
Human Interaction with the Rock Cycle.

Mining

Define the following terms

Mining – extraction of valuable material from the earth

Rock - a solid collection of minerals

Mineral - a naturally occurring substance with distinctive chemical and physical properties, composition and atomic structure.

Metal – iron, copper, zinc, lithium, aluminium

Ore – rock which contains valuable minerals

Raw Material – input for manufacturing



- **Use of Mining Outputs in Everyday Life**
- **Phone** (Copper, Silica, Lithium, Iron, Bauxite)
- **Bicycle** (Aluminium, steel, graphite, titanium)
- **Soccer Ball** (Mica, Cobalt, zinc, silicon, potash)
- https://www.youtube.com/watch?v=S4jsrqxl11A&list=PLR_AkCK1aBhIk-leTvpzDtjrpmB6s_phO&index=6
- 10 things about metals



A World of Minerals in Your Mobile Device

Mobile phones and other high-technology communications devices could not exist without mineral commodities. More than one-half of all components in a mobile device—including its electronics, display, battery, speakers, and more—are made from mined and semi-processed materials (mineral commodities). Some mineral commodities can be recovered as byproducts during the production and processing of other commodities. As an example, bauxite is mined for its aluminum content, but gallium is recovered during the aluminum production process. The images below show the **ore minerals** (sources) of some mineral commodities that are used to make components of a mobile device. On the reverse side, the map and table depict the major source countries producing some of these mineral commodities along with how these commodities are used in mobile devices. For more information on minerals, visit <http://minerals.usgs.gov>.

Display

A mobile device's glass screen is very durable because glassmakers combine its main ingredient, **silica** (silicon dioxide or quartz) **sand**, with ceramic materials and then add potassium.

Layers of indium-tin-oxide are used to create transparent circuits in the display. Tin is also the ingredient in circuit board solder, and **cassiterite** is a primary source of tin.

Gallium provides light emitting diode (LED) backlighting. **Bauxite** is the primary source of this commodity.

Sphalerite is the source of indium (used in the screen's conductive coating) and germanium (used in displays and LEDs).

Electronics and Circuitry

The content of copper in a mobile device far exceeds the amount of any other metal. Copper conducts electricity and heat and comes from the source mineral **chalcopyrite**.

Tetrahedrite is a primary source of silver. Silver-based inks on composite boards create electrical pathways through a device.

Silicon, very abundant in the Earth's crust, is produced from the source mineral quartz and is the basis of integrated circuits.

Arsenopyrite is a source of arsenic, which is used in radio frequency and power amplifiers.

Tantalum, from the source mineral **tantalite**, is added to capacitors to regulate voltage and improve the audio quality of a device.

Wolframite is a source of tungsten, which acts as a heat sink and provides the mass for mobile phone vibration.

Battery

Spodumene and subsurface brines are the sources of lithium used in cathodes of lithium-ion batteries.

