CNH

Comisión Nacional
de Hidrocarburos

Supporting technology development: The role of the public sector in Mexico

Heavy Oil Working Group
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Commissioner

Outline

- Mexico´s energy reform and the new E&P regulatory framework
- The National Hydrocarbon Commission (CNH)
- CNH activities associated with technology development
- Final remarks

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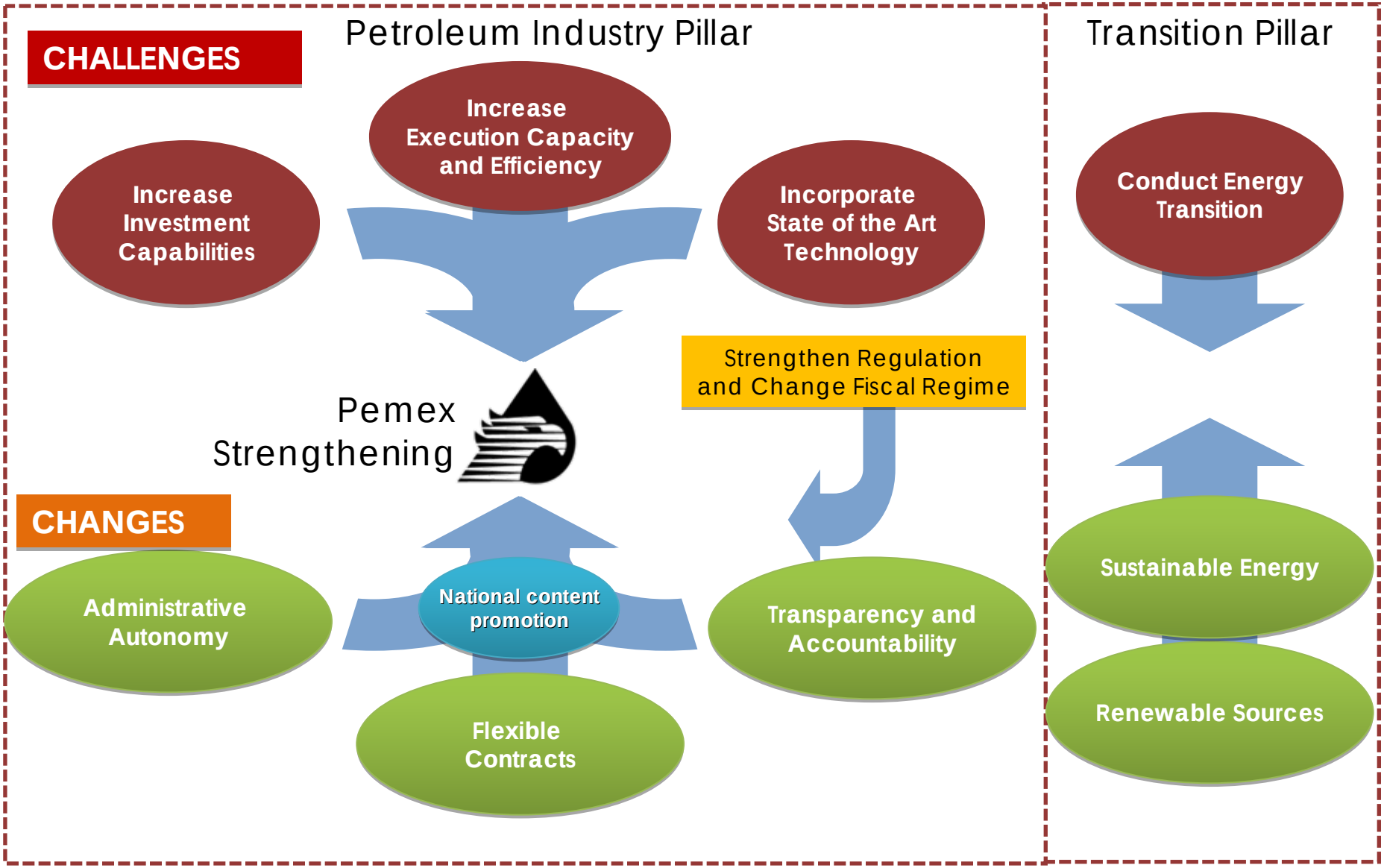
General background

In 2008 an assessment of Pemex's situation was performed by the Ministry of Energy (SENER):

1. **Internal Challenges within Pemex**
   - Decrease in production and declining reserves
   - Significant increase in imports of refined products
   - Insufficient transportation, storage and distribution infrastructure
2. **Challenges related to global oil industry trends**
   - Fewer discoveries of giant oil fields in accessible areas
   - Rise in production costs
   - Insufficient human capital
   - The need to advance in the process of energy transition

PEMEX operated under a legal framework which had not been revised since the late 1970s.

