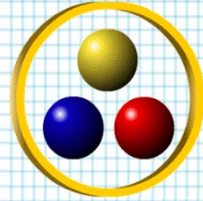


Eti Mine Works General Management



*World Boron leader*

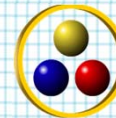
## Thorium potential of Turkey resource and recent developments

Numan Kalbitemiz BODUR, MSc., MBA  
Assistant Manager  
Strategic Planning&Investment Division

Workshop on Recent Developments in Evaluation of Uranium and Thorium Resources,  
Lisbon, Portugal, 15 - 18 October 2012



# Turkey At a Glance



## Neighboring Countries

Bulgaria, Greece, Syria, Iraq, Iran, Azerbaijan, Armenia, Georgia

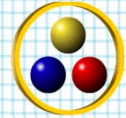
## Major Cities (Population)

Istanbul (13.3 million),  
Ankara (4.8 million),  
Izmir (3.9 million),  
Bursa (2.6 million),  
Adana (2.1 million)



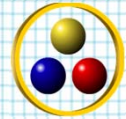


# Turkey At a Glance

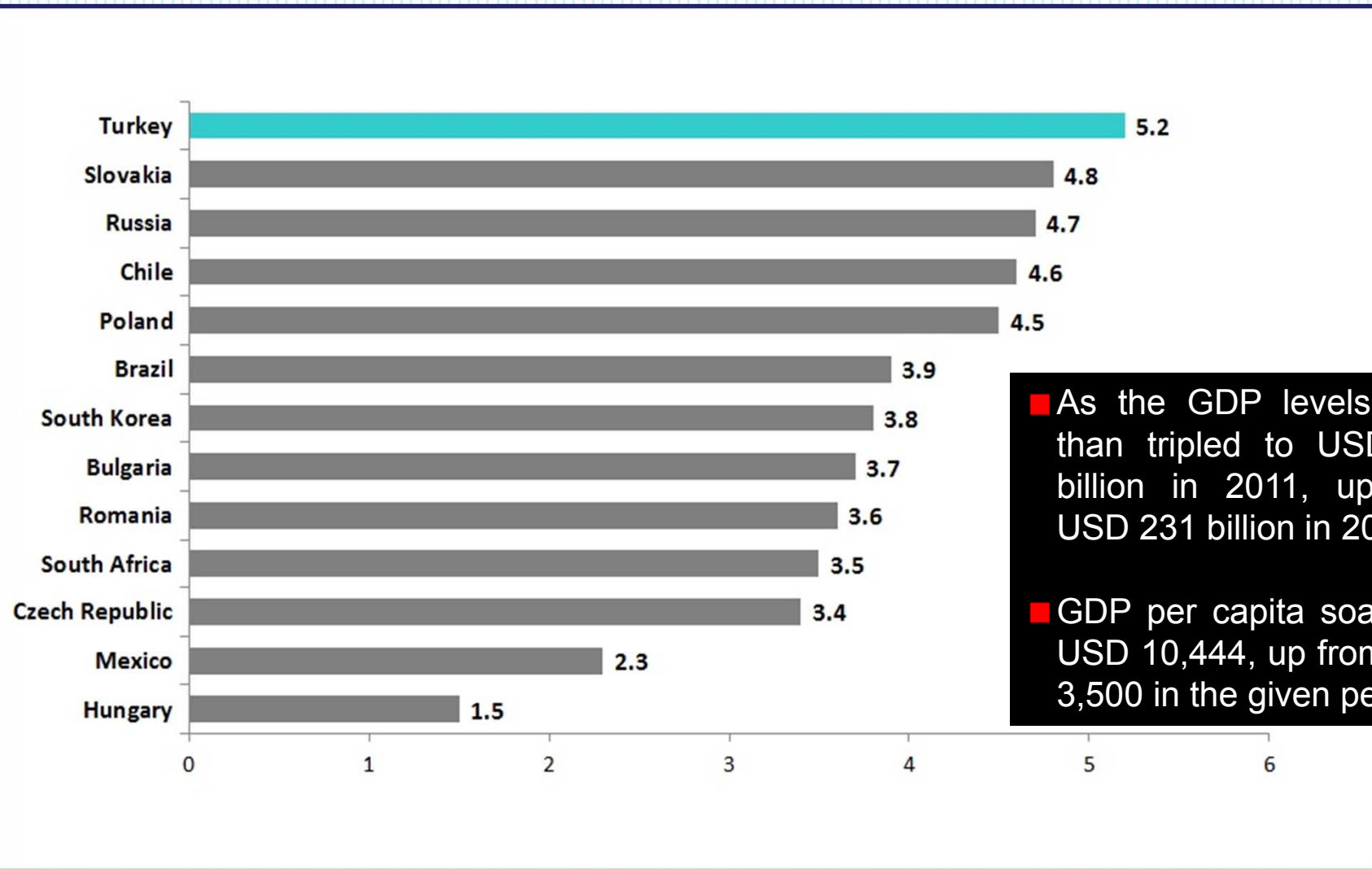


<b>Official Name of Country</b>	Republic of Turkey
<b>Capital City</b>	Ankara
<b>Government</b>	Parliamentary Democracy
<b>Population</b>	75 million (2011)
<b>Labor Force (Population)</b>	26.7 million (2011)
<b>Median Age</b>	29.7 (2011)
<b>Official Language</b>	Turkish
<b>President</b>	Abdullah Gul
<b>Prime Minister</b>	Recep Tayyip Erdogan
<b>Area</b>	783,562.38 km <sup>2</sup>
<b>Time Zone</b>	GMT +2
<b>Climate</b>	Temperate; hot, dry summers with mild, wet winters
<b>Currency</b>	Turkish Lira
<b>Financial Center</b>	Istanbul
<b>GDP</b>	USD 772 billion (2011-Current Prices)
<b>GDP Per Capita</b>	USD 10,444 (2011)
<b>Exports Value</b>	USD 135 billion (2011)
<b>Imports Value</b>	USD 241 billion (2011)





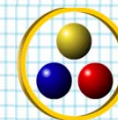
## Average Annual Real GDP Growth (%) 2002-2011



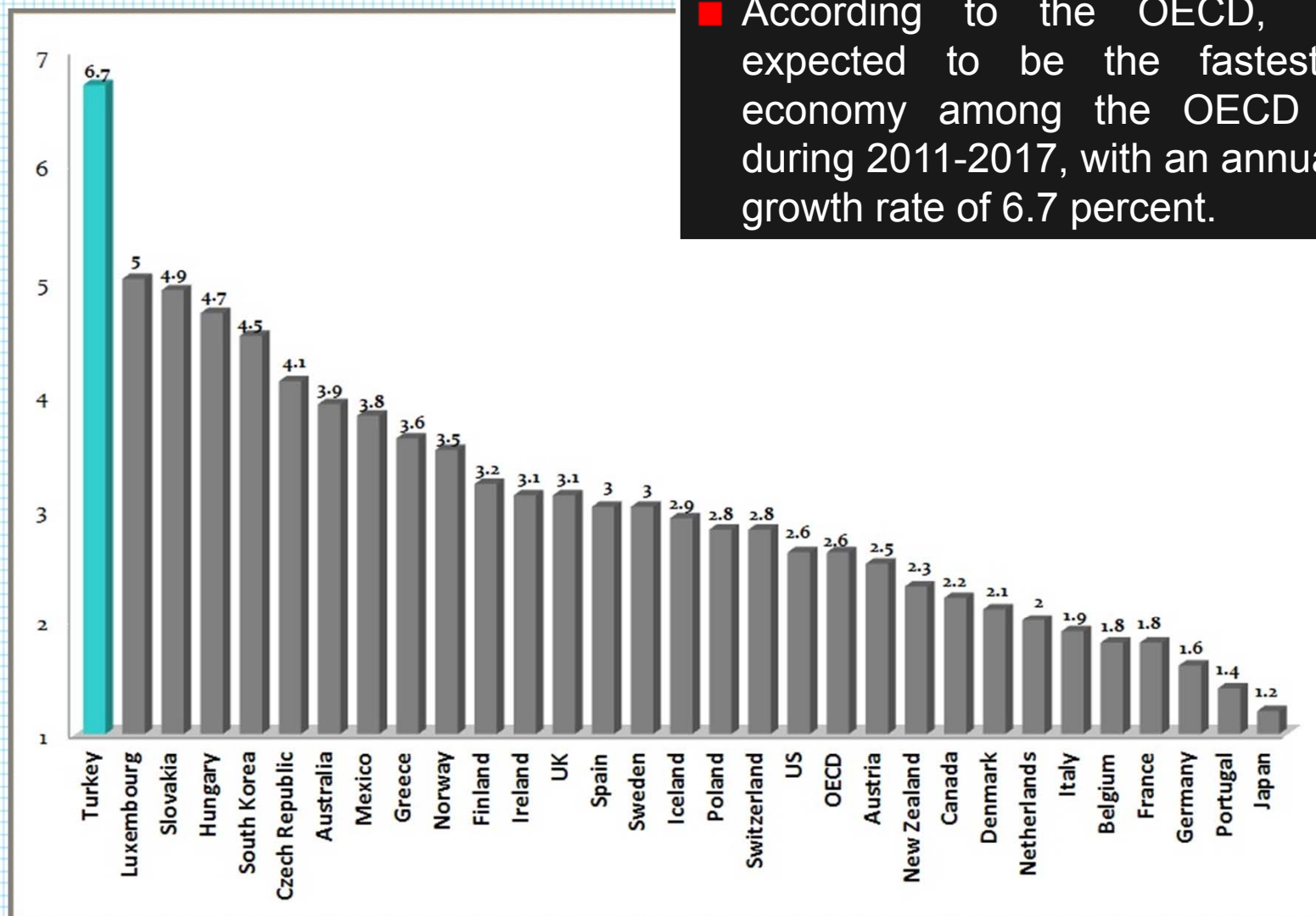
■ As the GDP levels more than tripled to USD 772 billion in 2011, up from USD 231 billion in 2002,

■ GDP per capita soared to USD 10,444, up from USD 3,500 in the given period.

