



A Sustainable Energy Future through Research and Education

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Sustainable access to energy for a growing population

Population	2008	⇒	2050
World average	6.7 billion		10 billion
	2.4 kW		3.0 kW

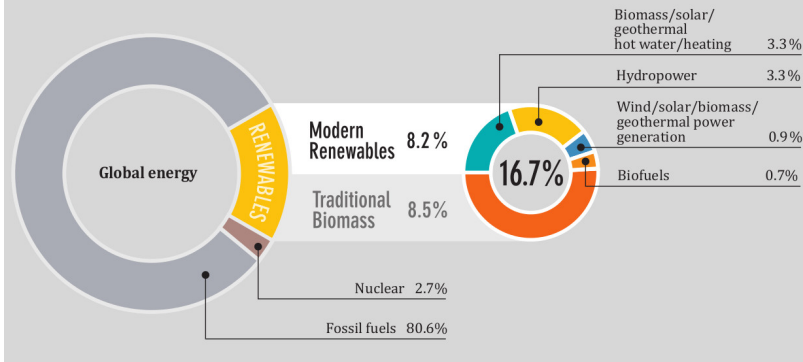
	1990	2008	2050
Power consumption:	11.7 TW	16.1 TW	30.0 TW
	$\simeq 14$ TW is needed in 40 years		

$$14000 \text{ GW}/40 \text{ years} = 350 \text{ GW}/\text{year} = \mathbf{1 \text{ GW}/\text{day}}$$

Good news: The massive investments can drive the economy

Fossil fuels dominate today

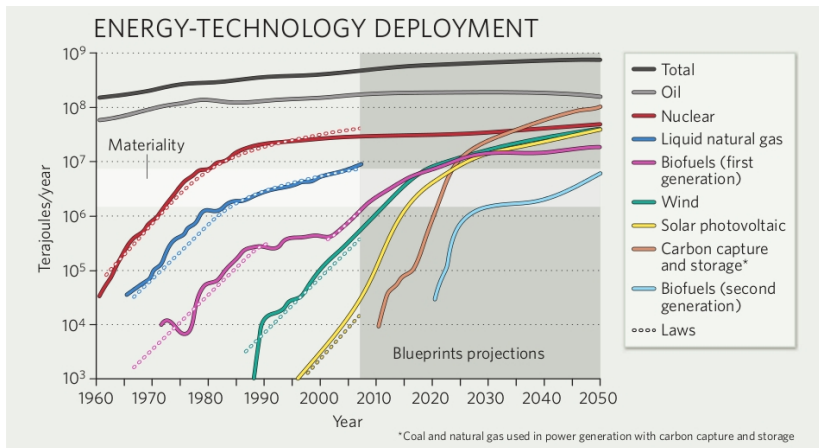
FIGURE 1. RENEWABLE ENERGY SHARE OF GLOBAL FINAL ENERGY CONSUMPTION, 2010



World energy production & consumption is dominated by fossil fuels.

Source: Renewable Energy Policy Network for the 21st Century www.ren21.net

Change takes time



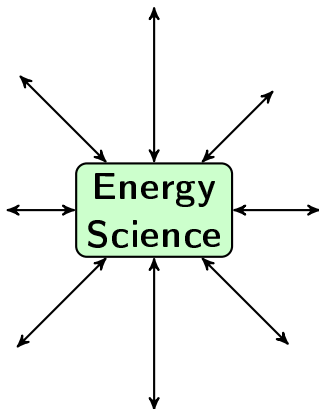
It takes around 30 years for a new technology to deliver 1% of the energy mix!

What can we do?

- Important
 - to follow several parallel routes!
 - to continuously build the human potential via research and education.
- Development of a wide range of energy sources is essential
 - various sources are suited to be used in different circumstances,
 - no chance to accelerate the change in energy system by only a few techniques
 - smart balance of energy sources can solve the intermittency problem that renewable energy sources suffer from.
- We also need basic research!