Energy reform strategy



New regulatory scheme

The main objective of the energy reform is to revitalize the E&P industry through:

- Innovative Decision Making
  - **Independent and professional Board members**
  - **Specialized Committees to support Pemex's Board**
  - **National Hydrocarbon Commission**

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- New planning tools
  - **National Energy Strategy**
  - **Pemex's Business Plan**
- New contractual schemes for priority activities
  - **Integrated E&P Contracts**

Main aspects of the reform

1. **Manage PEMEX as a company**

a) New and explicit mandate: create and maximize value

b) Freedom to adjust or redesign its organizational structure

c) Flexibility to set its budget

d) Procurement schemes determined by the company

e) Employee rewards linked to results

f) Independent Board Members

2. **New Control Scheme in PEMEX**

a) Internal Control:

- Auditing Committee (Independent Board Members)
- Internal Control Body only to review compliance

b) External Control:

- “Citizen Bonds”
- Reports (with benchmarks) to Congress by CEO / Board

Main aspects of the reform

3. Strengthening Regulation

a) Tools to develop long-term planning in the Ministry

- Consistency between policies and long term goals
- Allow the exploitation of transborder oil fields

b) Creation of the National Hydrocarbon Commission (CNH)

- Regulate exploratory and extractive activities
- Provide support in defining Hydrocarbon policy

c) Expanded role for the Energy Regulatory Commission (CRE)

- Terms and conditions for fuel oil, refined products and basic petrochemicals
- Efficiency-based pricing (fuel oil and basic petrochemicals)

d) Energy Transition

- Transition and Sustainable Energy Fund: US$200 million
- Renewable Energy Law and the Law for the Sustainable Use of Energy

Some specific aspects of the reform

4. New Model Contracts

a) Efficiency

- Contractors now have incentives to show their full capacity and execution skills
- PEMEX will hire contractors, fixing payment according to performance

b) Increase execution capacity (operational and financial)

- Third parties allowed in exploration activities
- Additional investment by third parties

c) Special procurement regulation

Some Specific Aspects of the Reform

5. National Content and Research Policy

a) Research & Development and Training Funds

BANOBRAS-CONACYT Fund with US$250 million per year (by 2012)

- Fund resources for:
  - Hydrocarbons
  - Renewable energy

b) National Content Policy

- Nafin Fund with US$330 million
- PEMEX strategic plan with the aim of increasing national content
  - Goal: To increase domestic content by 25%
- PEMEX strategic plan to promote small and medium companies' development

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The Mexican National Hydrocarbon Commission

- Created by law in 2008.
- According to the Law of the National Hydrocarbons Commission (CNH):

"The CNH has the fundamental objective to regulate and supervise the exploration and extraction of hydrocarbons…" (Art. 2)

- The CNH should ensure that E&P projects are carried out under the following basis*:
  - ✓ Increase **recovery**, obtaining the **maximum hydrocarbon volume**
  - ✓ Optimize **restitution** of hydrocarbon **reserves**
  - ✓ The use of right **technology**
  - ✓ The **environmental** protection and **sustainability** of natural resources
  - ✓ Observe **industrial safety**.
  - ✓ Minimize **flaring and venting** of gas and hydrocarbons.

* Article 3 - CNH Law

CNH's duties*

POLICY

To contribute with technical elements for hydrocarbon policy

To participate in restitution of reserves policy and assess, quantify and verify reserves.

OPERATION

To establish technical **guidelines** for projects.

To **sanction projects** and to establish limits.

To identify **technical proposals to optimize recovery factors.**

To issue and establish Official Standards.

Technical opinion on **land assignation** or cancelation for exploration and production activities.

SUPERVISION

To **supervise**, **check**, **monitor** and **certify** the fulfillment of dispositions.

To establish evaluation processes related to **operative efficiency**.

