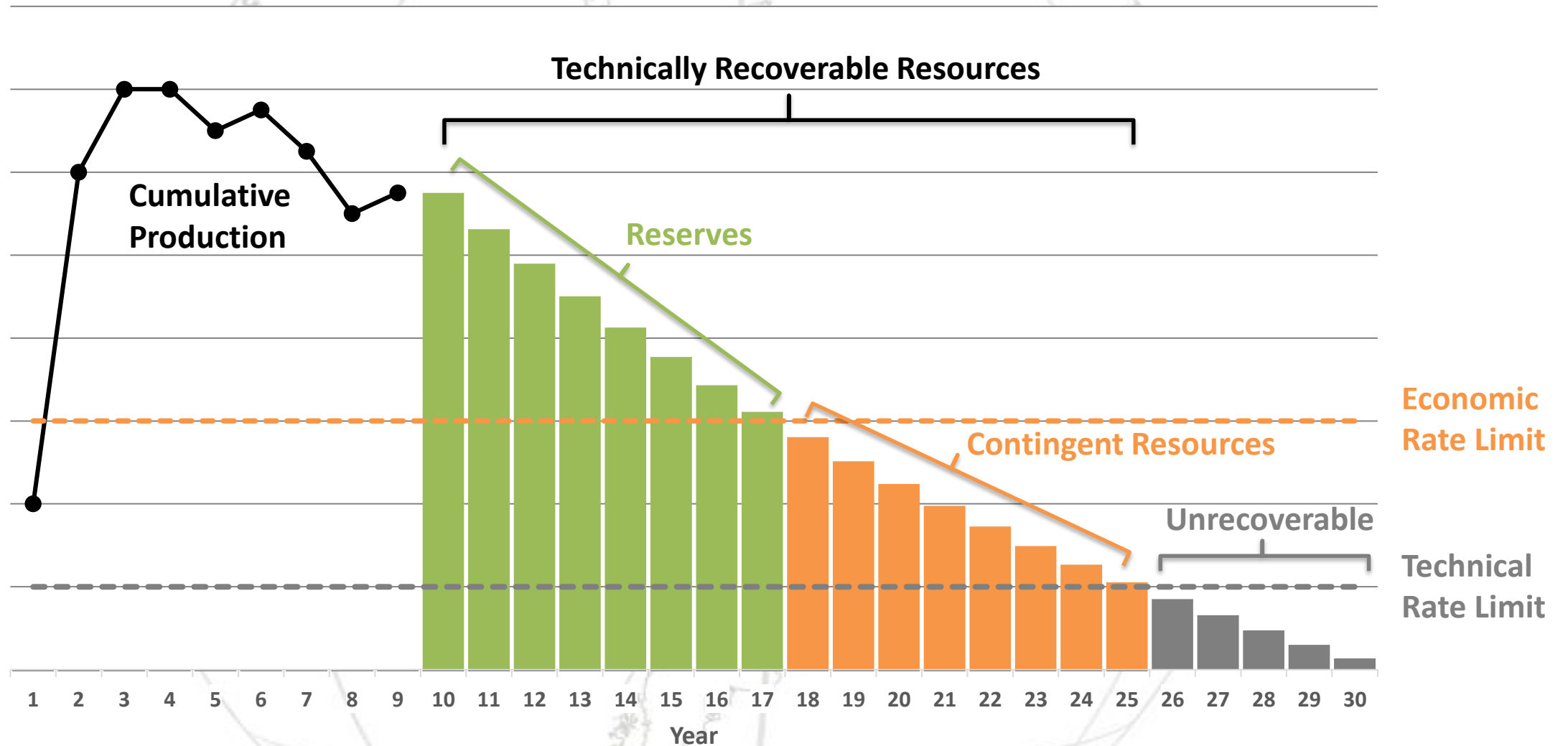
- In PRMS, resources is the “term used to encompass all quantities of petroleum...”
- TRR does not imply reserves cannot be part of the volumes.
- TRR volumes may include a portion already classified as reserves.
- For a given projection, it’s the total volume remaining that can be recovered, if not constrained by an economic limit.
- Way to show the expected maximum recoverable volume associated with a particular projection, and also to clearly convey that the projection has not been truncated by an economic limit.

