



# ELECTRO MAGNETIC FIELDS (EMF): CLEARING UP THIS NATURAL PHENOMENA

## GOAL OF DOCUMENT

Unfortunately in this last period, there were (as usual) some misleading information coming from Tecniplast competitors who are trying to generate fear and worries on already commonly used technologies that will help to revolutionize this industry. The way they are pushing is to generate confusion on electromagnetic fields concepts and try to establish doubts on technologies that might use them.

Goal of this document is to directly talk about EMF and the technology we are going to utilize in order to clear up the real situation and allow the final customer to make the right choice.

## BASIC CONCEPTS

Non-Ionizing radiation (NIR) refers to radiative energy that, instead of producing charged ions when passing through matter, has sufficient energy only for excitation. Nevertheless it is known to cause biological effects. The NIR spectrum is divided into two main regions:

1) Optical radiations.

2) Electromagnetic fields (EMF).

The optical can be further subdivided into ultraviolet, visible, and infrared.

The electromagnetic fields are further divided into radiofrequency (microwave, very high frequency and low frequency radio wave).

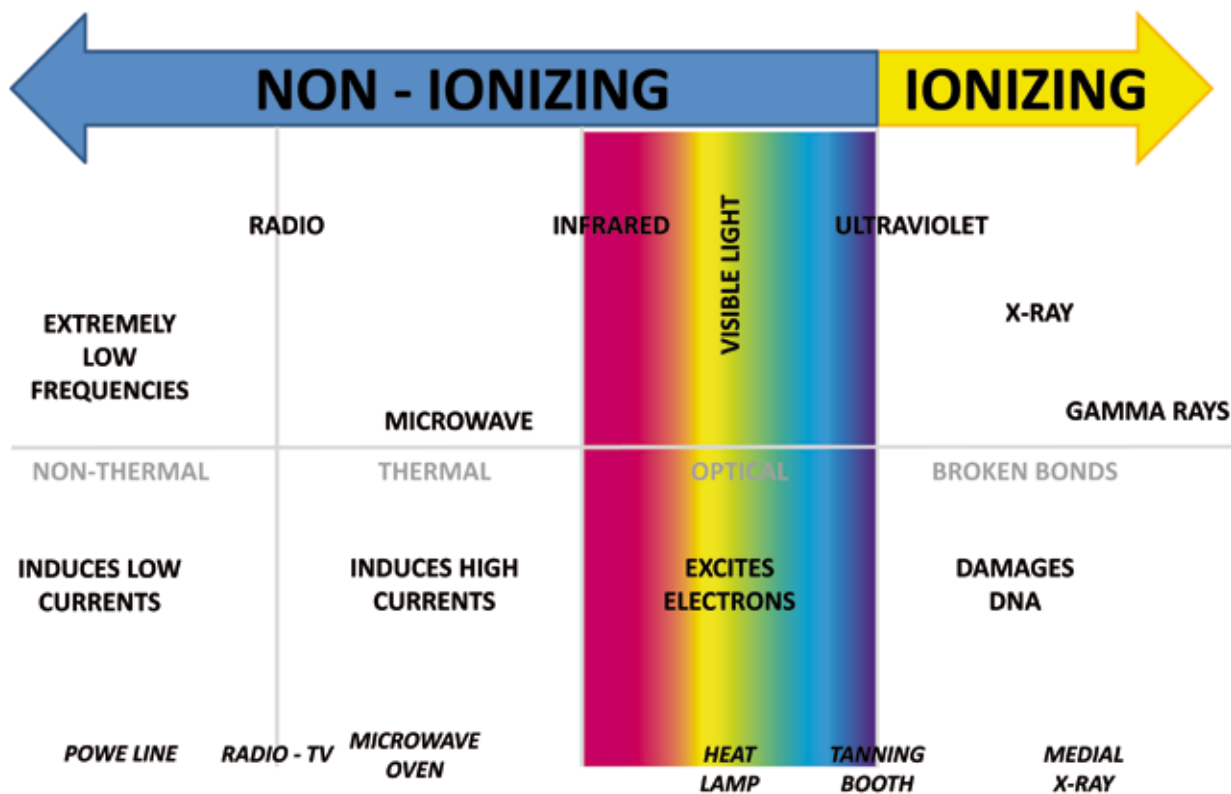


Figure 1

Non-Ionizing radiation originates from various sources: Natural origin (such as sunlight or lightning discharges etc.) and man-made (wireless communications, industrial, scientific and medical applications).

