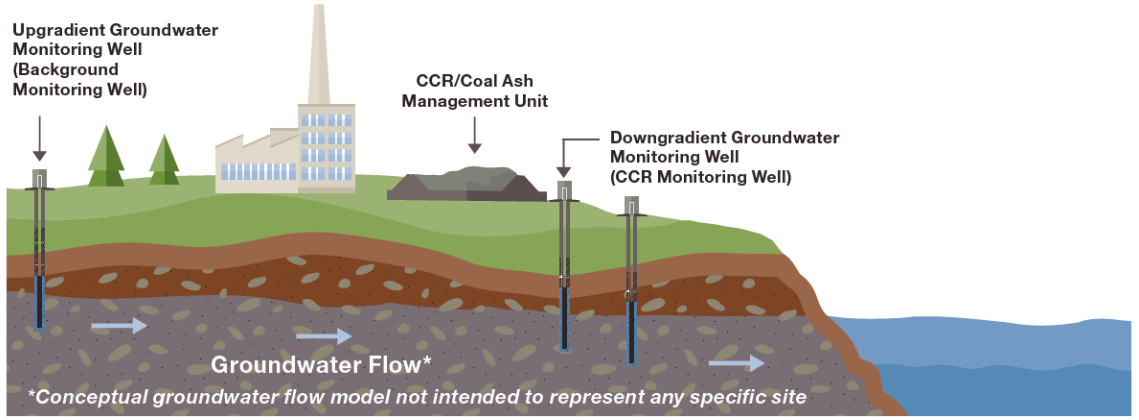
Addressing Public Fear with Facts: TVA Coal Ash Fact Sheets

Melissa Hedgecoth and Neil Carriker – Tennessee Valley Authority
Lisa Bradley – Haley & Aldrich, Inc.
Rock Vitale – Environmental Standards, Inc.
Kody Bootsman – Stantec Consulting Ltd.
Tamara Hinton – Story Partners, LLC

USWAG CCR Workshop
August 9, 2022

Overview

1. Coal Ash News Coverage and TVA's Perspective
2. Fact Sheet Development: Objectives and Approach
3. Format and Example
4. Final Fact Sheets



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News Coverage of Coal Ash is Biased and Incomplete

- Coal ash is in the news
- "Bad news sells" is well-documented in the media industry
- Some news outlets adopt this philosophy for coal ash articles
- Inflammatory terms are used to incite the public

"Coal ash …. contains a toxic stew of 26 cancer-causing pollutants and radioactive heavy metals."
Knoxville News Sentinel, 7/21/21

What they say:

- "Toxic"
- "Dangerous"
- "Cancer-causing"
- "Toxic stew"

What they don't say:

- These constituents also occur naturally in foods and soils to which we're exposed every day
- Toxicity requires exposure at concentrations and durations sufficient to cause adverse effects
- Ash management is highly regulated and the potential for exposure is low

TVA Perspective

- As an industry, utilities need to create opportunities to share accurate information and advance understanding of the complex issues we face
- We need to make sound, science-based decisions for our CCR programs
- This can be challenging because of a lack of understanding
- Accurate information and context are important

- Objective:
  - Develop a fact sheet program to address the misinformation about coal ash
- Fact Sheets:
  - Science-based
  - Short
  - Use easily understandable language

Team

Development Team

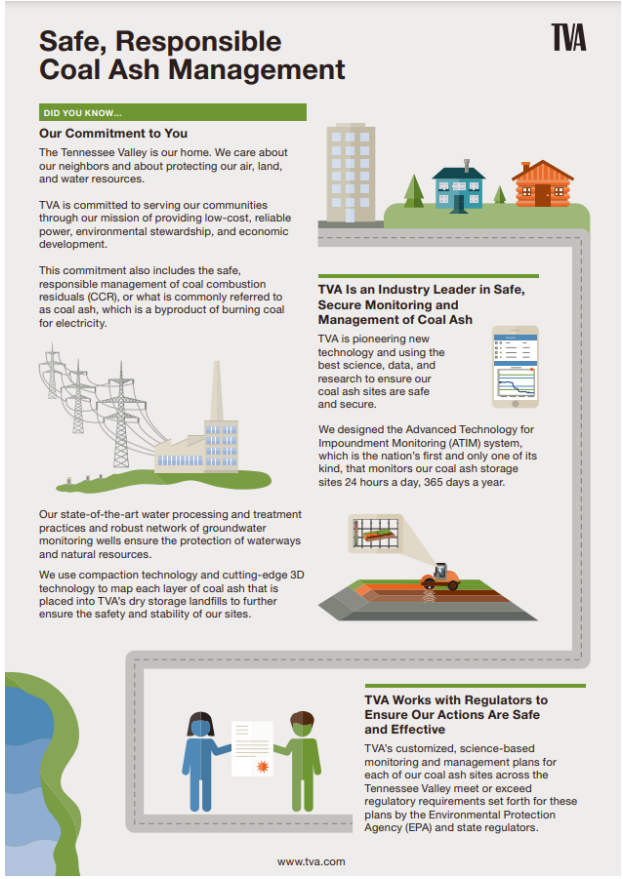
- TVA – Missy Hedgecoth
  - CCR Program Manager
- TVA – Neil Carriker
  - Historical context and risk assessment
- Environmental Standards, Inc. – Rock Vitale
  - Data source and constituent knowledge
- Haley & Aldrich – Lisa JN Bradley, Ph.D., DABT
  - Toxicology, risk assessment, communications
- Stantec – Kody Bootsman
  - Graphics
- Story Partners – Tamara Hinton
  - Messaging

Reviewers

- Internal review at TVA
  - Regulatory
  - Technical
  - Legal
  - Communications

Topics

- Constituents
  - Arsenic
  - Boron
  - Cobalt
  - Lead
  - Lithium
  - Molybdenum
  - Radiation
  - Selenium
- Topics
  - Coal Ash is Not Hazardous
  - Claxton Park Soil Sampling
- Previously Prepared
  - TVA Mission of Service
  - Robust Groundwater Monitoring
  - Advanced Technology for Impoundment Monitoring (ATIM) System
  - Intelligent Compaction
  - Benefits of Recycling Coal Ash
  - TVA Recycles CCR



www.tva.com/environment/coal-ash

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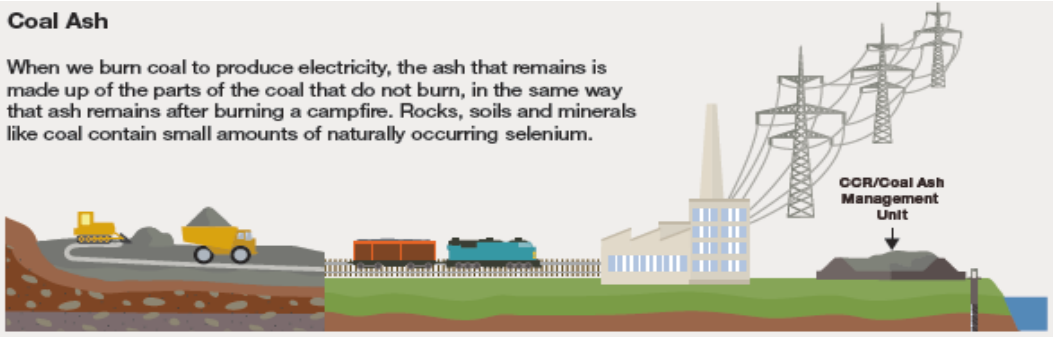
Format

