Uranium Resource availability Assessment for Niger's Nuclear Energy System by INPRO Methodology

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OUTLINE

I. Objectives of this presentation
II. Country Profile
III. Specification of the Nuclear Energy System
IV. Resources Classification schemes used by INPRO and other Institutions
V. Quantity of uranium Fu available for use in NES
VI. Quantity Du of Uranium needed for NES
VII. Conclusion

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Objectives:

This presentation aims to:

- **Compare Niger and INPRO Standards of resources Classification**

- **Assesse and Report Niger'conventional primary Identified resources of Uranium**

- **Verify the CR1.1 of UR1 of INPRO methodology fullfilement by Niger's NES**

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Country Profile :Location

Niger in Africa

Country profile (Cont.)

- **Republic of Niger**
- Capital: Niamey
- Land area: **1,267,000 km 2**
- Population[2]: **more than 17 millions inhabitants**
- Mining Industry[2]: major part of country economy (40% of exports) and 3% GDP and employs permanently more thousand people
- Uranium represents more than 60% of exportation Niger is interested in Nuclear Science and Technics and their pacifc applications since 60's
- We have created in the 60's IRI (Institut des radio Isotopes) for training and research in the field
- We are part of NPT (Non Proliferation of nuclear weapons Treaty)
- Part of the CTBT(comprehensive nuclear test ban treaty)
- *Niger has announced his intention to develop a Nuclear Energy Program since 2010*

Source: Institut National de la Statistique

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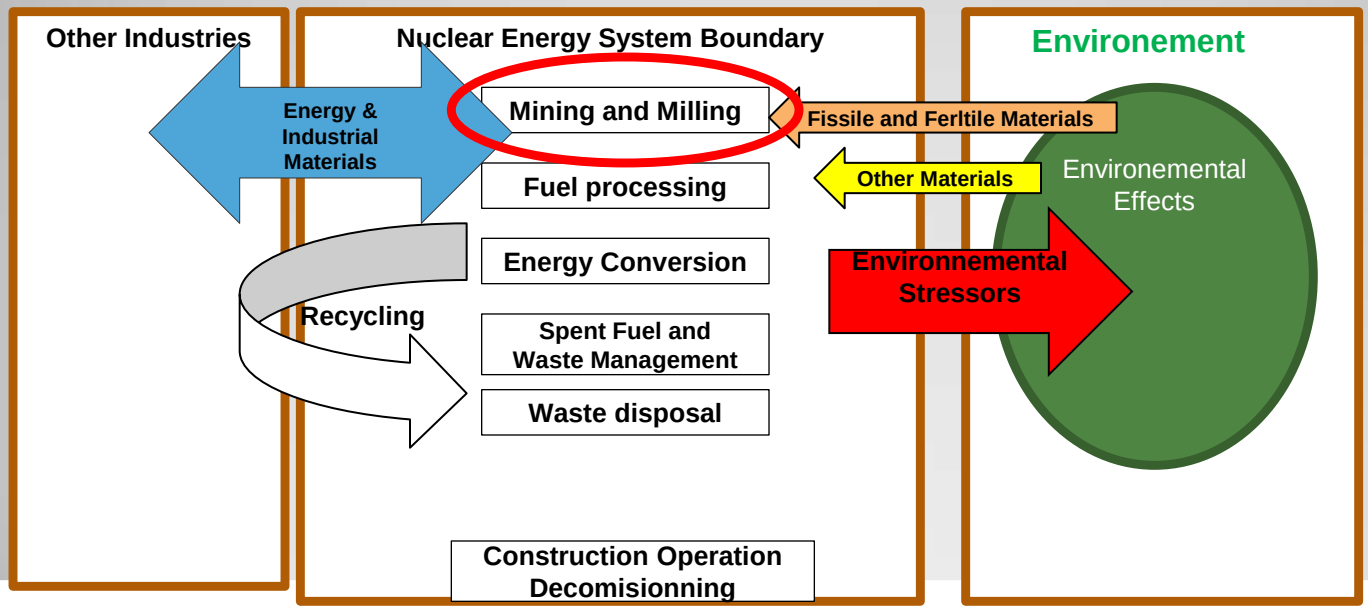
Specification of the Nuclear Energy System

Niger's NES is at the front end of Nuclear fuel production chain it consist of Mining and Milling.

