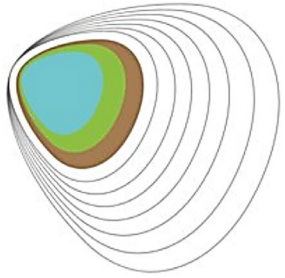
Politechnika Łódzka
Instytut Elektroniki



IV Międzynarodowa Konferencja
Pole elektromagnetyczne
i przyszłość telekomunikacji
Badania. Monitoring. Doświadczenia krajowe i zagraniczne.

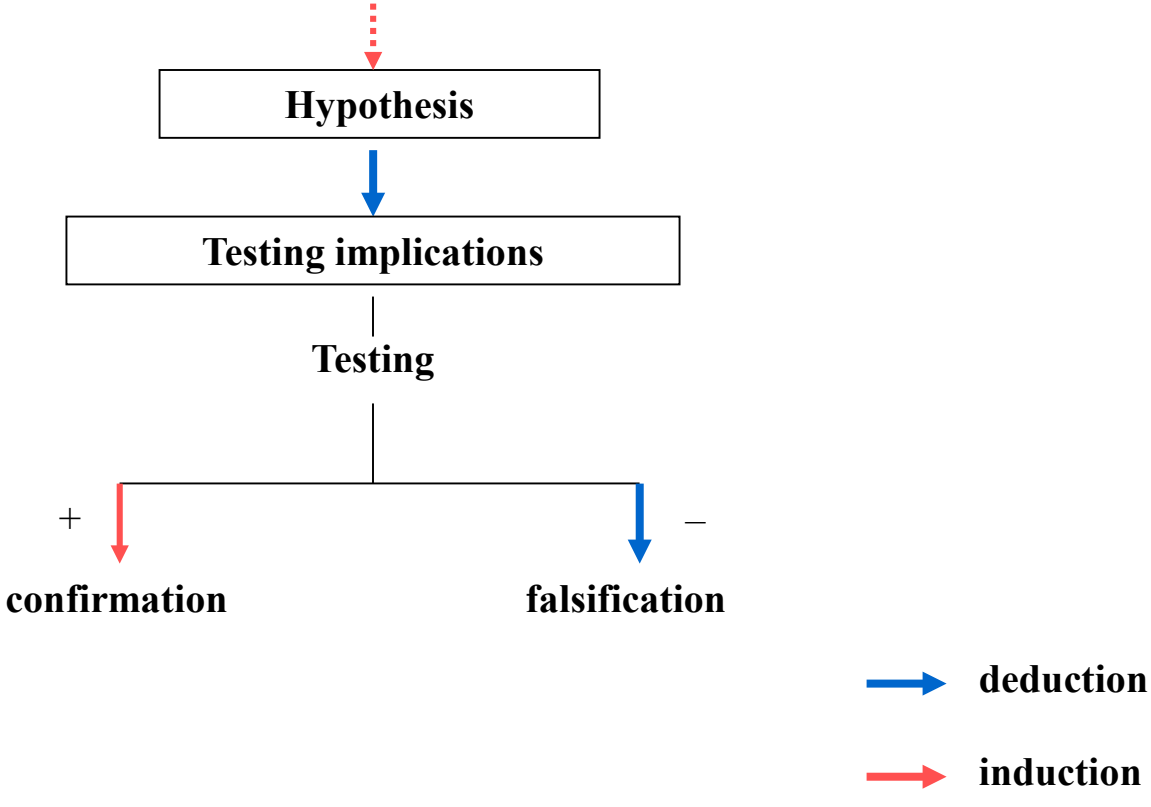
Can We Prove that Electromagnetic Fields Do Not Affect Our Health

