

Hvordan fungerer en elmotor?

Vil bruke én milliard kroner på å hjelpe deg med elsykkel-kjøpet

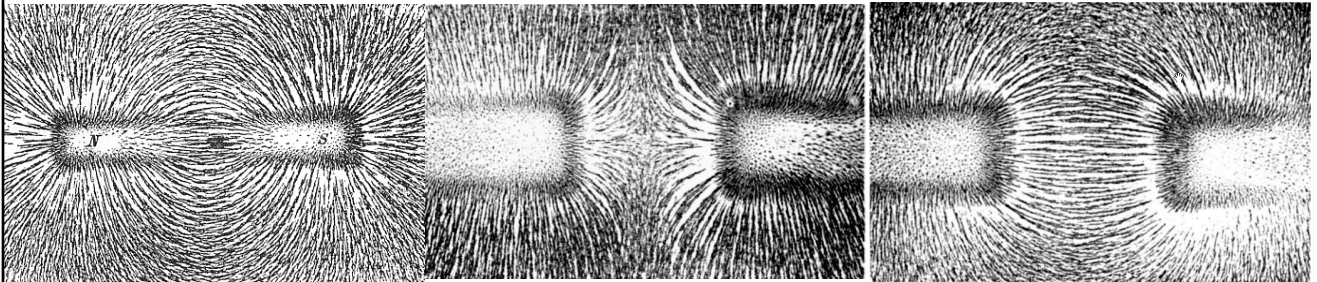
Det blir stadig flere elsykler på norske veier. Framtiden i våre hender kommer nå med flere forslag for å få enda flere til å velge elsykkel.



Petter Strøm
@peat_85
Journalist

Publisert 7. apr. kl. 07:50
Oppdatert 7. apr. kl. 16:27

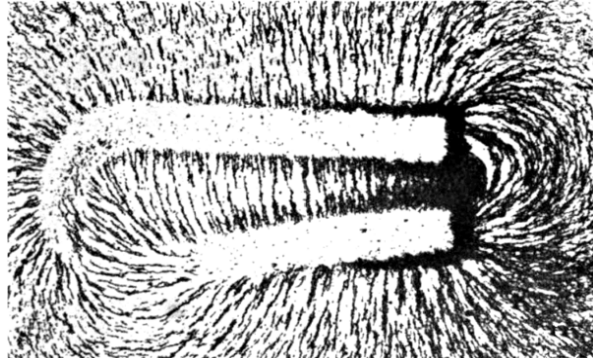
Magnetiske feltlinjer



<https://physics.stackexchange.com/questions/90793/does-greater-number-of-lines-of-force-around-the-magnet-imply-greater-magnetic-f>

https://commons.wikimedia.org/wiki/File:Magnetic_field_of_bar_magnets_repelling.png

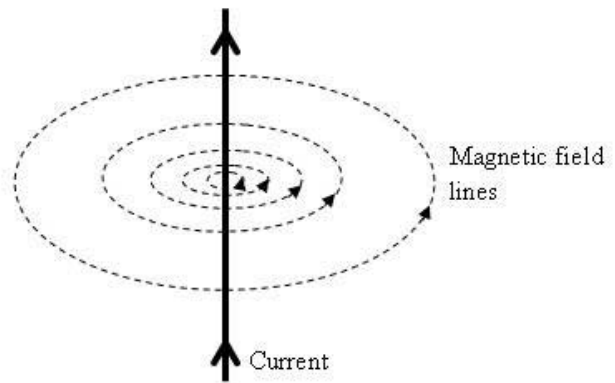
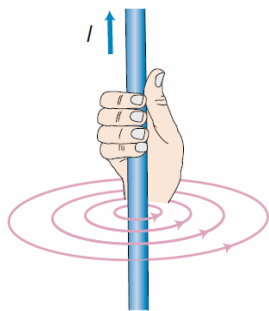
https://commons.wikimedia.org/wiki/File:Magnetic_field_of_bar_magnets_attracting.png



https://commons.wikimedia.org/wiki/File:Magnetic_field_of_horseshoe_magnet.png

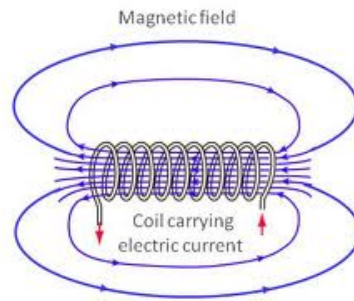
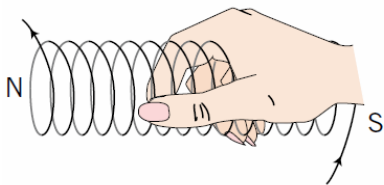
Magnetisk felt rundt en strømførende leder