**Source:** IMF World Economic Outlook April 2012, Turkish Statistical Institute (TurkStat)



## Annual Average Real GDP Growth (%) Forecast in OECD Countries 2011-2017

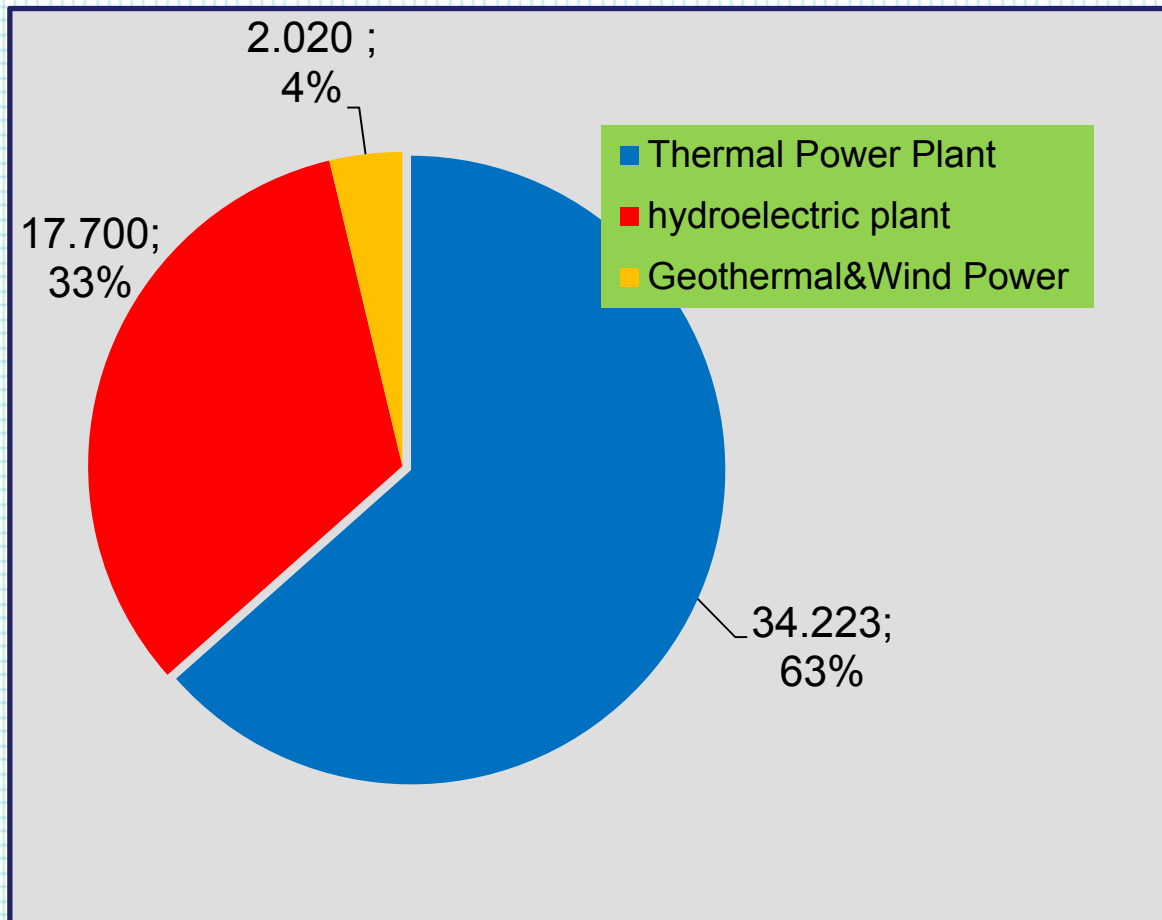
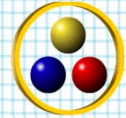


■ According to the OECD, Turkey is expected to be the fastest growing economy among the OECD members during 2011-2017, with an annual average growth rate of 6.7 percent.

**Source:** OECD Economic Outlook No: 86



# Installed Power Capacity (MW) of Turkey

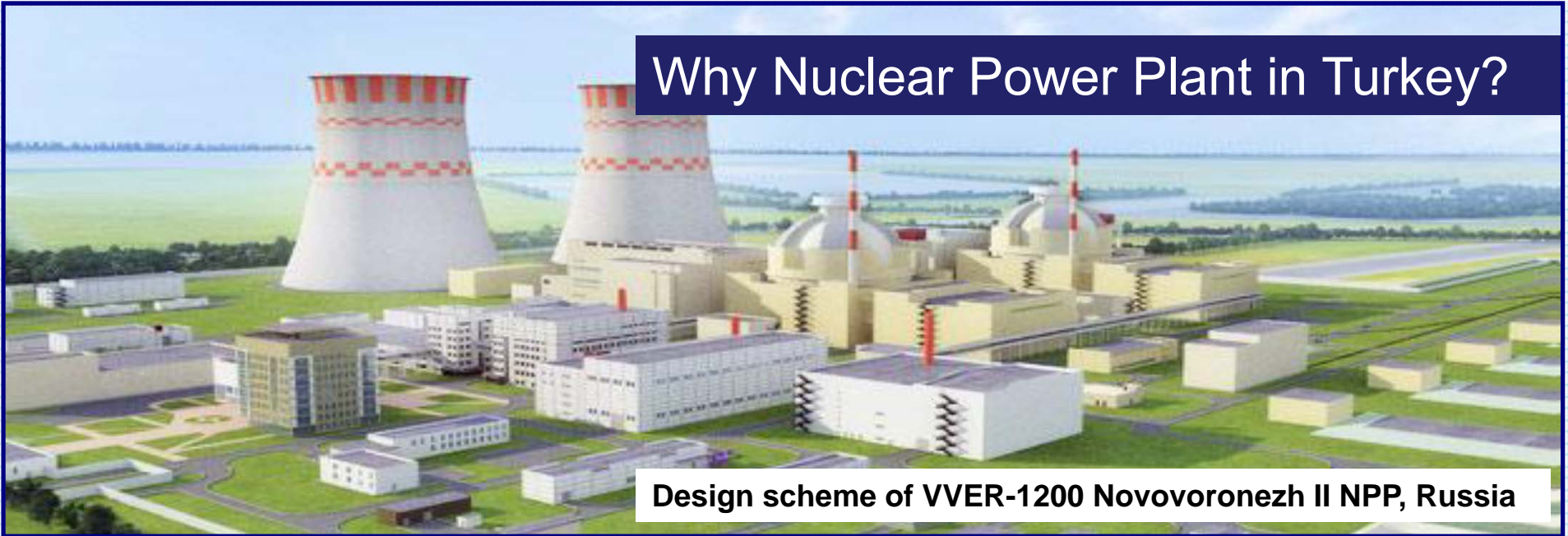


## Breakdown of Thermal Power According to Primary Fuel Consumption (%)

Coal (Lignite)	23,8
Coal (Hard Coal)	1,0
Imported Coal	11,7
Natural Gase	47,2
Fuel-oil	3,5
Multi-fuelled	12,4