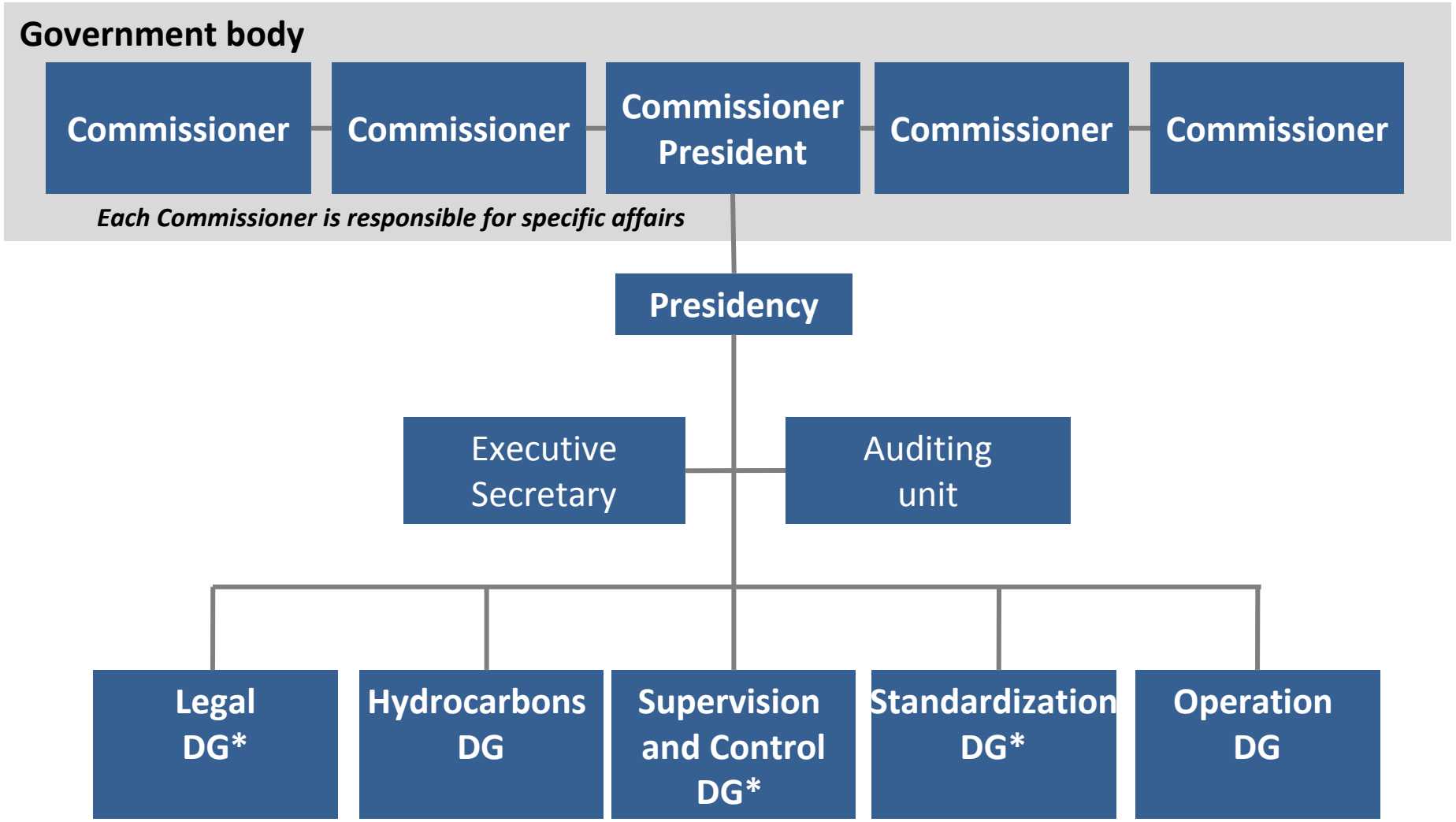
INFORMATION

To obtain, analyze and keep **information and statistics** up to date.

To establish a **petroleum public registry**.

*Article 4 – CNH Law

Composición de la CNH



* Not yet established

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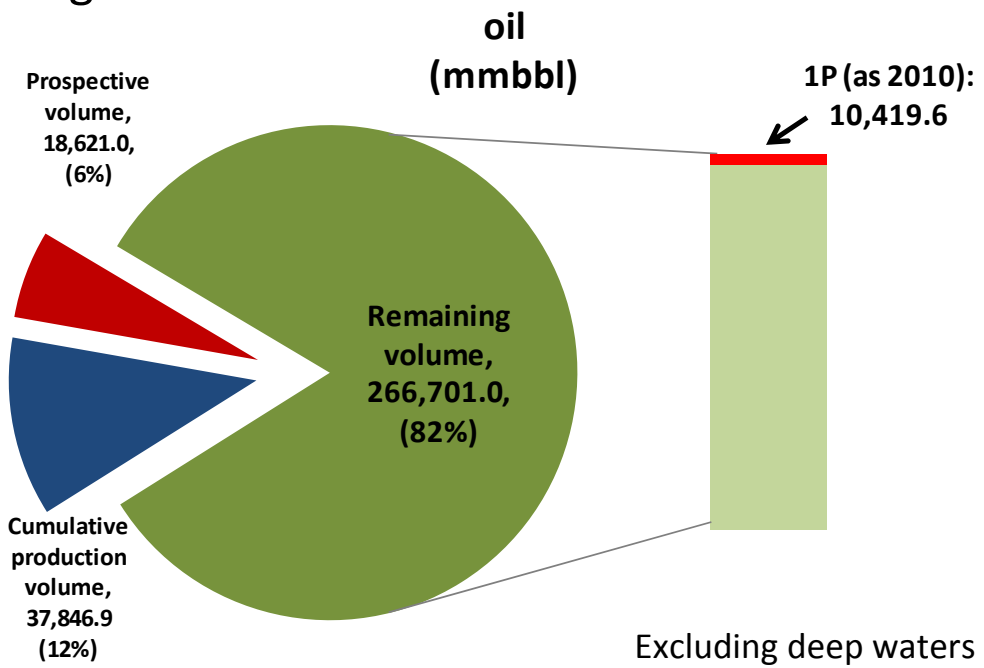
Special Studies: Enhanced Oil Recovery (EOR)

- CNH performed an analysis on the National Potential of EOR and has proposed a methodology to identify technological alternatives in each case.

Extracting by EOR methods just 10% of the remaining volume could triple the 1P reserves of the country



Excluding deep waters

Remaining volume

129 billion bbls

→

EOR to 10% of this volume

12.9 billion bbls

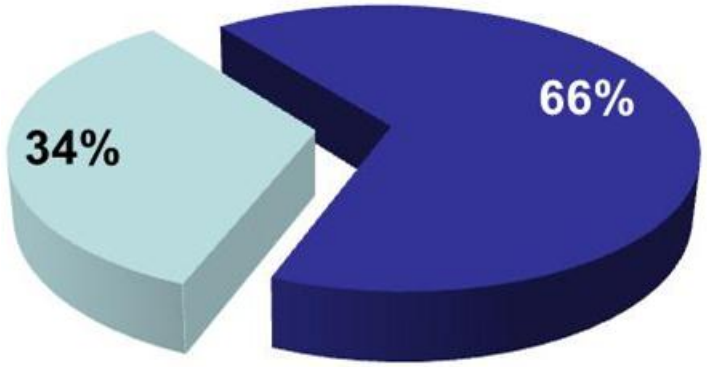
→

Maximum production rate @ R/P = 20 years

1.76 million bpd

Excluding Chicontepec and deepwaters

Mexico's remaining oil by reservoir



38 sandstone type / *141,805MMB*

- 29 at ATG / *137,118MMB*

Combustion, Immiscible gas, SP, ASP, Alkaline, Miscible CO2 and steam

- 5 at Cinco Presidentes / *2,536MMB*

Miscible hydrocarbons, Miscible CO2 , Immiscible gas, Combustion, SP, ASP and Alkaline.