# WHAT ABOUT SPLIT CLASSIFICATION?



- **Glossary:** *Split Classification:* A single project should be uniquely assigned to a sub-class along with its uncertainty range, For example, a project cannot have quantities categorized as 1C, 2P, and 3P. This is referred to as “split classification.” If there are differing commercial conditions, separate sub-classes should be defined.
- A projection may represent several projects.
- TRR represents the projection to a technical  $Q_f$ , so TRR may be a combination of several projects, and can include both reserves and resources.
- Conversely, it may take several projects to realize the TRR.

# TRR WITH RESERVES COMPONENT



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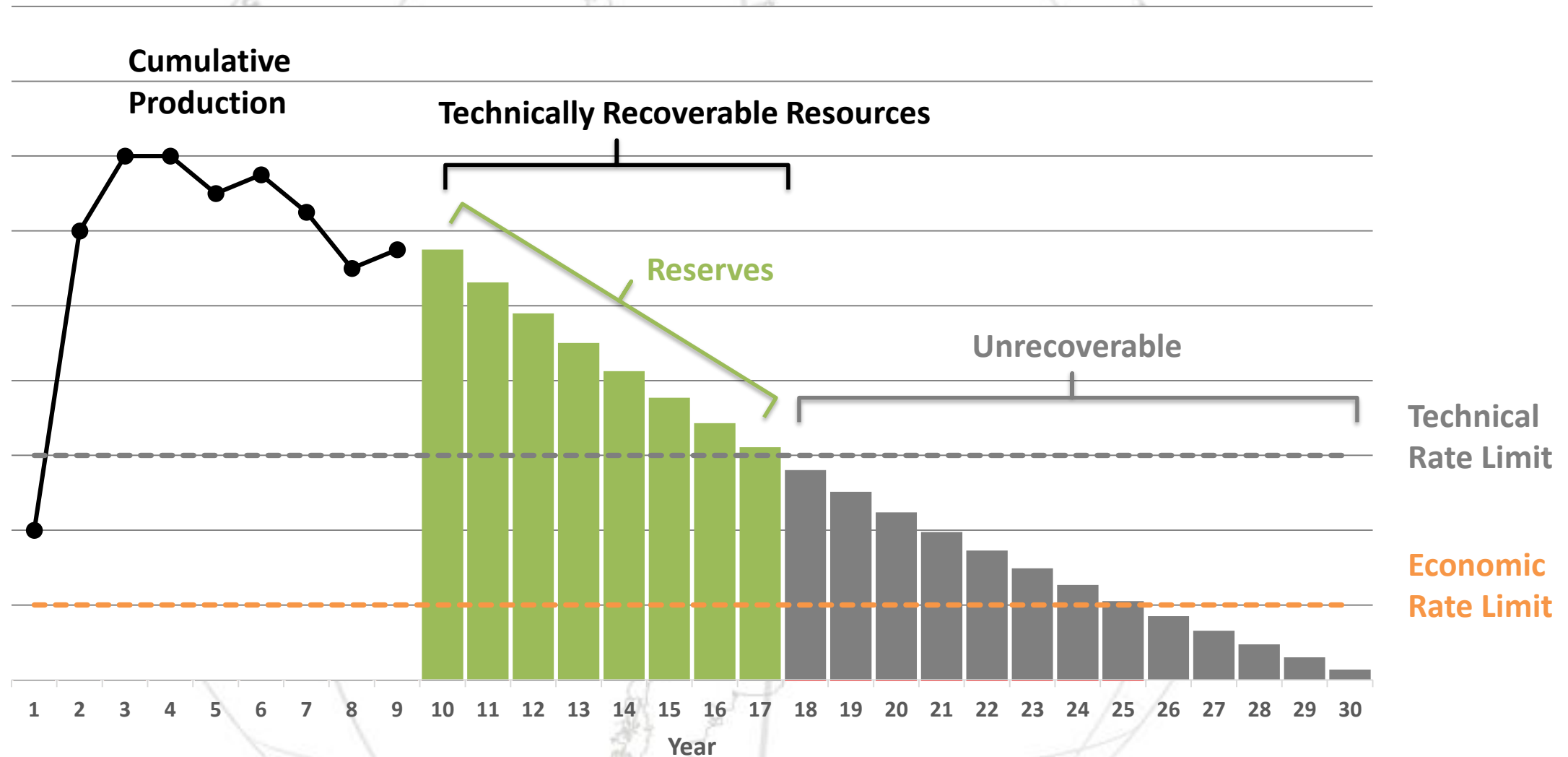
# WHAT IF THE TECHNICAL LIMIT IS $>Q_{EL}$ ?



