PSE on bainbridge island

Improving reliability

"Missing link" transmission line electric and magnetic fields information session

September 29, 2021

We'll begin at 5 p.m. — all participants will be muted.
Technical difficulties? Please call or text Faiza Hassan

Welcome Bainbridge Island!

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Safety moment – natural disaster preparation

To prepare for a natural disaster, have on hand:

1. Food and water for your family for a minimum of 14 days.

2. Medical supplies specific to your needs and the training to know how to use them.

3. Blankets, clothing, and tarps to stay dry and warm

BAINBRIDGE PREPARES
bainbridgeprepares.org

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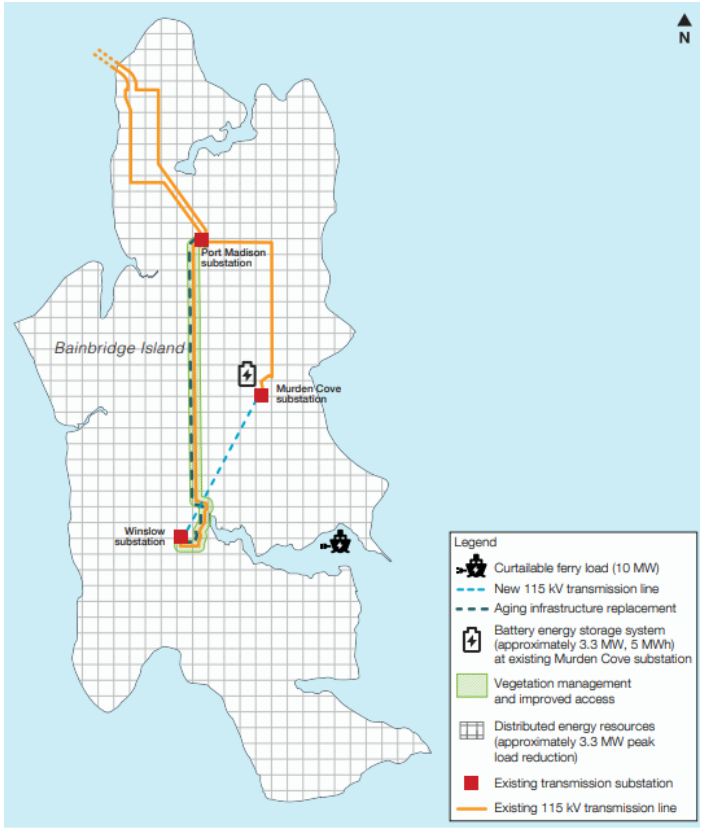
Overview: Improving reliability and community interest



- Reliability on the island needs to be improved
- Solutions package components
- Community interest on electric and magnetic fields

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Meeting agenda

- Welcome and safety moment – 5:00 p.m.
- Presentation on EMF – 5:10 p.m.
- Break – 5:30 p.m.
- Question & Answer – 5:35 p.m.
- Wrap up and next steps - 6:25 p.m.
- Adjourn – 6:30 p.m.