Sławomir Hausman

4 December 2019

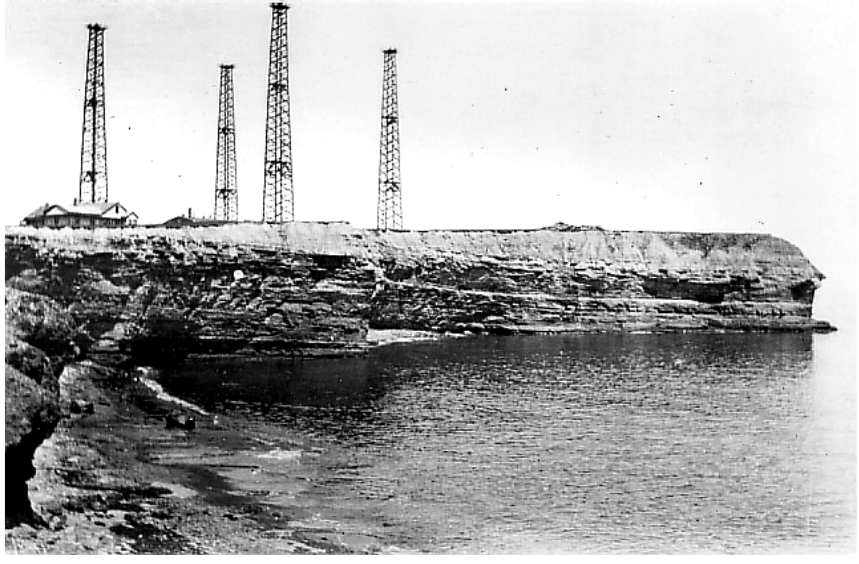
„Even if there is no evidence that weak electromagnetic fields can be harmful, we have to be sure that they are not”

Scientific knowledge, induction and deduction

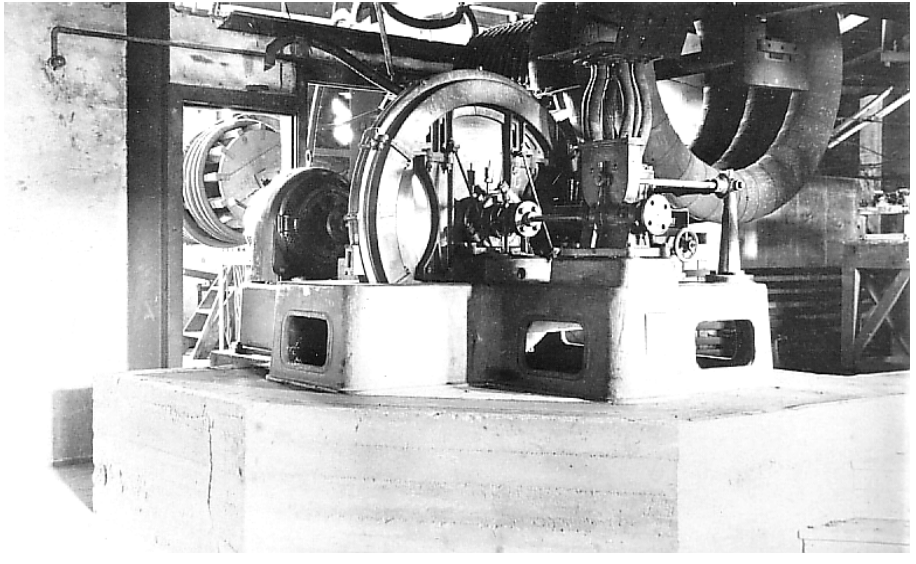


We have been immersed in human-made radio waves for more than a hundred years…

First Transatlantic wireless message (Marconi - 1901)

