World Liquid Hydrocarbon Resource Evaluation
The Way for a Post-Fossil Phase?
Presentation Outline

• Current Hydrocarbon Explo. & Prod. Context (3 main messages)
• Petroleum Resources Eval. Key Definitions Carbon Cycle, Hydrocarbon Resource Evaluation, YTF, YTP (4 main messages)
• Eval. Updates, Conclusions and Discussion

VP Exploration Total 2010-2015, EAGE Board Member 2015-2019
EAGE President 2017-2019, Retired since 2019, TPA Professor
-Is this Growth sustainable? No!
-An Addition better than a Transition?
-Hydrocarbon Resources?

Biomass
Coal
Hydro-Power (« Houille Blanche »)
Hydrocarbons
Nuclear
Coal Come Back...
Renewables

This Growth is not sustainable!
2025 PEAK; 60% Liquids Produced and less than 50% Gas Produced

→ Ultimate Hydrocarbon Resource Evaluation METHODS

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- A decreasing & almost linear trend! Still Possible « Nuggets »
- Unconventional HC outside USA and Argentina?
20 Gbo Annual Gap (Production, Discoveries) → Yet to Find issue
- Hydrocarbon Volume Planetary limits → Yet to Produce Issue?
Presentation Outline

• Current Hydrocarbon Explo. & Prod. Context
• Petroleum Resources Eval. Key Definitions
  Carbon Cycle, HC Resource Evaluation: YTF, YTP (4 mess.)
• Eval. Updates, Conclusions and Discussion
1-The Carbon Cycle: Life-Sediments-Hydrocarbons

Hydrocarbon Yield from Solar Energy  1/1 000 000
Non Migrated (Shale) HC: 30-50% of HC Generated
Migrated HC Yield < 1% of HC Generated

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1-Generated Hydrocarbons: HCG
2-Hydrocarbons into Source Rocks → Shale Oil & Gas
3-Hydrocarbons Expelled, Migrated and Accumulated: HCA

EUR = HCG x PSY x RF

PSY depending on the basin type

- 20% Compact systems (imbricated, superposed, small distance of HC migration)
- 5% Graben - Rifts (small distance and lateral migration)
- 2% Folded zone / Salt-tectonic basin (post-salt or ante-salt basins, intracratonic basins)
- 1% Deltaic petroleum provinces
- 0.5% Petroleum provinces with long distance migration (>100 km)
- 0.1% Basins with very old source rocks or having problems related to migration timing

EUR → ultimate Ultimate Recovery

HCA = Accumulated HC

PSY = \frac{HCA}{HCG}

UR? = \frac{HCR}{HCG}

Analogic Evaluation Method
Generated and migrated

Carbon Cycle, YTP, YTF

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Access to YTF
Access to Yet to Produce Numbers/field/per area—Worldwide

North Sea clastics

Middle East carbonates

10E+3 barrels per day

Recovery (%)


Analogic Evaluation Method Resources and Reserves

Carbon Cycle, YTP, YTF

3-World Production Profiles Evaluation, Ref Publication BRGM 2008

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MKH predicted the Lower 48 Peak oil Late 1960’s But didn’t not forecast the Source Rock HC Rebound

Mathematic Modeling Evaluation Method
Peak Hydrocarbon: All combined...but Shale HC
Carbon Cycle, YTP, YTF
Presentation Outline

• Current Hydrocarbon Explo. & Prod. Context
• Petroleum Resources Eval. Key Definitions
  Carbon Cycle, Hydrocarbon Resource Evaluation, YTF, YTP
• Eval. Updates, Conclusions and Discussion (2)
Conclusions (1): Combined-Reconciled Evaluation Results

Liquid Production 30-35 Gbo /year
Oil Produced: $1.5 \times 10^3$ Gbo

SPI-PSY Evaluation
Generated: 300 to $2000 \times 10^3$ Gbo

Trapped (IOIP): 6 to $10 \times 10^3$ Gbo
With PSY= 0.5-2%

Conv. Oil Recovery: 3 to $5 \times 10^3$ Gbo
Shale Oils: 0.4 to $1.8 \times 10^3$ Gbo
Total: $3.4 \times 10^3$ to $6.8 \times 10^3$ Gbo

PEAK OIL
2. $10^3$ to 3 $.10^3$ Gbo

Reserves + Resources + Prospective = 2000-3000 Gbo?, i.e 50-60 years?
→ Need to Prepare Transition. IEA and IPCC (Green Fields Ban)...

PROD.PROFILES and YTF
EUR = $f$ ($/bbl$, Technology ...)

$YTF= 400 +/ - 300$
$2C_r= 700 +/ - 300$
$2P= 900 +/ - 300$
$Np= 1500 +/ - 100$

3500 Gbo
Conclusions (2): Recommendations and Questions

Methods and Objectives

- Use the SPI-PSY Numbers and Conclusions (From Companies) and World Production Profiles Methodology (From Consultants) → Standard (IEA, IOC, NOC)-Monitoring HC Remnant Resources

- What ever the NZE scenario, 50 years is tomorrow!
  Implement Mandatory Changes and Plans for Other (than fossil) Liquid Fuel Consumption Solutions

- Gas scenarios remain more questionable and subject to debate according to “COP” recommendations
  Planetary limits?

- What about Coal uses (150 years + Reserves)?
- What about Critical Minerals and Metals? → SAME APPROACH
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Refer also to EAGE Annual or Local Conferences Presentations (@EarthDoc) and:

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