Jožef Stefan Institute

SCUALE: Sustainable Components for Underwater Acoustics using Lead-free Materials in Europe

Trajnostne komponente za podvodno akustiko z uporabo materialov brez svinca v Evropi

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EUROPEAN UNION

EUROPEAN DEFENCE FUND

SCUALE

Sustainable Components for Underwater Acoustics using Lead-free materials in Europe

SELECTED PROJECTS EUROPEAN DEFENCE FUND (EDF) 2022

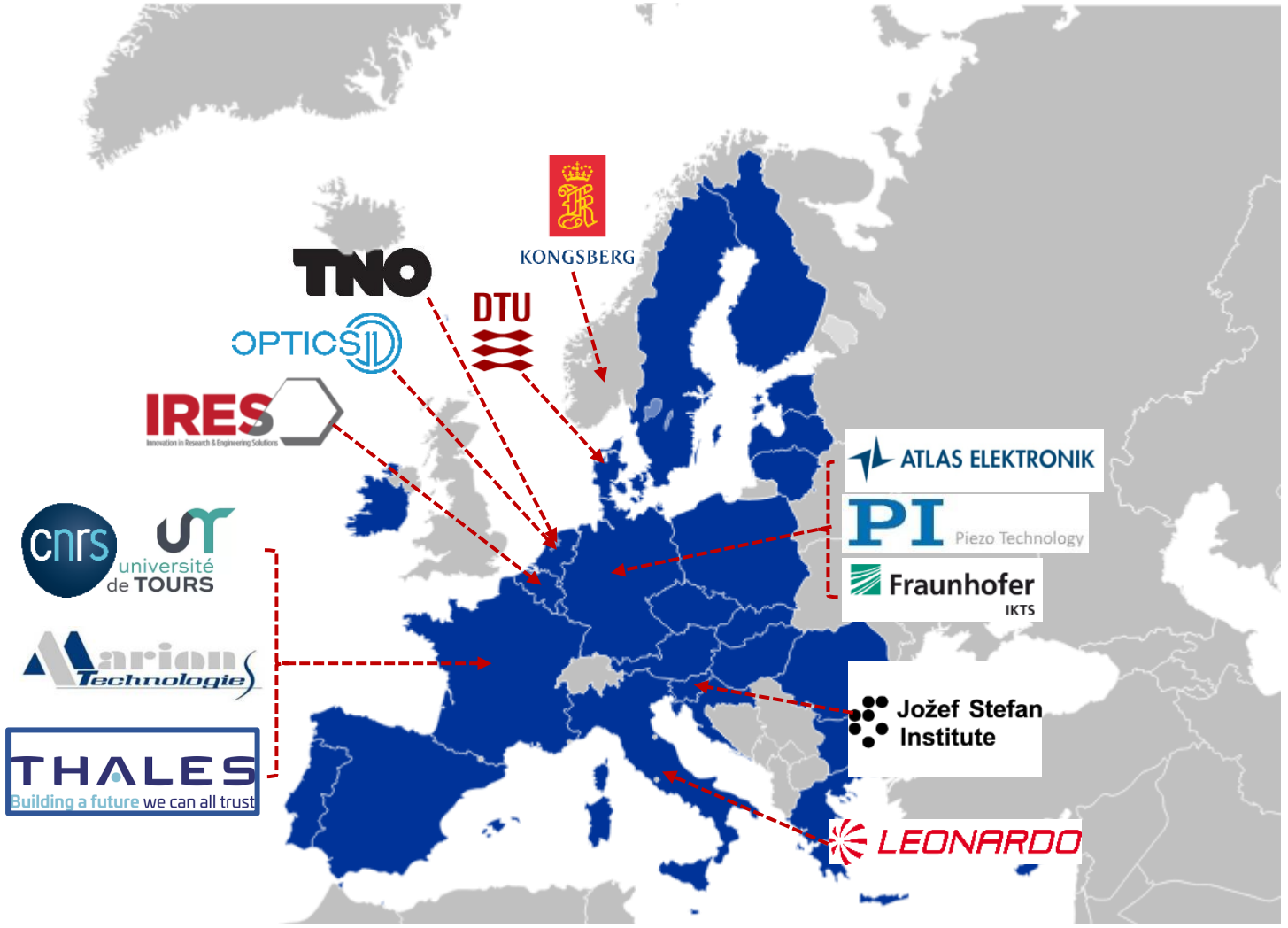
CALL TITLE:	Research actions
TOPIC TITLE:	Sustainable components for underwater applications
DURATION OF THE PROJECT:	36
TYPE(S) OF ACTIVITIES:	Studies, Generating knowledge, Design, Integrating knowledge
ESTIMATED TOTAL COST:	€ 19,331,577.00
MAXIMUM EU CONTRIBUTION :	€ 19,331,577.00

SCUALE

Coordinator:
THALES (FR)