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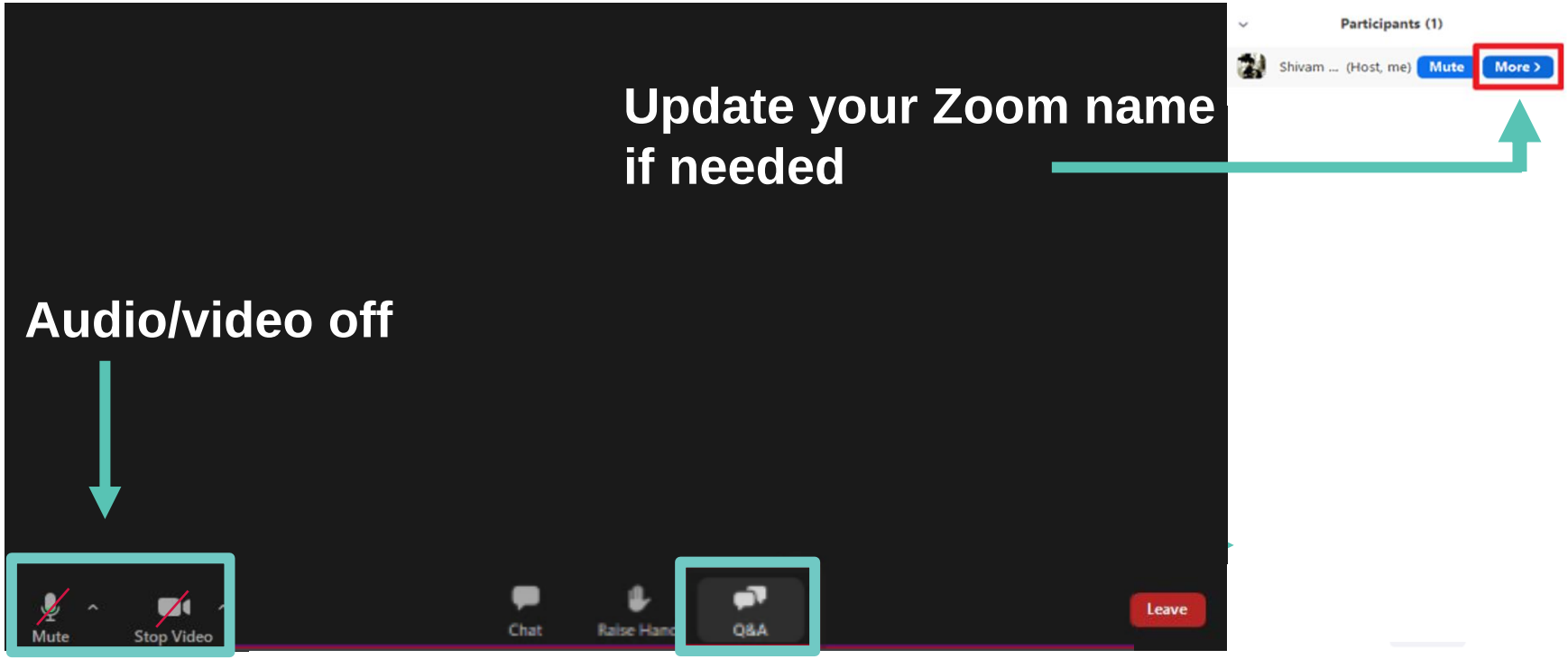
Zoom controls



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For today

Faiza Hassan
is our meeting host.

Please text/call
Faiza if you have
technical difficulties

- Large group: Muted with video off
- To ask a question during the Q&A: Use the Q&A chat box.
- Meeting conduct:
  - Listen to and appreciate the diversity of views and opinions
  - Behave constructively and courteously towards all participants
  - Respect the role of the facilitator to guide the group process

PSE PUGET SOUND ENERGY

Electric and magnetic fields (EMF)

Andrew Thatcher

PUGET SOUND ENERGY

Electromagnetic frequencies

Andrew H. Thatcher
Certified Health Physicist

BAINBRIDGE ISLAND COMMUNITY MEETING, SEPT 2021

Overview

What are magnetic fields?

Magnetic fields comparison between power lines and other electronic devices

Sample magnetic field levels from the proposed 115 kV transmission lines in conjunction with the existing 12.5 kV distribution lines