**We are all commonly and daily exposed to various types of NIR.**

Just as brief examples (Table 1):

Source	Typical maximum public exposure	
	Electric field (V/m)	Magnetic flux density (μT)
Natural fields	200	70 (Earth's magnetic field)
Mains power (in homes not close to power lines)	100	0.2
Mains power (beneath large power lines)	10000	20
Electric trains and trams	300	50
TV and computer screens (at operator position)	10	0.7

V/m = Volt per meter the Electric Field unit of measure

μT = micro Tesla (10<sup>-6</sup> Tesla or 1 millionth Tesla). Tesla is unit of measure of the magnetic flux intensity.

## EMF EXPOSURE STUDIES<sup>1</sup>

There are a quantity of studies with standardized protocols, conducted under the auspices of official organizations (e.g. The National Toxicology in the USA, the Institute of Engineering and Technology), exposing hundreds if not thousands of animals (wild type or genetically modified ones) to EMF throughout their lifetime.

These tests and experiments have been reviewed by Official Organizations, such as the World Health Organization, in their Environmental health criteria.

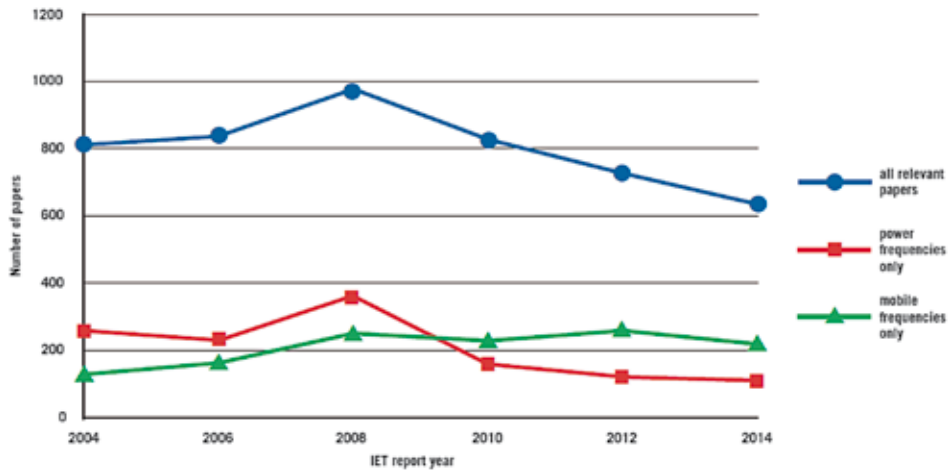


Figure 2: Trend in EMF Biological Effect publications

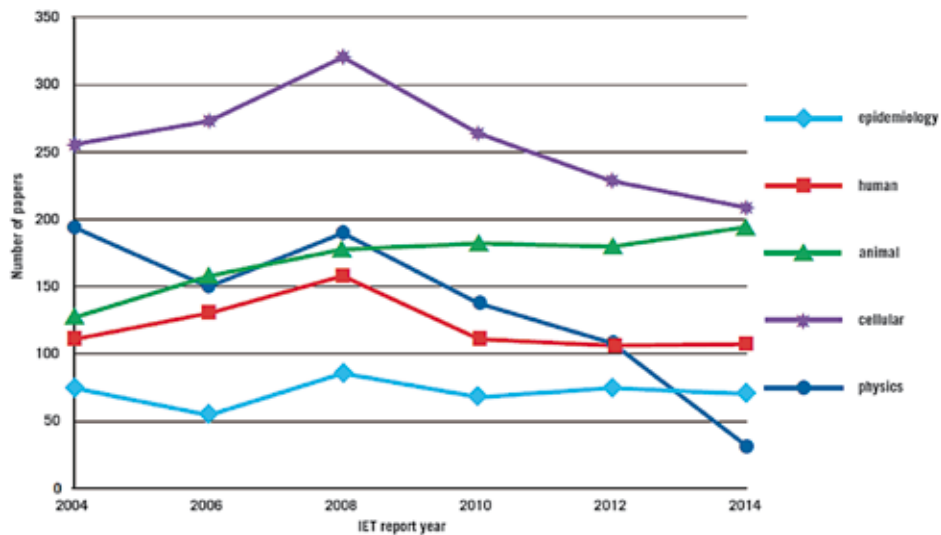


Figure 3: Paper numbers by subject

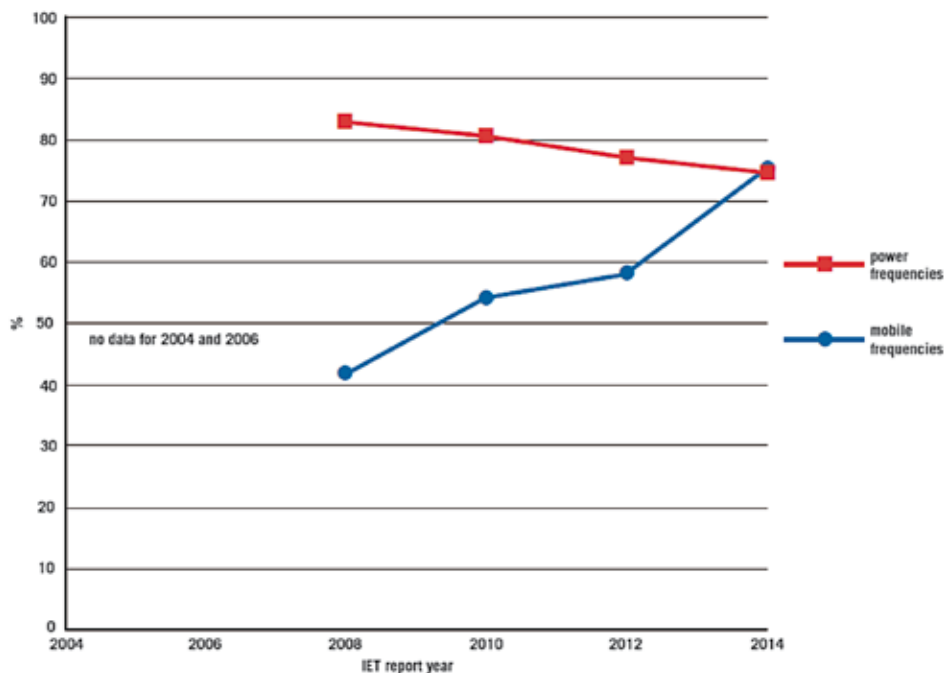


Figure 4: Percentage of papers reporting any EMF effect

<sup>1</sup>IET STATEMENT: "Are there harmful Biological Effects of LowLevel Electromagnetic Fields at frequencies up to 300 GHz?"

## **EPIDEMIOLOGICAL STUDIES<sup>2</sup>**

Over the past two decades, the possible relationship between exposure to power frequency (50 and 60 Hz) electromagnetic fields (EMF) and adverse human health outcomes has received significant attention in both the scientific community and the general population. Based on widely circulated accounts in the popular press, and on mass media reports of the results of selected epidemiologic investigations, a public perception has developed that human exposure to EMF may be associated with a range of adverse health effects, including reproductive dysfunction, developmental abnormalities, and cancer [...].