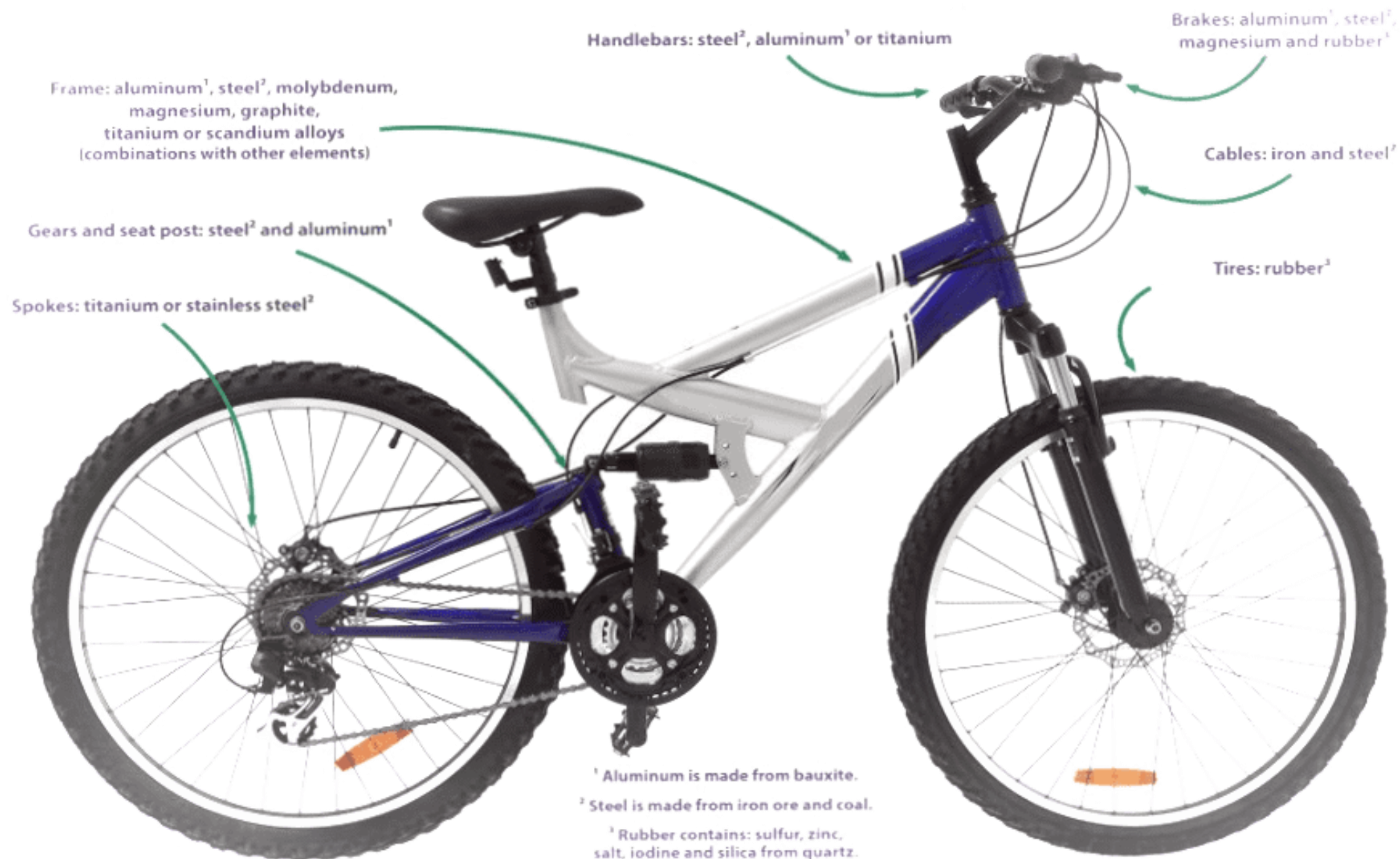
Graphite is used for the anodes of lithium-ion batteries because of its electrical and thermal conductivity.

Speakers and Vibration

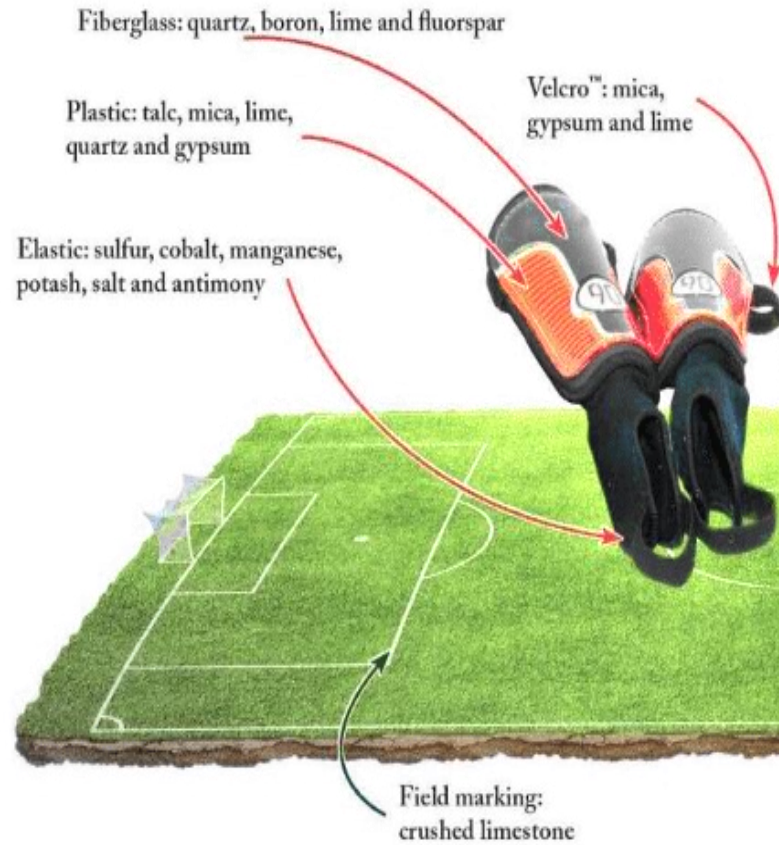
Bastnaesite is a source of rare-earth elements used to produce magnets in speakers, microphones, and vibration motors.