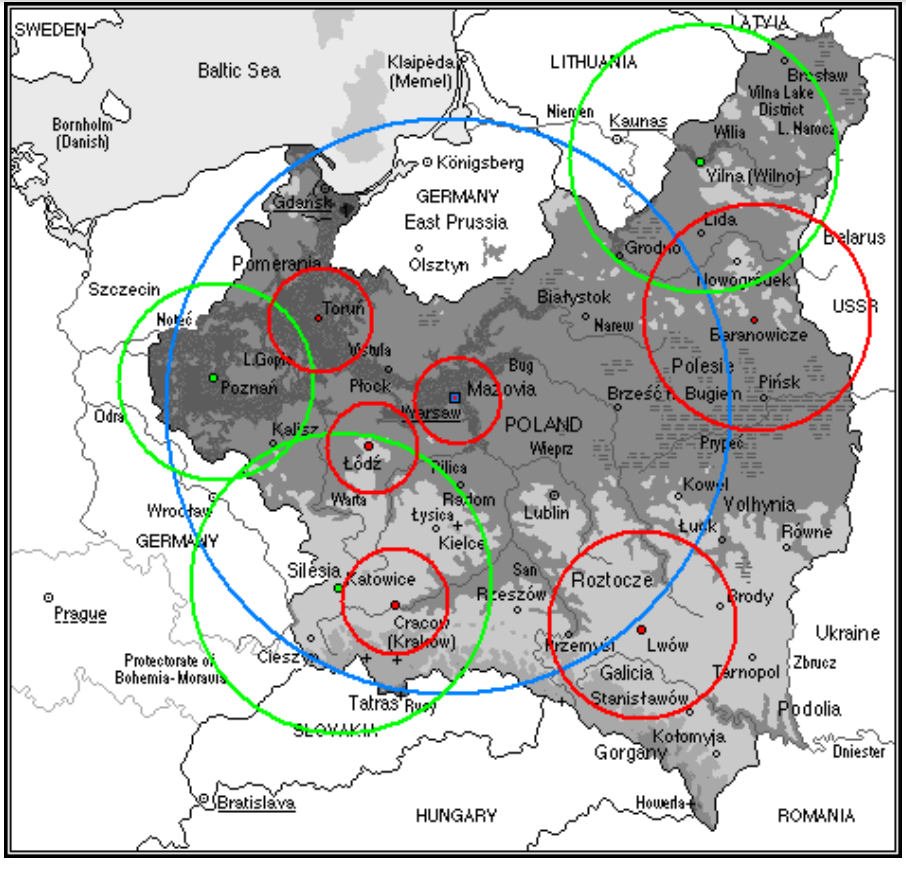


Cornwall, England



Glace Bay, Nova Scotia, Canada

Polish radio broadcasting network in 1939 r



Transmit power in the order of kW

Antena in Gąbin (height of 646 meters) was the tallest construction in the years 1974–1991. Transmit power of 2 MW.

https://commons.wikimedia.org/wiki/File:Rozgłośnie_Polskiego_Radia_1939.PNG

Base stations are all around us

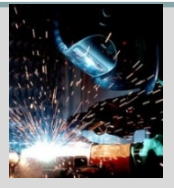
There are several thousands of base stations in a country the size of Poland some of them covert.

