

SVENSKA ARALSJÖSÄLLSKAPET



Swedish Aral Sea Society



Lars Rydén Professor Emeritus Uppsala University

Master Course on Sustainable Development and Sustainability Science For Uzbekistan by SASS and Karakalpak State University Spring 2024 Energy supply and use

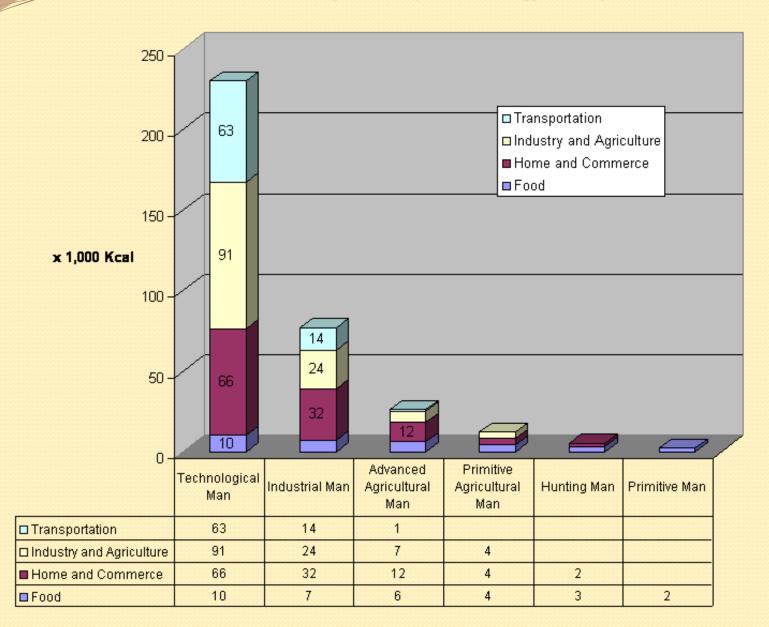
Energy use per capita in different societies

- Biological
- Gatherers, hunters
- Agriculture
- Industrial society
- Contemporary