- Usually, the economic limit is reached prior to the technical limit.
- In the rare case when a technical limit is reached prior to the economic limit, the technical limit becomes the controlling factor, thus no reserves are assigned beyond the technical  $Q_f$ .
- In such cases, there are no incremental volumes between technical limit and economic limit, thus no contingent resources can be recognized beyond the technical limit.
- Volumes beyond the technical limit, even though they might be above the economic limit, would be unrecoverable resources.



# WHAT IF THE TECHNICAL LIMIT IS $>Q_{EL}$ ?



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# WHAT DOES THE TRR TELL US?



- If the project is commercially mature, then the portion of the projection down to the  $Q_{el}$  would be the reserves. The remaining volume, that portion of the projection between the  $Q_{el}$  and the technical  $Q_f$ , would be the maximum amount of contingent resources that potentially could be promoted to reserves at some point in the future for the given development scenario and the projection category represented (low case, best estimate case, high case).

# Q<sub>F</sub> EXAMPLES



- Ideally, the technical limit of a well should be based on analogs in the area of interest.
- In an area where gas wells typically water out when they get down to around 50 mcf/d, then 50 mcf/d would be an appropriate Q<sub>f</sub>.
- In an area where gas wells produce water free and can produce down to very low rates, then the Q<sub>f</sub> rate would be more of a function of gathering line pressure and Q<sub>f</sub> rates far lower than 50 could be technically achievable.

# Q<sub>F</sub> DEPENDS ON THE PROJECT



- The technical Q<sub>f</sub> depends on the project scenario being evaluated:
  - A gas reservoir is being evaluated:
    - If compression is not likely to ever be installed, a Q<sub>f</sub> of 100 mcf/d might be appropriate. In this case, the TRR would be the projection taken to an ending rate of 100 mcf/d.
    - If compression is likely to be installed at some point, a Q<sub>f</sub> of 10 mcf/d might be appropriate, so the TRR would be the projection taken to an ending rate of 10 mcf/d.

## Is TRR a sub-class or sub-category?

- No. TRR is a way to show the expected maximum recoverable volume associated with a particular projection. It is meant to clearly convey that the projection has not been truncated by an economic limit.
- It was intended to be an acceptable substitute for the often heard but always incorrect term “technical reserves.”