Source: The Ministry of Energy and Natural Resources (ETKB), April 2012

# Why Nuclear Power Plant in Turkey?

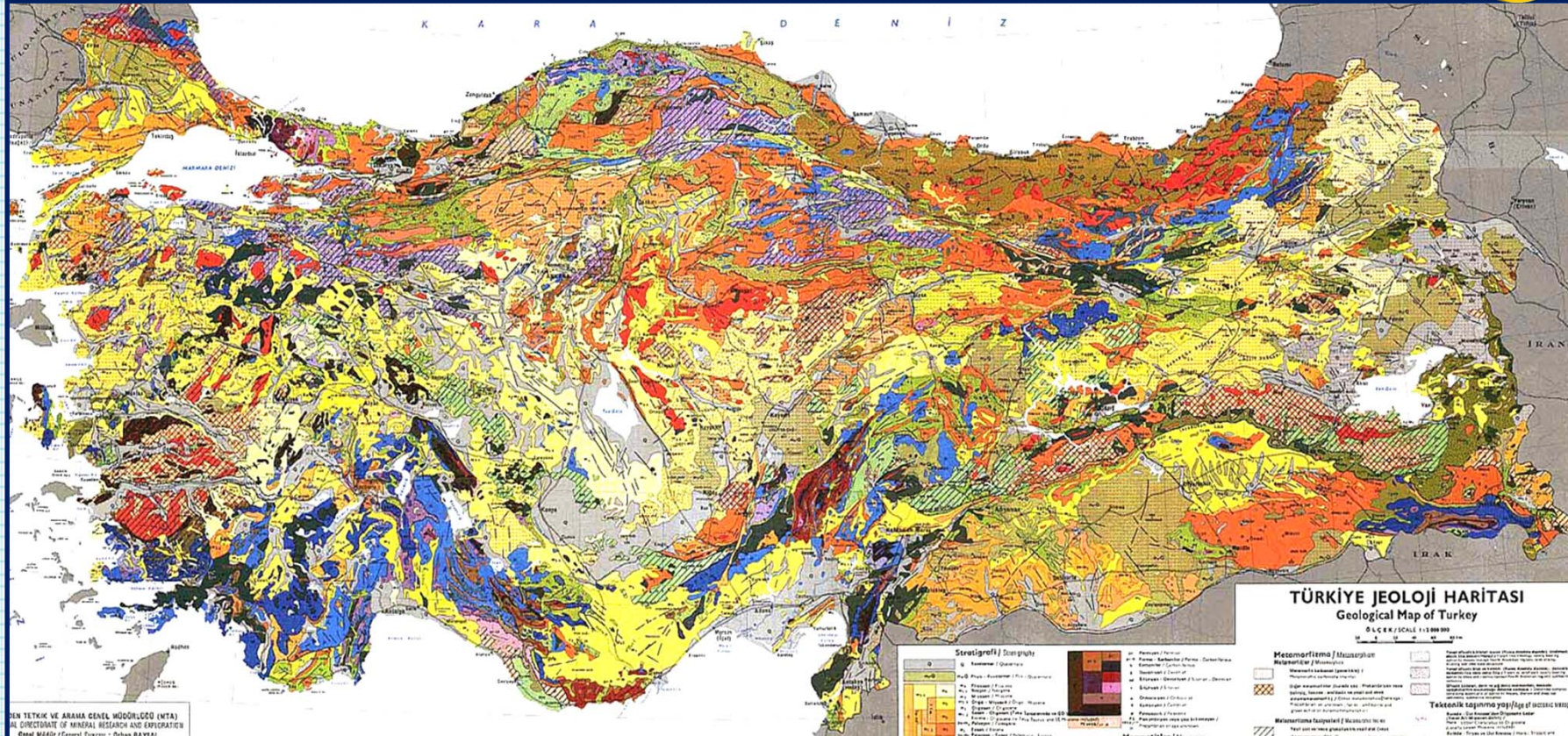


Design scheme of VVER-1200 Novovoronezh II NPP, Russia

- Annual energy demand has been increasing 7-8% and the country is second fastest growing country behind China in terms of energy demand.
- Turkey is a country having high dependency on primary energy resources with rate of 72%.
- According to “Strategic Plan 2023” installed power capacity has been targeted to increase to 110.000-130.000 MW. More than double of current figure.
- For the energy supply security and environmental considerations Turkey started to construct NPPs. One shall be constructed in Akkuyu-Mersin and the other in Sinop.
- After commissioning of two NPPs 80 billion kWh electricity will be generated which is 16 billion cubic meter (m<sup>3</sup>) natural gas equivalence.



# Geological Map of Turkey



Turkey, an important segment of the Alpine-Himalayan tectonic belt, hosts notably diverse mineral deposits. The complex geologic and tectonic structure of Turkey makes it more difficult for mine exploration and mining facilities, although it contributes to mineral diversity of the region. Turkey is one of the few countries which can provide most of their raw materials in spite of the geological and technological drawbacks.



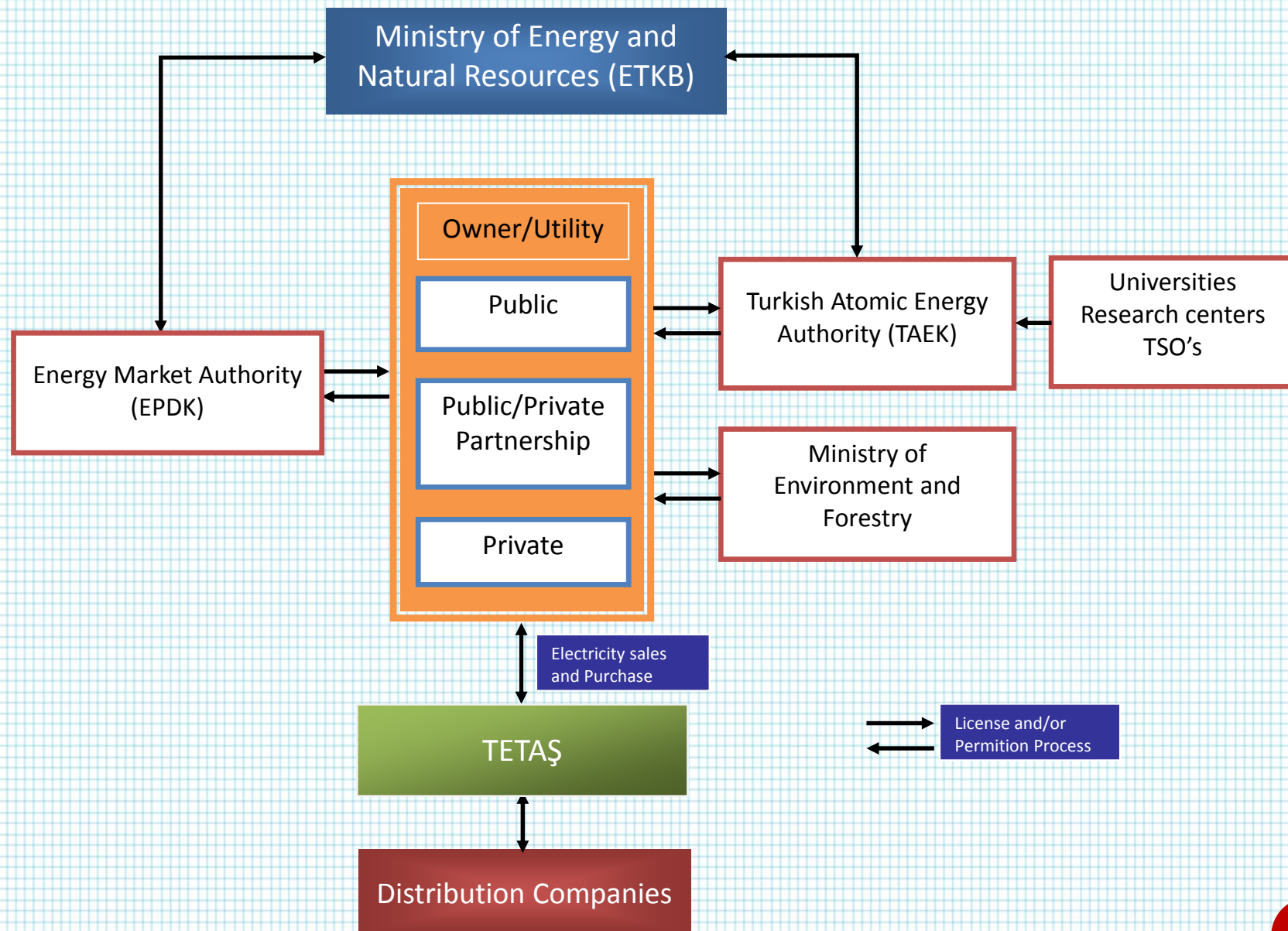
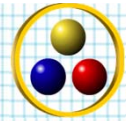
# Mineral Occurance in Turkey



- Turkey's geological structure is complex, therefore rich in mineral diversity,
- Turkey is at 10th in the rank of mineral diversity in the world,
- About 60 different type of minerals have been produced,
- Only 13 of 90 minerals which are traded in the world, not exists in Turkey,
- Turkey hosts 0.4% of metalic mineral, 2,5% of the industrial raw materials, 1% of the coal and 0,8% of the geothermal reserves.
- Boron, Chromite, Magnesite, Barite, Marble, Feldspar are common exported mineral products.
- Radioactive minerals: Uranium is not competitive, but Thorium is estimated in a sound amount.