Niger has three (03) operating mines: SOMAIR, COMINAK and SOMINA each company has its own processing Mill plant therefore Niger has three mining and three milling facillities



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Resources Classification Scheme by INPRO and Other institutions

Organisations and Countries use different methods of classifying resources but the various systems have several features in common:

-They all define ‘Mineral Resource’ as **concentration** or occurence of material of **intresec economic interest** in or on the earth crust in such form that there are **reasonable prospect for eventual economic extraction**

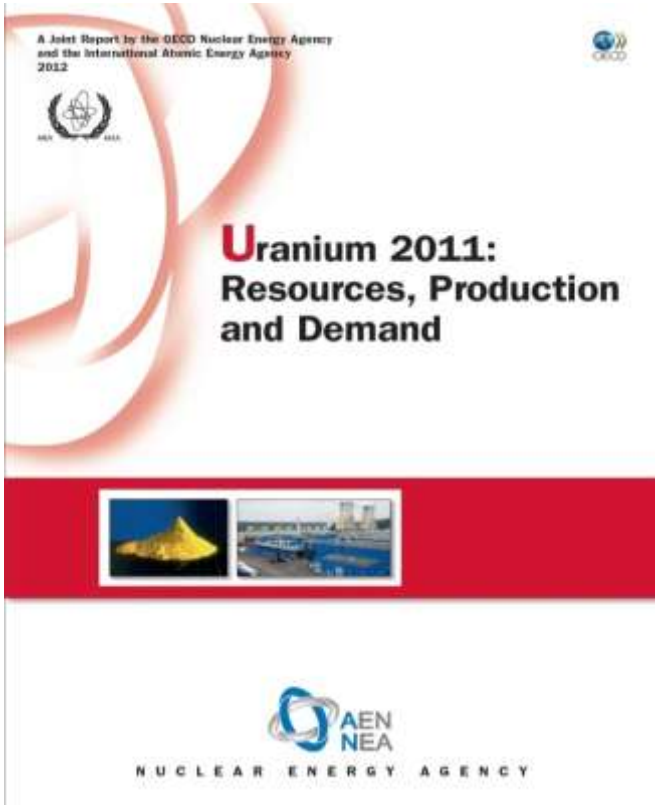
-They differenciate the resource in two main groups (Known and Undiscouvered)

- They all subdivide undiscouvered resources in two classes : one with a well known geology containing define deposits and one highly uncertain with a less known area containg speculative resources

IAEA has strived to develop a comprehensive inventory of recoverable uranium resources since 1960’s.

Classification of resources by INPRO

INPRO uses the system of classification developped by IAEA and NEA (Nuclear Energy Agency) of OECD (Organisation for Economic Co-operation and Development) to prepare the inventory of uranium resources published in the world report of uranium known as **Red Book**



NEA/IAEA classification scheme for uranium resources

The Red Book defines catégory of uranium that could be mined (called Primary ressources in opposition to secondary supply resources) based on confidence level in the quantities reported and cost to mine

It defines the primary resources in two broad classes:

- Conventional resources: those that have an establish hystory of uranium producing as a key product or an important by-product

- Unconconventional resources those from which uranium is only recoverable a minor by-product (phosphate mining)

Conventional resources are divided according to different confidence levels of occurrence into 4 categories :
Reasonable Asured Resources (RAR), Infered Resouces (IR), Prognostical Resources (PR) and Speculative Resources (SR)

RAR+IR = identified resources
PR+SR = undiscovered resources

NEA/IAEA Cost categories for uranium resources

The **Red Book** also defines four categories of costs in USD of uranium recovered at the ore processing plant:

<USD 40 / KgU , <USD 80/KgU, <USD 130/KgU, and <USD 260/KgU

The following therefore gives the 13 classes for U resources/reserves according to the Red Book scheme

IEA/IAEA classification schem for uranium resources

Increasing Economic attractiveness

	Identified Resouces		Undicouvered Resources	
< USD 40	R.A.R	I.R	Prognosticated Resources	SPECULATIVE RESOURCES
< USD 80	R.A.R	I.R	Prognosticated Resources	
< USD 130	R.A.R	I.R	Prognosticated Resources	
< USD 260	R.A.R	I.R	Prognosticated Resources	