Page 1

- Constituent is Naturally-Occurring
- Constituent in Soil
  - USGS Map of US and Tennessee
- Constituent and Health/Food
- **In all cases, information was derived from reputable regulatory sources, and the references provided**



Page 2

- Coal Ash
  - The same for all fact sheets
- Coal Ash and People
  - The same for all fact sheets
- Groundwater Monitoring
  - Monitoring requirements
  - Number of samples analyzed
  - Drinking water standard/screening level (SL)
  - % samples below the (SL)
  - Comparison to exposure in daily life
  - Parts-per-billion in context

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Arsenic in Our Environment

TVA

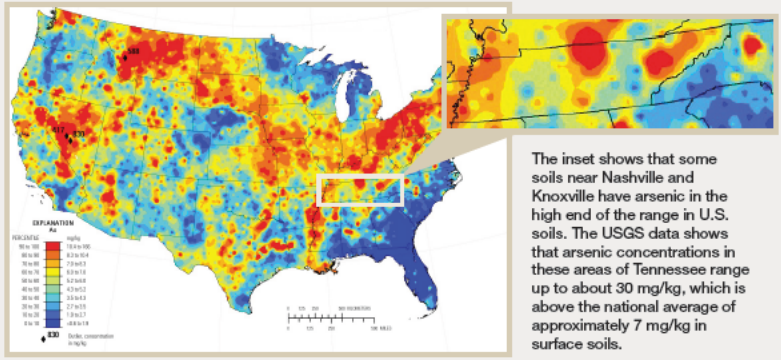
Arsenic Is Naturally Occurring

Nearly everyone is exposed to small amounts of arsenic every day without adverse health effects. Arsenic is a naturally occurring element that is widely distributed in the Earth's crust. Small amounts of arsenic are all around us, in the soils we walk on; the dusts we breathe; the groundwater we drink; and the streams and lakes we swim in, eat fish from and use for municipal water supplies.

Arsenic occurs naturally at low levels in phosphate rocks and in phosphate fertilizers we use on lawns, vegetables, flowers and orchards.

Arsenic in Soil

The map below, adapted from a U.S. Geological Survey (USGS) report,[1] shows relative amounts of naturally occurring arsenic in surface soils across the United States.



The inset shows that some soils near Nashville and Knoxville have arsenic in the high end of the range in U.S. soils. The USGS data shows that arsenic concentrations in these areas of Tennessee range up to about 30 mg/kg, which is above the national average of approximately 7 mg/kg in surface soils.

Arsenic in Food

Arsenic in soils and water is taken up by plants, crops and livestock and gets incorporated into our diets. Seafood, rice, mushrooms and chicken are some of the foods with the highest levels of arsenic. Beer, wine and some fruit juices can contain significant amounts of arsenic as well.

According to the Centers for Disease Control (CDC), "*Since arsenic is found naturally in the environment, you will be exposed to some arsenic by eating food, drinking water, or breathing air.*" [2]

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2 https://www.atsdr.cdc.gov/ToxProfiles/tp2-c1-b.pdf

Coal Ash and Arsenic

TVA

Coal Ash

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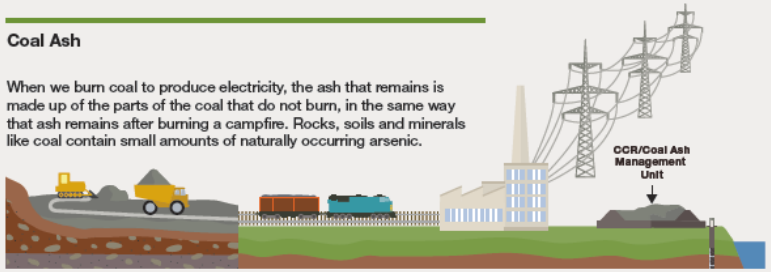

Groundwater Monitoring

The EPA requires electric utilities to measure levels of arsenic in groundwater from wells next to coal combustion residuals (CCR) management units. Since 2015, TVA has collected more than 6,600 groundwater samples around its coal-fired power plants to test for arsenic.

Although the groundwater next to TVA's CCR management units is not used for drinking water, over 90% of the samples had levels of arsenic **below** the EPA drinking water standard of 10 ug/L (parts per billion). And in nearly 58% of those samples, there was not enough arsenic present to measure. For comparison, the CDC reports that wine can contain up to 33 ug/L arsenic, and juices and instant cocoa can contain up to 13 ug/L arsenic.[3]

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Coal Ash and People

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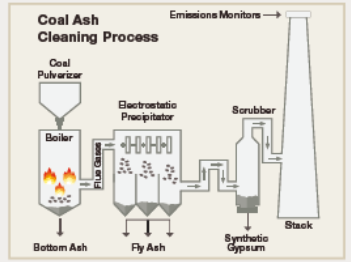

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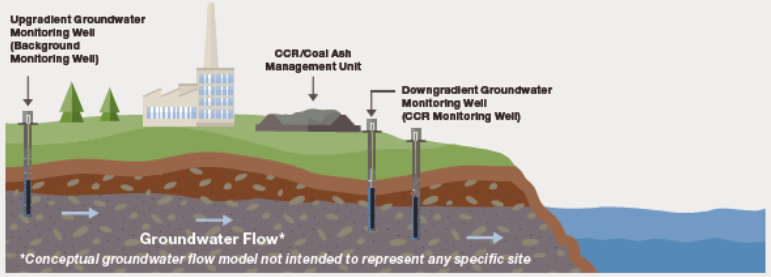