Source: images courtesy of
iStockphoto and iStock.com

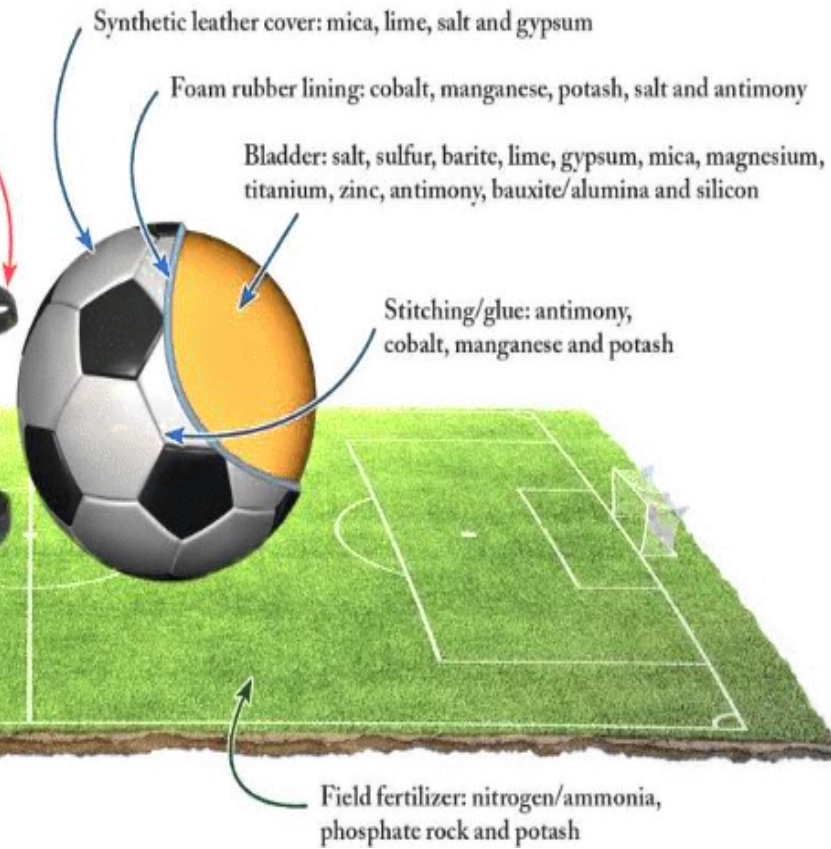
Minerals in Your Everyday Life



Shin Guards



Soccer Ball



- **Class Discussion.**
- Introduce the need to develop renewable energy resources, link to climate change and global warming.
- Examine the types of renewable energies available.
- Discuss the best options for Ireland.
- Wind (onshore and offshore).
- Solar.
- Make the link between construction, operation of these to key outputs from Mining activities.



Construction and operation of a windfarm is not possible without Mining Inputs.

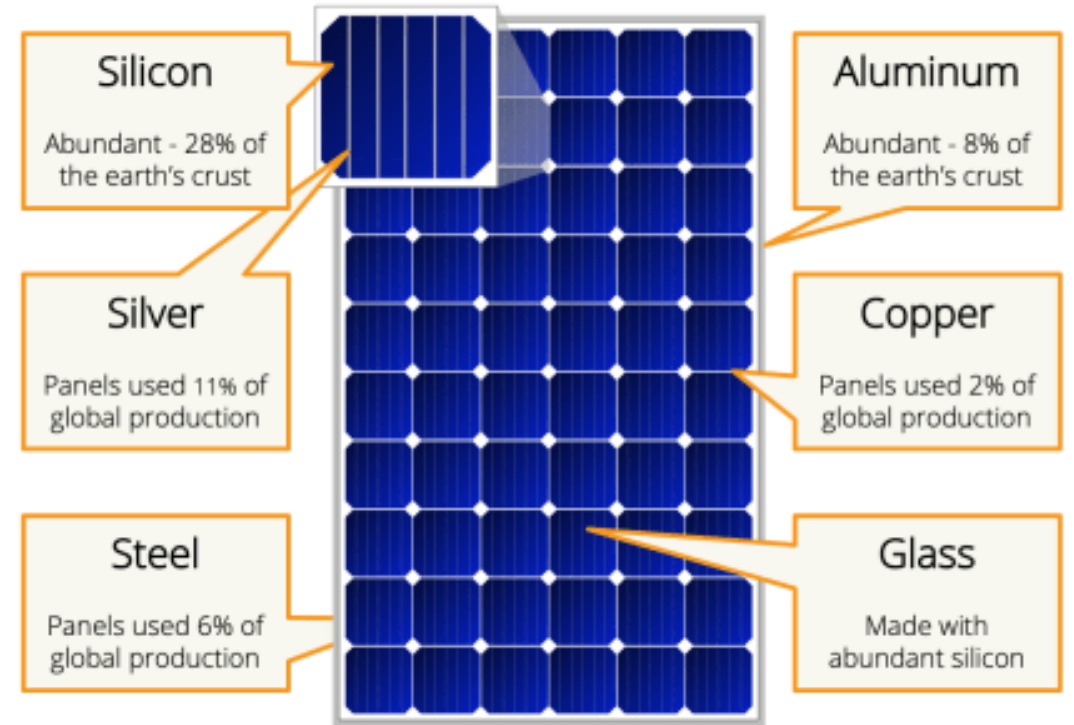


Construction and operation of Solar panels is not possible without Mining Inputs.