2.4 kWh/day

- 10 kWh/day
- 25-50 kWh/day
- 50-100 kWh/day
- 250 kWh/day

Daily Consumption of Energy Per Capita

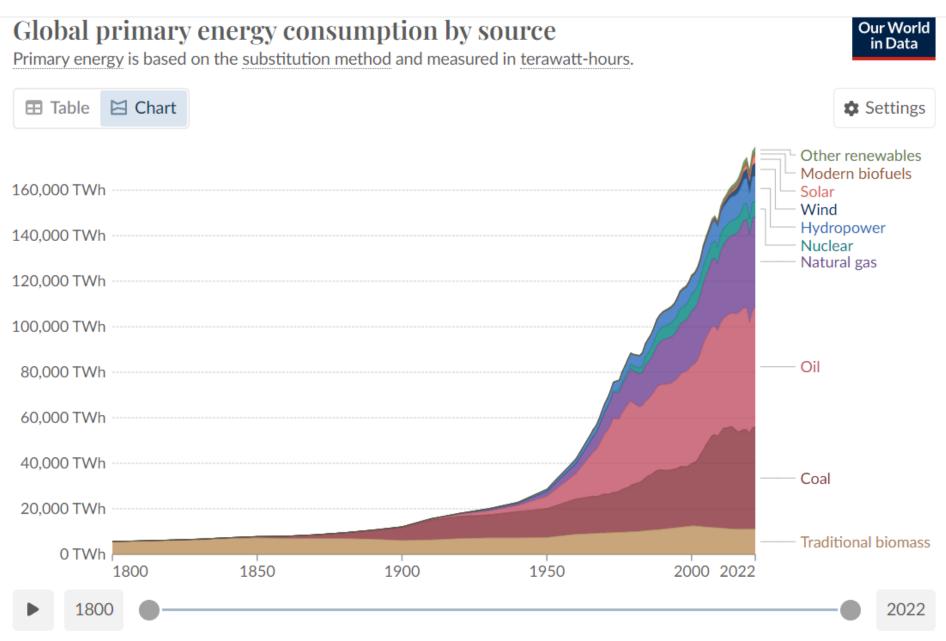


Two different kinds of energy

- Non-renewable (fossil) energy resources
 - Coal
 - Oil
 - Gas

- Renewable – flowing - energy resources

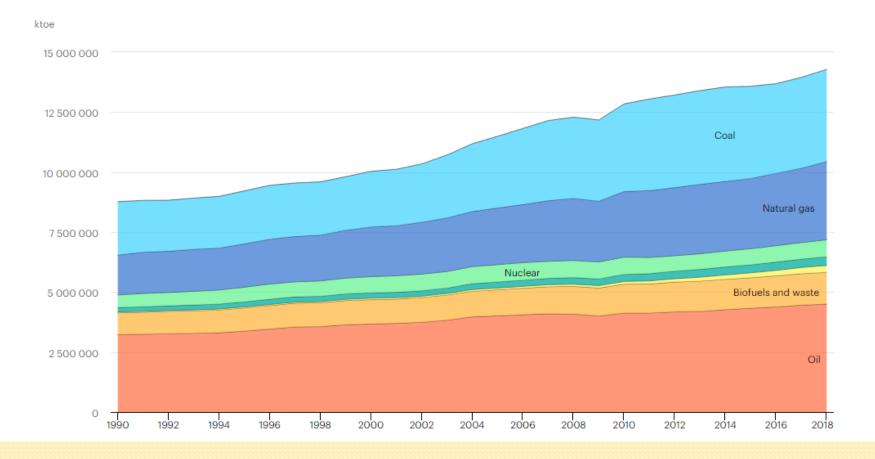
- Biomass and other forms of bioenergy
- Hydropower
- Wind power
- Solar power



Data source: Energy Institute - Statistical Review of World Energy (2023); Smil (2017) – Learn more about this data Note: In the absence of more recent data, traditional biomass is assumed constant since 2015.

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World Energy Outlook 2020 – Analysis – International Energy Agency, IEA



https://www.iea.org/data-and-statistics?country=WORLD&fuel=Energy%20supply&indicator=TPESbySource

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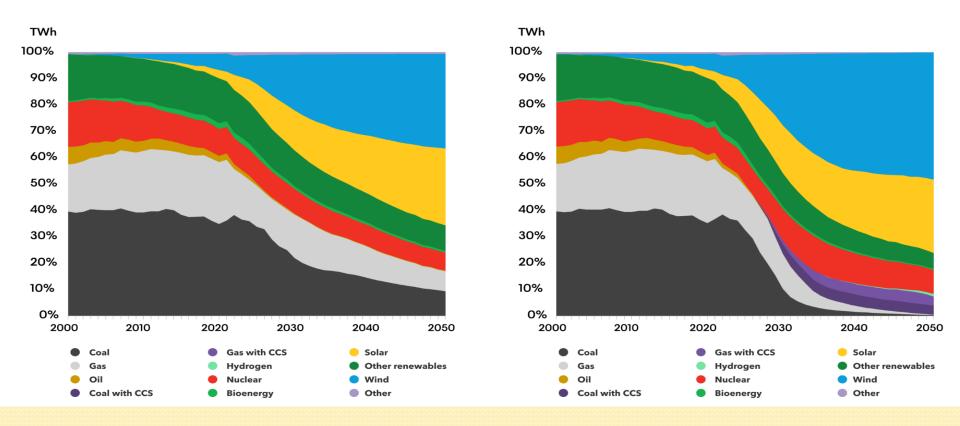