EMF sources around us

- Magnetic Resonance Imaging machines
- Medical diathermy, electrosurgery

- Microwave ovens

- Induction heaters
- Electric-arc furnaces, welders

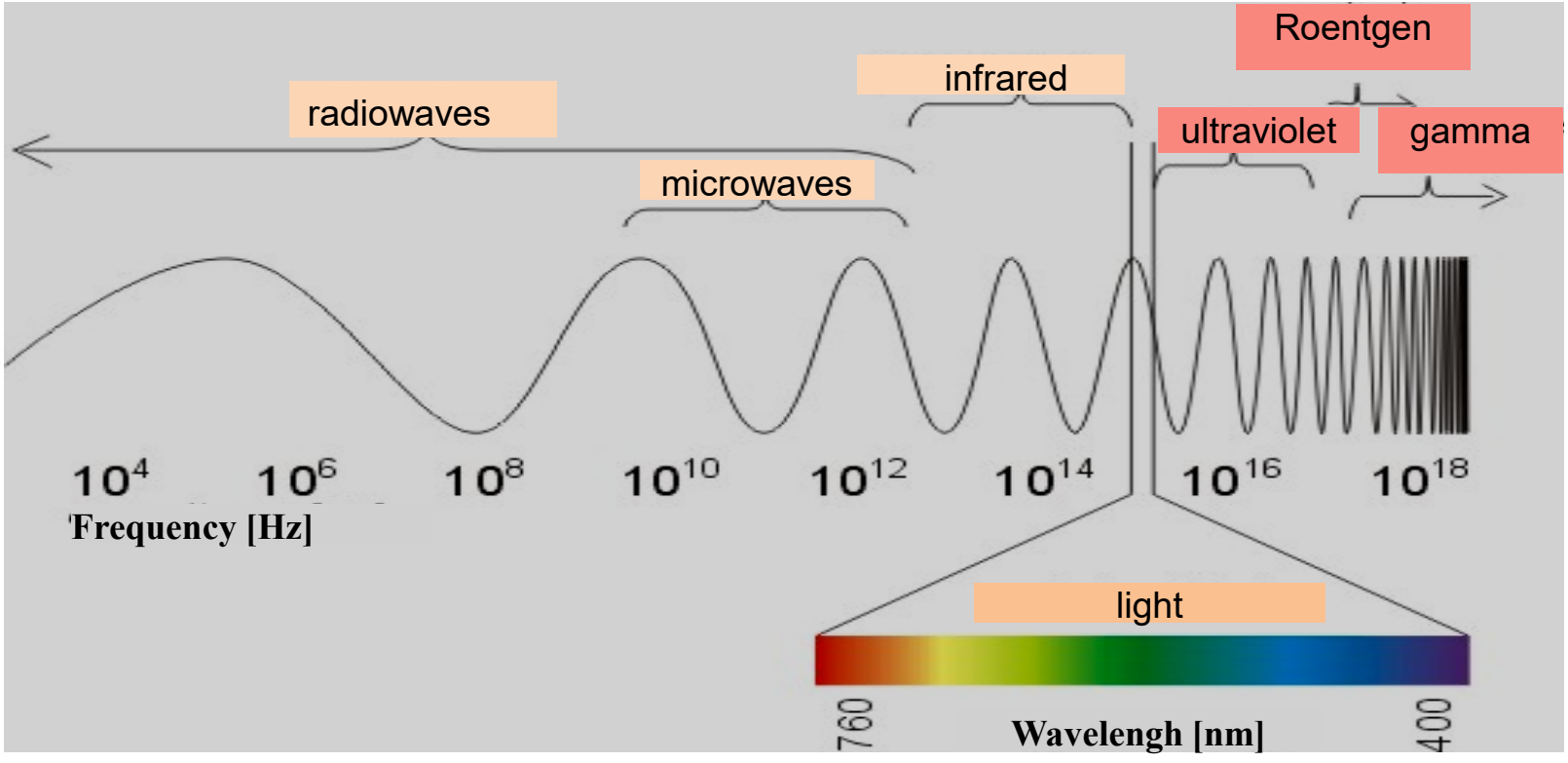


- Electrical grid, overhead power lines

- **Wireless communication systems**

- Electric vehicles

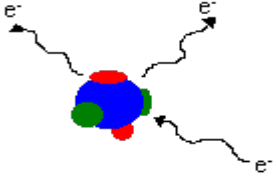
Electromagnetic spectrum



International Telecommunication Union w 1947 r. proposed the upper limit for radiowave frequency as 3 000 GHz.

Ionizing vs. non-ionizing radiation

Ionizing radiation is radiation that carries enough energy to knock electrons from atoms or molecules, thereby ionizing them.



<u>Radio waves are non-ionizing</u>.

Concern among the general public

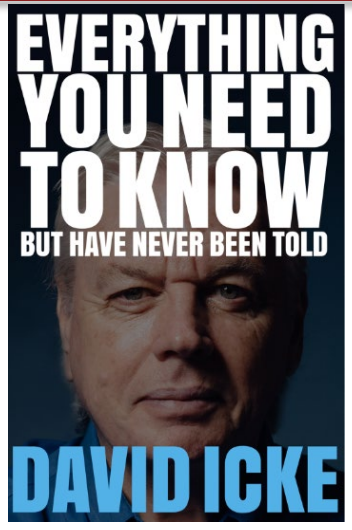
Concern among the general public

Concern among the general public

The town facing a 'humanitarian crisis' caused by the radiation from state-of-the-art street lamps: Residents have endured insomnia, nose bleeds and even stillbirths, scientist claim.

https://www.davidicke.com/article/468417/town-facing-humanitarian-crisis-caused-radiation-state-art-street-lamps-residents-endured-insomnia-nose-bleeds-even-stillbirths-scientist-claims

Concern among the general public



The AMA (The American Medical Association) made note of this in their warning, citing numerous studies that have linked bright light to reduced sleep, poor sleep quality and impaired function during waking hours. The warning also noted several studies which indicated that **cancer, diabetes, cardiovascular disease and obesity** risks could be increased by exposure to high-intensity light at night.

https://www.davidicke.com/article/468417/town-facing-humanitarian-crisis-caused-radiation-state-art-street-lamps-residents-endured-insomnia-nose-bleeds-even-stillbirths-scientist-claims

Research

World organizations investigating EMF safety

- International Telecommunication Union (**ITU**),
- World Health Organization (**WHO**),
- International Commission on Non-Ionizing Radiation Protection (**ICNIRP**)
- International Agency For Research On Cancer (**IARC**),
- EU Scientific Committee on Emerging and Newly Identified Health Risks (**SCENIHR**),