Will we run out of materials to make solar panels?

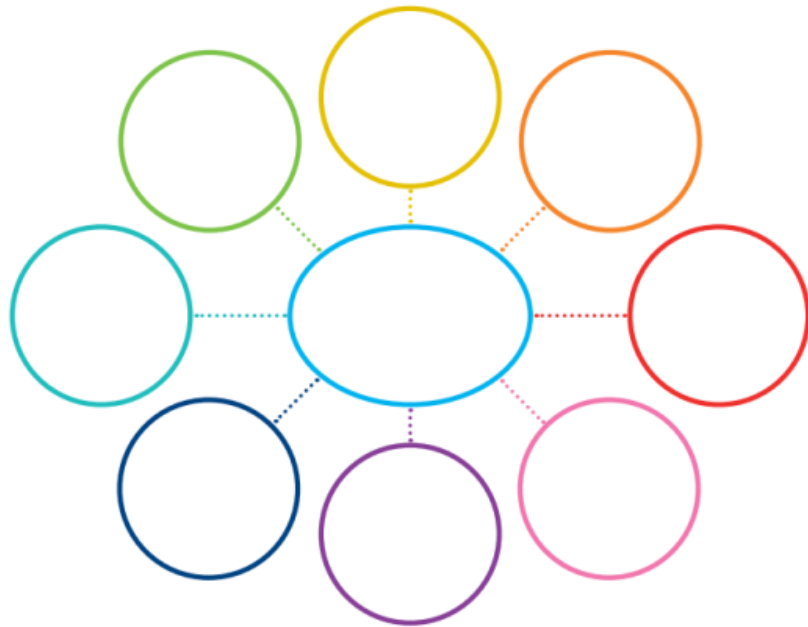
Not even close.

Solar panels are manufactured with widely abundant, earth-friendly materials. In 2018, panel manufacturing only used a fraction of the annual production of its key materials.



FREEING
ENERGY

- Class Activity – Ask students to design a memory map to illustrate their perceptions of Mining as an activity.



- From that activity – create a list of perceptions using the guidelines of Advantages and Disadvantage.
- Use headings of Economic, Social and Environmental.



- Concept of Sustainable Development.
- *“Development which meets the needs of current generations without compromising the ability of future generations to meet their own needs”*
- Bruntland Commission 1987.



- Sustainable Mining – resource extraction undertaken in a manner which seeks to improve social, economic and environmental outcomes.
- *“Before you run in you must plan how you will walk out”*
- Overall sustainable mining is possible if efforts are made to enhance the benefits of mining activity and to the reduce or mitigate negative impacts.
- Involvement of the local community in the process allows companies a *“social licence to operate”*.



- Life Cycle of Mining
- Finite resource
- Resource depletion
- Limited lifespan
- Eventual closure
- Post-mining land use