Brief discussion regarding undergrounding as it relates to EMF exposure

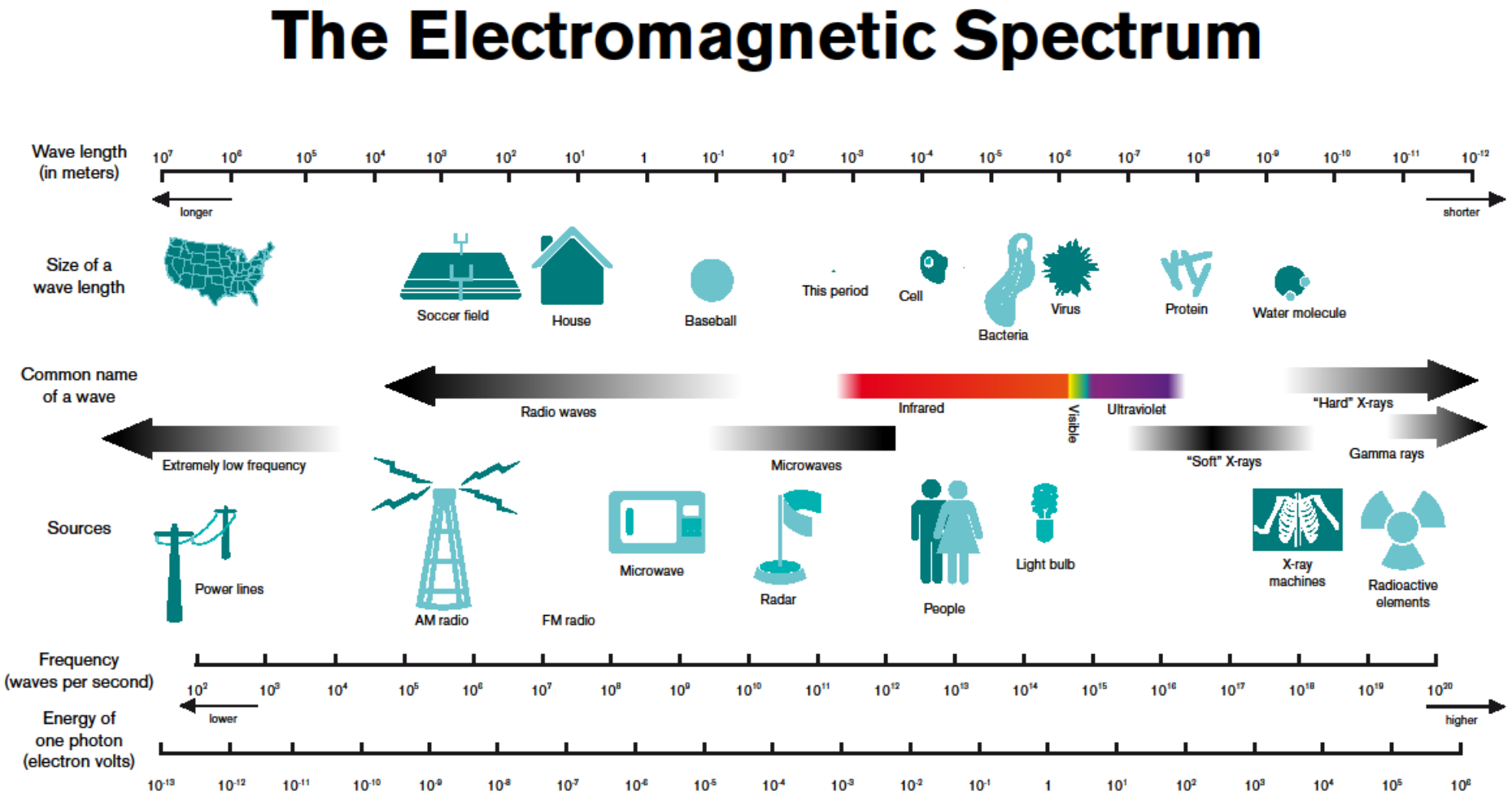
Review of science to-date

- Human studies (epidemionlogy), animal studies (in vivo) and cellular studies (in vivo)