Although individual epidemiologic studies provide suggestive evidence of the potential oncogenicity of EMF, the total body of epidemiologic data linking EMF exposure and cancer risk is by no means conclusive. Since 1990, more than 50 epidemiologic studies designed to investigate the possible association between occupational or residential exposure to magnetic fields and cancer risk have been published. The methods used in these more recent studies are often substantially improved in comparison to methods used in earlier investigations; specific areas of improvement include the use of larger sample sizes and better exposure assessment. However, despite these improvements in epidemiologic methods, **EMF cancer epidemiologic studies continue to generate both positive and negative results. When considered together, the results of these studies are insufficient to either support or refute the hypothesis that exposure to EMF is a significant risk factor for human cancer.**

## **EMF ON ANIMAL STUDIES<sup>2</sup>**

In situations where epidemiology does not support the conclusive identification and quantitation of the potential risks associated with exposure to an environmental agent, laboratory studies conducted in appropriate experimental model systems increase in importance. Well-designed and controlled animal studies permit evaluation of biological effects in vivo under tightly controlled exposure and environmental conditions, and in the absence of potential confounding variables. In consideration of the conflicting results of EMF epidemiologic studies, and difficulties associated with exposure assessment in such studies, animal studies may provide the best opportunity to identify effects of EMF exposure that could translate into human health hazards.