14 partners from
8 countries

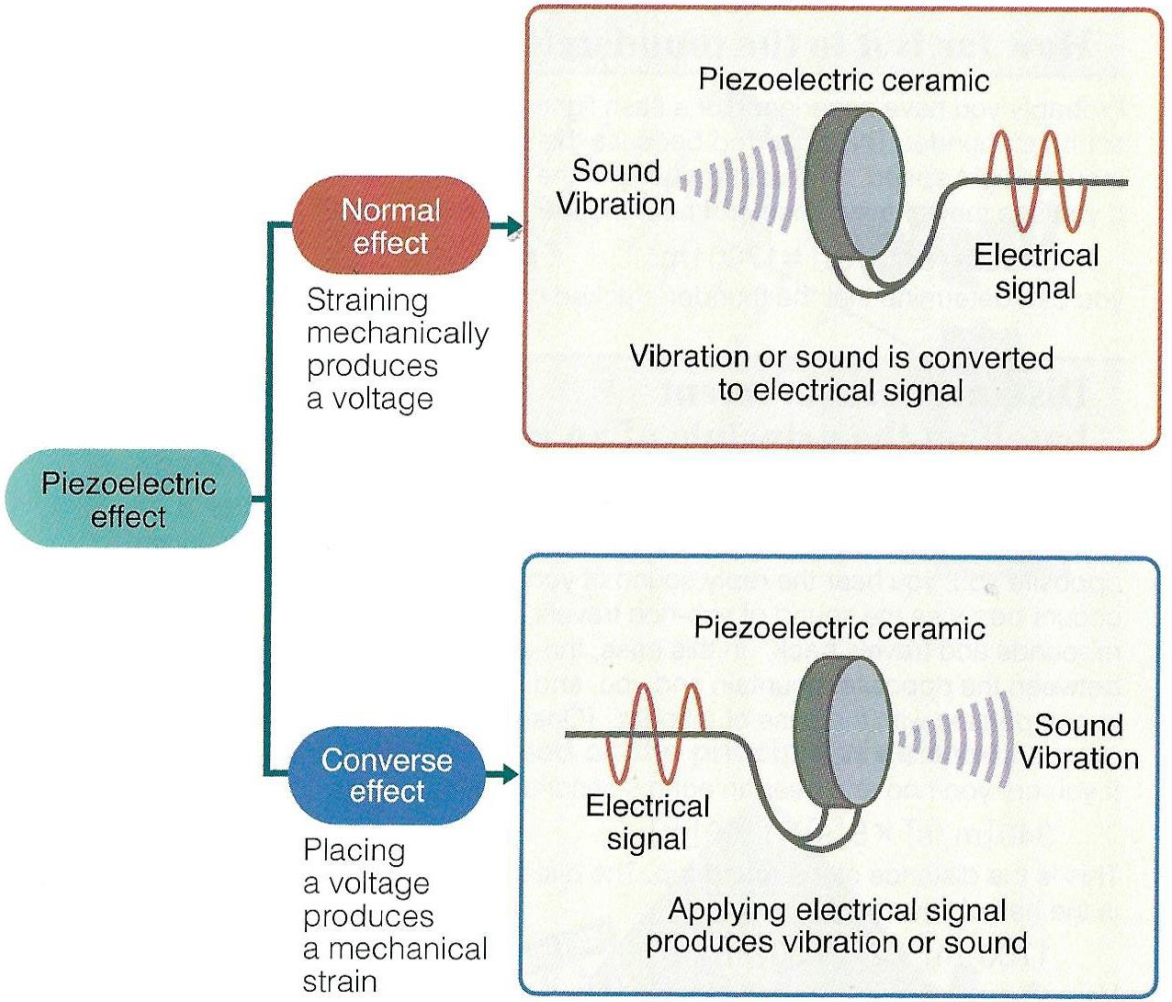
Companies
SMEs
Research institutes
Universities



Piezoelectric ceramics in applications

Ultrasound transducers:

- Sonars*
- Medical ultrasound
- Pressure sensors
- Car-parking systems



*WW1: piezoelectrics used for sonars in submarines

Scheme: The World of Unheard Sound, Honda Electronics, 2007

PZT:

- lead zirconate titanate, discovered in 1952
- the most commercially spread piezoelectric ceramic
- contains about 60 weight % lead (Pb) thus representing an environmental hasard

RoHS (Restriction of Hazardous Substances):