Latest studies and what they tell us

Wrap up

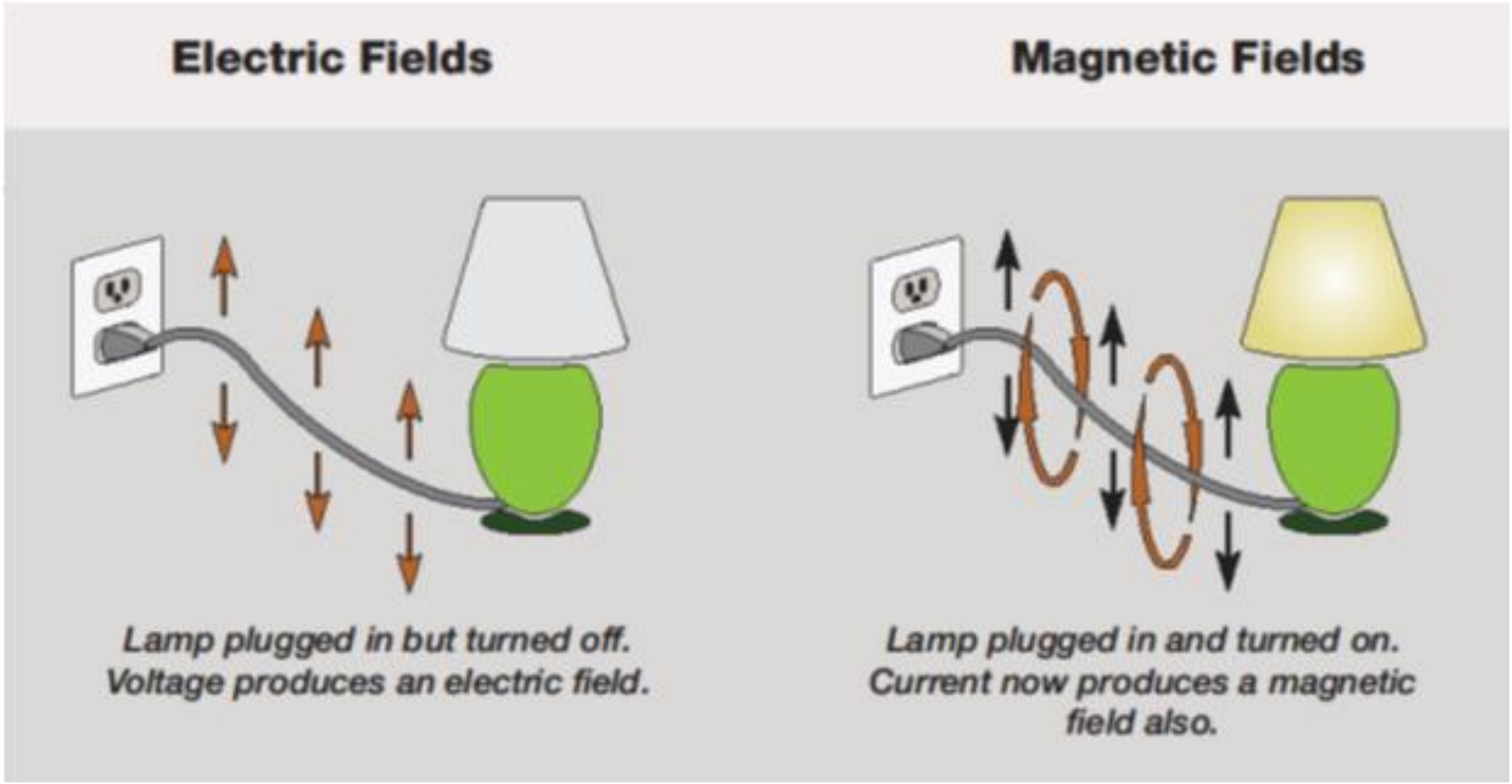
What is EMF?


The Electromagnetic Spectrum
Wave length (in meters)
longer
shorter
Size of a wave length
Soccer field
House
Baseball
This period
Cell
Bacteria
Virus
Protein
Water molecule
Common name of a wave
Radio waves
Infrared
Visible
Ultraviolet
"Hard" X-rays
Extremely low frequency
Microwaves
"Soft" X-rays
Gamma rays
Sources
Power lines
AM radio
FM radio
Microwave
Radar
People
Light bulb
X-ray machines
Radioactive elements
Frequency (waves per second)
lower
higher
Energy of one photon (electron volts)

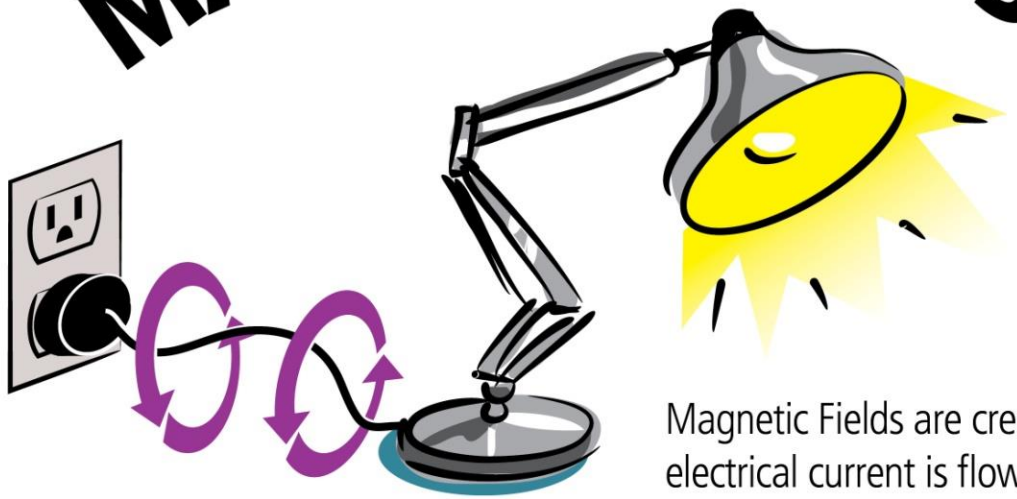
What is EMF?