Høyrehåndsregel 1

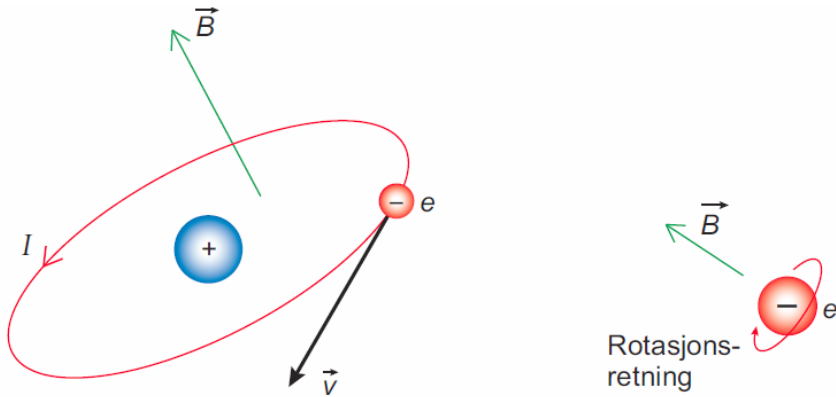


Magnetisk felt rundt en spole

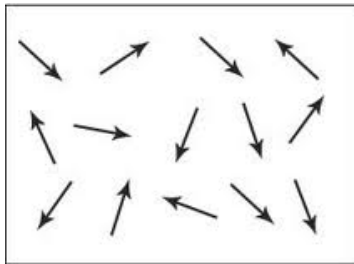
Høyrehåndsregel 2



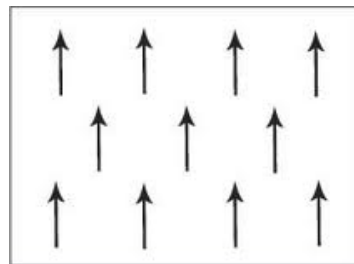
Atomer som magneter



Magnetiske materialer og permanentmagneter



Ikke en magnet: Magnetfeltene fra alle atomene kansellerer hverandre

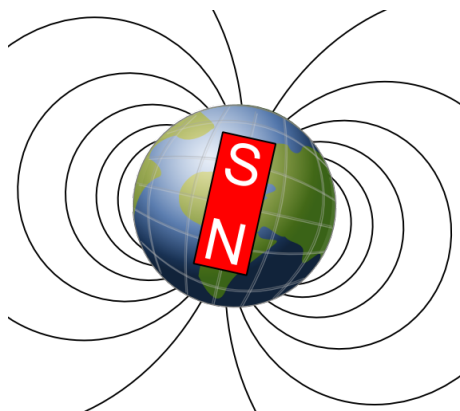


Magnet: Magnetfeltene fra mange atomer peker i samme retning

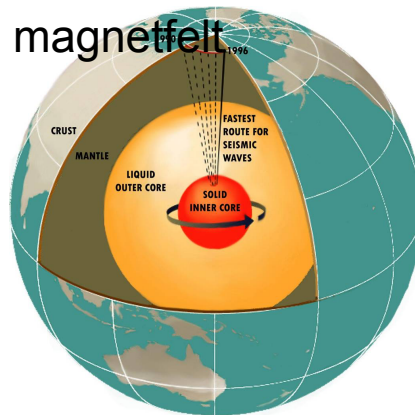
Ferromagnetisme: Materialet blir magnetisk i et eksternt magnetfelt

Permanentmagnet: Materialet forblir magnetisk selv når det eksterne magnetfeltet fjernes