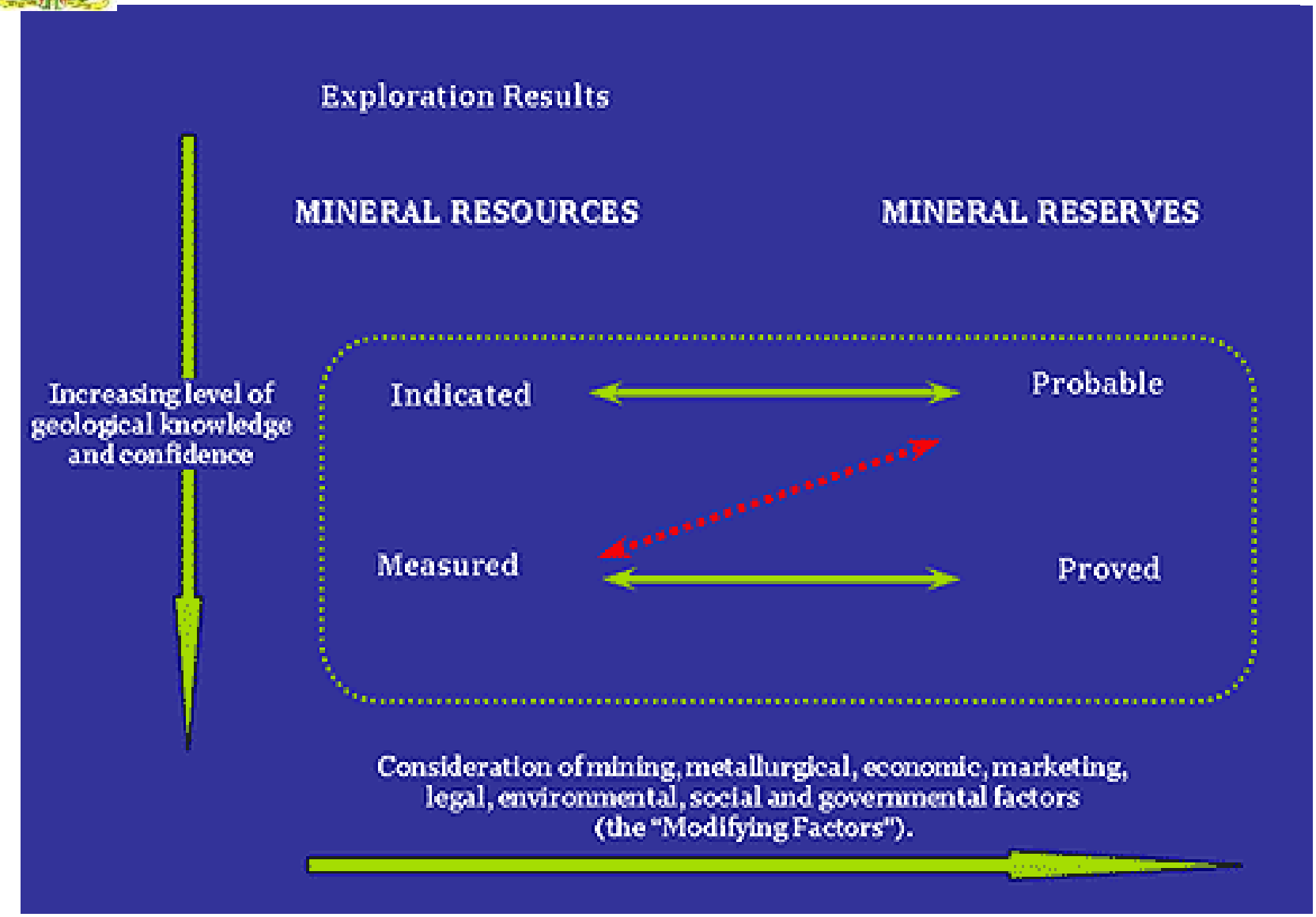
Discreasing confidence in estimates

UNFC/CRIRSCO resources classification scheme

In 2009 United Nations Economic Commission for Europe (UNCE) developed a classification scheme called UN framework Classification (UNFC) it is based on three fundamental criteria : economic (E), field project status and faisability (F) and geological knowledge (G).
According to UNFC each project is categorised by a combination of three numbers (111, 112, 211 etc..)

Committee for Mineral Reserves International Reporting Standards (CRIRSCO) has classified resources in two main classes: Exploration Results and Mineral resources which is divided into indicated and measured resources.
According to CRIRSCO Mineral reserve are part of mineral resources that are economicaly, technicaly, environnementaly minable and are divided into probable reserve and prooved reserve

CRIRSCO Relationships beetween Mineral Resouce and Reserve



NEA-IAEA/CRIRSCO Schemes Comparison

	Identified Resouces			Undicouvered Resources	
NEA- IAEA used by INPRO for Resource assesment	Reasonably Assured		Infered	Prognosticated	SPECULATIVE RESOURCES
CRIRSCO Used by Niger and Canada mining companies	Measured	Indicated	Infered	Prognosticated	
United States (DOE)	Reasonably Assured		Estimated Additional		
UNFC	G1+G2		G3	G4	G4

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Quantity of uranium F_u available for use in NES: Conventional primary Identified Resources

Undiscovered Uranium resource

- **Niger's first commercial uranium mine began operating in 1971.**
- **Niger has three significant uranium mines providing 7.5% of world mining output from Africa's highest-grade uranium ores. (COMINAK, SOMAIR, SOMINA)**
- **Six (06) junior companies are active in uranium exploration (GPB Minerals, Global Atomic Fuels, GoviEx, Niger Uranium, NGM)**
- **There is strong government support for expanding uranium mining.**
- Niger is the world fourth uranium producer in 2013 it produces 4,528 tU and cumulative production from the country is 123,541 tU.