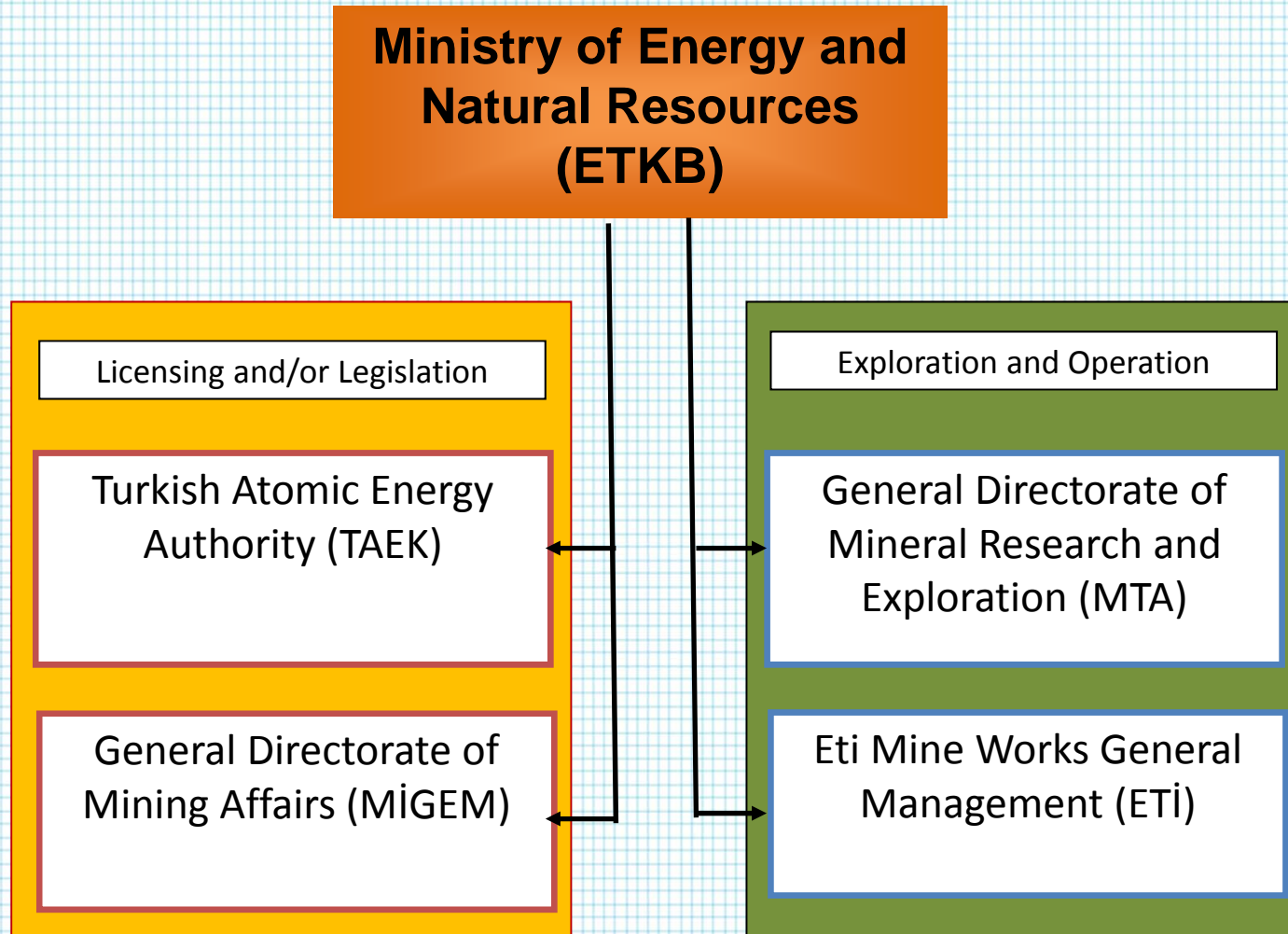
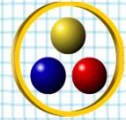


# Institutional Organization/Energy

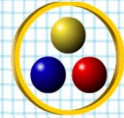




# Institutional Organization/Exploration&Mining

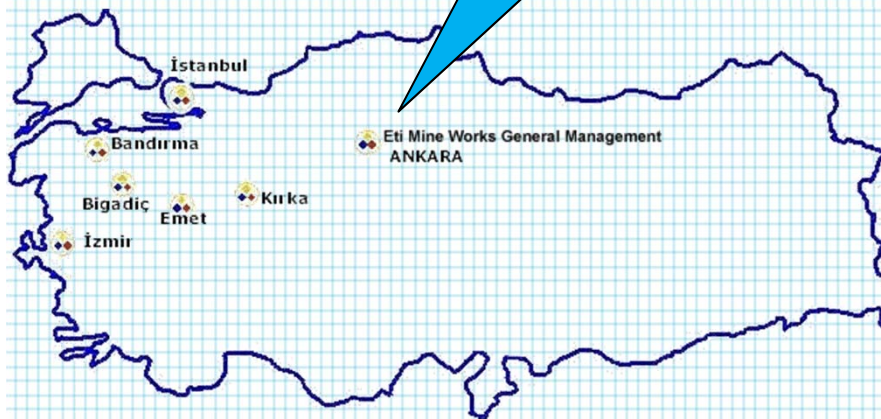






# Eti Mine

Headquarter



**Date of Establishment: 1935**

1935 -1998 ETİBANK

1998 -2004 ETİ Holding A.Ş.

2004 -....Eti Mine Works General Management

**Main Field of Activity:**

The production and sales of boron products.

**Legal Status:** State owned company

**Total Employee:** 3,827 person, 2011

**Revenue:** US\$ 854 million, 2011

**Export:** US\$ 829 million, 2011  
to 80 countries.

**Market Share:** 47%

**Management Systems:**

**Integrated Management Systems**

Quality Management System TS-EN-ISO 9001: 2008

Environmental Management System TS-ISO-EN-14000

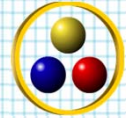
Occupational Health & Safety Management System

TS-İSG-OHSAS 18001

General requirements for competence of test and  
calibration laboratories TS-EN ISO/IEC 17025







# Production Sites&Products



## **BANDIRMA BORON WORKS**

- Borax Decahydrate
- Borax Pentahydrate
- Boric Acid
- Boron Oxide
- Etidot-67 (Agri Boron)
- Sodium Perborate



## **EMET BORON WORKS**

- Boric Acid
- Concentrated Colemanite



## **KIRKA BORON WORKS**

- Etibor-48 (Borax Pentahydrate)
- Etibor-68 (Anhydrous borax)
- Calcined Tincal (Compacted)

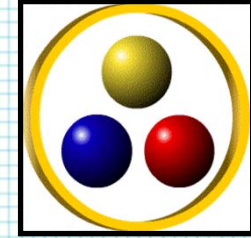


## **BİGADIÇ BORON WORKS**

- Ground Colemanite / Ulexite
- Concentrated Colemanite / Ulexite
- Natural Zeolite

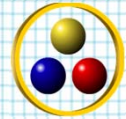


# Legal Status of Radioactive Minerals in Turkey



- The radioactive minerals industry is under the authority of Ministry of Energy and Natural Resources (ETKB) and the authority of the Turkish Atomic Energy (TAEK).
- The Ministry of Energy and Natural Resources is the principal competent authority in the national energy sector and is responsible for the preparation and implementation of energy policies in coordination with its subsidiary and related institutions.

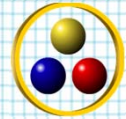




## Articles related to Radioactive Minerals

- the relevant provisions of the Turkish Constitution and the Mining Legislation, “minerals” are subject to the exclusive ownership and disposition of the State and are not considered part of the land where they are located.
- Under the Mining Legislation, the State delegates its right to explore and operate the mines to individuals or legal entities for specific periods by issuing licences subject to payment of a royalty to the State.
- Article 6 of the Mining Law clearly sets forth that mining rights may only be given to either Turkish citizens or legal entities established under Turkish laws. Accordingly, only Turkish citizens, who are entitled to use their civil rights, and the companies established under Turkish laws specifically for mining purposes are entitled to hold mining rights.
- Companies that are established in Turkey with foreign capital are deemed Turkish companies and are entitled to hold mining rights.





# Mining Law: Grouping the Minerals

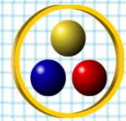
The Mining Law divides minerals into six groups and separately details the licensing procedures for each group of minerals.

The groups can be summarised as follows:

- sand and gravel (Group I)
- marble and other similar decorative stones (Group II)
- salts in solution that can be obtained from aqueous solutions (Group III)
- metal and industrial minerals (Group IV)
- precious metals and gem stones (Group V)
- radioactive minerals and substances (Group VI)

Exploration and mining activities are regulated, inter alia, under an Exploration Licence (“ELs”) and an Operating Licence/Permit (“OLs and OPs”) respectively.