https://energytransition.org/2018/06/central-asias-green-horizons/

Sun and wind power dominates investments today, and will dominate in the future

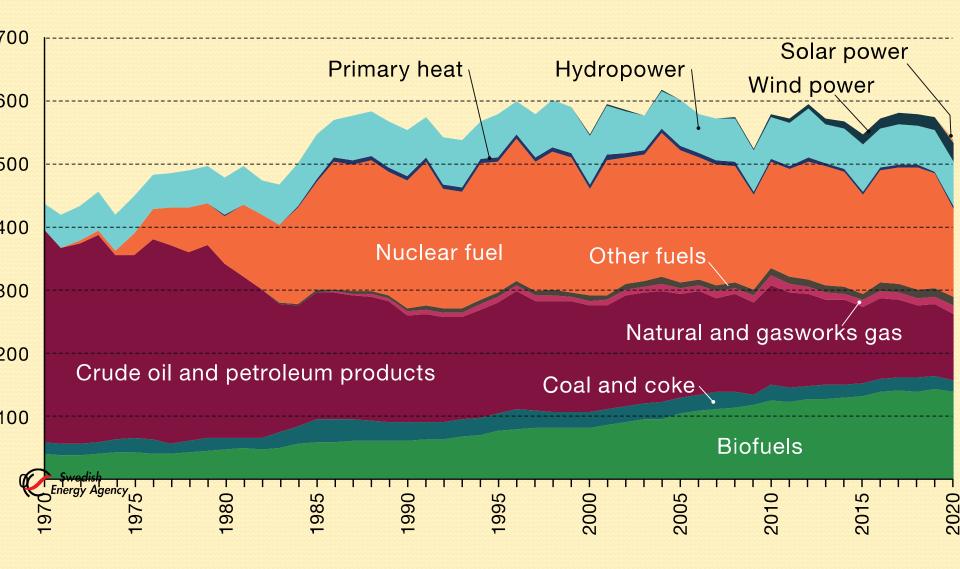
Electricity generation by technology, by scenario

Economic Transition Scenario



Net Zero Scenario

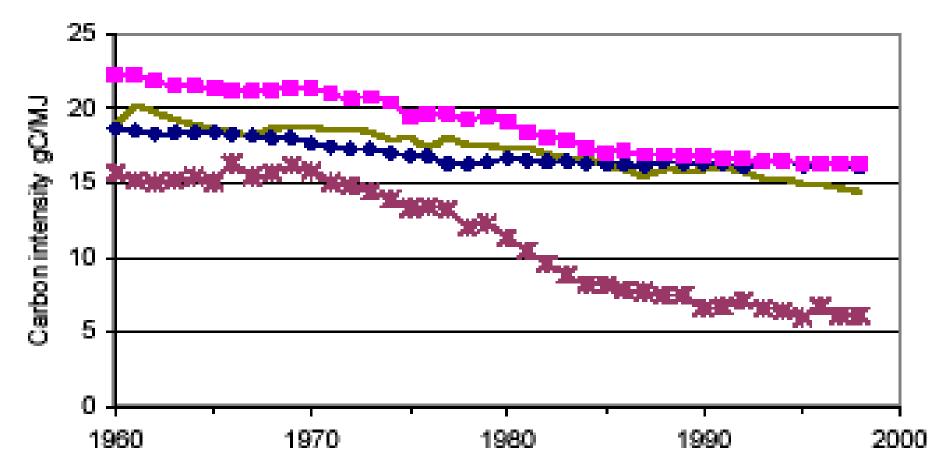
Sweden - Total supplied energy 1970–2020, TWh



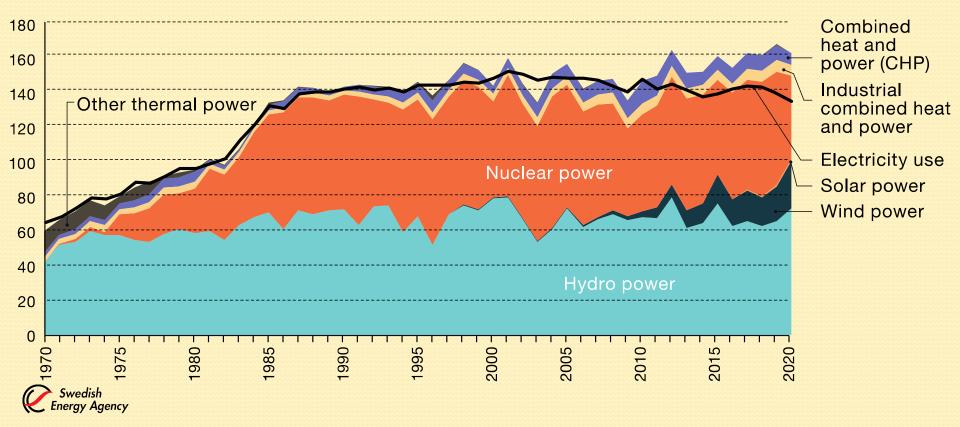
Carbon content of energy

From *Decoupling*, Azar, Holmberg and Karlsson, Chalmers University of Technology, 2002 based on IEA statistics