April 2022

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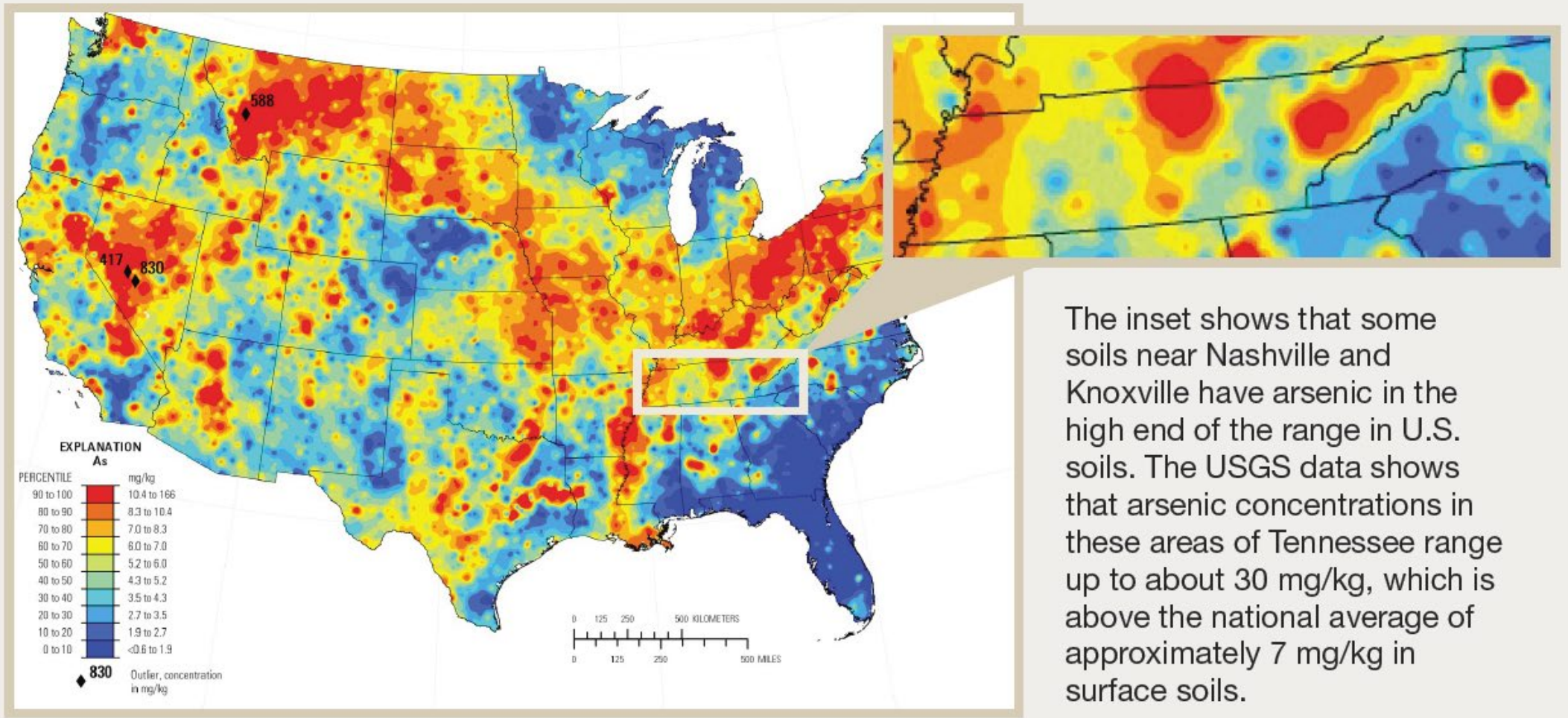

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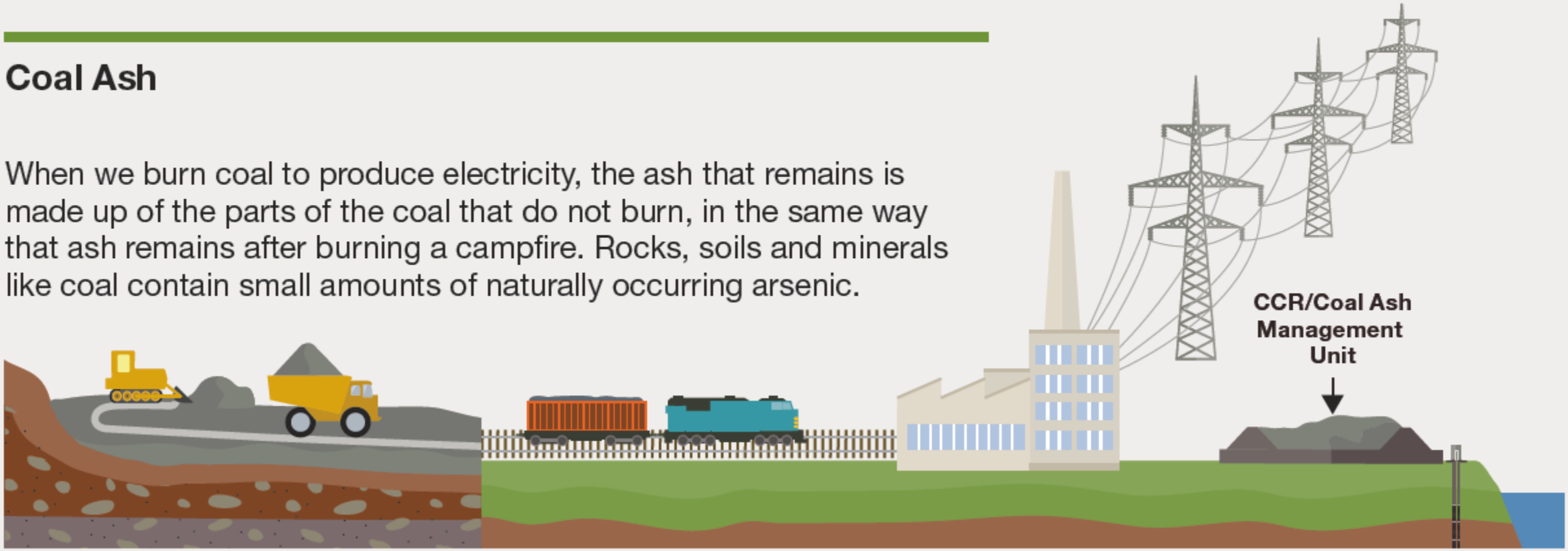