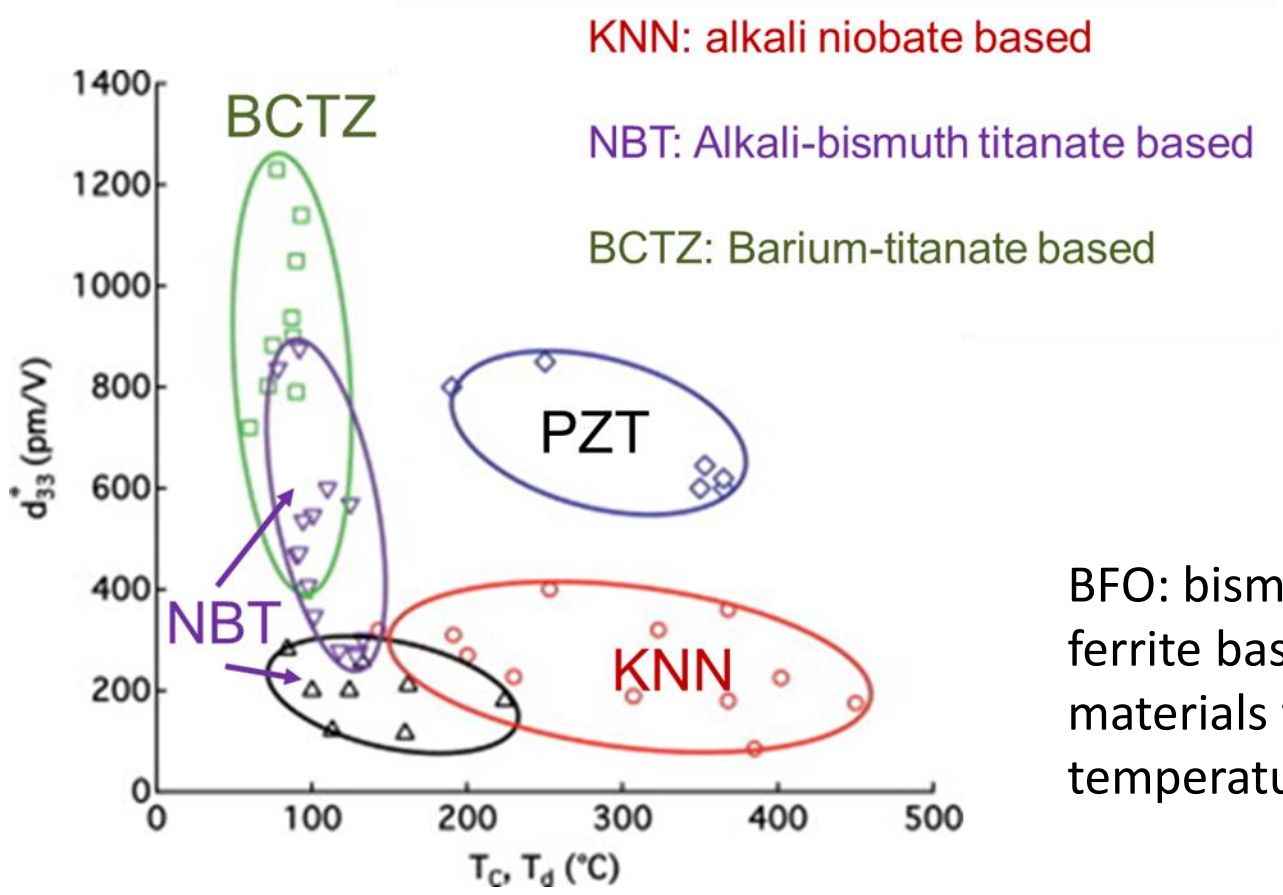
- mercury (Hg)
- cadmium (Cd)
- **lead (Pb)**
- hexavalent chromium (Cr^{VI})
- polybrominated biphenyls (PBB)
- polybrominated diphenyl ethers (PBDE)

Electonic waste (e-waste):

20 to 50 million metric tons of e-waste per year are disposed worldwide.
Only 12.5% of e-waste is currently recycled.
Estimate: about 4 % of lead in e-waste.
Source: Google search

Scheme adapted after J. Roedel et al., J. Europ. Ceram. Soc., 35, 1659, 2015.

Lead-free piezoelectric ceramic alternatives to PZT



BFO: bismuth ferrite based materials for high-temperature range

There is still no single lead-free piezoelectric ceramic material that would cover the broad spectrum of PZT functionality obtained by chemical modification and microstructural design within a broad temperature range.

PZT; $Pb(Zr,Ti)O_3$
KNN: $K_{0.5}Na_{0.5}NbO_3$
NBT: $Na_{0.5}Bi_{0.5}NbO_3$
BCTZ: $(Ba,Ca)(Ti,Zr)O_3$
BFO: $BiFeO_3$

Scheme adapted after J. Roedel et al., J. Europ. Ceram. Soc., 35, 1659, 2015.

Aims of SCUALE project:

- to study, develop and produce advanced **lead-free materials** and **components** with improved performance to replace existing piezoelectric ceramics for **military underwater acoustics** applications.

- to initiate establishing at least **one European supply chain** of lead-free piezoelectric materials suitable for military underwater acoustics applications.