- 1 at Cantarell / *674MMB*

Miscible hydrocarbons, Miscible CO2 and Immiscible gas

- 1 at Ku-Maloob-Zaap / *393MMB*

Miscible CO2 and Immiscible gas.

- 1 at Litoral Tabasco/ *433MMB*

Miscible hydrocarbons, Miscible CO2 and Immiscible gas

- 1 at Samaria-Luna / 648MMB

Steam

75 carbonates / *97,760MMB*

Miscible hydrocarbons, Miscible CO2 and Immiscible gas

- 16 at Ku-Maloob-Zaap / *26,800MMB*.
- 15 at Poza Rica-Altamira / *17,695MMB.*
- 11 at Abkatún-Pol-Chuc / *9,118MMB.*
- 10 at Litoral Tabasco / *5,051MMB.*
- 8 at Cantarell / *22,693MMB.*
- 6 at Samaria-Luna / *8,173MMB.*
- 5 at Muspac / *3,553MMB.*
- 4 at Bellota-Jujo / *4,673MMB*.

We need to develop a Strategy for Fractured Carbonates and for Chicontepec's reservoirs

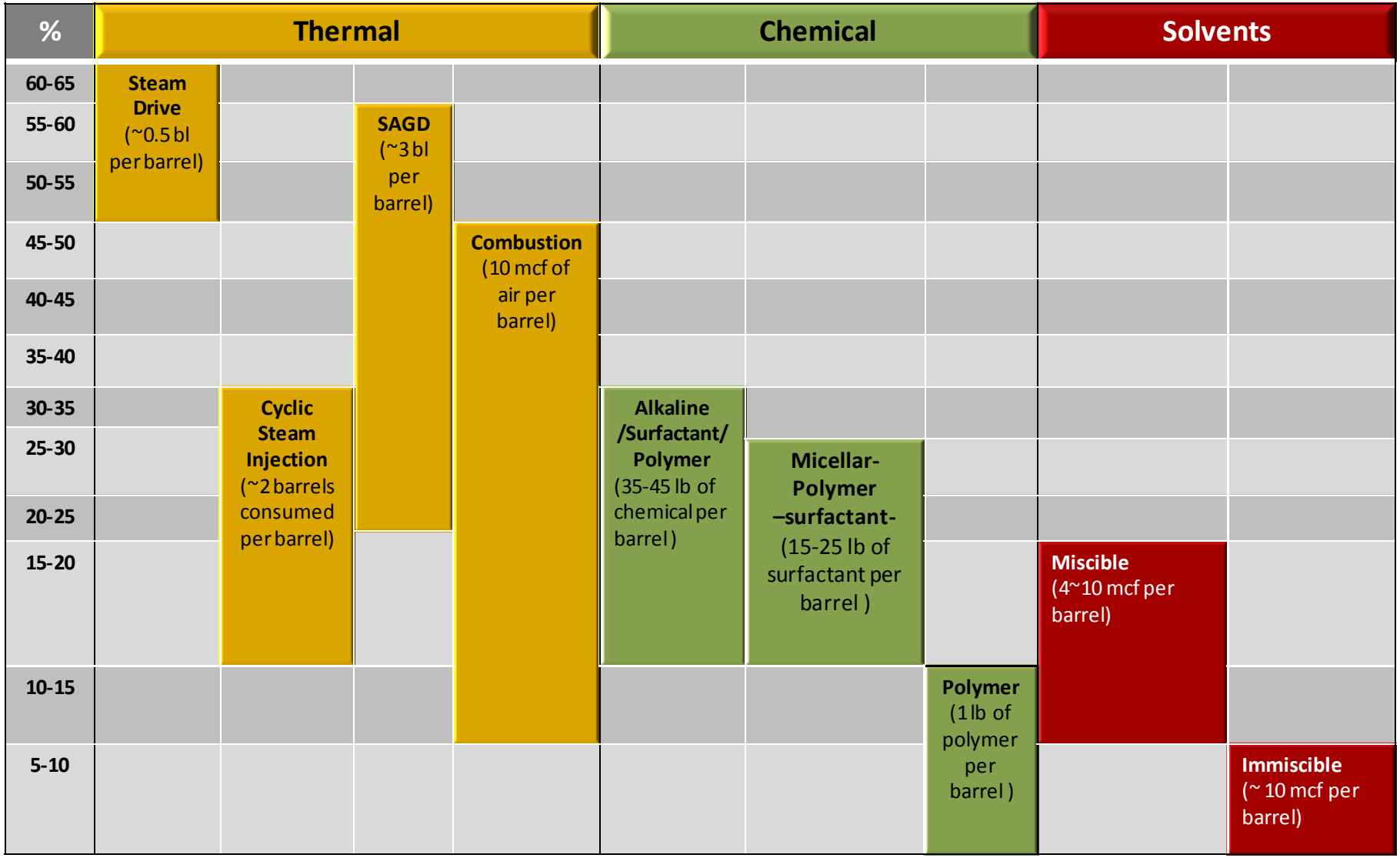
Results

Business units	Original volume (mmb)	Remaining volume (mmb)	Volume to recovering for more pessimistic method (mmb)	Volume to recovering for more optimistic method (mmb)	Volume to recovering average (mmb)	Volume to recovering to 10% (mmb)
Ku-Maloob-Zaap	**30,083**	**27,194**	**1,061**	**2,309**	**1,685**	**2,719**
Carbonates	**29,683**	**26,800**	**1,042**	**2,132**	**1,587**	**2,680**
Light	505	505	25	76	51	51
Heavy	29,178	26,295	1,016	2,056	1,536	2,630
Sandstone type	**400**	**394**	**20**	**177**	**98**	**39**
Heavy	400	394	20	177	98	39
Cantarell	**36,813**	**23,368**	**1,168**	**2,593**	**1,881**	**2,337**
Carbonates	**36,038**	**22,694**	**1,135**	**2,290**	**1,712**	**2,269**
Light	491	408	20	61	41	41
Heavy	35,548	22,286	1,114	2,229	1,671	2,229
Sandstone type	**775**	**674**	**34**	**303**	**169**	**67**
Heavy	775	674	34	303	169	67
Poza Rica-Altamira	**21,128**	**17,378**	**555**	**1,349**	**952**	**1,738**
Carbonates	**21,128**	**17,378**	**555**	**1,349**	**952**	**1,738**
Light	7,344	5,309	240	721	480	531
Heavy	13,783	12,069	314	629	472	1,207
Abkatún-Pol-Chuc	**14,273**	**9,119**	**456**	**1,308**	**882**	**912**
Carbonates	**14,273**	**9,119**	**456**	**1,308**	**882**	**912**
Light	13,073	7,918	396	1,188	792	792
Heavy	1,201	1,201	60	120	90	120