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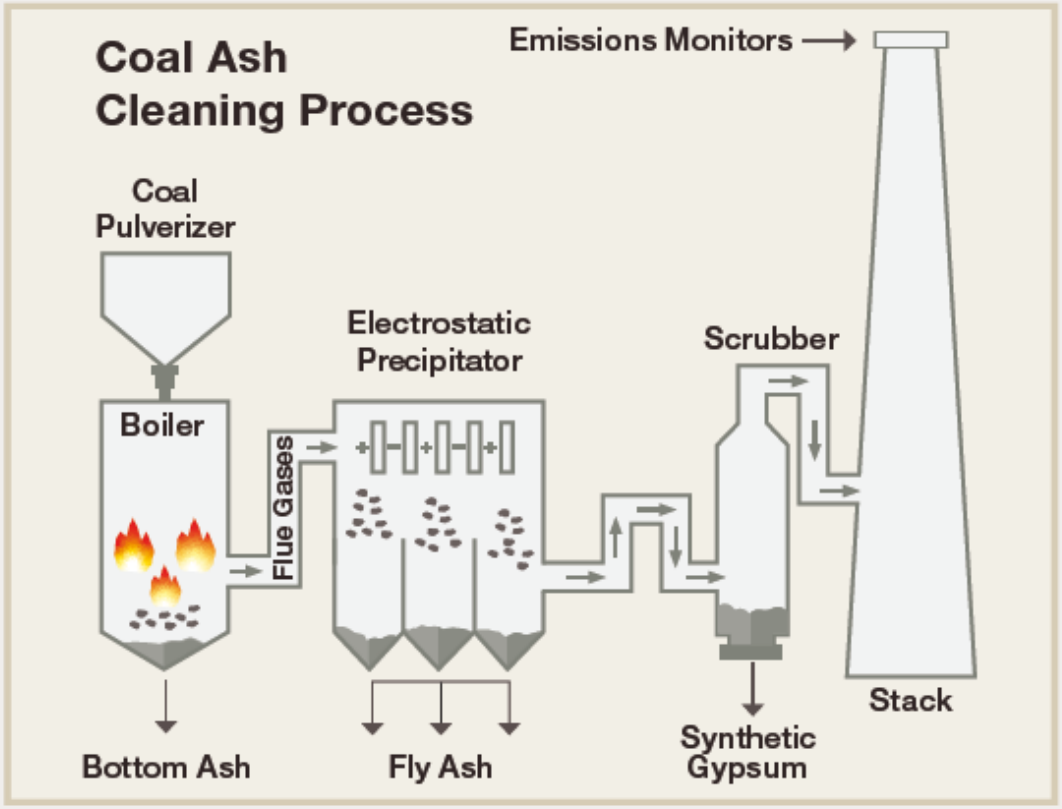

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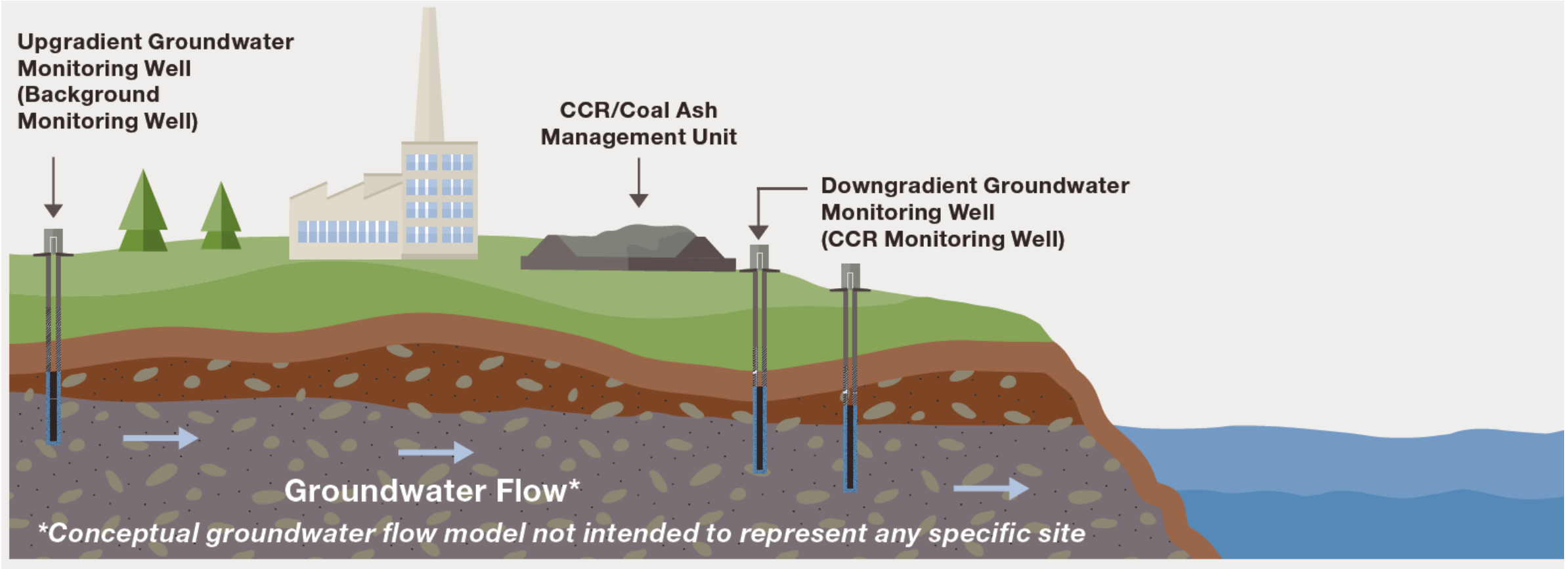
Groundwater Monitoring



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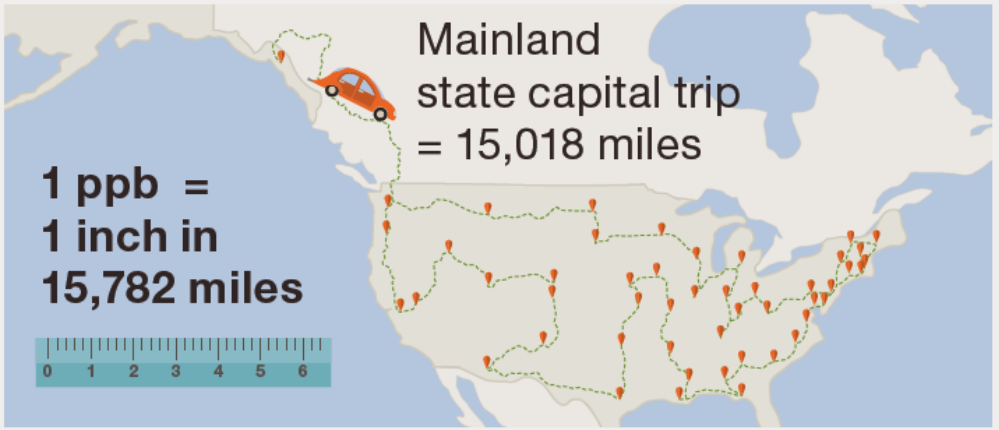