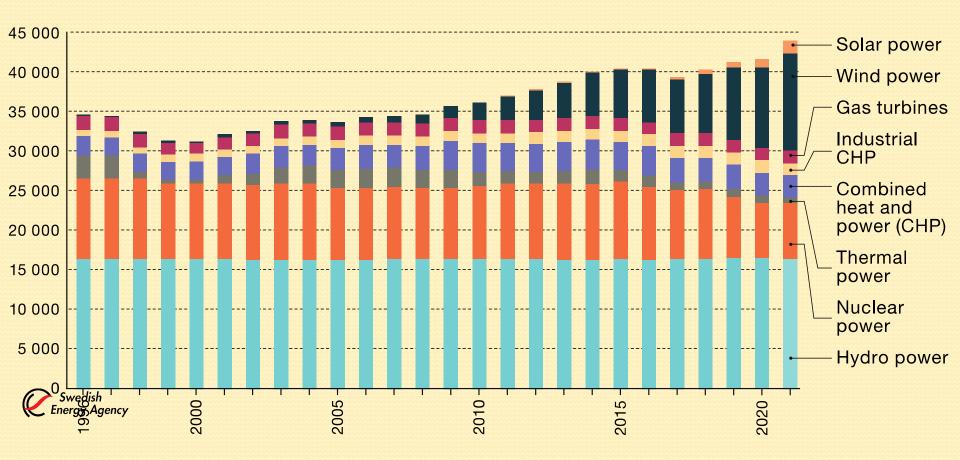




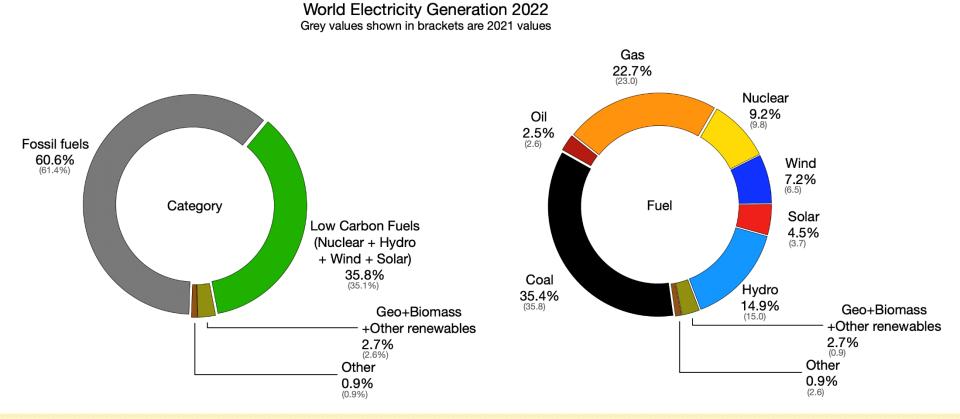
Electricity use and electricity generation per type of power 1970–2020, TWh