- EMF refers to two types of fields:
  - Electric fields
  - Magnetic fields

A Comparison of Electric and Magnetic Fields

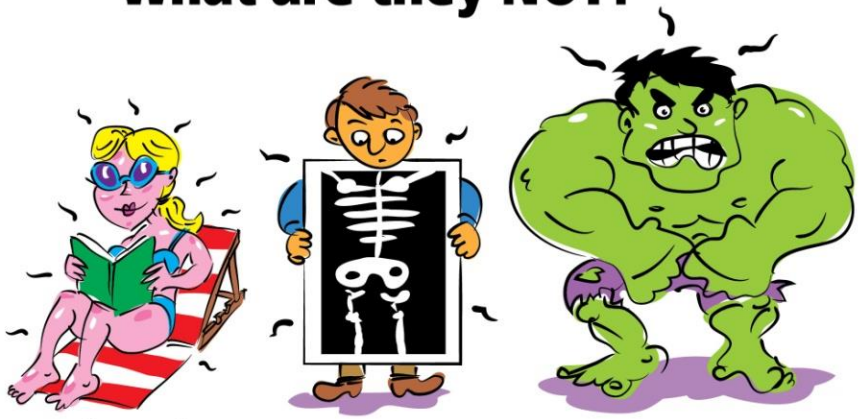


What Are MAGNETIC FIELDS?



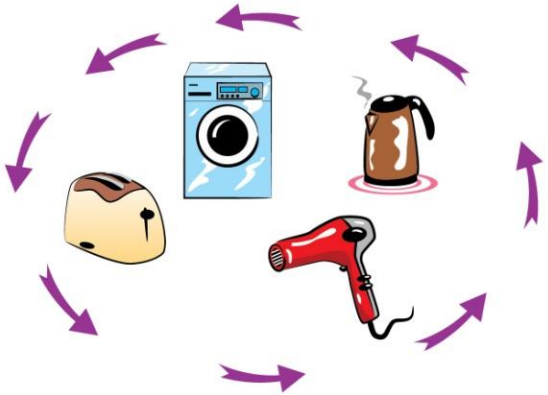
Magnetic Fields are created when electrical current is flowing.

What are they NOT?



Ultraviolet X-Rays Gamma Rays

WHERE are they?



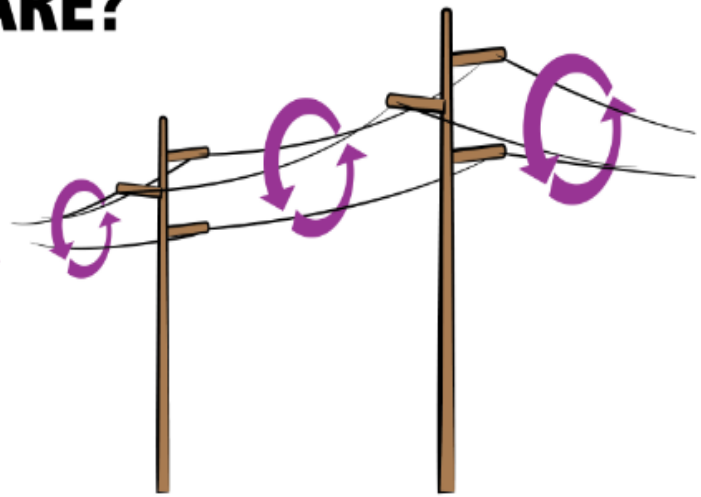
Anywhere electricity is used.

How do they COMPARE?