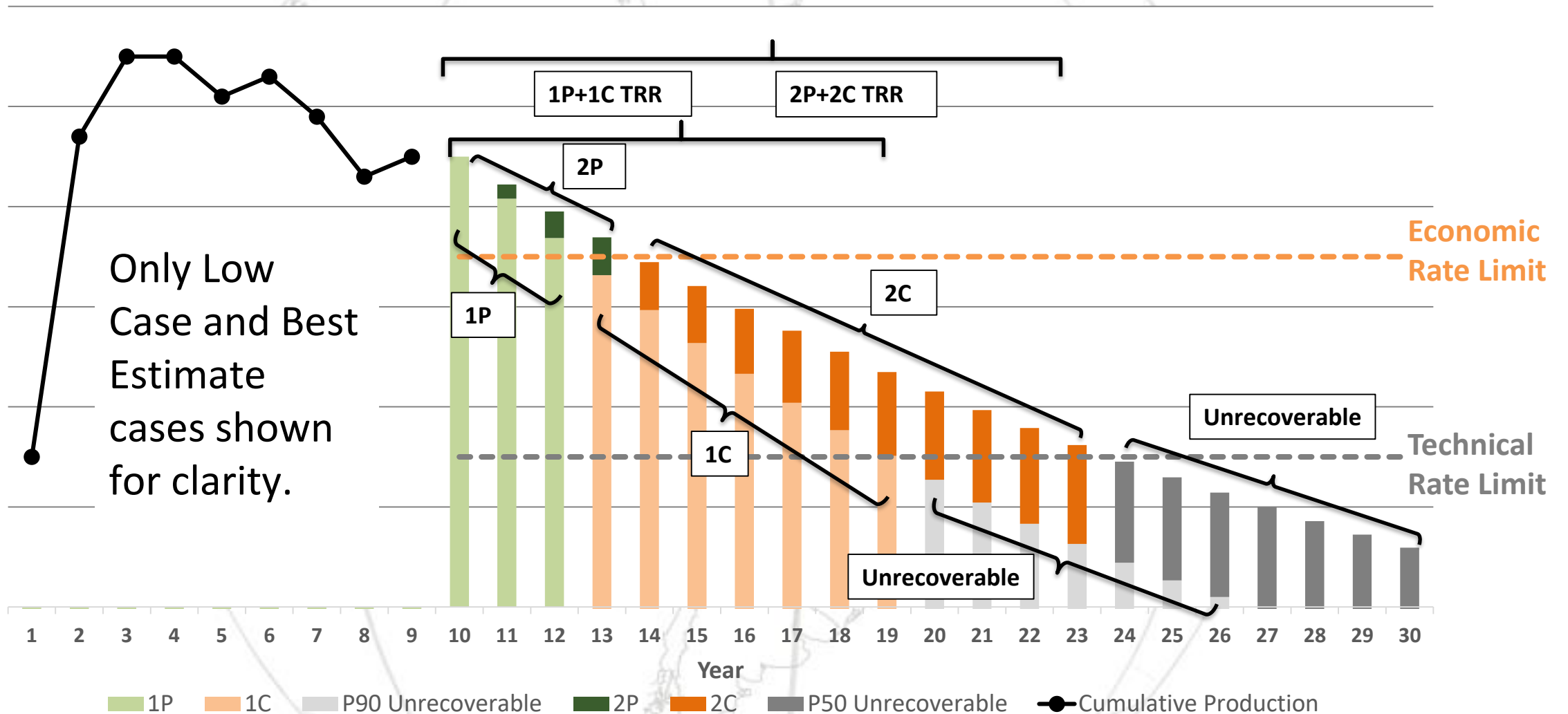


# FAQ #2

## When someone asks me what the TRR for a project is, how should I respond?

- Example response(s):
- TRR for the low estimate case projection is X. If some portion of X has been shown to be proved reserves, then X would be  $1P + 1C = TRR_{Low}$
- Best estimate projection is Y, and if some portion of Y has been shown to be probable reserves, then  $Y = 2P + 2C = TRR_{Best\ Estimate}$ .
- High estimate projection is Z, and if some portion of Z has been shown to be possible reserves, then  $Z = 3P + 3C = TRR_{High}$ .
- **Suggested format is TRR = X = Reserves + Contingent Resources (R+CR).**

# TRR IS CATEGORY DEPENDENT



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# FAQ #3

## Does TRR = CR?

- TRR is  $\leq$  Reserves + Contingent Resources (R+CR).
- Since TRR is a function of a particular projection, which is a function of at least one particular project, TRR = R+CR if that project is expected to exploit all of the potential CR that can be recognized. In other words, if there are no incremental projects anticipated that might result in additional recovery; TRR = R+CR, and the rest of the PIIP is unrecoverable.
- If additional subsequent projects are identified, then some of the unrecoverable moves to R+CR, and the TRR associated with the current project/projection is now less than the sum of the current TRR plus the R+CR potential of the new project.

## At what level is TRR determined? Well level? Field level? Some other level?

- TRR is usually “well specific.” Not all wells, even in the same field, necessarily have the same technical  $Q_f$ .
  - Example: two oil wells in a field, one uses a rod pump, the other is being gas lifted. Would you expect them to have the same technical  $Q_f$ ?