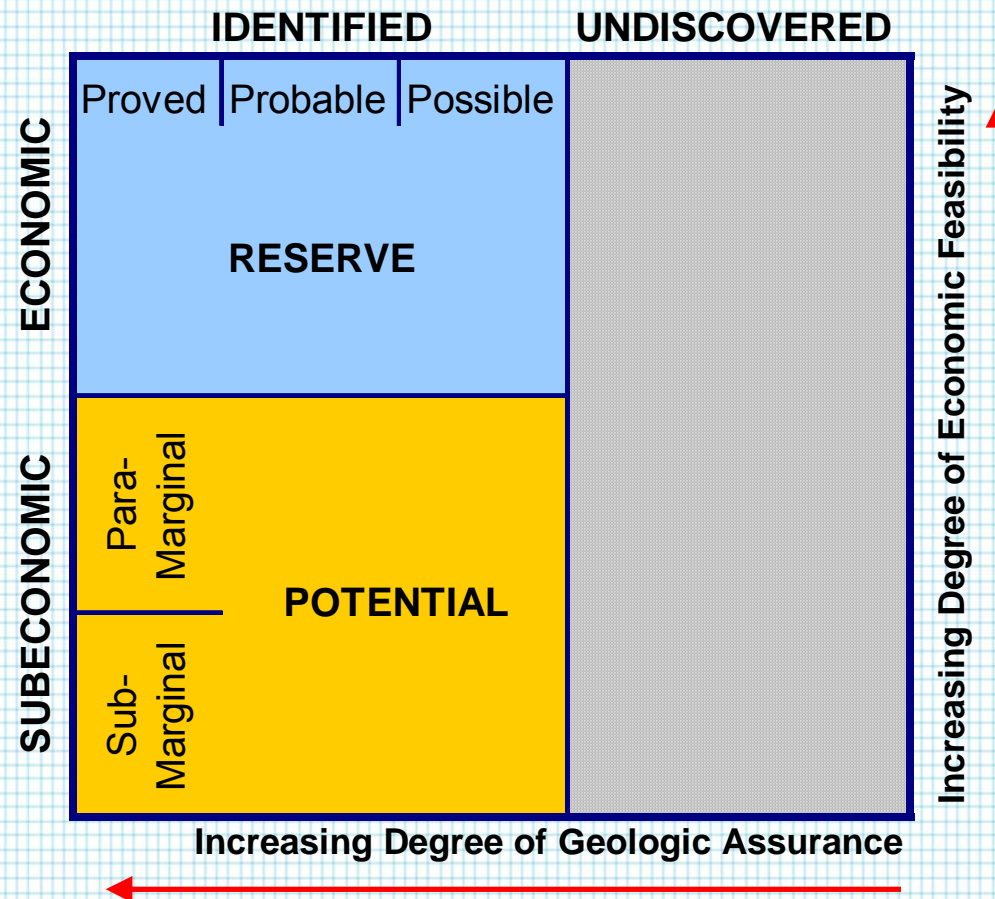




# National Classification System

Adapted from  
Mc. Kelvey, 1972.

It is also base of the  
USGS classification  
system.



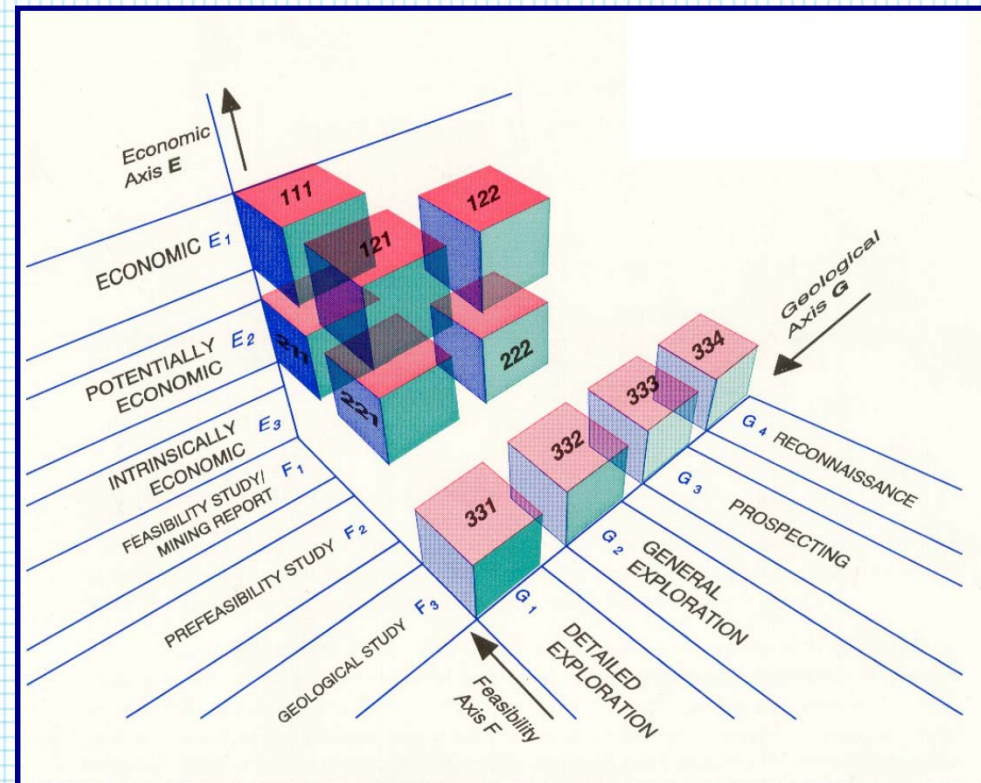




# UNFC System:

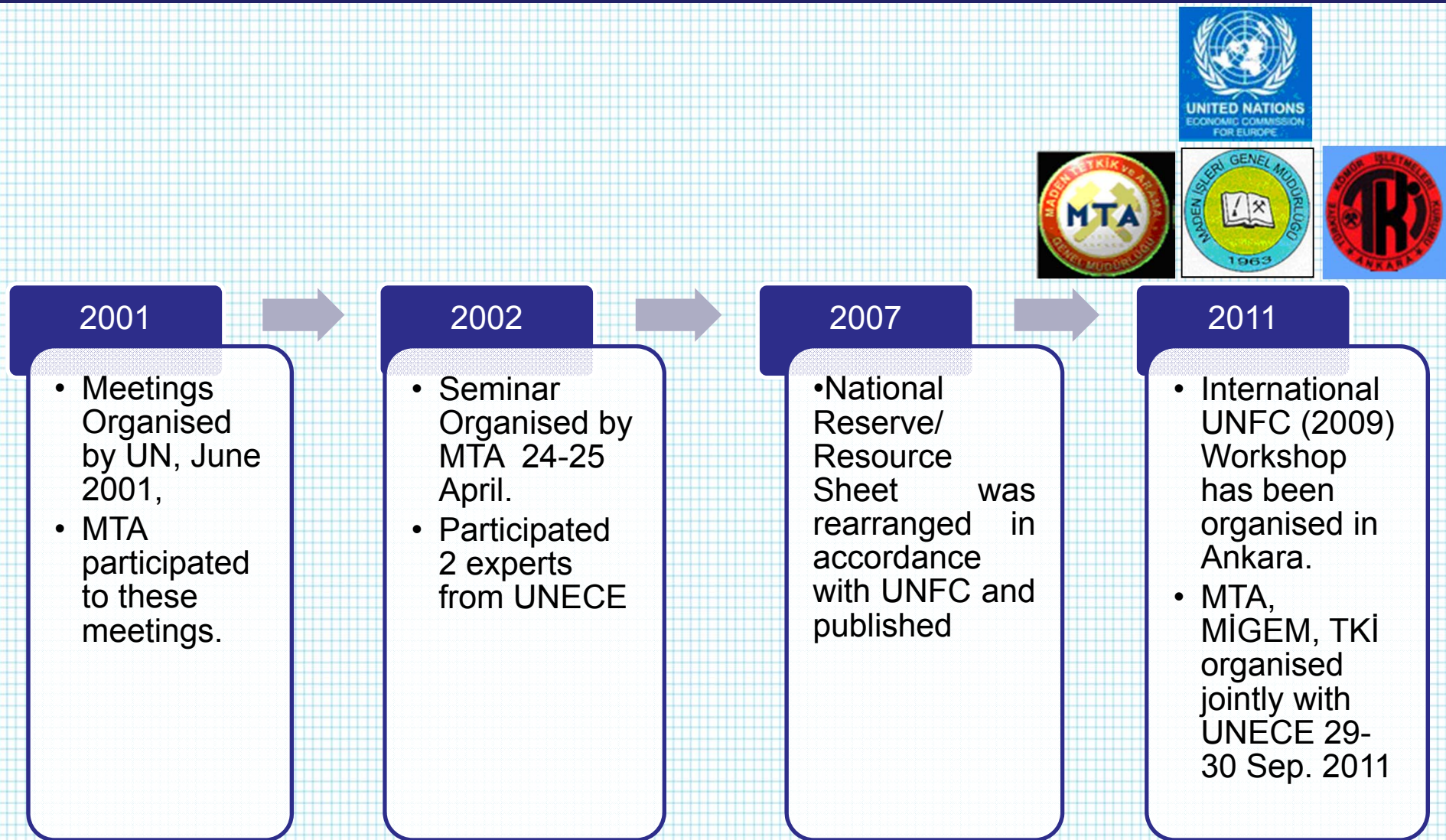
## Categories:

- ♦ E axis categories: Economic and social viability  
 $E_1, E_2, E_3$
- ♦ F axis categories: Field Project status and feasibility  
 $F_1, F_2, F_3$
- ♦ G axis categories: Geological knowledge  
 $G_1, G_2, G_3$



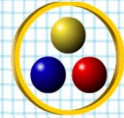


# Adaptation Studies of National Classification System to UNFC Model

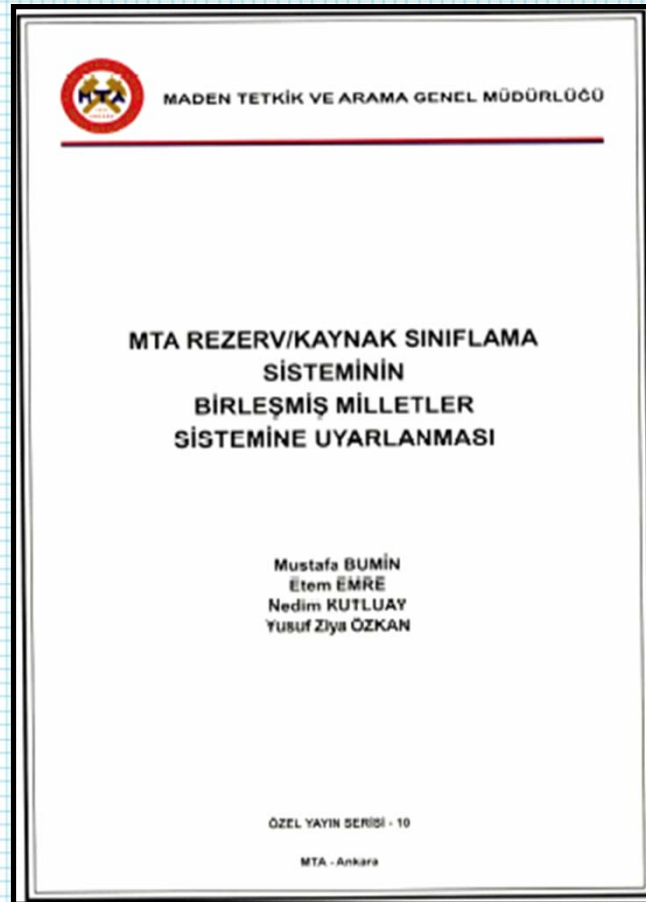


MTA: General Directorate of Mineral Research and Exploration  
MİGEM: General Directorate of Mining Affairs  
TKİ : General Directorate of Turkish Coal Enterprises





# Adaptation Studies of National Classification System to UNFC Model



		IDENTIFIED RESOURCE		
		PROVED	PROBABLE	POSSIBLE
ECONOMIC		PROVED RESERVE (111)	POBABLE RESERVE (121+122)	
POTENTIALLY ECONOMIC		PROVED RESOURCE (211)	PROBABLE RESOURCE (221+222)	
INTRINSICALLY ECONOMIC		PROVED RESOURCE (331)	PROBABLE RESOURCE (332)	
Increasing Degree of Geologic Assurance				

Increasing Degree of Economic Feasibility

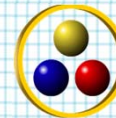


## Adaptation Studies of National Classification System to UNFC Model

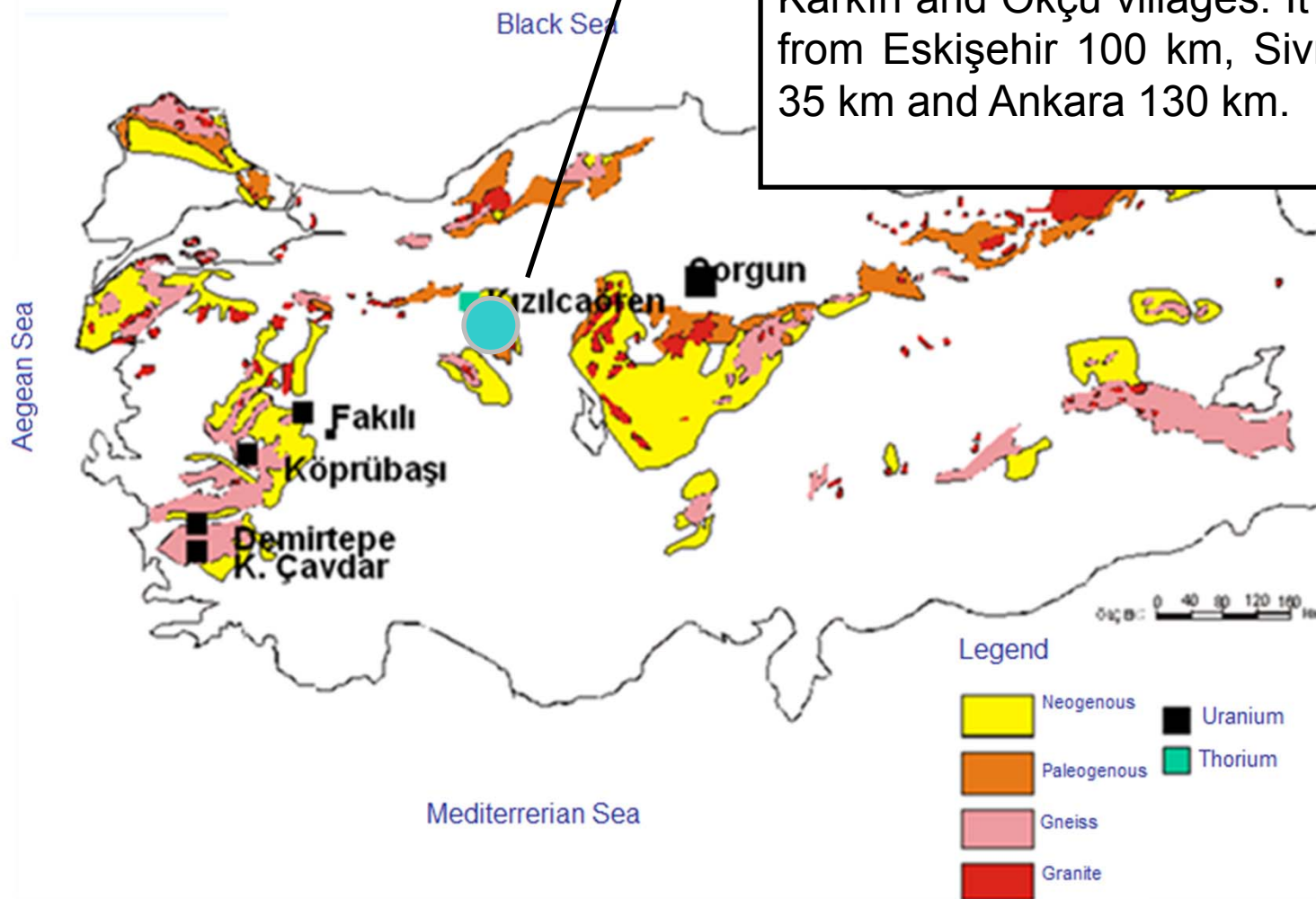
Degree of Economic Viability	Feasibility Studies	Exploration	Codification (EFG)
Economic	Feasibility	Detail Exploration	111
Economic	Prefeasibility	Detail Exploration	121
Economic	Prefeasibility	Exploration	122
Potentially Economic	Feasibility	Detail Exploration	211
Potentially Economic	Prefeasibility	Detail Exploration	221
Potentially Economic	Prefeasibility	Exploration	222
Intrinsically Economic	Geological Evaluation	Detail Exploration	331
Intrinsically Economic	Geological Evaluation	Exploration	332
Intrinsically Economic	Geological Evaluation	Prospecting	333
Intrinsically Economic	Geological Evaluation	Reconnaissance	334



## Uranium and Thorium Areas in Turkey



Mine site is located in Kızılcaören, Karkın and Okçu villages. It is far from Eskişehir 100 km, Sivrihisar 35 km and Ankara 130 km.