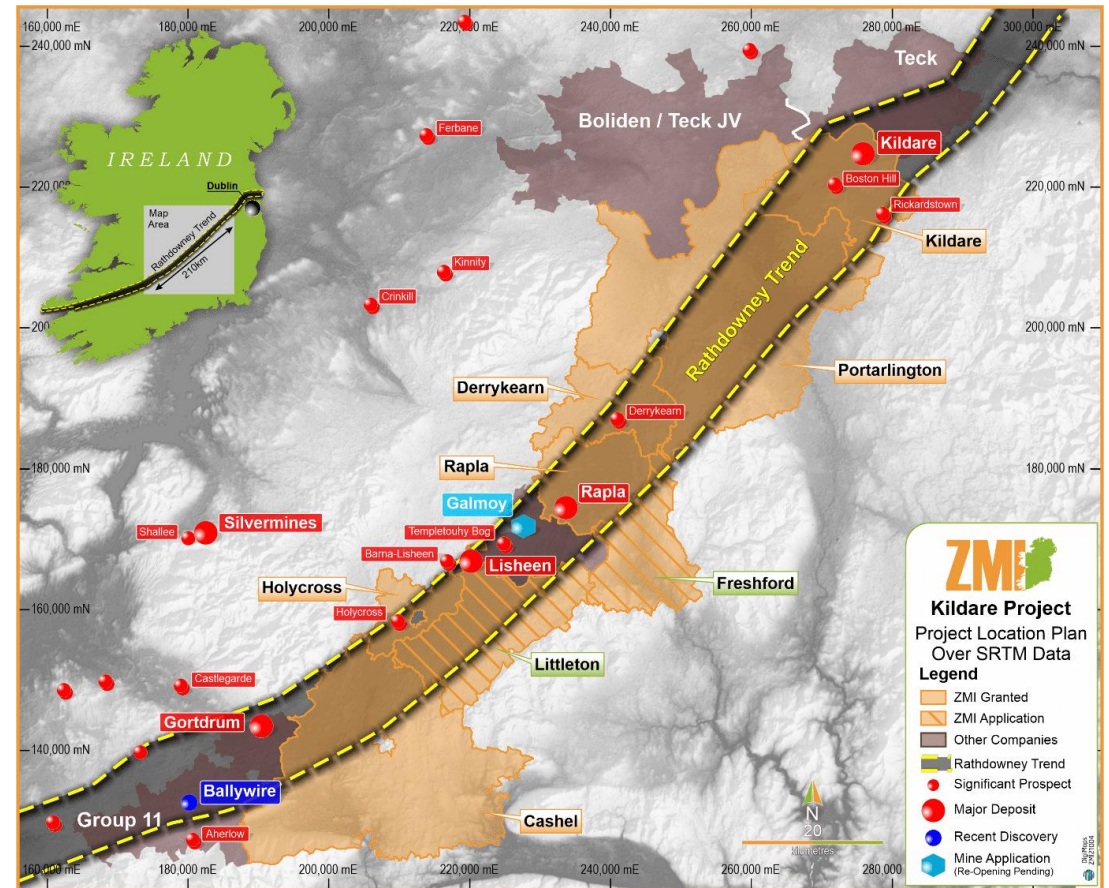


- **History of Mining In Ireland**

- Ireland has a rich history with respect to mining and mineral exploration, dating back to the Bronze Age (2000 BC).
- However, mining did not begin to flourish until the late 18th and 19th centuries, with the South East of the country associated with Copper, Iron in the East, lead and silver in the Midlands and Gold in Wicklow.
- Today mining is a relatively small but important part of the Irish economy.
- Despite this long history, awareness remains low regarding the importance of mining raw materials to society, the potential for Ireland to expand mining activities and the social and economic benefits of sustainable mining.



- **Advantages of Ireland for the Mining Industry**
- Geological resources (long history of exploration, good scientific knowledge of resources)
- Transport links (road, rail, ports)
- Telecommunications
- Pro-active govt policy (tax incentives)
- Technical expertise and labour supply (young, educated, flexible workforce)
- Stable economy (investment opportunities)
- Democratic system (stability)



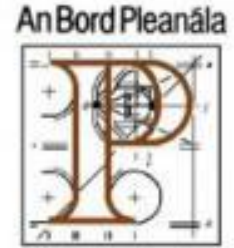
- **Economic Benefits of Mining to Ireland.**
- Outputs (Lead, Zinc, Gold)
- Employment (Direct, indirect)
- Wages (positive multiplier effect)
- Taxes (to government)
- Rates (local authorities)
- Community support (investment in sports facilities)
- Regional Development (rural areas in particular)
- Resource orientated (industry tied to location)
- Reduced dependency on imports



- **Direct expenditure on mineral exploration in Ireland for the period 2009-2019**
- 234m Euro.
- metal mining annually contributes 550m directly to the economy.
- a further 230m in gross added value.
- over 1,400 regional jobs, many of which are highly skilled.
- Mining has a broad regional distribution and has a positive economic and social impact on local communities (wages, provision of infrastructure and services and a positive multiplier effect.).
- The industry is also locational specific, or resource orientated and many workers are domiciled within the community or hinterland.
- Long-term spin off industries associated with mining include:
- geochemical laboratories, drilling companies, design, consultancy, and contracting services companies in the fields of engineering, geology and the environment.

Institutions involved in the Regulation of the Mining Industry in Ireland.

- The Minister (the Department) of Communications, Climate Action and Environment.
- The Environmental Protection Agency (EPA).
- The local Planning Authorities (LA) (County or City Councils).
- An Bord Pleanála, the national independent appeals board.