## Can TRR be applied at some level above the well level?

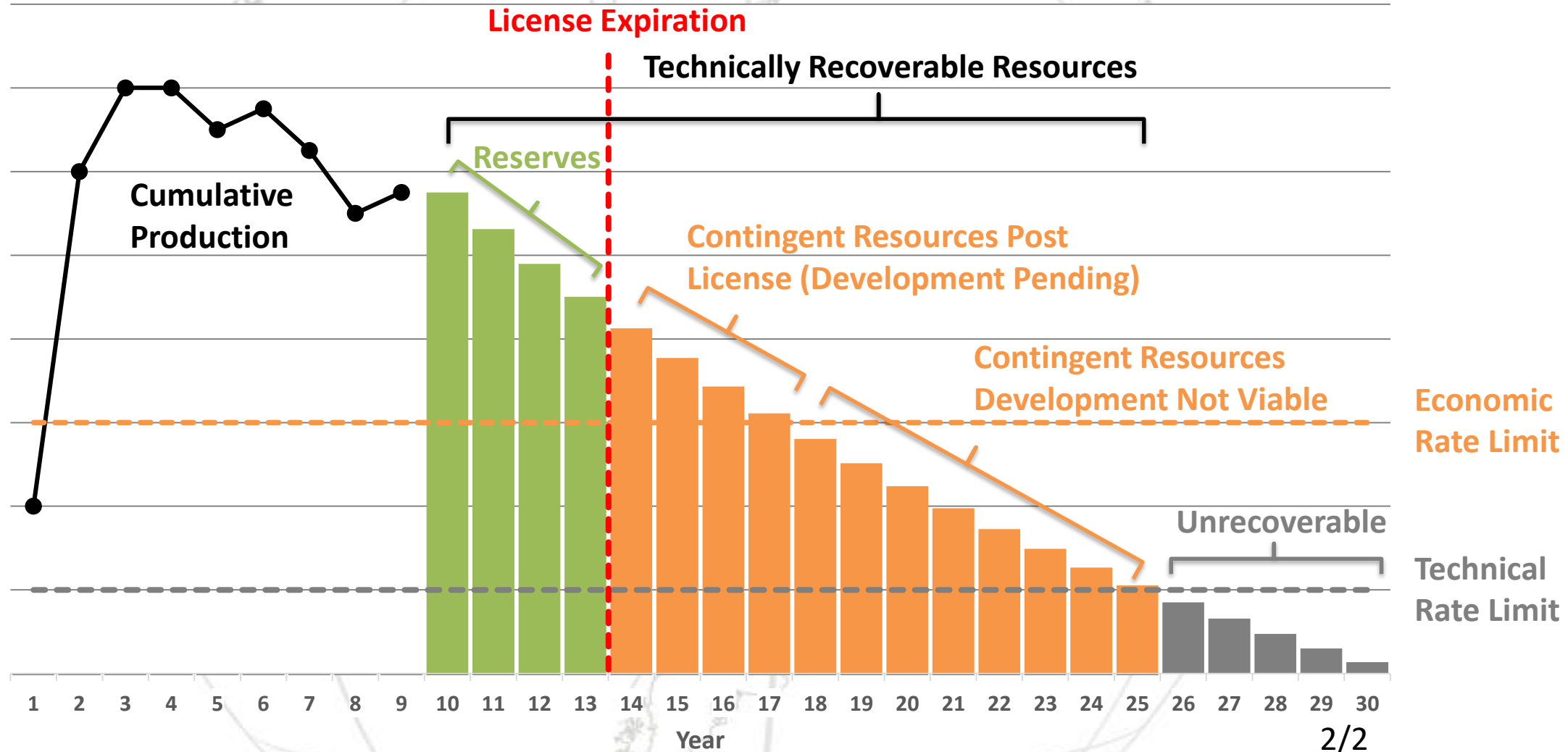
- Yes, TRR is scalable, but caution is advised:
  - A TRR for an offshore platform, a multi-well pad, or a grouping of wells serviced by compression may be an appropriate application.
  - Facility technical limits may override well level technical limits.
  - Imposing technical limits at levels above an individual well may result in missing some contingent resources under alternate development project scenarios.
  - If the project drops off in “steps”, TRR (both R and CR) may be overstated unless care is taken.