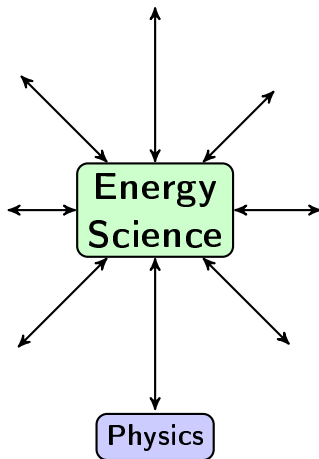
Energy science: we can all contribute

Energy science is truly interdisciplinary.



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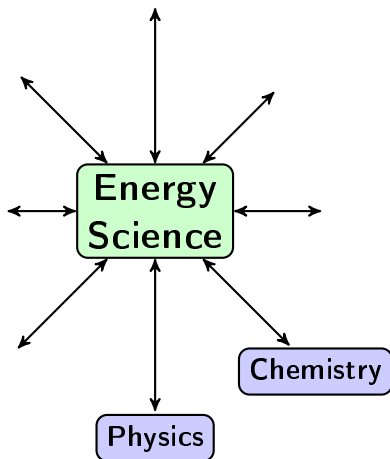
Energy science is truly interdisciplinary.



Naturally it relates to physics through the fundamental concept of energy, isotopes, fission, fusion, flows, and energy conversion

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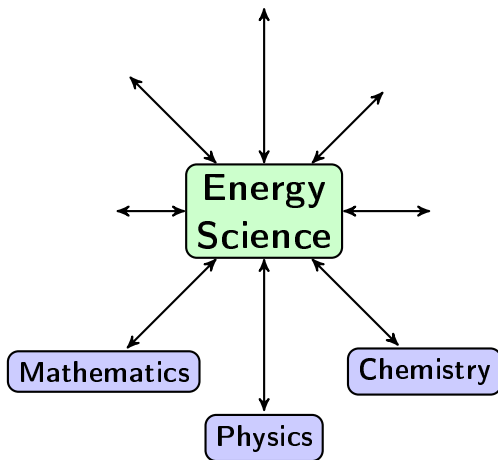
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To chemistry through the understanding of burning of fossil fuels and production of renewable energy.

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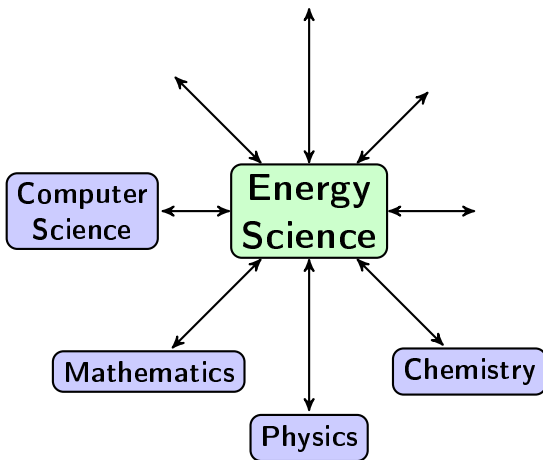
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To mathematics through the mathematical methods needed for theoretical modelling

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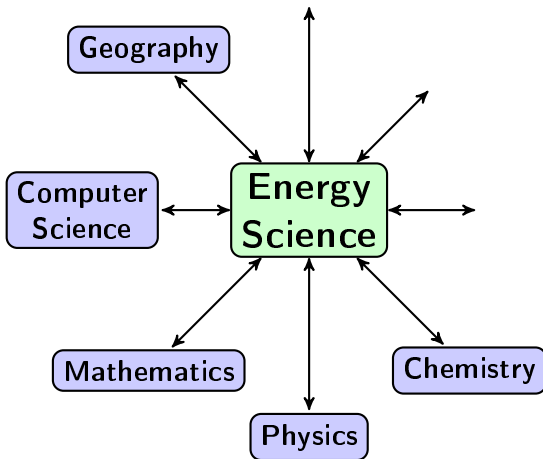


It relates to computer science via the need for simulations, data analysis, visualisation, control systems, etc.