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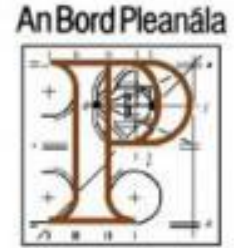
- **Planning Application Process.**

- **Stage One**

- Application for a prospecting licence to Dept of ECC.
- A Prospecting licence permit is given for a period of 6 years which allows exploration in a specific geographic area. It can be renewed.
- It does not give permission to mine

- **Stage Two**

- Application for Planning Permission permit (LA)
- The applicant must provide detailed information regarding mining operations, processing, waste storage facilities and infrastructural requirements, public consultation is also undertaken.



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- **Stage Three**

- The next stage is the granting of an **Integrated Pollution Control (IPC) licence** from the EPA.



- **Stage Four**

- The granting of a **mining lease or licence** from the Department of the ECC
- Allows the EPA to regulate environmental performance, including emissions to water and air, noise and vibration impacts and the generation and disposal of waste.
- Mining companies are required to plan and provide adequate finance for the closure and after care of mines.



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MINE CLOSURE & REHABILITATION

Mining provides the critical minerals and metals needed for society. However, mining activities can impact local environment and biodiversity when not properly managed.

The mines of today prepare for a rehabilitated landscape right from the beginning, in a process known as **Progressive Reclamation**.

WHAT IS PROGRESSIVE RECLAMATION?

Progressive reclamation, also known as **rehabilitation**, plans for post-closure activities during the entire mining process, from start to finish.

BEFORE MINING

INTEGRATED MINE PLANNING FOR CLOSURE AND RECLAMATION



The rehabilitation planning process starts before mining begins.



Detailed closure and reclamation plans are integrated into the permitting process for mine development.



Continuous monitoring throughout the whole life cycle of the mine.

DURING MINING

PLANNING FOR CLIMATE CHANGE IMPACTS AND LAND USE



An area of the mine can be reclaimed even as other parts of the mine are in operation.



Mitigating the impacts of land disturbance during operations are critical to returning the land to a viable state.



Climate change impacts (e.g., precipitation, erosion and chemical processes) should also be accounted for in this ongoing process to ensure successful closure and reclamation.

AFTER MINING

CLOSURE AND RECLAMATION



Once the mining process is complete, the land can be returned to a natural state and prepared for post closure reuse.



Evidence of the mining operation must be removed as much as possible.



Mine closure and rehabilitation activities need to take local environmental conditions into account.

ENVIRONMENTAL STUDIES

Data gathering, and establishing biodiversity baseline.

FINANCIAL OPTIONS

Secure funding for closure and reclamation activities.

MITIGATING IMPACTS

Ongoing minimizing, monitoring and assessment of waste materials where appropriate. E.g., soil removed during excavation can be saved for reclamation work.

WATER MANAGEMENT

Surface and mine waters are treated to ensure compliance, water recycle, watershed management.

CONTINUED RELATIONSHIP

Incorporate traditional knowledge into planning and work with Indigenous people and communities, including leveraging local employment to monitor and obtain field samples.

EVALUATING REHABILITATION

Compare water quality and end land use to baseline.

REUSING THE LAND

Mine sites can be repurposed for other uses, including for agriculture, solar panel farms, biofuel production, and even recreational and touristic use.

EXAMPLE: A SOLAR PANEL FARM



Mining operations can generate business opportunities for new industries in the region and create local benefits.

Reverting mines to a rehabilitated state will ensure that the landscape can support life for centuries to come.

- **Class Discussion**

- Is this degree of regulation likely to result in sustainable mining activity ?

- Will it encourage investment in the sector ?



Case Study: Lisheen Mines.

The Lisheen Mine is a former lead and zinc mine located between the villages of Moyne and Templetuohy in North Tipperary.

Stage one

- **Exploration and Feasibility Study**
- Lead and Zinc deposits discovered in 1990
- Early 1990's Feasibility Study undertaken which involved,
- Technical, Economic, Environmental and Planning studies and Community consultation.



Stage Two

- **Mine Design and Planning**
- 1995 Submission of an Environmental Impact Statement (EIS) and Planning application to North Tipperary County Council.
- Approved in August 1996.
- June 1997 An Integrated Pollution Control Licence was issued by the Environmental Protection Agency (EPA).
- June 1997 final planning permission granted by An Bord Pleanála.
- October 1997 a State Mining Licence was issued by Minister.

Stage Three

- **Construction and Installation**
- Construction work started in 1997, went on for 2 years employing up to 700 workers.
- Total development cost of 256 million Euro

Stage Four

- **Extraction and Economic Benefits**
- Production began in October 1999 and continued for 16 years until 2015.
- 300,000 tonnes of zinc concentrate produced annually.
- 2.8 Billion in mine revenue.
- 350 direct jobs.
- 352 million Euro in wages
- 500 indirect jobs
- Over its 15 years of operation the mine generated
 - 1.3 billion Gross Value Added to the Irish Economy
 - 5.8 billion in direct, indirect and induced spending
 - 257 million to the State in royalties, taxes and rates.