## The concession is a PSC/PSA and economic life occurs before the concession expires. What is my TRR?

- The TRR is in the absence of economic factors such as the concession expiration.
- TRR is set by the technical limit ( $Q_f$ ) of the projection
- The legal framework of participation has no bearing on the TRR.

# FAQ #6 EXAMPLE



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## Does TRR include volumes already produced?

- No. The TRR is the projection of the future remaining production volumes at the “as of” date.
  - It’s Technically Recoverable Resources (TRR), not Technically Recovered and Recoverable Resources (~~TRRR~~).
  - If prior production volumes are included, then you would have the expected EUR associated with that TRR.

# FAQ #8

## What about projects that are in the Contingent Resources category that have not achieved FID?

- FID has no bearing on the technical ending rate.

# FAQ #9

## Is TRR gross or net?

- Since the projection is typically based on gross numbers, the resulting TRR will be gross also.
- But if you want to show Working Interest or Net Revenue Interest TRR, just denote it as such:
  - Working Interest TRR = X, TRR = X (working interest basis), Net TRR = x, etc.
- If no such qualifier is included, TRR's are going to be assumed to be gross volumes.



# FAQ #10



## Is TRR before or after shrinkage?

- TRR represents the technically feasible volume that can be produced.
- Implies that it would be before the effects of fuel & shrinkage.
- If you project volumes that include shrinkage, then the TRR associated with that projection would include shrinkage.
- If you project gross (unshrunk) volumes but want to present the TRR after shrinkage, it would be acceptable to show “Gross (Unshrunk) TRR of X mcf”, “Net (shrunk) TRR of Y mcf”, etc.

## What about the volume after the technical limit?

- These volumes would represent the unrecoverable portion of the PIIP associated with the contingent resources.
- Based on the projection being evaluated and the technical limit involved, these volumes are unrecoverable.
- Some portion may become recoverable under new or incremental projects, i.e. secondary or tertiary recovery projects.

*Glossary: **Contingent Resources** – Those quantities of petroleum estimated, as of a given date, to be **potentially recoverable** from known accumulations **by application of development projects**, but which are not currently considered to be commercially recoverable owing to one or more contingencies.*