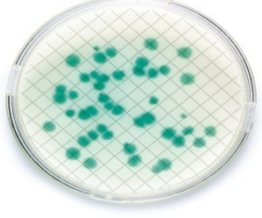
Research objects

– People – adults and children

– Animals (mice, rats, drosophila, …)

– Plants

– Tissue cultures (e.g. in vitro)



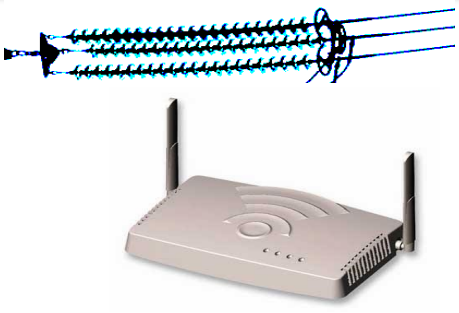
Investigated effects

- **Cognitive performance** (memory, concentration capacity, task solving capacity, place and time orientation, etc.)
- **Laboratory tests** (blood, cerebrospinal fluid, tissue sections)
- Various **diagnostic examination techniques**: MRI, ECG, EEG, …
- **Epidemiological studies** (tumors, cancer Parkinson's and Alzheimer's desease)

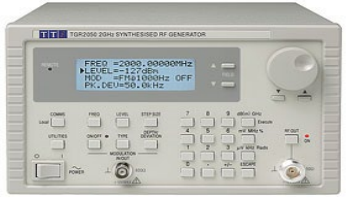
flavor.monell.org

EMF sources

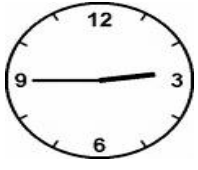
- **Environmental** (at work, at home): radio communication systems and devices, power lines



- **Laboratory generated**: various frequency bands, various field stregths, continuous or modulated

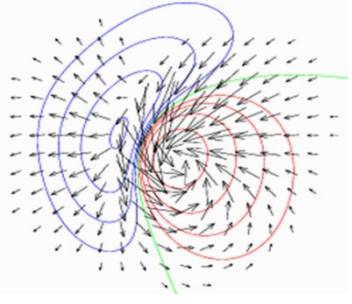


- **Exposition duration**: short-term, long term



Effect types

– **Thermal effects** –primary health effects when living tissue absorbs enough EMF power to cause heating.



– **Non-thermal efects** – without heating or independent of heating.

Most biochemical and physiological responses are temperature-dependent.

Example study methods

- Sixty healthy female medical school students aged 18–25 years were divided into a low exposure group (30 subjects, <30 min daily use by the head) and high exposure group (30 subjects, >90 min daily use by the head).
- Magnetic resonance spectroscopy (MRS) was used to examine the brain by detecting the levels of some metabolites related to neuronal and glial conditions.
- Analysis of the spectroscopic results revealed no significant difference in specific metabolites between the groups.

Omur Gulsum Deniza et al. „Effects of short and long term electromagnetic fields exposure on the human hippocampus”, Journal of Microscopy and Ultrastructure, 5 (2017) 191–197

Example study methods

- Magnetic resonance imaging (MRI) was used for volumetric measurements of the hippocampus.
- No significant difference was determined between the groups in terms of hippocampal volumes.
- Because people tend to hold phones next to the side of the head that corresponds to their dominant hand, the right-side hippocampus was evaluated on images from right-handed medical students, and the left hippocampus on images from left-handed medical students.
- Prolonged use of mobile phones found no impact on memory tasks.

Omur Gulsum Deniza et al. „Effects of short and long term electromagnetic fields exposure on the human hippocampus”, Journal of Microscopy and Ultrastructure, 5 (2017) 191–197

International Agency For Research on Cancer report (2011)

The IARC considered hundreds of scientific articles has classified radiofrequency electromagnetic fields as possibly carcinogenic to humans (Group **2B**).

The evidence was reviewed critically, and overall evaluated as being limited or inadequate among users of wireless telephones. The evidence from the occupational and environmental exposures mentioned above was judged inadequate.

Group **2B** is used for agents, mixtures and exposure circumstances for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence of carcinogenicity in experimental animals.

Coffee was also classified as **2B** which has been re-evaluated recently.

Correlation between variables does not mean cause and effect relationship!