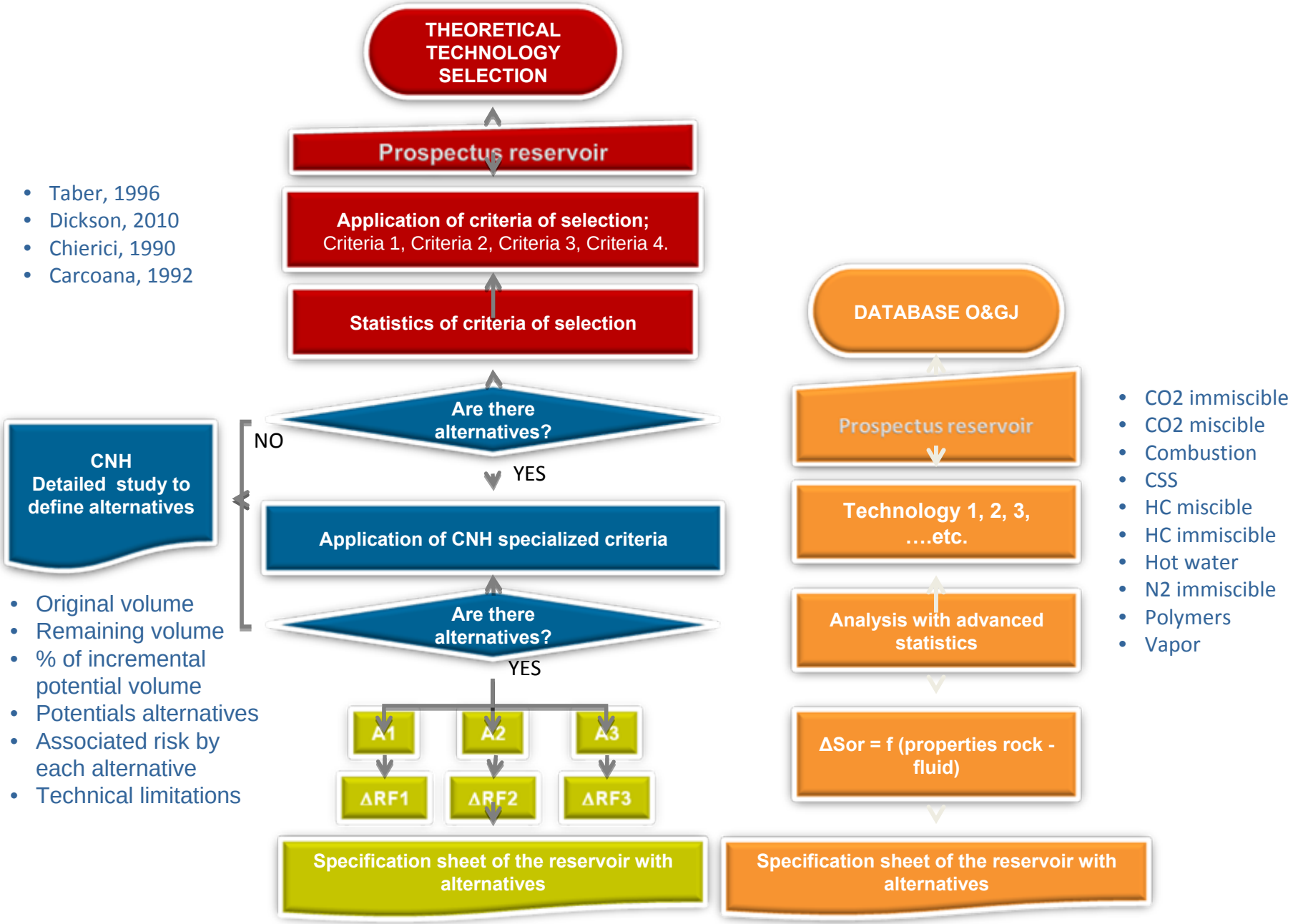
Results

Business units	Original volume (mmb)	Remaining volume (mmb)	Volume to recovering for more pessimistic method (mmb)	Volume to recovering for more optimistic method (mmb)	Volume to recovering average (mmb)	Volume to recovering to 10% (mmb)
Samaria-Luna	**11,920**	**8,822**	**474**	**1,648**	**1,061**	**882**
Carbonates	**11,271**	**8,173**	**409**	**1,226**	**817**	**817**
Light	7,232	5,033	252	755	503	503
Extra light	4,039	3,140	157	471	314	314
Sandstone type	**649**	**649**	**65**	**422**	**243**	**65**
Heavy	649	649	65	422	243	65
Litoral de Tabasco	**5,643**	**5,485**	**274**	**921**	**598**	**548**
Carbonates	**5,210**	**5,051**	**253**	**726**	**489**	**505**
Light	2,264	2,156	108	323	216	216
Heavy	1,359	1,359	68	172	120	136
Extra light	1,587	1,537	77	230	154	154
Sandstone type	**433**	**433**	**22**	**195**	**108**	**43**
Heavy	433	433	22	195	108	43
Bellota-Jujo	**6,319**	**4,674**	**234**	**701**	**467**	**467**