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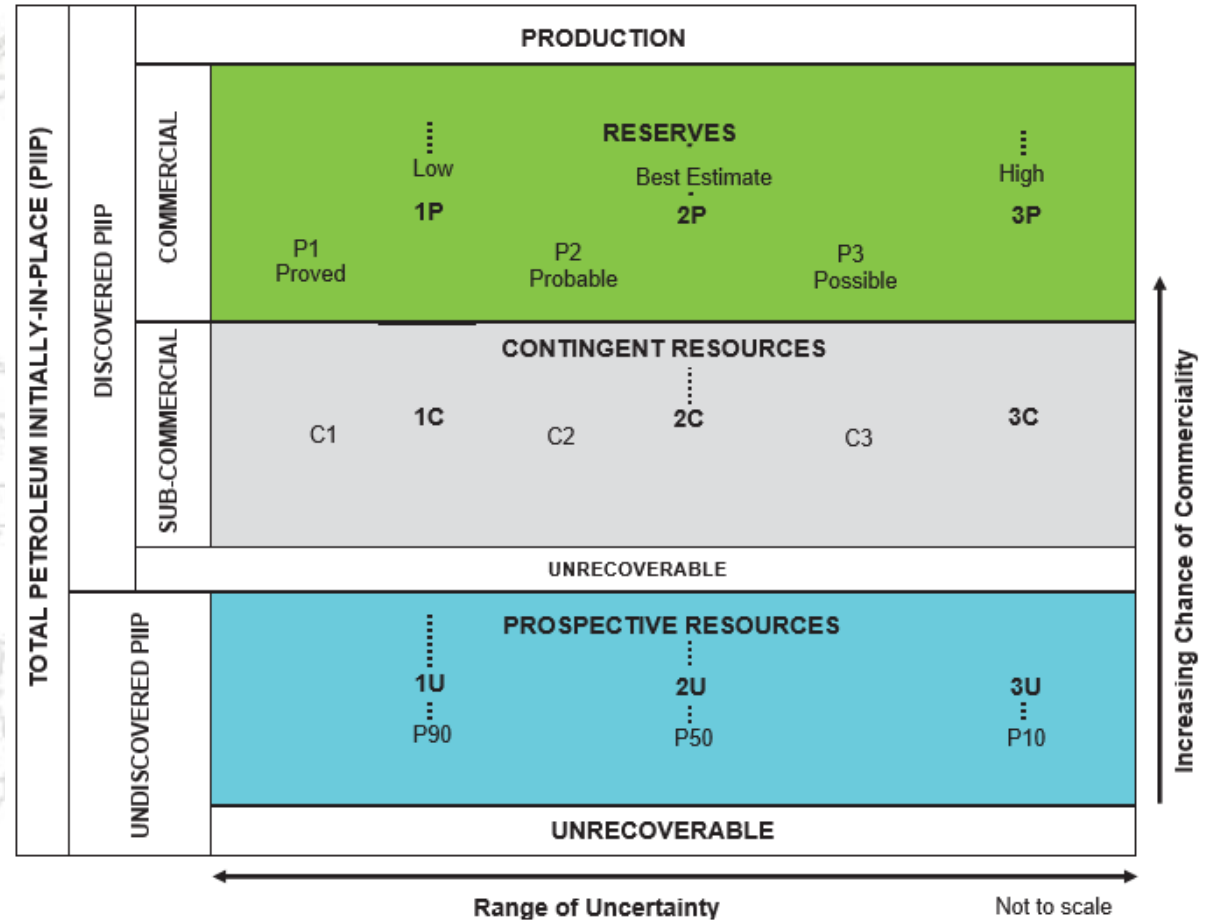
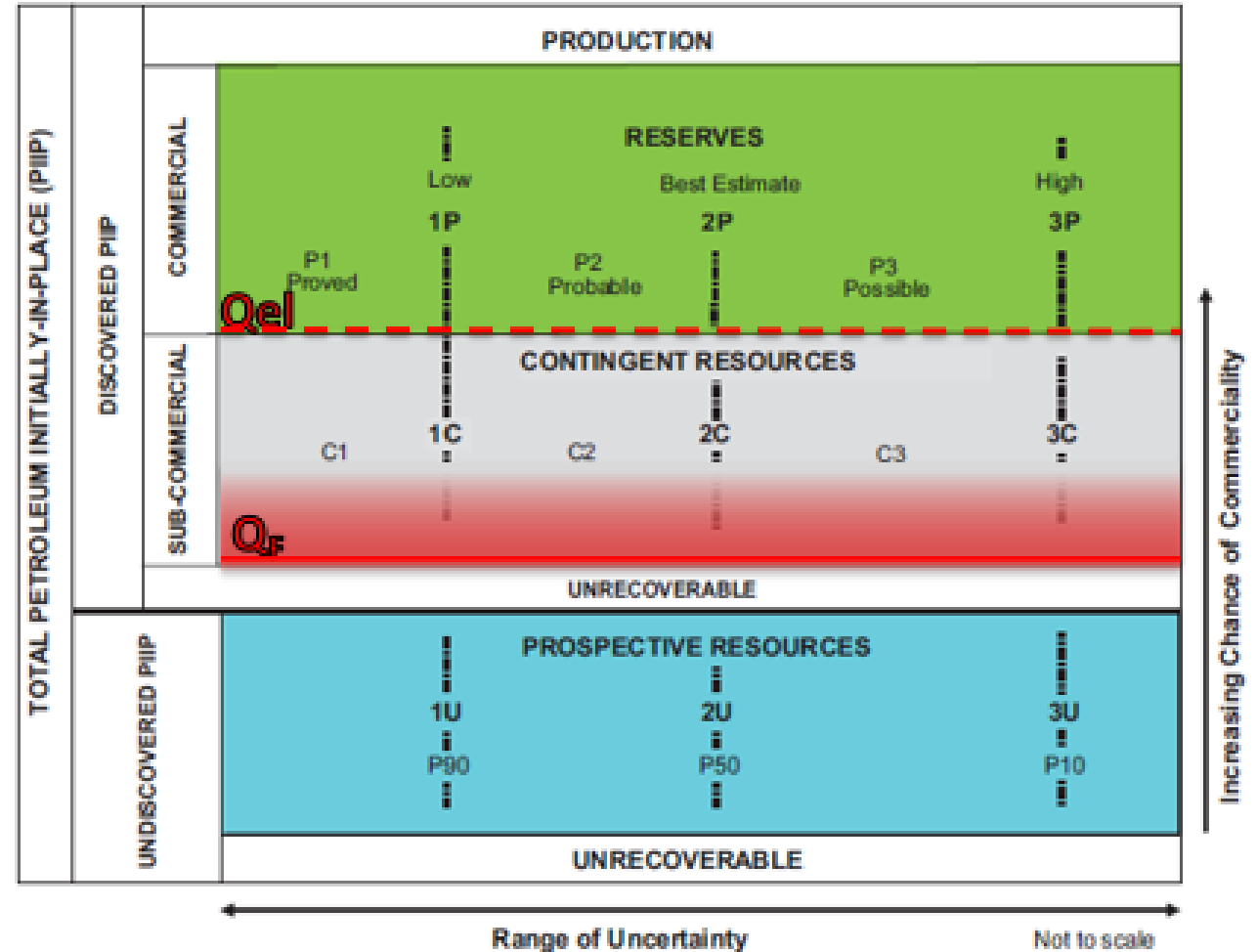