Stage Five

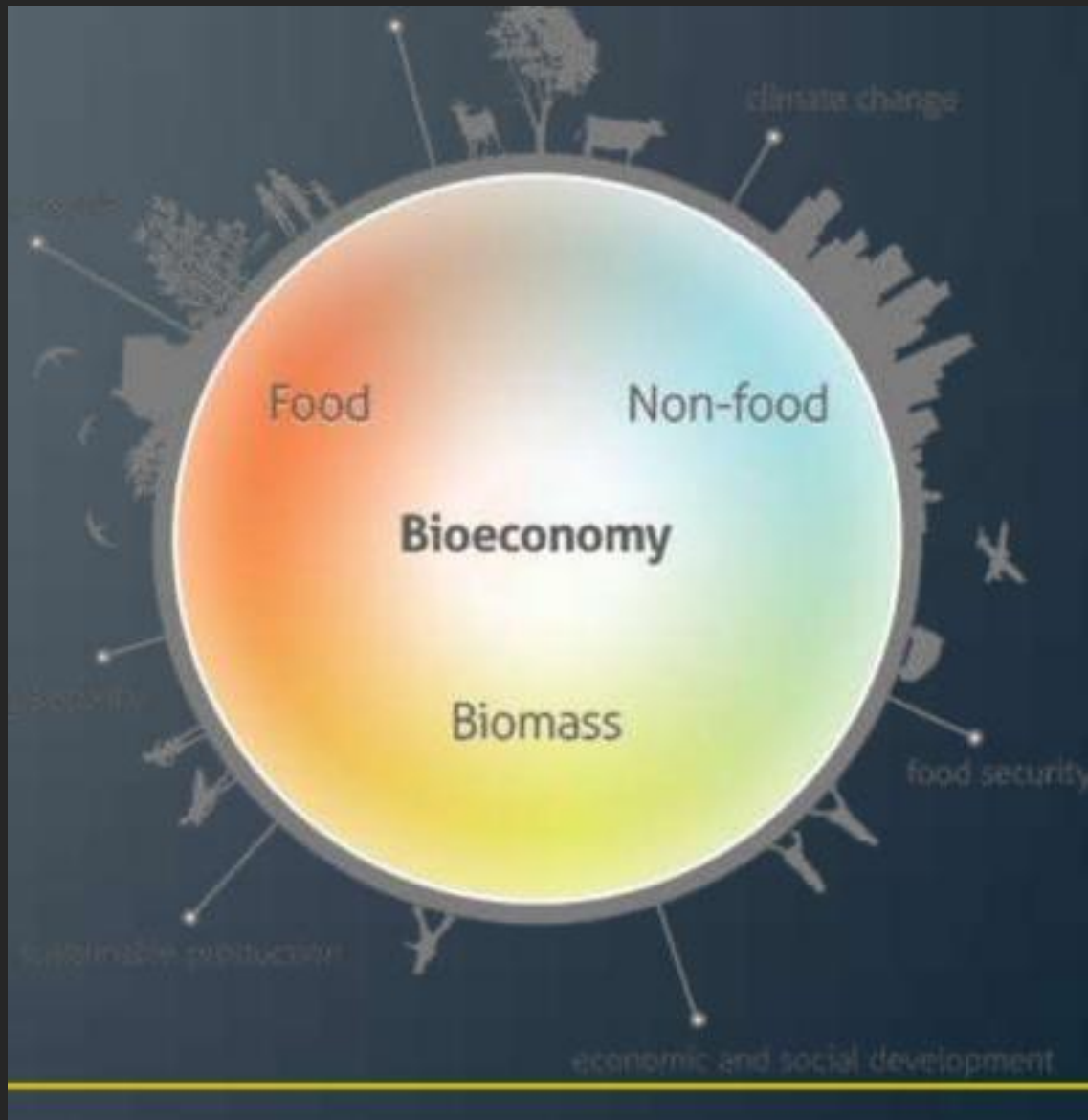
- **Mine Closure and Aftercare**
- As part of its Mining Licence, the company was required to submit Closure, Rehabilitation and Aftercare Management Plan (CRAMP) and to allocated funding for same (27million).
- Prior to Closure, Rehabilitation work was undertaking in the tailing ponds (storage of ore residue) and was 60% completed by 2015
- After the mine closed in 2015 work continued including:
 - Backfilling of the underground mine
 - Clearing and removal of buildings and equipment
 - Removal of ground contaminated with Lead and Zine
 - Rehabilitation of tailing ponds to agricultural land
- All work undertaken was closely monitored by relevant authorities.