Carbonates	**6,319**	**4,674**	**234**	**701**	**467**	**467**
Light	4,793	3,562	178	534	356	356
Extra light	1,526	1,111	56	167	111	111
Muspac	**4,605**	**3,554**	**178**	**533**	**355**	**355**
Carbonates	**4,605**	**3,554**	**178**	**533**	**355**	**355**
Light	4,140	3,262	163	489	326	326
Extra light	465	292	15	44	29	29
Cinco Presidentes	**3,322**	**2,537**	**123**	**611**	**367**	**254**
Sandstone type	**3,322**	**2,537**	**123**	**611**	**367**	**254**
Light	3,322	2,537	123	611	367	254
Gran total	**134,106**	**102,129**	**4,522**	**11,973**	**8,248**	**10,213**

Technological implications of EOR recovery factors



Expected technological process



- Taber, 1996
- Dickson, 2010
- Chierici, 1990
- Carcoana, 1992

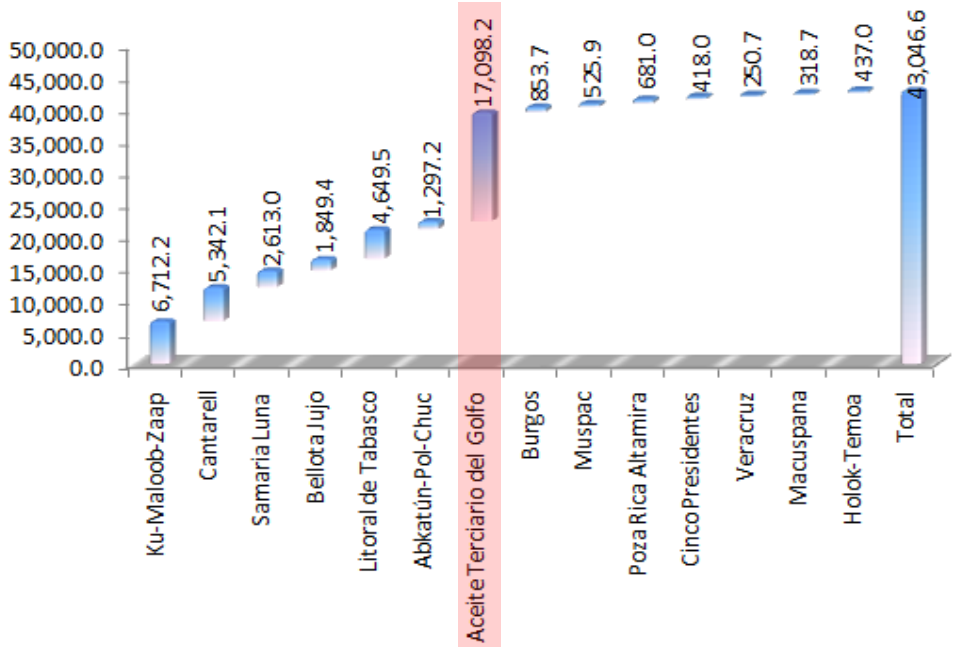
- Original volume
- Remaining volume
- % of incremental potential volume
- Potentials alternatives
- Associated risk by each alternative
- Technical limitations