550 mG, static field

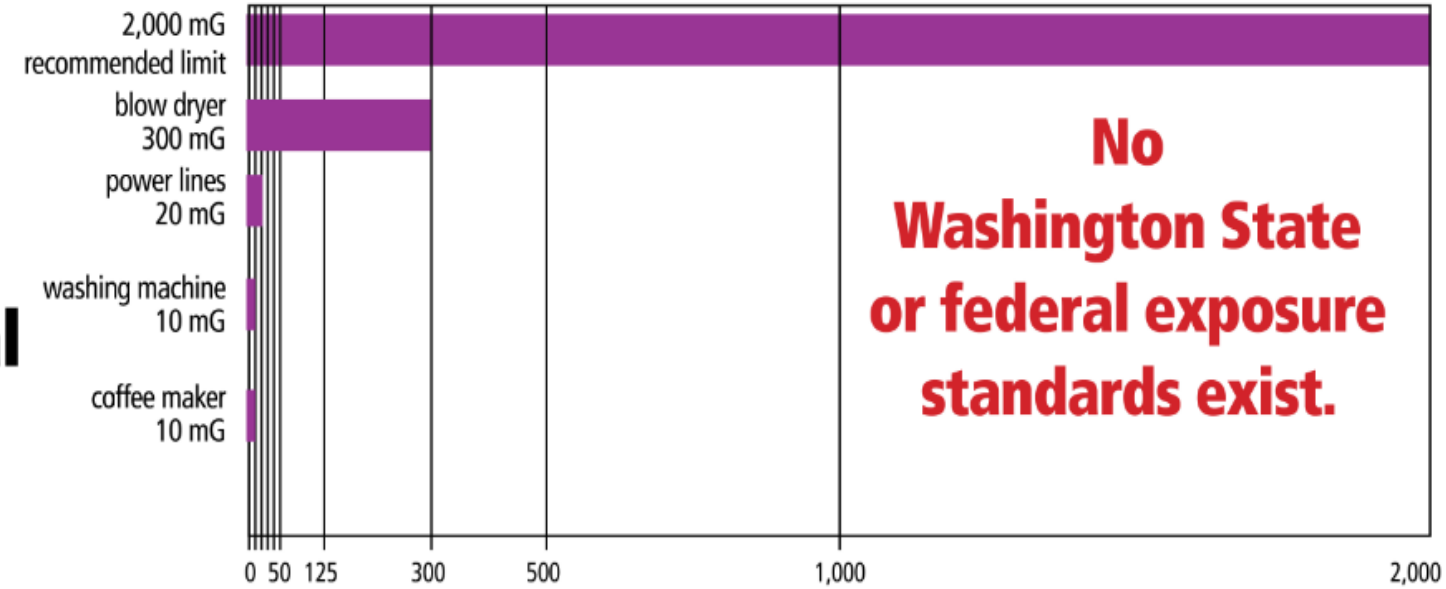
mG = milliGauss

Exposure at 1 ft distance



115 kV Power Line:
at 50 feet the magnetic field is ~6 mG
at 100 feet the magnetic field is ~2.5 mG

How do exposures compare to international guidelines?



No Washington State or federal exposure standards exist.

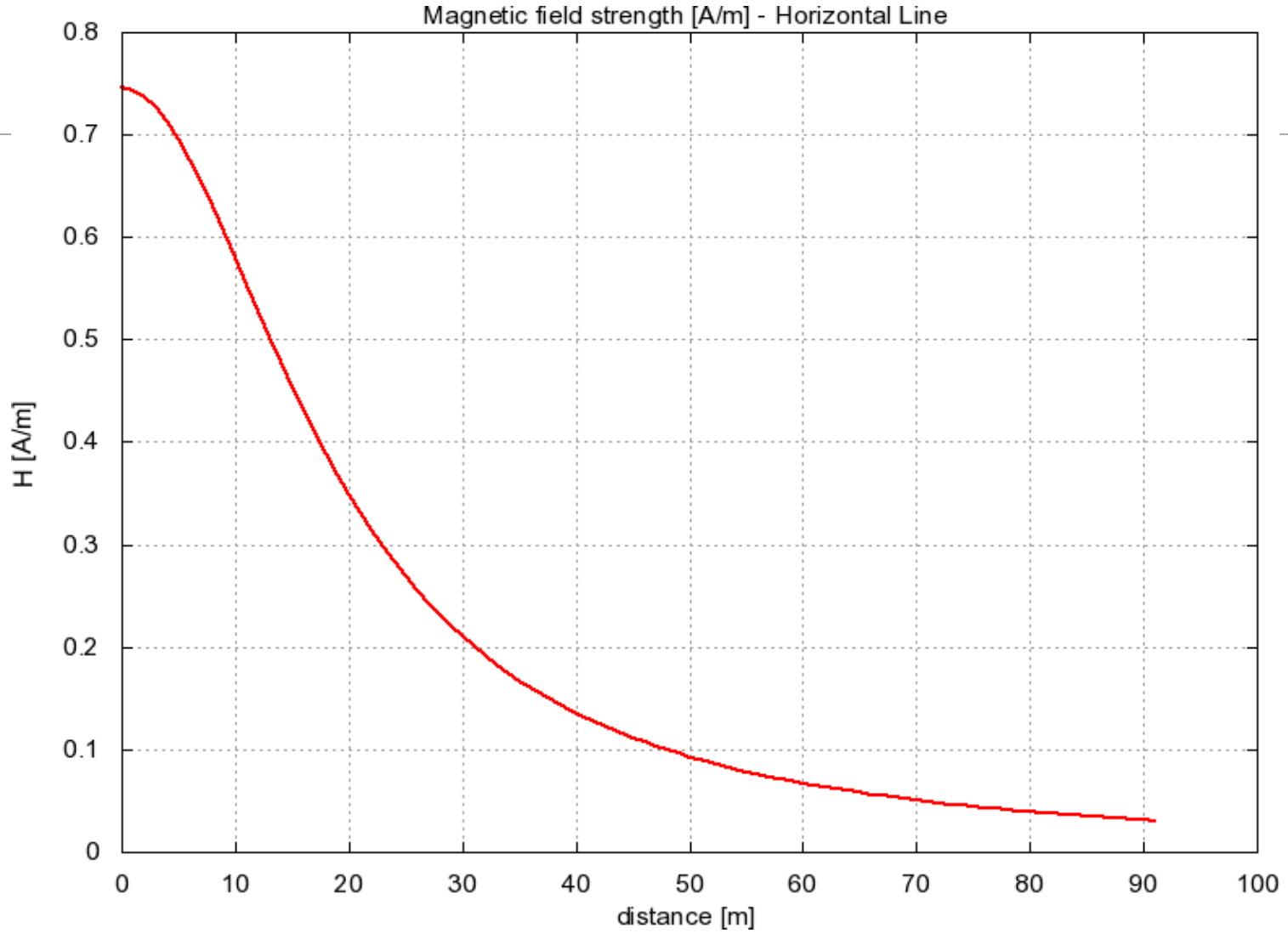
Estimated Magnetic Fields from Overhead and Underground Transmission Lines (mG)