Tailings Dam Rehabilitation



- **Post-Mining Land Use**

- Mine infrastructure removed
- Wetlands to trap water runoff
- Buildings used to support other economic activities
- Campus for National – Bio economy – production of renewable biological resources and their conversion into food, feed, biobased products and bioenergy.
- Development of 44 wind Turbines which supply electricity to power 70,000 homes (size of Galway City)
- Improvement of road network, telecommunications, new fresh water supply, investment for local sport facilities and community hall
- Reskilling and upskilling of mines workforce.





Mine closure and site restoration



IBF – Pilot, Research & Innovation Facility
CMP – Mushroom Substrate facility
AgriChemWhey – bio refinery project

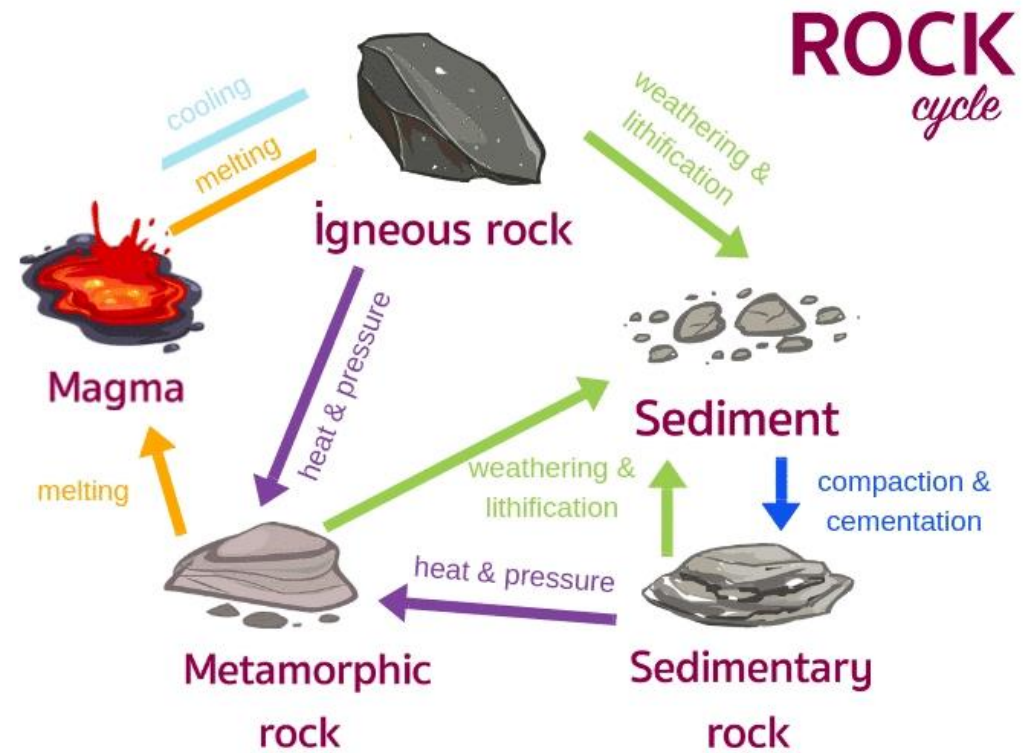
- Key Question :
- Is Lisheen Mine an example of sustainable Mining ?
- Overall sustainable mining is possible if efforts are made to enhance the benefits of mining activity and to reduce or mitigate negative impacts.
- Involvement of the local community in the process allows companies a “*social licence to operate*”.

- Future of Mining In Ireland

Geological Survey of Ireland.

“Ireland can offer more. Strong potential exists to further explore for zinc, in addition to other known metals critical to the green economy which are also found on the island including silver, gold, copper, lead, lithium, barytes, antimony, cobalt, platinum group elements and rare earth elements”

- **Examination Questions in past papers.**
- **Human Interaction with the rock cycle:**
Physical Section: 30 marks.
- **Higher Level**
- 2009, 2010, 2011, 2013, 2015, 2018, 2020, 2022 ?
- **Ordinary Level**
- 2010, 2013, 2014, 2016, 2017, 2018, 2019, 2020, 2021



- Examination Questions in past Higher level papers.
- **Conflict of Interests: Economic Elective :30 marks**
- 2009, 2010, 2012, 2014, 2016, 2018, 2021
- Ordinary Level
- 2010, 2012, 2014, 2016, 2018, 2020



- Examination Questions in past Higher level papers.
- **Environmental impacts of economic activities:
Economic Elective: 30 marks.**
- 2018
- 2015