Recent research results

Two recent animal studies investigating the carcinogenic potential of long-term exposure to radiofrequency electromagnetic fields (EMFs) associated with mobile phones have been released: one by the U.S. National Toxicology Program (NTP 2018a, b) and the other from the Ramazzini Institute (Falcioni et al. 2018).

Istituto Ramazzini
COOPERATIVA SOCIALE ONLUS

National Toxicology Program
U.S. Department of Health and Human Services

ICNIRP NOTE ON RECENT ANIMAL CARCINOGENESIS STUDIES, Munich, Germany, 04.09.2018

Recent research results

Although the NTP (2018a, b) and Falcioni et al. (2018) studies used large numbers of animals, best laboratory practice, and exposed animals for the whole of their lives, consideration of their findings does not provide evidence that radiofrequency EMF is carcinogenic. NTP reported that their strongest findings were of increased malignant cardiac schwannoma in male rats, however that is not consistent with the results of Falcioni et al. (2018), is not consistent with the NTP female rat nor male or female mouse results, and is not consistent with the radiofrequency EMF cancer literature more generally.

ICNIRP NOTE ON RECENT ANIMAL CARCINOGENESIS STUDIES, Munich, Germany, 04.09.2018

Risk level example

City of Łódź, Poland

- Population: ~ 700 000
- Newly diagnosed cancers ~ 2000/year
- Newly diagnosed intracranial canc. ~ 30/year
- Applying NTP results we could attribute 1 in males and 0 in females out of 30 to the influence of RF EMFs.
- Killed or injured in road accidents ~ 700/year

Radio waves save life

Radio waves save life

VitalPatch - mobile cardiac telemetry

VitalPatch®

- Single-Lead ECG
- Heart Rate
- RR Interval
- Respiratory Rate
- Skin Temperature
- Body Posture
- Fall Detection
- Activity including Steps

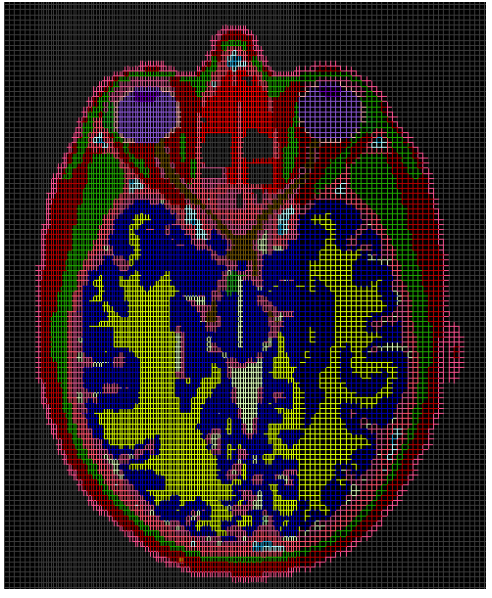
- Battery life 96h
- Bluetooth

http://www.medibiosense.com/vitalpatch/

EMFs in 5G

Simulation of radiowave penetration in the human body

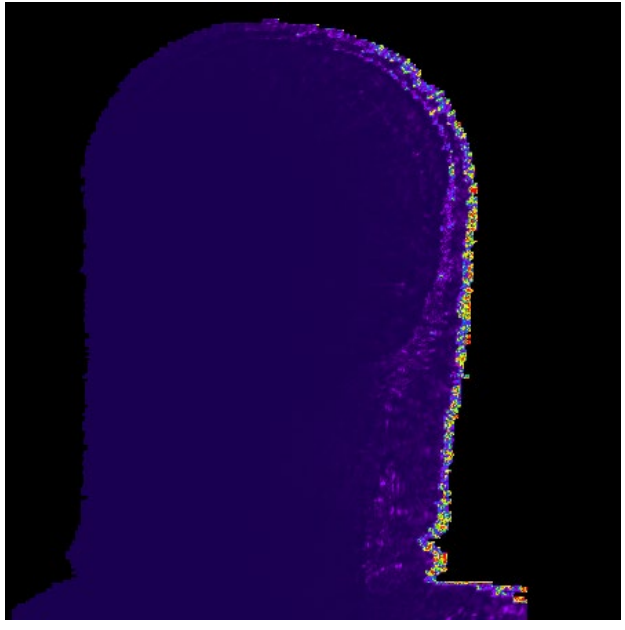
- Finite-Difference Time-Domain (FDTD) computational electromagnetics method recommended by IEEE *
- Local temperature rise can be calculated considering many factors, including
  - skin blood flow rate,
  - models for vasodilation,
  - sweating,
  - clothing, etc.