115 kV Transmission Lines, 12.5 kV distribution line	Maximum in ROW	50'	100'	300'
Line Type				
115 kV Overhead Line, single circuit, normal phase 10 Amp; 12.5 kV overhead line, single circuit normal phase 500 Amp	**10.96**	**4.29**	**1.29**	**0.017**
115 kV Overhead Line, single circuit, normal phase 170 Amp; 12.5 kV overhead line, single circuit normal phase 500 Amp	**13.44**	**4.327**	**1.95**	**0.127**
Underground Line, normal operations, concrete encased duct bank	**?**	**<1**	**<1**	**0**
Underground Line, higher 115 kV load, concrete encased duct bank	**?**	**<1**	**<1**	**0**

Note: These values are ballpark estimates

Magnetic Field versus distance from an overhead power line

115 kV line, 55’ elevation, 1” wire diameter



What is considered a safe exposure level?

From ICNIRP for the general public, a whole body magnetic field of 2,000 mG to limit an induced current in the body of ~2 mA/m^2

Since magnetic fields penetrate the body without attenuation we would expect similar findings of effects throughout the body and in different species, which we are not.

Background on EMF Studies

Epidemiology – the study of exposures to humans

Animal and laboratory studies

What does the latest science tell us?

Background on EMF Studies

How it all started….

- A study in 1979 that identified a slight excess risk based on wire code classification.
- Subsequent detailed analysis in the 1990s (Linet 1997), (McBride 1999) provided little support for the association of childhood leukemia and power frequency EMF
- Greenland (2000) pooled analysis from 15 studies identifies an OR of 1.7 for results greater than 3 mG , others with results at 4 mG
- In total, over 35 epidemiological studies have been performed over the years.
- Important to note that this exposure is a time weighted average exposure to an individual, not an instantaneous spot measurement

International Commission on Non-Ionizing Radiation Protection (ICNIRP) Current State of Knowledge

Areas where further research is **not considered necessary**:

- Neurobehavior (brain electrical activity, cognition, sleep and mood, etc) – no substantiated effects below existing guidelines
- Inflammation and the immune system. No evidence for such effects.
- Reproduction and development. Studies do not support the hypothesis that ELF-MF are related to adverse pregnancy outcomes.
- Cardiovascular disorders – convincing null findings.
- Health effects from co-exposure with ELF-MF. Current research reviews show that existing studies lack consistency. ICNIRP does not see merit in further research for developing guidelines
- Breast Cancer

Health Physics Journal 118(5): 533-542; 2020

International Commission on Non-Ionizing Radiation Protection (ICNIRP) Proposed Areas for Research