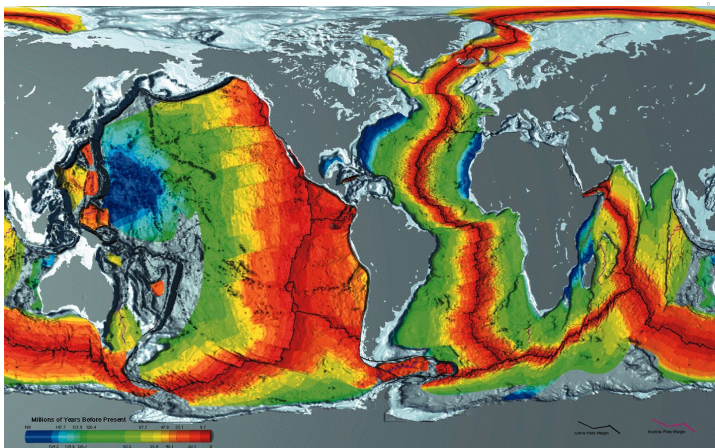
Jordas magnetfelt



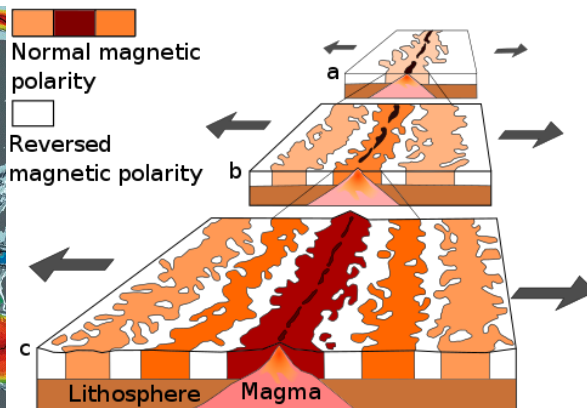
https://commons.wikimedia.org/wiki/File:Earth%27s_magnetic_field,_schematic.png



https://www.nasa.gov/mission_pages/sunearth/news/gallery/earths-dynamiccore.html



https://en.wikipedia.org/wiki/Mid-ocean_ridge#/media/File:Earth_seafloor_crust_age_1996_-_2.png



<https://commons.wikimedia.org/wiki/File:Oceanic.Stripe.Magnetic.Anomalies.Scheme.svg>

Magnetisk feltstyrke

B-feltKraft på en ladning i bevegelsebevegelse \perp B-felt \perp : vinkelrett på

$$F_m = qvB$$

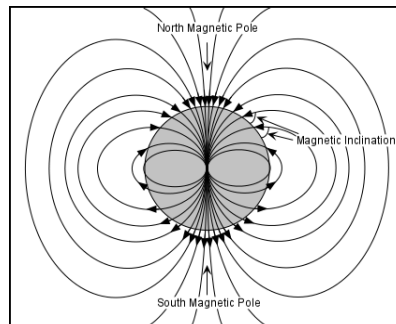
$$B = \frac{F_m}{qv} \quad \vec{v} \perp \vec{B}$$

$$[B] = \frac{N}{Cm/s} = T \quad \text{tesla}$$

Magnetisk feltstyrke



MRI: 1-3 T



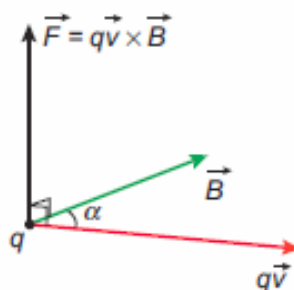
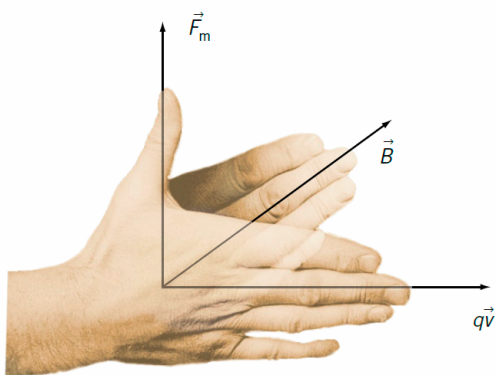
Jorda: 0,000025 -
0,000065 T

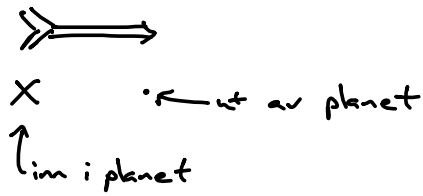
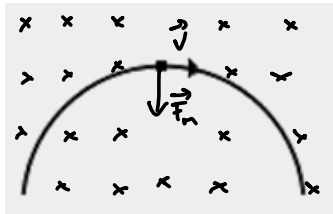
Smallest value in a magnetically shielded room
Interstellar space
Earth's magnetic field
Small bar magnet
Within a sunspot
Small NIB magnet
Big electromagnet
Strong lab magnet
Surface of neutron star
Magstar