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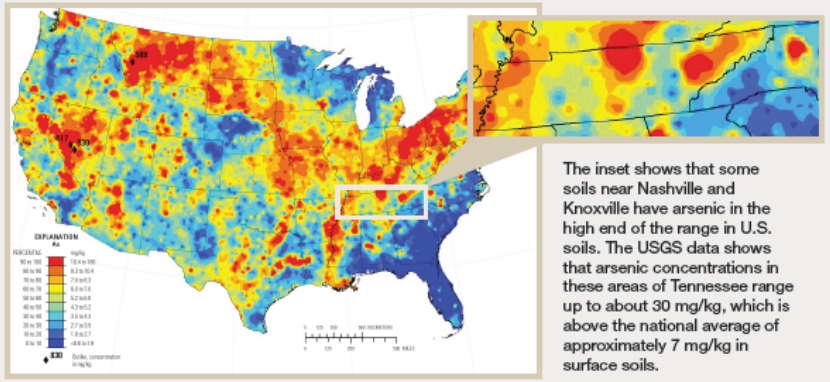

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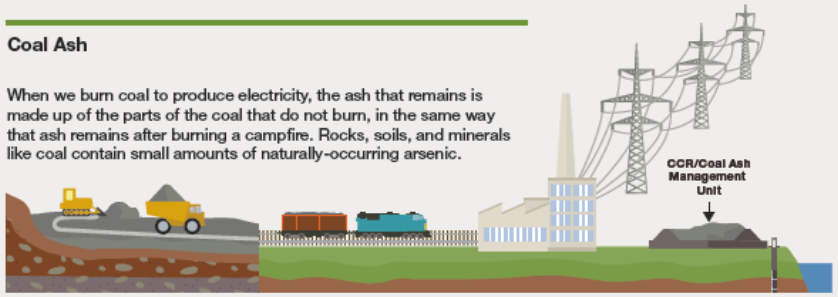

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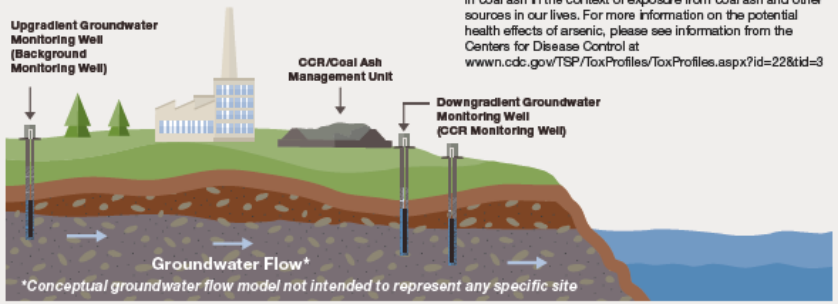

Coal Ash & People

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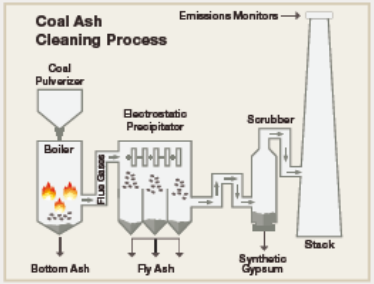

3 https://www.atsdr.cdc.gov/ToxProfiles/tp2.pdf, p. 352

This publication provides information on constituents present in coal ash in the context of exposure from coal ash and other sources in our lives. For more information on the potential health effects of arsenic, please see information from the Centers for Disease Control at wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=22&tid=3

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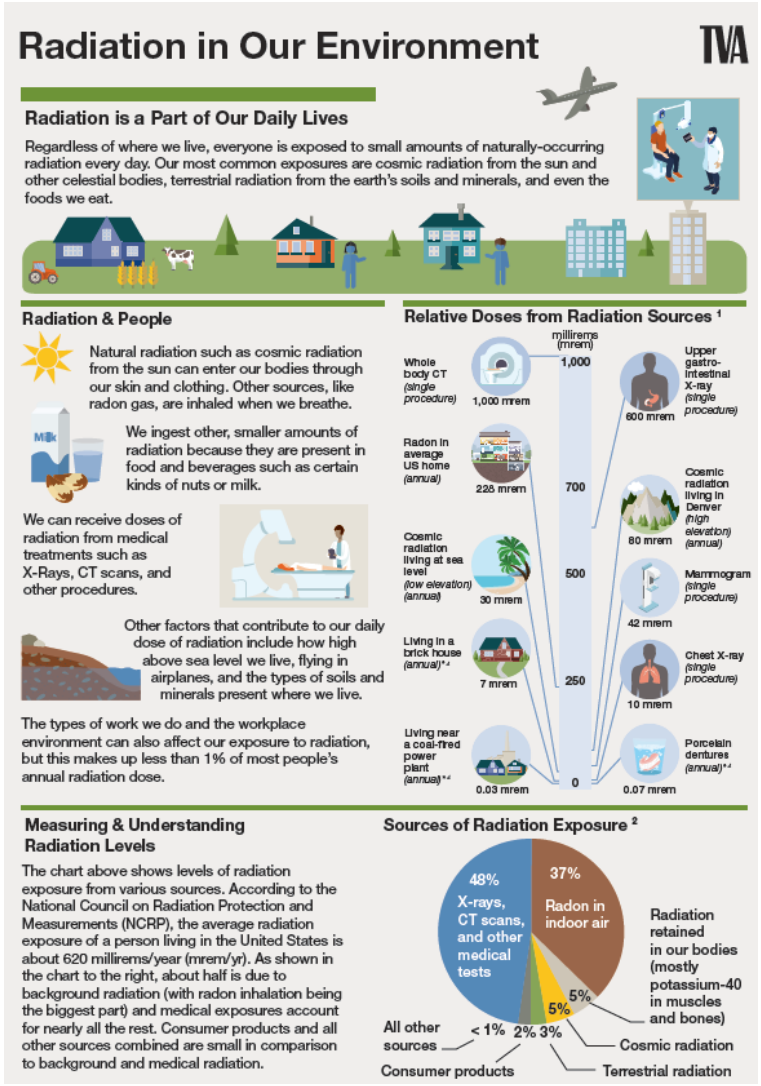
Radiation

> *"Radioactive elements in coal and fly ash should not be sources of alarm. The vast majority of coal and the majority of fly ash are not significantly enriched in radioactive elements, or in associated radioactivity, compared to common soils or rocks."* [3]



Radiation in Our Environment

TVA

Radiation is a Part of Our Daily Lives

Regardless of where we live, everyone is exposed to small amounts of naturally-occurring radiation every day. Our most common exposures are cosmic radiation from the sun and other celestial bodies, terrestrial radiation from the earth's soils and minerals, and even the foods we eat.