The results of acute, subchronic, and chronic toxicity and oncogenicity studies conducted in experimental animal model systems provide little support for the hypothesis that exposure to power frequency magnetic fields is a significant risk factor for human disease. Although positive results have been reported in a small number of animal studies, essentially all of those results either:

- (a) Have not been replicated in subsequent studies conducted in other laboratories.
- (b) Were generated using nontraditional experimental models whose value as predictors of human responses is largely or completely unknown.

## **CONCLUSIONS**

EMF is all around us in many different Non-Ionizing radiation forms. These include both optical irradiation (nonthermal or thermal) and Electromagnetic Fields (EMF). The Trend in EMF biological publications peaked in 2008 related to funding for these projects.

There is an ongoing support and interest in animal studies with better definition and study designs and controls, and more papers on cellular effects than power effects as most of the power frequency magnetic fields as a significant risk factor have little support.

<sup>2</sup>McCormick (2006) - *ELF in Animal Model Systems*.

## DVC™ PLATE OFFICIAL VALUES

The revolutionary DVC™ system is based on proximity sensor technology that applies the same principles commonly used in Tablet devices.



DVC™ generates **MICRO EMF (Electro Magnetic Fields)** that are **only detectable** by professional antennas specifically designed to perform an EMF exposure assessment.

Results from an independent EMC Certification Company during the analysis of the DVC™ while in use on a Tecniplast Rack, showed that the EMF Fields generated are negligible compared to other sources of EMF commonly found in many Animal Rooms. An EMF exposure assessment on our DVC™ rack, in a specific animal room, were compared to the guidelines of ICNIRP (International Commission on NonIonizing Radiation Protection, an independent organization). The results are presented in Table 2 below:

Potential EMF Exposure in GM500 IVC Cages Fitted with DVC					
EMF STRENGTH r.m.s. [V/m]	Values detected within the GM500 cage AHU operating	Values detected within the GM500 cage with DVC™	Values detected within the GM500 cage with DVC™ and Changing Station at 2m distance	Values detected directly under the Changing Station	ICNIRP Reference levels for general public exposure [V/m]
5Hz - 100Hz	0.63	2.24	3.12	62.0	From 5000 to 2500
100Hz - 1KHz	0.15	0.7	0.8	3.90	From 2500 to 250
1KHz - 100KHz	0.25	0.46	0.42	2.40	From 250 to 8.3
100KHz - 3GHz	1.73	1.51	1.69	na	8.3

The detected magnetic field values into the spectrum are extremely low and comparable to the sensitivity of the EMF Testing equipment used to perform the analysis (completely overlapping with background magnetic field noise of the room). Copy of original report available on request.

## COMPETITOR MISLEADING INFORMATION

Looking back at the misleading list of references published by our competitor and comparing these values with the ones used in the experiments, it is immediately clear that we are absolutely comparing different values of EMF intensity (several orders of magnitude, from thousand to billions).

Many cited experiments only refer to the magnetic fields in the ELF range and the DVC™ does not add anything extra to the environmental conditions.

Some other cited experiments refer to mobile communications (900MHz, 1800MHz) and microwave range (from 300MHz to 300GHz).

Moreover, in general, these cited experiments come from "questionable" sources (for instance Pakistan Journal of Biological Science, Iraqi Journal of Veterinary Sciences, etc.).

The complete list of all the all the cited documents and their analysis is available on request.

## CONCLUSIONS<sup>3</sup>

Several experiments have been performed with normal mice and rats, several more with animals genetically modified to make them more sensitive, and even more looking for combined effects of EMFs and other agents. These experiments have failed to find effects on cancer. This is a strong piece of evidence against EMFs causing cancer, but it is not conclusive.

Literally hundreds, probably thousands, of experiments have been performed "in vitro" that is, looking for effects of EMFs on cells or tissues. Many of these studies have reported positive findings. But when other scientists have tried to replicate these results, they have usually been unable to do so. Some scientists are not particularly bothered by this failure to replicate results.

They believe the results could be dependent on very specific circumstances, and the replication did not reproduce exactly those circumstances. But many scientists, and in particular the authoritative scientific review groups, look at the totality of the results and see a failure to produce any robust, replicable result. Further, the continued failure to replicate reported results makes scientists, quite properly, more skeptical each time a new finding is reported.