10^{-14} Tesla
 10^{-10} Tesla
0.00005 Tesla
0.01 Tesla
0.15 Tesla
0.2 Tesla
1.5 Tesla
10 Tesla
100,000,000 Tesla
100,000,000,000 Tesla

Kraft på ladet partikkel i magnetfelt

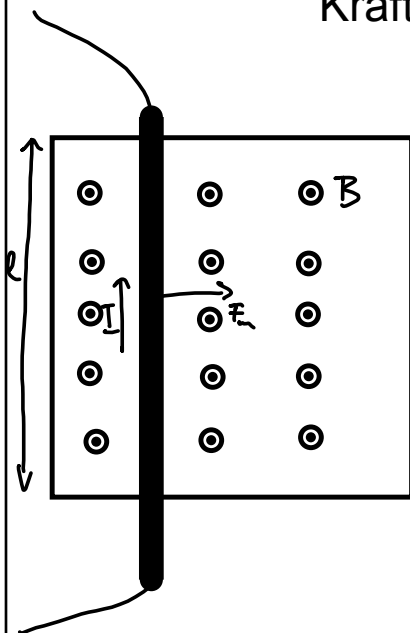
Høyrehåndsregel 3





Figuren viser litt av banen til et elektron som er i bevegelse i et homogent magnetfelt. Banen ligger i papirplanet. Hvilken retning har magnetfeltet?

Kraft på strømførende leder i magnetfelt



$$F_m = qvB$$

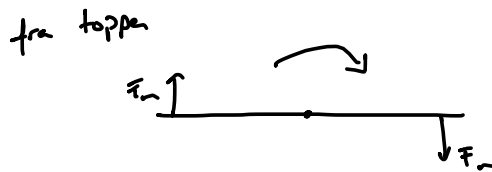
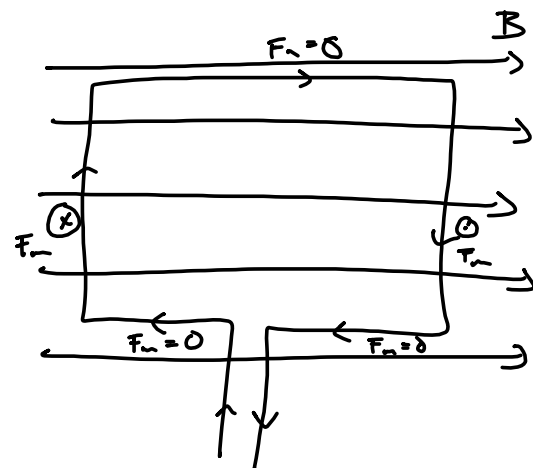
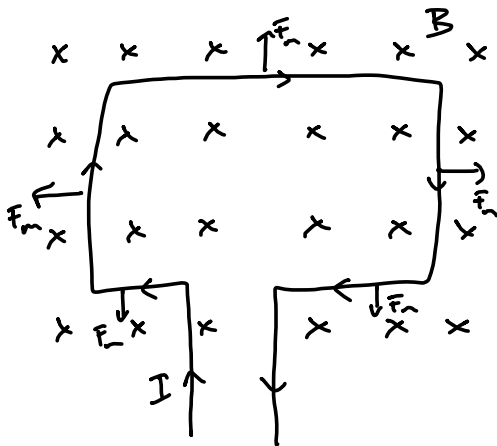
$$I = \frac{q}{t} \Rightarrow q = It$$

$$v = \frac{l}{t}$$


$$F_m = I \cdot \frac{l}{t} \cdot B$$

$$F_m = IlB$$

Strømsløyfe i magnetfelt



Likestrømsmotor

 http://www.walter-fendt.de/html5/phen/electricmotor_en.htm

Hvordan fungerer en elmotor?

NRK Nyheter Sport TV Radio Distrikt  

Troms Se Nordnytt-TV Tips oss Send inn bilder NRK Kvensk Facebook og Twitter Hør radiosendinger

Vil bruke én milliard kroner på å hjelpe deg med elsykkel-kjøpet

Det blir stadig flere elsykler på norske veier. Framtiden i våre hender kommer nå med flere forslag for å få enda flere til å velge elsykkel.