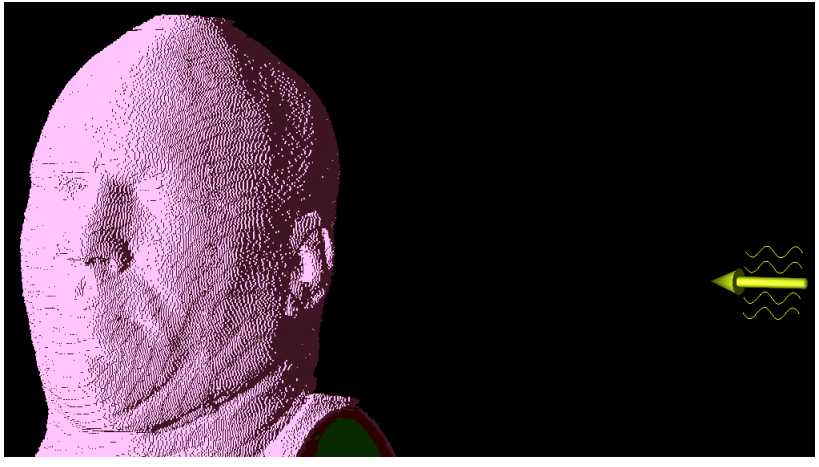
Multi-tissue human head model cross-section

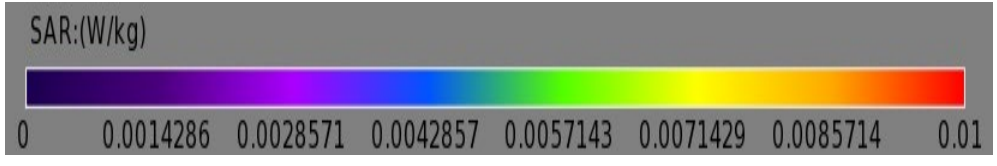
*IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields,100 kHz-300 GHz," in *IEEE Std C95.3-2002 (Revision of IEEE Std C95.3-1991)* , vol., no., pp.i-126, 2002