- Pain perception – further research resulting from strong contact currents
- ALS and Alzheimer's disease – Results are not consistent and it remains unclear whether occasionally observed results are a true association or due to bias in the studies
  - This is related to mechanistic studies regarding pathways for harm from ELF-MF exposures. There is evidence of ELF-MF exposures causing oxidative stress but we have considerable evidence from WHO, SCENIHR and others that the minimum threshold for such effects is at least 1,000 mG
- Childhood Leukemia –
  - Animal studies consistently show no effects when exposed to ELF-MF alone but increases were observed in co-exposure scenarios.
  - There is no supporting data from animal studies and no mechanistic data that can explain effects at these low exposure levels
  - The size of the reported association has been decreasing in recent studies
  - Synoptic analysis (macro view) using all epi studies shows that the observed association is an artifact caused by small numbers and depends entirely on statistical power. When the analysis is pooled the results consistently converge toward a zero risk.

Health Physics Journal 118(5): 533-542; 2020

WHO Summary Statement

"Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields."

Results of Interest

- ELF magnetic fields given before damaging chemical or physical treatment is able to reduce the induced damage.
- Behavioral and cognitive disturbances in animal studies were observed in the 1 mT (10 Gauss) range
- Preventative effect of 0.5 mT (5G) exposure to ELF magnetic fields was observed in an Alzheimer disease (AD) mouse model.

Results of Interest

- Many studies support the use of pulsed static and low frequency magnetic fields to improve bone health through increasing of calcium deposition in bones. (~ 50 Gauss and greater).
- Static and low frequency magnetic fields exert anti-tumor function independent of tumor effects, are effective in promoting the absorption of chemo drugs and or enhance inhibitory effects of regulating apoptosis and cell cycle related proteins.
- Magnetic fields have shown beneficial results in peripheral nerve regeneration, osteo-necrosis, and injury-induced osteoporosis.

Aoshu, X et al, Progressive Study on the Non thermal Effects of Magnetic Field Therapy in Oncology Frontiers in Oncology, 2021; 11:638146

Epidemiological Studies: A Summary

Takeaways from epidemiological studies:

- 60 Hz power frequency magnetic fields have shown a weak but relatively consistent pattern an increase in childhood leukemia for exposures greater than a time weighted average to 3 to 4 mG.
- However, the epi studies are weakened by methodological problems associated with selection and reporting biases. This highlights the need to use laboratory studies to support such claims.
- Epidemiology is like a weathervane that points us in the direction to devote further laboratory research to determine whether the epi finding is supported.

Animal Studies

Why conduct animal studies?

The reason why all almost major scientific review organizations have failed to conclude that the possible risk from exposures and childhood leukemia is real is because animal and cellular studies have consistently failed to demonstrate any reproducible effects that show that magnetic field exposures cause or promote cancer.

Animal and cellular studies had consistently been negative in regard to magnetic field exposures and possible genetic effects with a small caveat.

- We now have rat strains that mimic the leukemia found in humans. The initial study results using these strains have also failed to find an association.

Lab Data and Biological Basis for Effects

More than 1,000 lab studies have been conducted on EMF exposure.

Most studies have used exposures greater than 1,000 mG.

Both cellular and animals have consistently shown a lack of replicated health effects.

Magnetic fields can affect the body through interactions at the cellular level

Minimum magnetic field densities for effects are on the order of the earth's background magnetic field.

How the Evidence Stacks Up for Adverse Health Effects

Weak but somewhat consistent epidemiological data regarding childhood leukemia and magnetic field exposures.

No supporting evidence from animal or cellular studies.

No dose response relationship

No plausible biological mechanism

Arguments Against Carcinogenicity

There has never been a carcinogen known to humans that does not also leave other tell tales signs of an impact.

For example: UV light causes skin cancers but also causes sunburn in short term acute exposures, loss of elasticity, freckles, nevi, fibrous tissue, etc

Conclusions

Over 45 years of research on EMF. EMF is a consequence of using power in our lives

$500 million spent on research in the United States alone

About 2,900 studies conducted to date related to cancer

- Very large amount of scientific knowledge

World Health Organization concluded that:

- “The current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields”

The international public exposure limits:

- 2,000 mG - International Commission on Non-Ionizing Radiation Protection
- 9,040 mG - Institute of Electrical and Electronic Engineers

http://www.who.int/peh-emf/about/WhatisEMF/en/index.html

Questions?

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Next steps and wrap up

Karen Brubeck, PSE

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Next steps

- PSE currently analyzing route options to determine a preliminary preferred route
- Fall: Community Sounding Board meeting
- Anticipated late 2021: Preferred route announcement

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For more information

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