Petter Strøm
@peat_85
Journalist

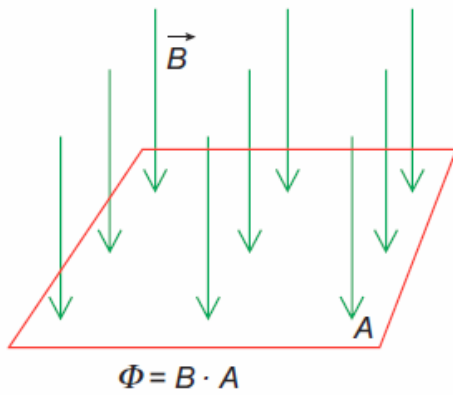
Publisert 7. apr. kl. 07:50
Oppdatert 7. apr. kl. 16:27

Hvordan kan en vindmølle gjøre at jeg kan koke vann på komfyren?



Bilde: Wikimedia - Smøla.jpg

Magnetisk fluks



$$\phi = BA$$

← flux

$$[\Phi] = \text{Tm}^2 = \text{Wb} \quad \text{weber}$$

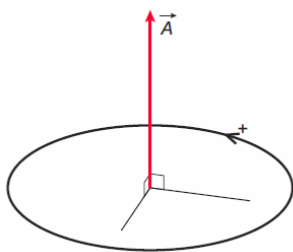
7-13 Fluksen er produktet av feltstyrken og arealet.
a Ulik fluks fordi feltstyrken er ulik.
b Ulik fluks fordi arealet er ulikt.



a

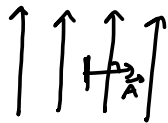
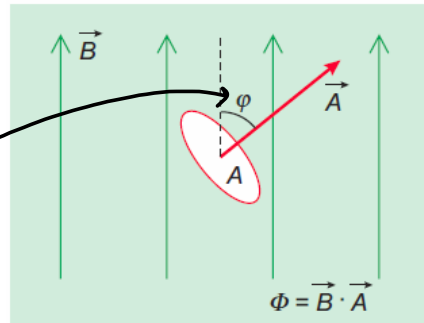


b



$$\phi = BA \cos \phi$$

(i baka: α)



$$\phi = 90^\circ$$

$$\cos 90^\circ = 0$$

$$\phi = BA \cos 90^\circ = 0$$



$$\phi = 0$$

$$\cos 0 = 1$$

$$\phi = BA \cos 0^\circ = BA$$

Faradays induksjonslov

Indusert ems \mathcal{E} (i en lukket krets)

↓
elektromotorisk spenning

(gir strøm tilsvarende batteri med $U = \mathcal{E}$)

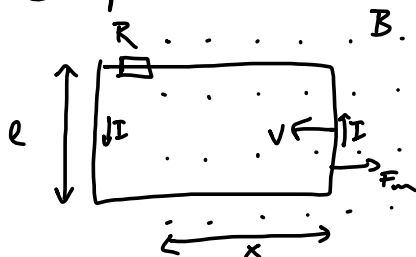
$$\mathcal{E} = - \frac{\Delta \phi}{\Delta t}$$

← endring i fluks
← per tidsenhet

spole, n vindlinger

$$\mathcal{E} = -n \frac{\Delta \phi}{\Delta t}$$

Eksempel 27.4



$$R = 0,15 \Omega$$

$$v = 0,5 \text{ m/s}$$

$$l = 0,12 \text{ m}$$

$$B = 0,30 \text{ T}$$

$$\mathcal{E} = ?$$

$$I = ?$$

$$F_m = ?$$

$$\mathcal{E} = - \frac{\Delta \phi}{\Delta t}$$

$$\phi = BA \quad A = lx$$

$$\Delta \phi = \Delta(BA) = B \Delta A = B \Delta(lx) = Bl \Delta x$$

$$\mathcal{E} = - \frac{Bl \Delta x}{\Delta t} = -Blv$$

$$= Blv = 0,30 \text{ T} \cdot 0,12 \text{ m} \cdot 0,5 \text{ m/s} = 18 \text{ mV}$$