Radiation & People

Natural radiation such as cosmic radiation from the sun can enter our bodies through our skin and clothing. Other sources, like radon gas, are inhaled when we breathe.

We ingest other, smaller amounts of radiation because they are present in food and beverages such as certain kinds of nuts or milk.

We can receive doses of radiation from medical treatments such as X-Rays, CT scans, and other procedures.

Other factors that contribute to our daily dose of radiation include how high above sea level we live, flying in airplanes, and the types of soils and minerals present where we live.

The types of work we do and the workplace environment can also affect our exposure to radiation, but this makes up less than 1% of most people's annual radiation dose.

Relative Doses from Radiation Sources [1]

millirems (mrem)

1,000
700
500
250
0

- Whole body CT (single procedure): 1,000 mrem
- Radon in average US home (annual): 225 mrem
- Cosmic radiation living at sea level (low elevation) (annual): 30 mrem
- Living in a brick house (annual)*: 7 mrem
- Living near a coal-fired power plant (annual)*: 0.03 mrem
- Upper gastro-intestinal X-ray (single procedure): 600 mrem
- Cosmic radiation living in Denver (high elevation) (annual): 80 mrem
- Mammogram (single procedure): 42 mrem
- Chest X-ray (single procedure): 10 mrem
- Porcelain dentures (annual)*: 0.07 mrem

Measuring & Understanding Radiation Levels

The chart above shows levels of radiation exposure from various sources. According to the National Council on Radiation Protection and Measurements (NCRP), the average radiation exposure of a person living in the United States is about 620 millirems/year (mrem/yr). As shown in the chart to the right, about half is due to background radiation (with radon inhalation being the biggest part) and medical exposures account for nearly all the rest. Consumer products and all other sources combined are small in comparison to background and medical radiation.

Sources of Radiation Exposure [2]

Coal Ash and Radiation

TVA

Coal Ash

When we burn coal to produce electricity, the ash that remains is made up of the parts of the coal that do not burn, in the same way that ash remains after burning a campfire. Rocks, soils, and minerals like coal contain small amounts of naturally-occurring radiation.

Federal agencies (U.S. Geological Survey, U.S. Environmental Protection Agency [EPA]) agree that the trace levels of radiation in coal ash are not significantly greater than in common soils and rocks.

"Radioactive elements in coal and fly ash should not be sources of alarm. The vast majority of coal and the majority of fly ash are not significantly enriched in radioactive elements, or in associated radioactivity, compared to common soils or rocks." [3]

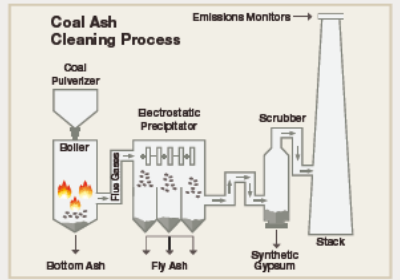
Groundwater Monitoring

The EPA requires electric utilities to measure levels of radium in groundwater from wells next to coal combustion residual (CCR) management units. Since 2015, TVA has collected more than 6,000 groundwater samples around its coal-fired power plants to test for radium. And even though the groundwater next to TVA's CCR management units is not used for drinking water, over 99% of the samples had levels of radium **below** the EPA drinking water standard.

Coal Ash & People

Coal ash is maintained and managed on access-controlled industrial sites. The chance of anyone from the community coming into contact with the coal ash is remote and, thus, the chance of receiving a significant radiation dose from coal ash is also remote. TVA's modern air pollution control technologies capture more than 99.5% of coal ash particulates and reduce the potential human exposure to background levels.

For example the Nuclear Regulatory Commission dose calculator[4] estimates that someone living near a coal-fired power plant receives an additional radiation dose (0.03 mrem) that is about half the dose from having a porcelain dental crown or wearing dentures (0.07 mrem).



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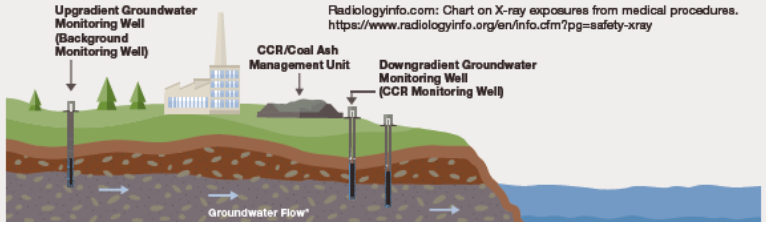
EPA Radiation Sources and Doses: Includes links to dose calculator, fact sheet on types of radiation, pie chart from NCRP Report 160, and other useful information.
https://www.epa.gov/radiation/radiation-sources-and-doses#dosescommon

EPA RadTown site: General information for teachers; includes links to other information sources.
https://www.epa.gov/radtown

Radiologyinfo.com: Chart on X-ray exposures from medical procedures.
https://www.radiologyinfo.org/en/info.cfm?pg=safety-xray



U.S. Nuclear Regulatory Commission Personal Radiation Dose Calculator.
https://www.nrc.gov/about-nrc/radiation/around-us/calculator.html

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Coal Ash in Perspective

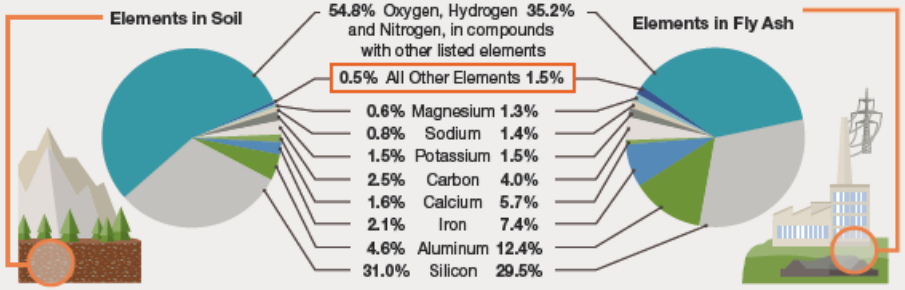
Coal Ash is Not Hazardous

We are all familiar with soil and rocks in our environment. Coal is one type of rock. When we burn coal to produce electricity, the ash that remains is made up of the parts of the coal that do not burn, in the same way that ash remains after burning a campfire.