➢ Undiscovered Uranium resources are mainly in the Tim Mersoi Sedimentary Basins that covers more than 114.000 Km² and has a potential resource estimated at of **480 000** tones of uranium* with grade comprising between 0.3 and 0.6 %

*** Source: Présidence de la République du Niger www.presidence.ne**

Inferred resources

- The total inferred resources evaluated in Niger in 2013 is more than 83.000 tU:

Project	Inferred (tU)	Year of estimation
Imouraren	2 879	2009
SOMAIR	41 230	2011
COMINAK	2 239	2011
SOMINA	-	-
GOVIEX	9 200	2010
Gloabl Uranium	21 000	2011
Niger Uranium	1.700	2011
NGM	5. 000	
TOTAL	**83,248**	

Sources: Ministry of Mine World Nuclear Energy

Reasonably assured reserves

In 2014 the country RAR resouces that can be mined less than 130 USD/Kg is estimated to 278,143.2 tU reported by the following companies:

Project	R.A.R (tU)	Year of estimation
Imouraren	213,722	2013
SOMAIR	38,211	2009
COMINAK	14, 062	2013
SOMINA	12,148.20	2014
TOTAL	**278,143.2**	

Source: Ministry of Mines

Quantity of uranium Fu available for use in NES

The total amount of Fu of uranium available for the NES is estimated to be more than 841.000 tones uranium.

This is the quantity of uranium available today at a cost < **260 USD/KgU**

It consist of the sum of Prognosticated uranium resource, Infered uranium resouce and Reasonably Assured Resource

Fu = 480,000 tU + 83,248 + 278,143.2 tU = 841,391.2 tU

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Quantity Du of Uranium needed for NES

Although the country has no nuclear power plant it suplies the global market an important part of its uranium need hence Niger is the world's fourth-ranking producer of uranium in 2013 and produced 4,528 tones of Uranium in its three (3) mines :

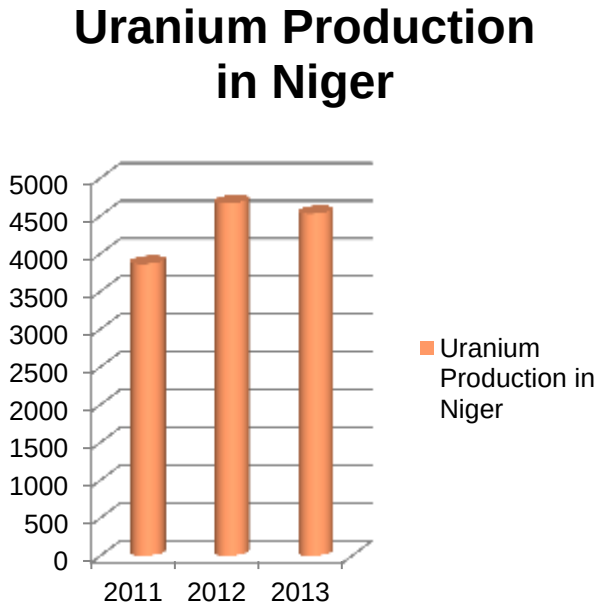
✓ Société des Mines de l'Aïr (SOMAIR) , an open pit mine

✓Compagnie Minière d'Akouta (COMINAk) that is an underground mine operating at a depth of about 250 metres

✓Société des Mines d'Azelik (SOMINA) which is an open pit and underground operation using alkaline leach

Du: Uranium Production in Niger

Project	2011	2012	2013
SOMAIR	2726	3065	2730
COMINAK	1075	1506	1508
SOMINA	64	96	290
TOTAL	**3 865**	**4 667**	**4 528**



In 2011 total production of Niger (Du needed in the NES for global market) was 3 865 tU It has significantly increased in 2012 (around 7.7%) at 4.667 tU. And and decerase (around 3%) in 2013 to 4528 tU

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Conclusion:

Niger's NES resource avalability fulfills the INPRO criteria CR.1.1 of User Requirement UR1 since that with more than 841.000 tones (Fu) of primary uranium resources and assuming today's production capacity less than 5.000 tU/year (Du) Even when any new deposit is discovered over years one can estimate that Niger will continue producing uranium for more than 168 years without running out of resources

Then Fu(t) > Du (t) for any t < 100 years !

THANK YOU!