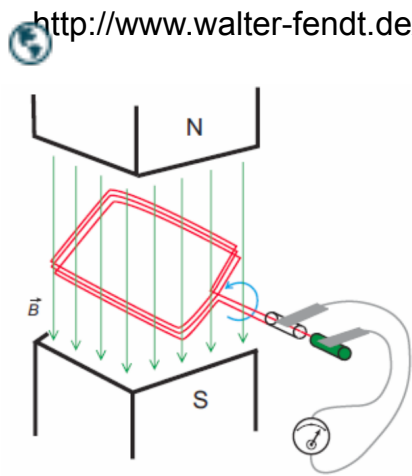
$$I = \frac{\mathcal{E}}{R} = \frac{18 \cdot 10^{-3} \text{ V}}{0,15 \Omega} = 0,12 \text{ A}$$

$$F_m = IlB = 0,12 \text{ A} \cdot 0,12 \text{ m} \cdot 0,30 \text{ T} = 4,3 \text{ mN}$$

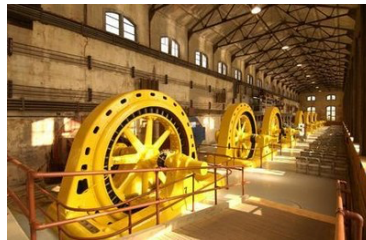
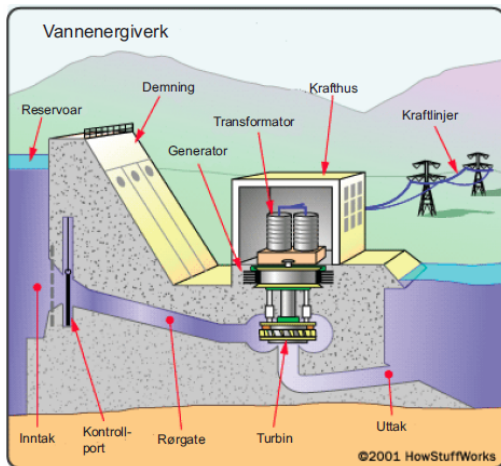
retning til indusert strøm:
motvirke endring i magnetisk
fluks

Vekselstrømgenerator

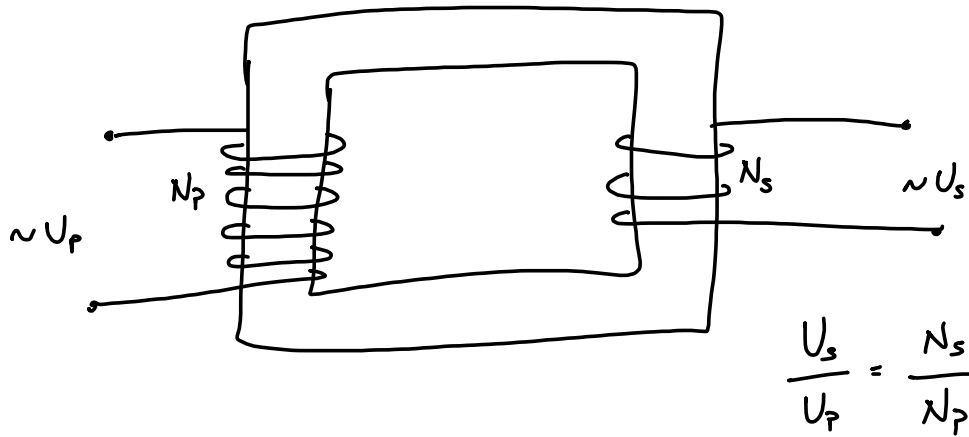
http://www.walter-fendt.de/html5/phen/generator_en.htm



Generator

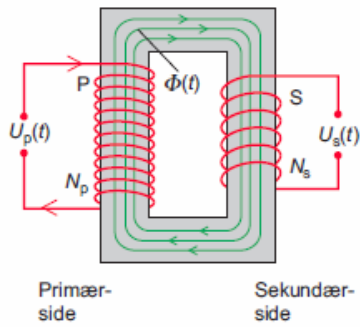
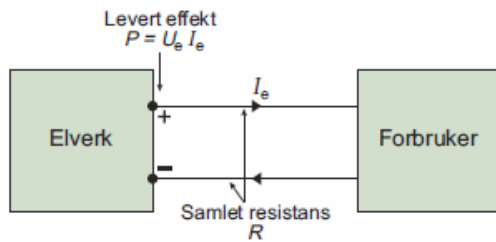


Transformer



$$\frac{U_s}{U_p} = \frac{N_s}{N_p}$$

Transformator



Induksjonsoppvarming



Hvordan kan en vindmølle gjøre at jeg kan koke vann på komfyren?



Bilde: Wikimedia - Smøla.jpg