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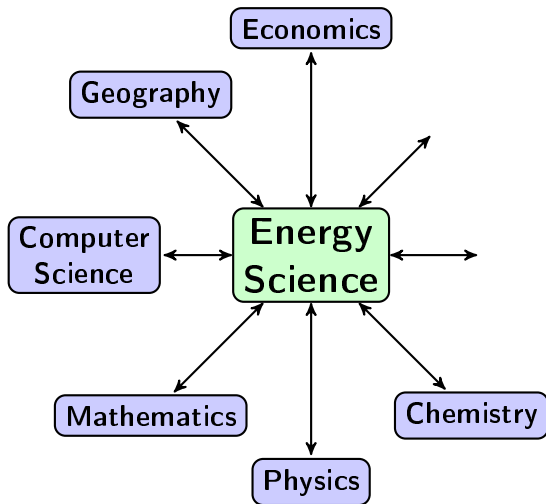
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It also relates to geography through the location of energy resources



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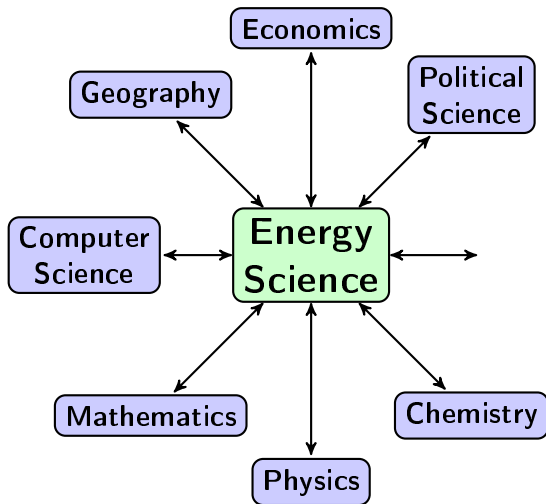
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to economics
through energy
pricing and
policies,

Energy science: we can all contribute

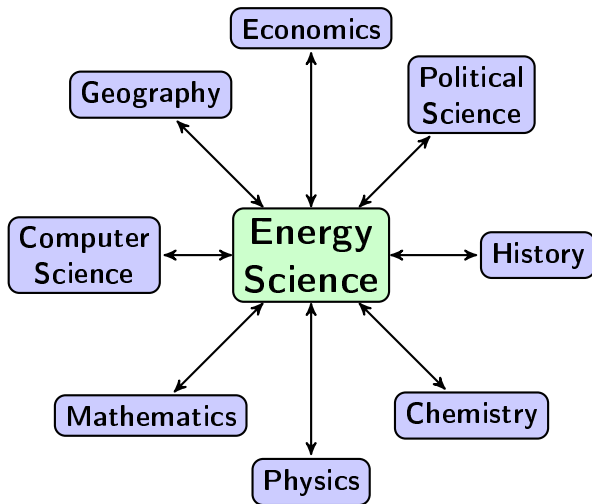
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to political science
for the need of
international
agreements

Energy science: we can all contribute

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and to history for examples of earlier global challenges and transitions.

Education and research serve a strategic role

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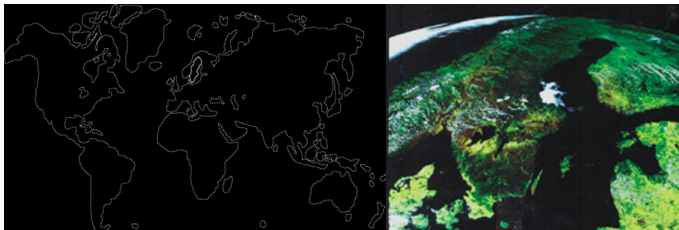
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- How can we repeat this success?
 - Research and education is the key to both!

Conclusions and discussion questions

- ① Realise the sheer magnitude of the transition
- ② Need to join forces: we can all contribute
- ③ Research and education is the key

Main question:

How can You contribute?



Sweden

Gothenburg

... situated on the beautiful west coast of Sweden