- CO2 immiscible
- CO2 miscible
- Combustion
- CSS
- HC miscible
- HC immiscible
- Hot water
- N2 immiscible
- Polymers
- Vapor

Technology evaluation of Chicontepec

- Chicontepec is a complex geological deposit with 29 fields.
- Exploitation began in 1952.
- It is the largest hydrocarbon deposit in the country. The OOIP is over 100 billion barrels of oil*:

3P Reserves–Pemex 2011 Evaluation by administrative unit



*Pemex estimations as January 1st , 2011

Chicontepec's first revision

- In April 2010 CNH conducted a review of the project.
- The review identified that the design phase was not completed to the required level, and therefore the technological alternatives had not been fully and thoroughly analyzed.
- CNH recommended the redefinition of the exploitation strategy, strengthening the consensus to develop more studies to define the right technology.
- Field labs were established with the main objective of analyzing technological alternatives for conventional and unconventional wells, completion, fracturing, ALSystems, surface facilities, production management, etc.
- The modest and steady rise in production observed after the revision confirmed the correct route.

Project sanctioning

CNH will establish technical guidelines to be followed in the design of projects for exploration and extraction of hydrocarbons...[that] identify specific elements that exploration and extraction projects shall include, among others:

- The exploration success and the incorporation of reserves.
- The technologies used to optimize the operation at various stages of projects.
- The rate of extraction of the oilfields.
- The recovery factor of the reservoirs.
- The technical evaluation of the project.
- Technical references in accordance with best practices.

CNH Guidelines

I. **Identification of alternatives.**

II. **Evaluation of main alternatives.**

III. **Project Development Plan.**

IV. **Geological, geophysical and engineering aspects.**

a) Geology, seismic, petro physics, volumetric, PVT studies, pressure-production testing , chemistry of fluids, mechanisms of production and models, etc.

b) Production profiles and recovery factors.

c) IOR/EOR.

V. **Strategy of development and exploitation.**

a) Development, forecasts of production and reserves.

b) Drilling and production facilities.

c) Processing facilities.

VI. **Economic evaluation.**

VII. **Metering.**

VIII. **Gas utilization program.**

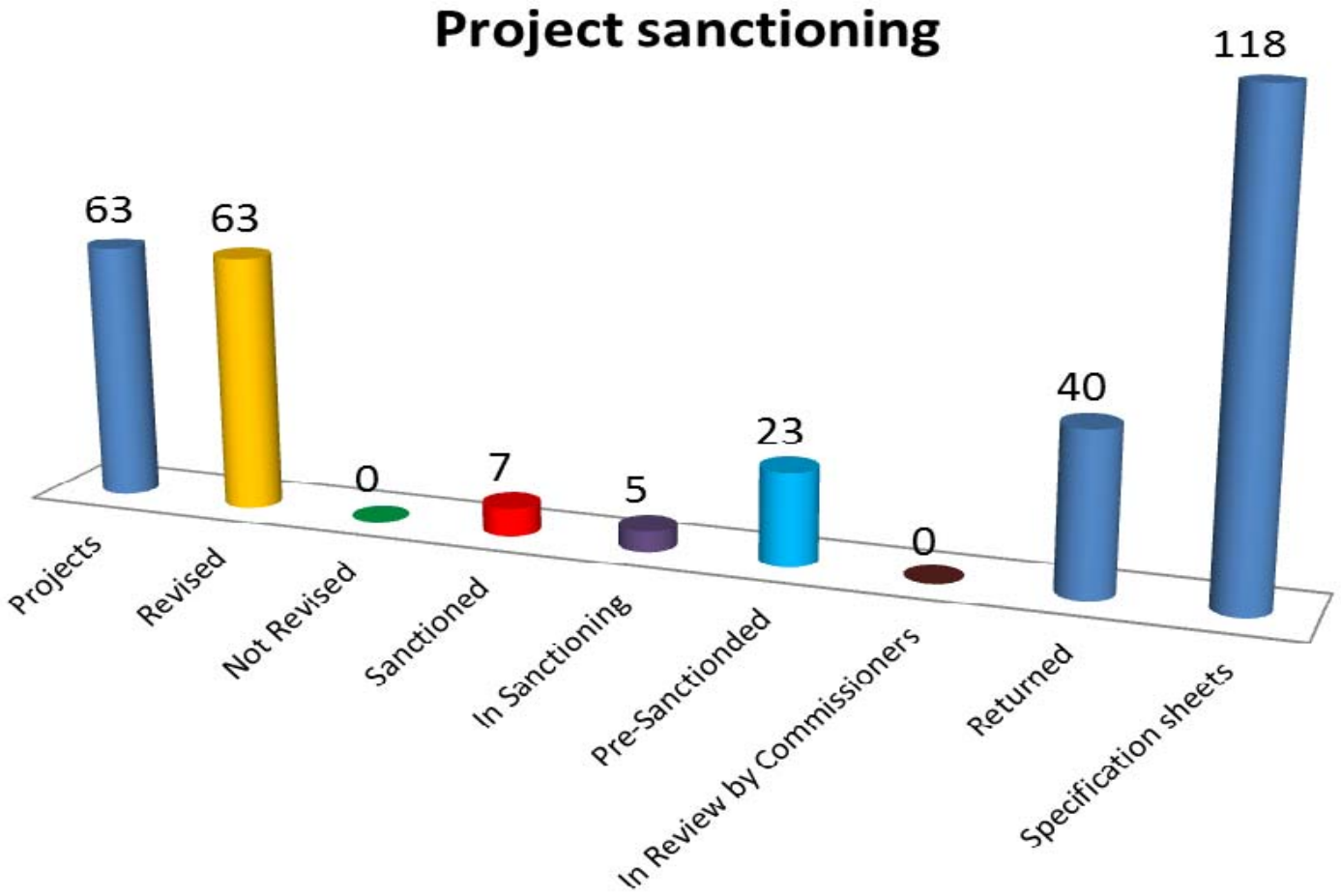
IX. **Industrial safety and environmental protection.**