TVA's commitment to our communities includes the safe, responsible management of coal combustion residuals (CCR), or what is commonly referred to as coal ash. The EPA classified coal ash as **non-hazardous** solid waste. This designation is based on extensive review and detailed studies of the components of coal ash over many years by regulatory agencies, academic institutions, and expert third parties. This designation is also backed up by rigorous toxicity testing. Further, as illustrated on this fact sheet, the constituents of coal ash are nearly identical to common soil.

Coal Ash and Soil

The constituents that make up coal ash are the same as soils and rocks. These constituents are naturally occurring and consist mainly of oxygen, hydrogen, and nitrogen that together with carbon make up the building blocks of all life. Other major components in soil and coal ash are silicon (in the form of silicon oxides, or sand), aluminum, iron, calcium, and other common minerals, as shown in the chart below.[1]



Regulatory Oversight of Coal Ash Management

While TVA is an industry leader in the safe, secure management and monitoring of coal ash, there is also extensive regulatory oversight of coal ash sites because of the volume of material to manage and monitor. Regulatory agencies such as the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the Nuclear Regulatory Commission (NRC), state environmental agencies such as the Tennessee Department of Environment and Conservation (TDEC) and the Tennessee Department of Health (TDH) and others are responsible for implementing laws passed by Congress and the States to manage health and environmental risks associated with air emissions, wastewater discharges, solid waste disposal, and potential exposure from commercial, industrial, and government operations. Constituents of coal ash and the management of coal ash are regulated to protect the environment, public health, and worker health.

Coal Ash and People

Everything present in coal ash is also naturally present in the soils we encounter at our homes and parks and schools. We're exposed to these constituents every day in the soils we garden in and in the foods we eat. Coal ash is maintained and managed on access-controlled industrial sites. The chance of anyone from the community coming into contact with the coal ash is remote and, thus, the chance of receiving a significant exposure to any constituents present in coal ash is also remote. TVA's modern air pollution control technologies capture more than 99.5% of coal ash particulates and reduce the potential human exposure to background levels.

Decades of Studies Have Demonstrated That Coal Ash is Not Hazardous

The news media frequently describes coal ash as "toxic," but this demonstrates a misunderstanding of toxicology, risk assessment, the roles of regulatory agencies, and the processes those agencies follow in developing and implementing policies and regulations.

When subjected to toxicity testing, coal ash is not considered toxic because the constituents within it are not present at high enough levels, alone or in combination, to be toxic. We know this from available published studies that assess the overall risks of coal ash to humans and the environment.

The US Approach to Chemical Evaluation

In the US, EPA evaluates a material based on the constituents present in the material. Thus, the EPA's national risk assessment for coal ash evaluated the constituents present in coal ash. The Toxic Substances and Control Act (TSCA) administered by the EPA also regulates on a per chemical basis. This per-constituent approach has led to questions about whether there is a risk if someone is exposed to all of these constituents in coal ash (or soil) at once. The US does not have a program to conduct testing on coal ash as a whole product, however, Europe does. It is a program called REACH, and such testing has been conducted on coal ash.

REACH: Registration, Evaluation, Authorisation and Restriction of Chemicals

The European Chemical Agency's REACH program regulates a comprehensive program of toxicity testing of materials and has registered coal ash for commerce in Europe. That registration is based on testing whole coal ash using a variety of 47 different human health-based toxicity tests and 39 different aquatic toxicity tests. All of those 86 test results support characterizing coal ash as non-hazardous.[2]

These toxicity studies have been conducted on coal ash as a whole material. All of the constituents present in ash are present together, thus, these studies answer the question of what additive effects the constituents may have on health.

REACH Coal Ash Human Health-Based Toxicity Studies

Toxicity Test	Publications and Reports	Conclusion
Acute Oral Toxicity	3	No Hazard
Acute Inhalation Toxicity	1	No Hazard
Acute Dermal Toxicity	2	No Hazard
Skin Irritation	12	No Hazard (11) Inconclusive (1)
Eye Irritation	6	No Hazard (5) Inconclusive (1)
Skin Sensitization	4	No Hazard
Repeated Dose Inhalation Toxicity	3	No Hazard
Repeated Dose Oral Toxicity	2	No Hazard
Genetic Toxicity	7	No Hazard
Reproductive Toxicity	2	No Hazard
Worker Epidemiology	5	No Hazard

47 toxicity studies relevant to humans

No adverse effects were identified in any of the studies for both short-term and long-term exposure durations for:
Inhalation, ingestion, and dermal contact

REACH Coal Ash Aquatic Toxicity Studies

Toxicity Test	Publications and Reports	Conclusion
Acute Toxicity to Fish	4	No Hazard
Acute Toxicity to Aquatic Invertebrates	8	No Hazard
Toxicity to Aquatic Algae and Cyanobacteria	16	No Hazard
Toxicity to Microorganisms	8	No Hazard
Chronic Toxicity to Fish	1	No Hazard
Chronic Toxicity to Aquatic Invertebrates	2	No Hazard

39 aquatic toxicity studies

No adverse effects were identified in any of the studies for both short-term and long-term exposure durations for:
Fish, invertebrates, and micro-organisms

All of the 86 studies concluded "no hazard"

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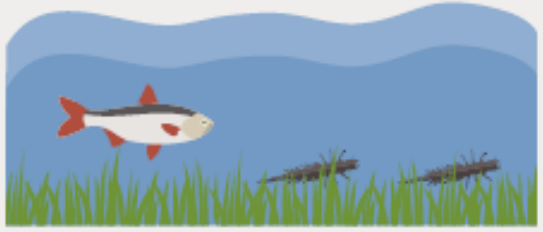
Whole product testing of coal ash in the EU: 86 studies conducted

47 toxicity studies relevant to humans

No adverse effects were identified in any of the studies for both short-term and long-term exposure durations for:

Inhalation, ingestion, and dermal contact



39 aquatic toxicity studies

No adverse effects were identified in any of the studies for both short-term and long-term exposure durations for:

Fish, invertebrates, and micro-organisms

All of the 86 studies concluded that coal ash poses "No Hazard"

REACH Coal Ash Human Health-Based Toxicity Studies

Toxicity Test	Publications and Reports	Conclusion
Acute Oral Toxicity	3	No Hazard
Acute Inhalation Toxicity	1	No Hazard
Acute Dermal Toxicity	2	No Hazard
Skin Irritation	12	No Hazard (11) Inconclusive (1)
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REACH Coal Ash Aquatic Toxicity Studies

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Chronic Toxicity to Fish	1	No Hazard
Chronic Toxicity to Aquatic Invertebrates	2	No Hazard