# Thorium Resource of Sivrihisar-Turkey

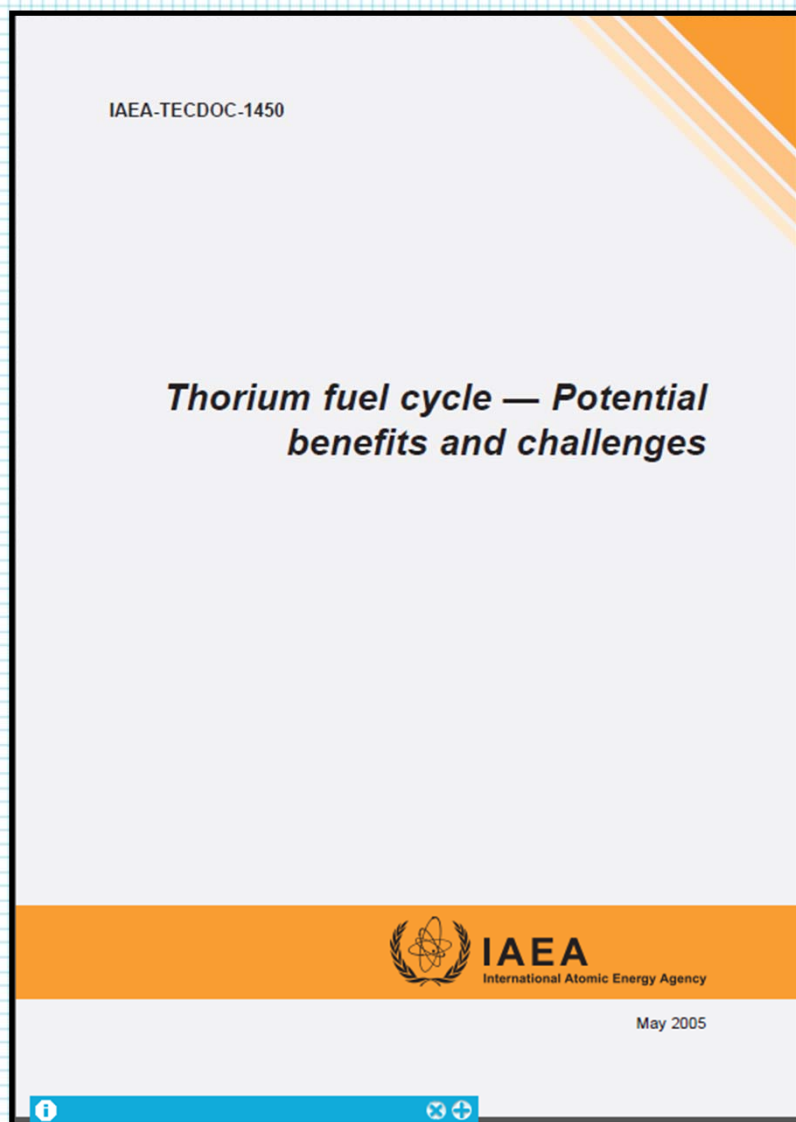
- Calculations are based on the data collected from #72 drill holes in the years of 1974-1977
- Thorium determination is done by the radiometric measurements.
- Thorium is within the Basnasite mineral which is basically a REE mineral.
- Uranium is also studied but the grade is found too low for assuming as an uranium resource.
- Average  $\text{ThO}_2$  is about 0.2%.

RESOURCE					
IDENTIFIED			UNDISCOVERED		
PROVED	PROBABLE	POSSIBLE			
ECONOMIC	PROVED RESERVE (111)	POBABLE RESERVE (121+122)	500.000 tons ThO <sub>2</sub>		
POTENTIALLY ECONOMIC	PROVED RESOURCE (211) 286.000 tons ThO <sub>2</sub>	PROBABLE RESOURCE (221+222) 94.000 tons ThO <sub>2</sub>			
INTRINSICALLY ECONOMIC	PROVED RESOURCE (331)	PROBABLE RESOURCE (332)		POSSIBLE RESOURCE (333+334)	
Increasing Degree of Geologic Assurance					
Increasing Degree of Economic Feasibility					

Source: Adapted from report, Hüseyin Kaplan, MTA, 1977



# World Thorium Resources (Tonnes of Th Metal)



Country	RAR	EAR
Australia	19.000	-
Brazil	606.000	700.000
Canada	45.000	128.000
Greenland	54.000	32.000
Egypt	15.000	309.000
India	319.000	-
Norway	132.000	132.000
South Africa	18.000	-
Turkey	380.000	500.000
United States	137.000	295.000

RAR: Reasonably Assured Reserves

EAR: Estimated Additional Reserves

Source: IAEA, May 2005



# World Thorium Resources(Tonnes of Th Metal)

Country	Tons	% of Total
India	846.000	15,7
Turkey	744.000	13,8
Brazil	606.000	11,3
Australia	521.000	9,7
USA	434.000	8,1
Egypt	380.000	7,1
Norway	320.000	5,9
Venezuela	300.000	5,6
Canada	172.000	3,2
Russia	155.000	2,9
South Africa	148.000	2,7
China	100.000	1,9
Greenland	86.000	1,6
Finland	60.000	1,1
Sweden	50.000	0,9
Kazakhstan	50.000	0,9
Other countries	413.000	7,7
World total	5.385.000	100,0

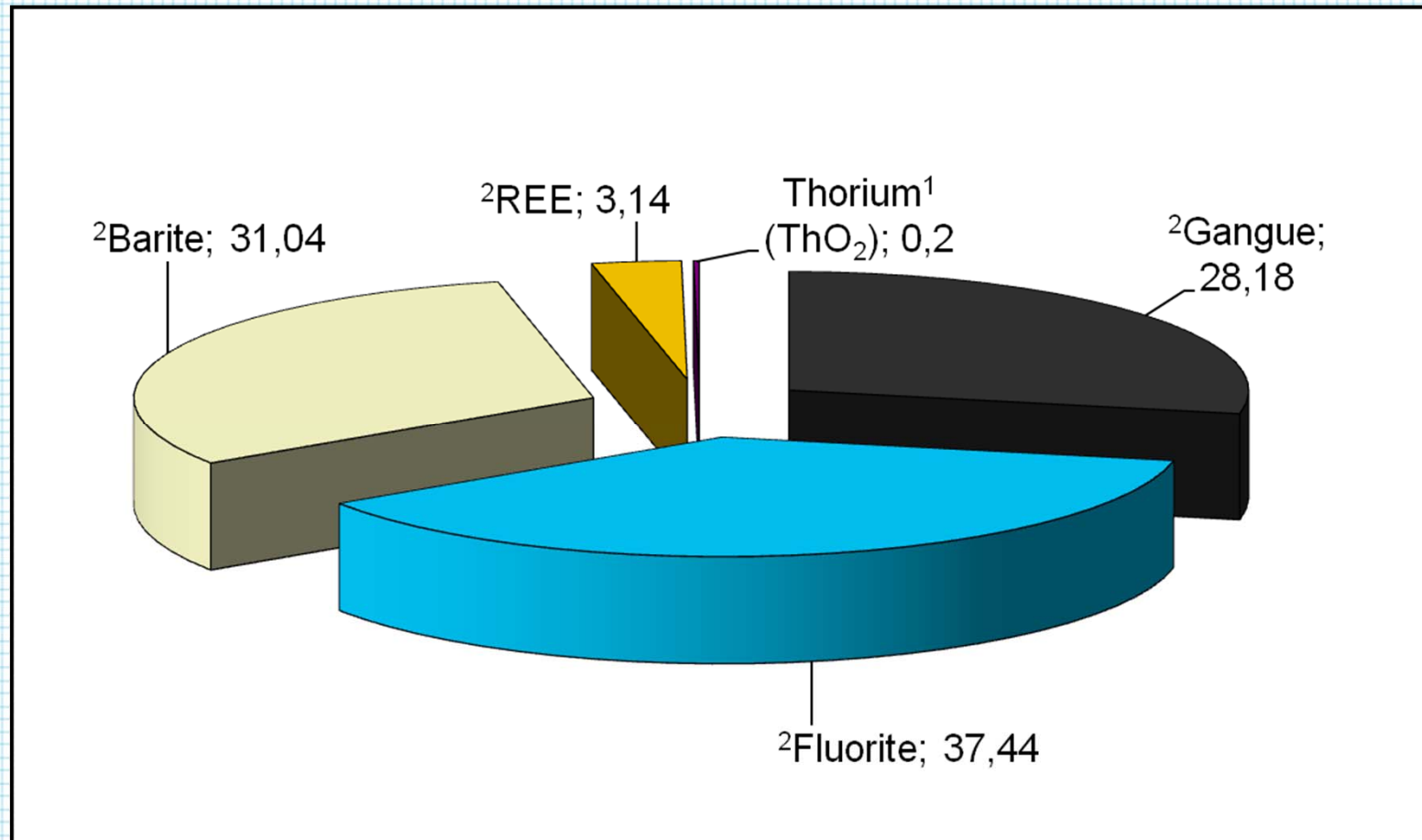
Country	Reserves
United States	440.000
Australia	410.000
Brazil	16.000
Canada	100.000
India	290.000
Malaysia	4.500
South Africa	35.000
Other countries	90.000
World total	1.400.000