X. **Abandonment.**

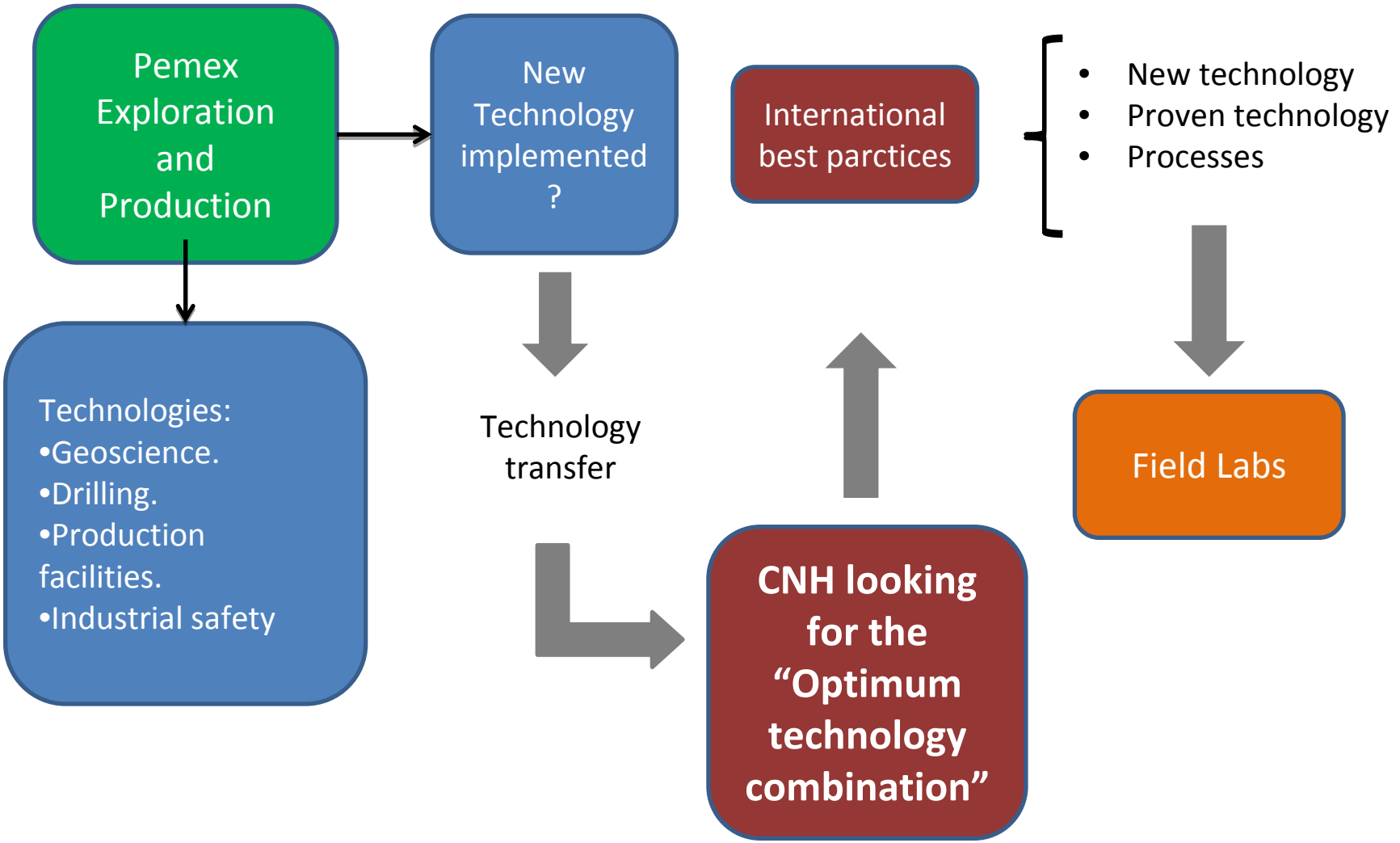
CNH will ensure that only the best projects will be carried out by Pemex, including those developed through the new contract model

Current status

- As a result of the reform, CNH has to technically sanction at least 63 projects by September 2012.



The sanction role and technology development



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- Technology development in the NHC activities
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Final Remarks

- The energy reform has established proper legal and regulatory frameworks to face internal and external challenges, including technology development
- Independent Board Members and Specialized Committees will provide the degree of analysis, transparency and accountability to manage Pemex as a company.
- For the first time in Mexico's history a technical autonomous E&P regulator is established.
- CNH guidelines for E&P project design ensures analysis and selection of the best technological alternatives.
- CNH attributions to contribute with technical proposals to increase recovery factor and national research funds will foster technology development, transfer and application.