SAR simulation at 28 GHz



Plane wave E=10 V/m, 28 GHz





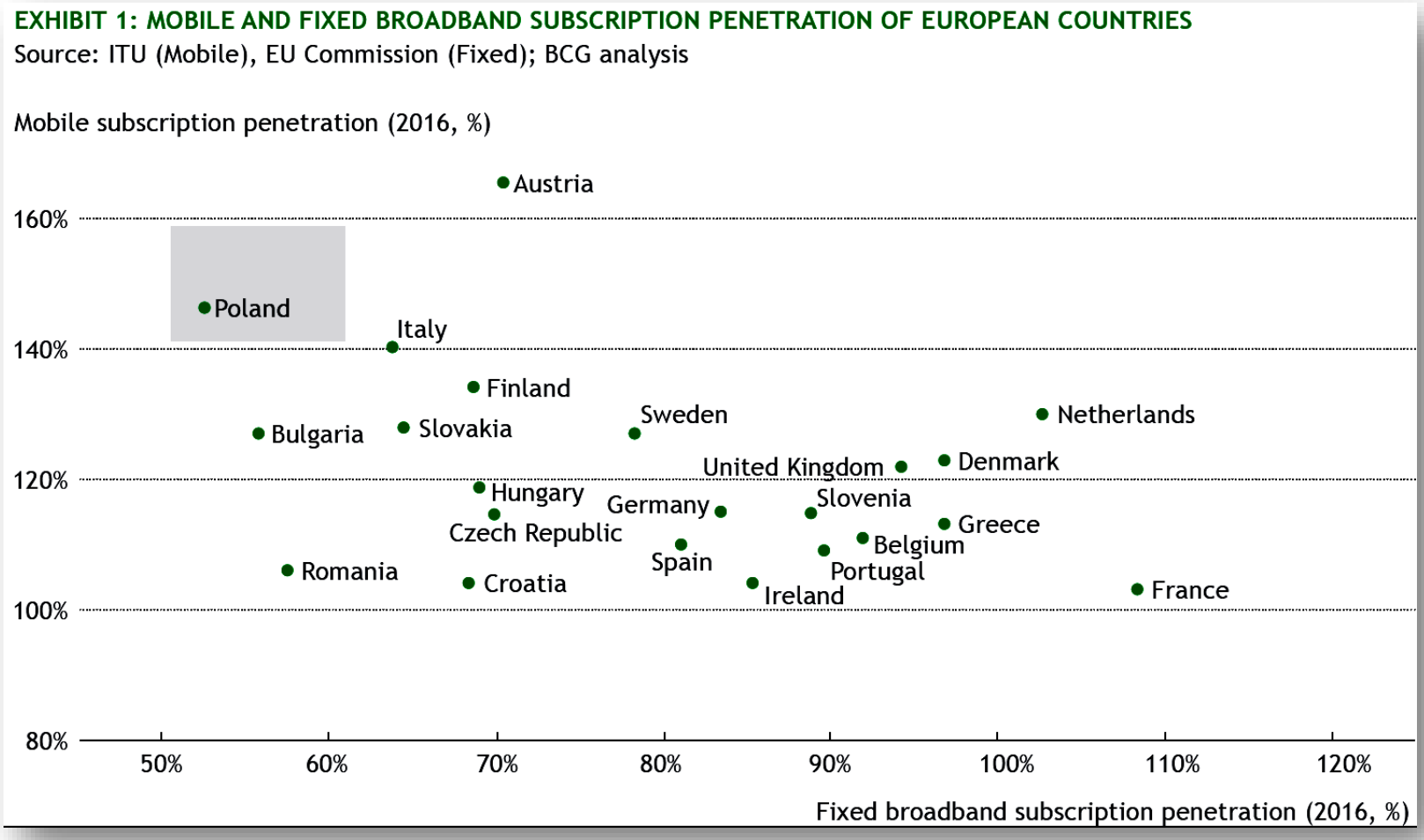
Based on: Ł. Januszkiewicz, *Ekspozycja od urządzeń 5G i Internetu rzeczy - wybrane zagadnienia symulacyjne,* PEM 2017

Do we need 5G in Poland?

Do we need 5G in Poland?

BCG
THE BOSTON CONSULTING GROUP

Effects of the Polish Power Density Limits (PDL) in Wireless Communication: Poland Risks Falling behind in the Evolution to 5G?, The Boston Consulting Group, 2018



Effects of the Polish Power Density Limits (PDL) in Wireless Communication: Poland Risks Falling behind in the Evolution to 5G?, The Boston Consulting Group, 2018

Do we need 5G in Poland?

- Poland has one of the lowest 4G speed in Europe
- Fixed broadband subscription penetration is low
- The future 5G mobile technology can fuel the economic development and create jobs in Poland

- Poland has the lowest power density limits in Europe
  0.1 W/m^2

Effects of the Polish Power Density Limits (PDL) in Wireless Communication: Poland Risks Falling behind in the Evolution to 5G?, The Boston Consulting Group, 2018

Power density limits can restrict 5G in Poland

- The capital expenditure of Polish mobile operators is in-line with European average, so Polish mobile operators are not ‘under-investing’ into their networks
- The strict power density limits in Poland negatively affect:
  - effective use of spectrum,
  - technology (determining the spectral efficiency),
  - network topology (number of sites and sectors).

Effects of the Polish Power Density Limits (PDL) in Wireless Communication: Poland Risks Falling behind in the Evolution to 5G?, The Boston Consulting Group, 2018

Summary

Summary (1)

- For more than a hundred years, we have been immersed in radio waves made by human beings. At the same time life expectancy has been constantly increasing.
- Some people are concerned that radio waves from mobile phones and base stations may cause health problems and this concern must be addressed.
- A substantial number of scientific studies conducted by various research bodies have indicated that EMF, at levels limited by offical safety standards and recommendations, cause no adverse effects to human health.
- Research results are available in the open scientific literature.

Summary (2)

- WHO have reviewed the total amount of research and have consistently concluded that the balance of evidence does not demonstrate any health effects associated with radio wave exposure from either mobile phones or radio base stations.
- 5G equipment will comply with established radio wave exposure limits.
- The future 5G mobile technology can fuel the economic development, create jobs and enable development of e-health in Poland (and elswhere) and if EMF levels recommended by ICNIRP are assumed.

Summary (3)