CCR Groundwater Monitoring Results TVA Facilities 2021

https://www.tva.com/environment/coal-ash

Key

- All < GWPS
- 1+ > GWPS

2021

Constituent	GWPS mg/L	Background Well	CCR Monitoring Wells								
		CUF-201	CUF-202	CUF-205	CUF-206	CUF-207	CUF-208	CUF-209	CUF-211	93-2R	CUF-212	93-3
Antimony	0.006											
Arsenic	0.01											
Barium	2											
Beryllium	0.004											
Cadmium	0.005											
Chromium	0.1											
Cobalt	0.006											
Fluoride	4											
Lead	0.015											
Lithium	0.04											
Mercury	0.002											
Molybdenum	0.1											
Rad226+228	5 pCi/L											
Selenium	0.05											
Thallium	0.002											

2021

Constituent	GWPS mg/L	Background Well	CCR Monitoring Wells						
		2	47	48	49	50	10-51	10-52	S
Antimony	0.006								
Arsenic	0.01								
Barium	2								
Beryllium	0.004								
Cadmium	0.005								
Chromium	0.1								
Cobalt	0.006								
Fluoride	4								
Lead	0.015								
Lithium	0.04								
Mercury	0.002								
Molybdenum	0.1								
Rad226+228	5 pCi/L								
Selenium	0.05								
Thallium	0.002								

2021

Constituent	GWPS mg/L	Background Wells	CCR Monitoring Wells				
		CA5	COF-102	COF-104	COF-105	COF-106	COF-111
Antimony	0.006						
Arsenic	0.01						
Barium	2						
Beryllium	0.004						
Cadmium	0.005						
Chromium	0.1						
Cobalt	0.006						
Fluoride	4						
Lead	0.015						
Lithium	0.04						
Mercury	0.002						
Molybdenum	0.1						
Rad226+228	5 pCi/L						
Selenium	0.05						
Thallium	0.002						

2021

Constituent	GWPS mg/L	Background Well	CCR Monitoring Wells								
		ALF-210	ALF-216	ACC-5B	ALF-201	ALF-202	ALF-212	ALF-217	ALF-213	ALF-206	ALF-205	ALF-204	ALF-203
Antimony	0.006												
Arsenic	0.01												
Barium	2												
Beryllium	0.004												
Cadmium	0.005												
Chromium	0.1												
Cobalt	0.006												
Fluoride	4												
Lead	0.015												
Lithium	0.04												
Mercury	0.002												
Molybdenum	0.1												
Rad226+228	5 pCi/L												
Selenium	0.05												
Thallium	0.002												

2021

Constituent	GWPS mg/L	Background Well	CCR Monitoring Wells								
		AD-1	AD-2	AD-3	KIF-105	KIF-106	KIF-109	6AR	KIF-103	KIF-104	
Antimony	0.006										
Arsenic	0.01										
Barium	2										
Beryllium	0.004										
Cadmium	0.005										
Chromium	0.1										
Cobalt	0.006										
Fluoride	4										
Lead	0.015										
Lithium	0.04										
Mercury	0.002										
Molybdenum	0.1										
Rad226+228	5 pCi/L										
Selenium	0.05										
Thallium	0.002										

2021

Constituent	GWPS mg/L	Background Wells	CCR Monitoring Wells								
		JSF-104	JSF-200	JSF-205	JSF-103	JSF-105	W-32	10-36	JSF-201	JSF-202	JSF-203	JSF-204
Antimony	0.006											
Arsenic	0.01											
Barium	2											
Beryllium	0.004											
Cadmium	0.005											
Chromium	0.1											
Cobalt	0.006											
Fluoride	4											
Lead	0.015											
Lithium	0.04											
Mercury	0.002											
Molybdenum	0.1											
Rad226+228	5 pCi/L											
Selenium	0.05											
Thallium	0.002											

2021

Constituent	GWPS mg/L	Background Wells	CCR Monitoring Wells				
		B-9	JOF-101	JOF-103	JOF-104	10-AP1	10-AP3
Antimony	0.006						
Arsenic	0.01						
Barium	2						
Beryllium	0.004						
Cadmium	0.005						
Chromium	0.1						
Cobalt	0.006						
Fluoride	4						
Lead	0.015						
Lithium	0.04						
Mercury	0.002						
Molybdenum	0.1						
Rad226+228	5 pCi/L						
Selenium	0.05						
Thallium	0.002						

2021

Constituent	GWPS mg/L	Background Wells	CCR Monitoring Wells								
		95-48A	PAF-101	PAF-104	PAF-108	PAF-109	10-5	PAF-105	PAF-106		
Antimony	0.006										
Arsenic	0.01										
Barium	2										
Beryllium	0.004										
Cadmium	0.005										
Chromium	0.1										
Cobalt	0.006										
Fluoride	4										
Lead	0.015										
Lithium	0.04										
Mercury	0.002										
Molybdenum	0.1										
Rad226+228	5 pCi/L										
Selenium	0.05										
Thallium	0.002										

GROUNDWATER QUALITY MONITORING WELL LOCATIONS

CCR Monitoring Wells

Constituent	GWPS mg/L	94-35A	PAF-114	PAF-103	PAF-115	PAF-116	PAF-110	95-47C	PAF-113	PAF-112	PAF-119	10-6	PAF-118	PAF-117	PAF-107	10-4
Antimony	0.006															
Arsenic	0.01															
Barium	2															
Beryllium	0.004															
Cadmium	0.005															
Chromium	0.1															
Cobalt	0.006															
Fluoride	4															
Lead	0.015															
Lithium	0.04															
Mercury	0.002															
Molybdenum	0.1															
Rad226+228	5 pCi/L															
Selenium	0.05															
Thallium	0.002															

2021

Constituent	GWPS mg/L	Background Well	CCR Monitoring Wells			
		SHF-102G	D-11B	D-30B	D-74B	SHF-101G
Antimony	0.006					
Arsenic	0.01					
Barium	2					
Beryllium	0.004					
Cadmium	0.005					
Chromium	0.1					
Cobalt	0.006					
Fluoride	4					
Lead	0.015					
Lithium	0.04					
Mercury	0.002					
Molybdenum	0.1					
Rad226+228	5 pCi/L					
Selenium	0.05					
Thallium	0.002					

Summary

- We need to speak with one voice about **science and data**
- We need to provide the perspective and information to pave the way for more **accurate reporting**
- To achieve that goal, we developed a set of **accurate** and **easy to understand** fact sheets
- We continue to develop information and **fact sheets** as issues arise
- **TVA is happy to share this information**

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