Figure 1.1—Resources classification framework

# FAQ #11 CONTINUED



Unrecoverable is not part of Contingent Resources, but the boundary between Contingent Resources and Unrecoverable is a function of the project(s) applied to the PIIP. Incremental projects should increase the TRR, and the increase comes from promoting volumes from Unrecoverable to Contingent Resources



Modified PRMS Figure 1.1

# FAQ #12

**Can you sum up the TRR's of multiple projections where each has a different technical limit?**

- Yes, this would be the TRR for a group of projections or projects.



## Can you incorporate the Project Maturity Sub-classes into TRR?

- Yes. For example, a particular Contingent Resource projection could be viewed as follows:
  - Portion expected to be promoted to Reserves is considered as Development Pending
  - Portion expected to be between the  $Q_{e1}$  and the  $Q_f$  could be considered as Development Not Viable.
- The portion below the technical limit would not be part of the TRR, as it would represent Discovered PIIP – Unrecoverable.
- Under a subsequent or alternate project, such as secondary or tertiary recovery, may move up from Unrecoverable in that subsequent or alternate project.

TRR

## Is the TRR a No Further Activity (NFA) case?

- The TRR is based on a specific projection. If that projection represents an NFA case, then the TRR would be an NFA case.
- TRR's represent only the projection on which they are based.
- TRR's are all NFA cases in the sense that they don't represent any activity beyond what is represented in the projection.

## Are Technical $Q_f$ rates constant over the life of a well?

- No. A well may be subject to multiple projects over its life. Technical  $Q_f$  rates are constant\* over the life of the project(s) being evaluated, but incremental projects may have different technical  $Q_f$  rates.
  - For example, the gas compression installation discussed in an earlier slide.
- \* Technical  $Q_f$  rates may be updated as more information becomes available, particularly when analogs form the basis for  $Q_f$ . But absent this, the  $Q_f$  rate for a particular projection should remain constant.

## You see a report citing a 1P TRR. Is this acceptable?

- What does this mean? It is essentially saying we have a proven technical resource volume.
  - Is it reserves or resources?
  - If reserves are projected to the economic limit, what limit was used here?
  - While we might assume that it infers reserves and resources, the volume could easily be misinterpreted to be all reserves.

# DAN OLDS



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Dan has over 35 years of experience in petroleum engineering, specializing in reservoir engineering and economic evaluation. He has performed numerous evaluations domestically and internationally under various guidelines, such as SEC, PRMS, NI 51-101, with an emphasis on regulatory compliance.


Dan is an expert witness in Ryder Scott's litigation work and is also the in house expert on bankruptcy and workout restructurings.

He is a registered Petroleum Engineer in the State of Texas, a member of the SPE, SPEE, OGRC.

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