**Source:** U.S. Geological Survey, Mineral Commodity Summaries, January 2012.

**Source:** OECD/NEA & IAEA, 2012: Resources, Production and Demand "Red Book". Data for reasonably assured and inferred resources recoverable at a cost of \$80/kg Th or less. Via <http://www.world-nuclear.org>



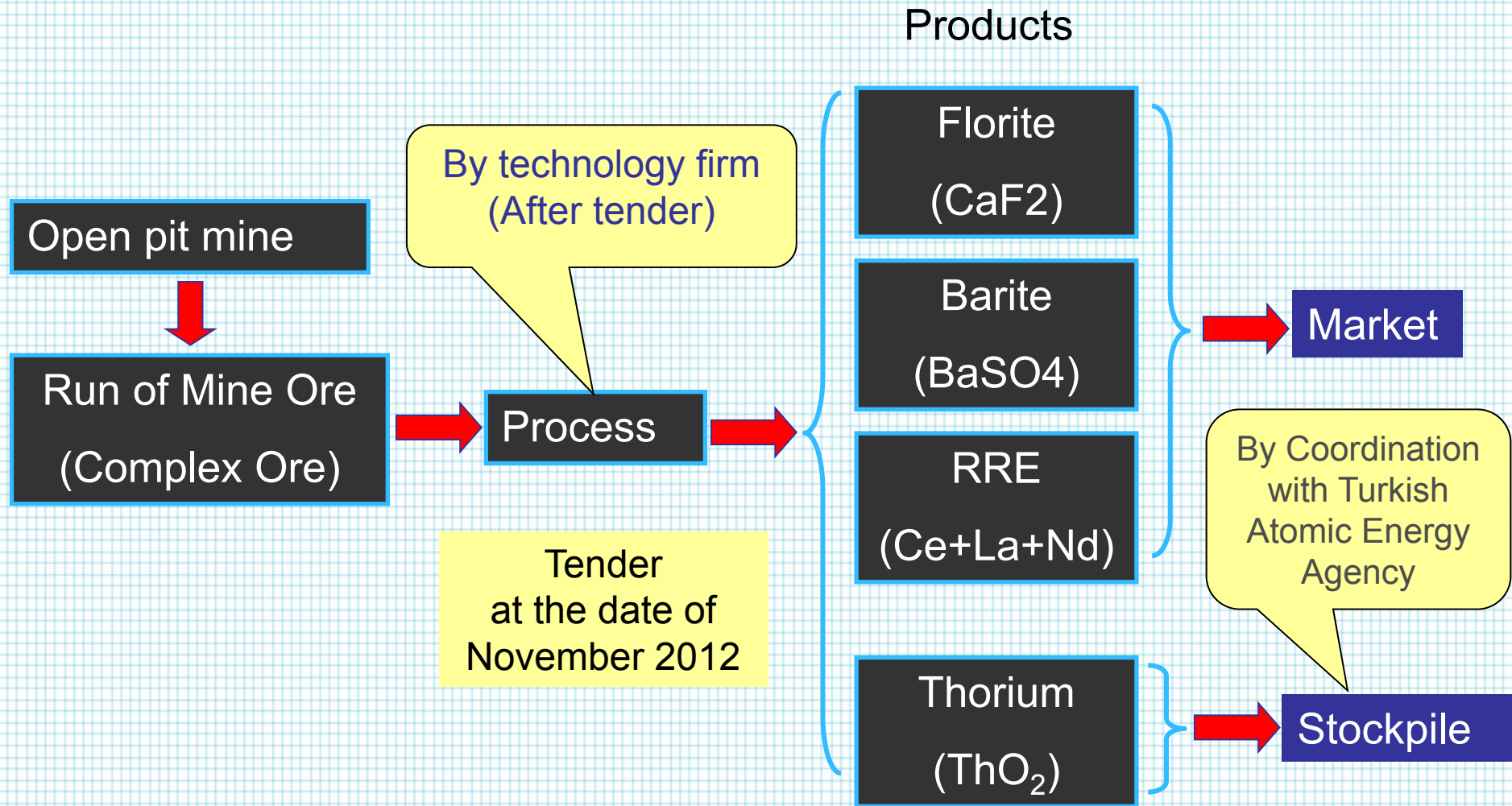
# Mineral Distribution of the Resource, Sivrihisar (by Percentage)



Source: <sup>1</sup> Report, Hüseyin Kaplan, MTA, 1977.  
<sup>2</sup> Report, İsrail Kayabalı, MTA, 1986.

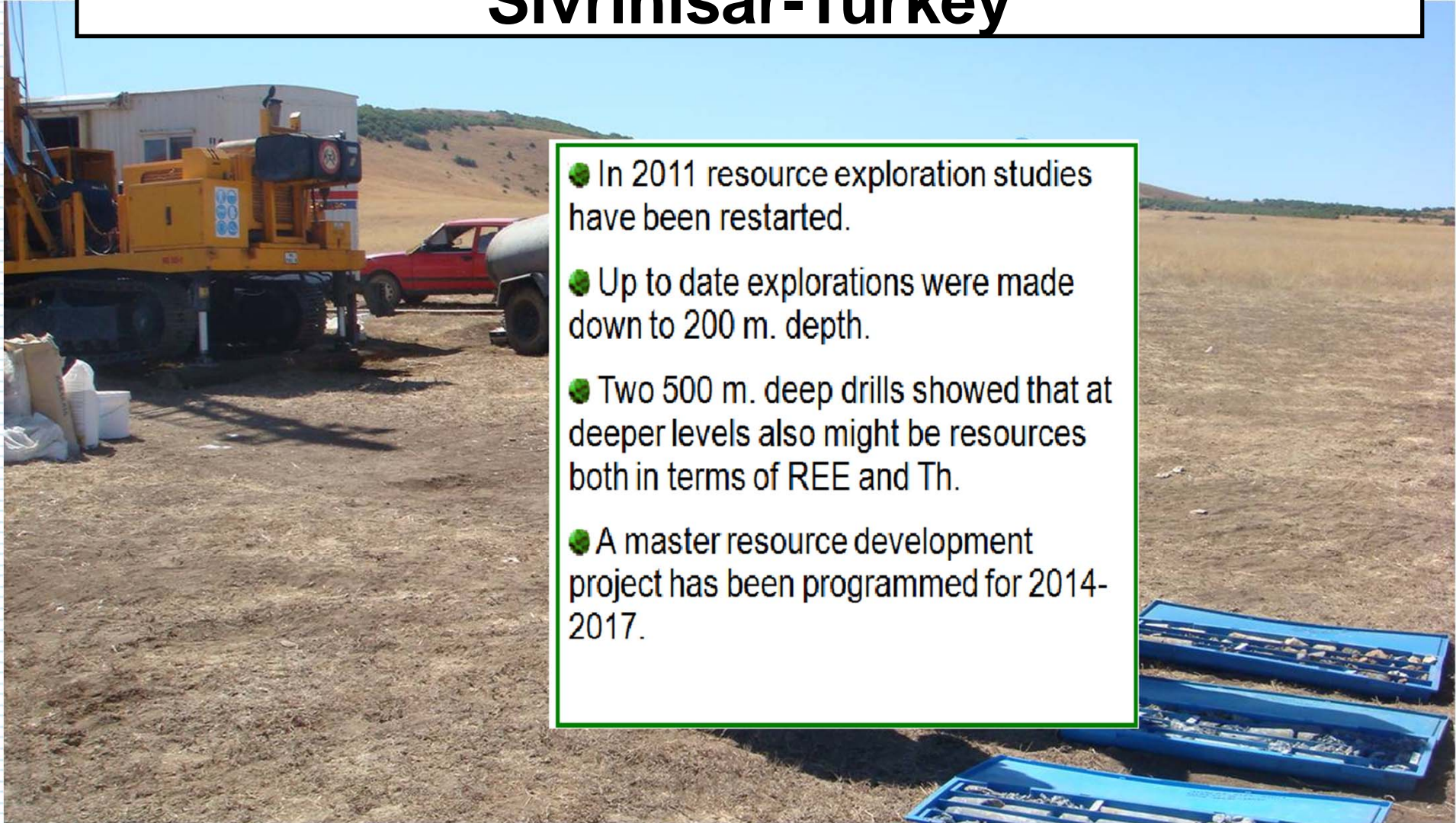


# Operation Plan of the Mine






# Resource Development Project Sivrihisar-Turkey



- In 2011 resource exploration studies have been restarted.
- Up to date explorations were made down to 200 m. depth.
- Two 500 m. deep drills showed that at deeper levels also might be resources both in terms of REE and Th.
- A master resource development project has been programmed for 2014-2017.





Thank You for Your Attention