A summary of studies which confirms the above conclusions (Table 3):

Animal model	field	Exposure	Result	Reference
<b>Large-scale lifetime studies</b>				
Male and female mice	60 Hz 2 $\mu$ T - 1 mT continuous and intermittent	2 years	No effect on incidence of most tumours	McCormick et al 1999
Male and female rats	50 Hz 500 $\mu$ T - 5 mT	2 years	No effect on incidence of most tumours	Yasui et al 1997
Female rats	60 Hz 2 $\mu$ T - 2 mT	2 years	No effect on incidence of most tumours	Mandeville et al 1997
Male and female rats	60 Hz 2 $\mu$ T - 1 mT continuous and intermittent	2 years	No effect on incidence of most tumours. Increase in thyroid tumours in mice.	Boorman et al 1999
Male and female mice	50 Hz 500 $\mu$ T - 5 mT	Exposure prior to mating and during pregnancy. Follow-up 78 weeks	No effect on incidence of tumours in offspring	Otaka et al 2002
<b>Leukaemia/lymphoma</b>				
Leukaemia-prone female mice	12 Hz or 460 Hz 6 mT pulsed	1 hr/week until death, 5 generations	No effects on survival	Bellossi 1991
Male and female mice	60 Hz 25 mT	3 generations	Increase in lymphoma incidence in 3 <sup>rd</sup> generation, but could be age effect	Fam and Mikhail 1993, 1996
Transgenic mice prone to lymphoma	50 Hz 1 - 1000 $\mu$ T continuous and intermittent	18 months	No effect on lymphoma	Harris et al 1998
Knock-out mice prone to low incidence of lymphoma	60 Hz 1 mT	18.5 hours/day 23 weeks	No significant effect on lymphoma incidence	McCormick et al 1998
Mice with virus predisposed to lymphoma	50 Hz 1 - 10 $\mu$ T	38 weeks from 4 - 5 weeks of age	No significant effect on lymphoma incidence	Sommer and Lerchi 2004

<sup>4</sup>EMFs site: <http://www.emfs.info/research/laboratory/rodents/>

There are several peer reviewed articles in the field that show certain results and others showing opposite ones. There are many reference papers which have analyzed Physiological Effects in Rodents exposed to low level EMF. Many of them are peer reviewed published papers which have explored and uncovered physiological effects on experimental rodents exposed to low level EMF. No significant histopathological alterations were observed in the treated animals after a specific interval of time. Studies did not find any histopathological effect on kidney and testis of mice.

Kidney did not show any congested blood vessels, calcified and degenerated renal tubules with necrosis in the renal epithelium. Studies did not find any carcinogenic effect of low level magnetic fields, even if they have been designed to reveal a possible tumor promotion. Cell studies showed that magnetic fields at some high frequencies, amplitudes and wave forms interact with biological systems. No interaction with low level EMF and enzymes related to growth regulation, on calcium balance in the cell, on gene expression, and on pineal metabolism and its excretion of the oncostatic melatonin. Cellular and physiologic studies do not suggest any effect that may be related to cell multiplication and tumor promotion.

No studies have shown that biological effects on the cellular and subcellular level can be related to low level electromagnetic fields. Although there is a large number of studies which have studied EMF, there is no peer reviewed study which has identified behavioral effects on experimental rodents exposed to low level EMF. There is not a single study which has identified or expressed visible individual panic, reaction, disorientation and a greater degree of anxiety. No decrease in eating and drinking habits was also observed.

**The DVC™ uses micro EMF which are comparable to, or below, normal background situations. As the data in Table 2 show, it is much lower than other EMF sources generated by common electrical equipment already present in Animal Rooms, and which have not been shown to affect animal welfare.**

**Since our competitor list of references is absolutely not relevant for the all the INTENSITY levels of the EMF generated in each experiment, Tecniplast strives to share the more independent information to be used by the entire Lab Animal Industry community in order to make the right choice.**

## ENVIRONMENTAL SUSTAINABILITY: MINIMIZE IMPACT MAXIMIZING VALUE

What Tecniplast did to become leader in sustainability:

### Company:

- Quality Management System Certification according to ISO 9001 and Environmental Management System Certification according to ISO 14001.
- Certified Environmental Report according to Eni Foundation Enrico Mattei Guidelines.

### Products:

- Life Cycle Assessment (LCA) according to ISO 14040 and ISO 14044.
- Carbon Footprint according to PAS 2050.
- Environmental Data Sheet according to ISO 14025.
- Contribution to credits under the LEED rating system.



# TECNIPLAST®

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