Installed electricity generation capacity by type of power 1996–2021, MW

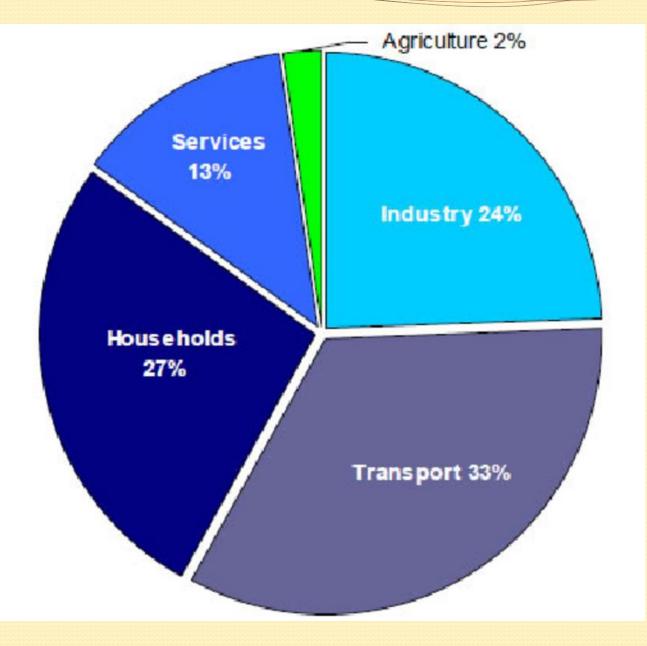


World Electricity Generation 2022

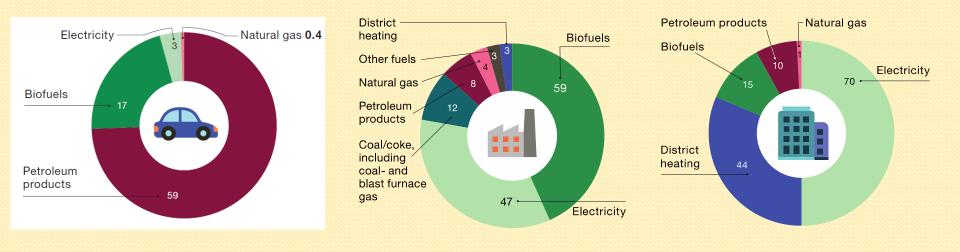


https://www.worldenergydata.org/world-electricity-generation/

Energy use



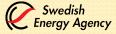
Final energy use in the different sectors 2020, TWh



Transport

Industry

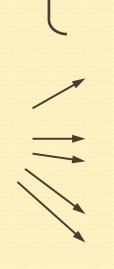
Households and business



Energy intensity (J/h)

Very low (zero)

Use of appliances: medium high



Commuting: high

Activity	Happiness
Sex	4,7
Socialising	4,0
Relaxing	3,9
Praying/meditating	3,8
Eating	3,8
Exercising	3,8
Watching TV	3,6
Shopping	3,2
Preparing food	3,2
Talking in phone	3,1
Taking care of children	3,0
Computer/internet	3,0
Housework	3,0
Working	2,7
Commuting	2,6

Storage of energy



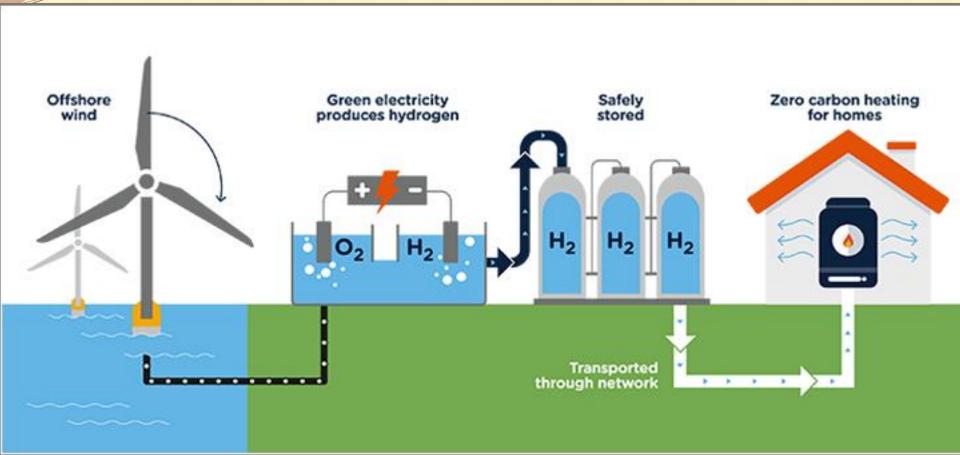
Enormous amounts of energy is stored in biomass



How can we best harvest the biomass?

Energy is stored in the reservoirs of hydropower plants

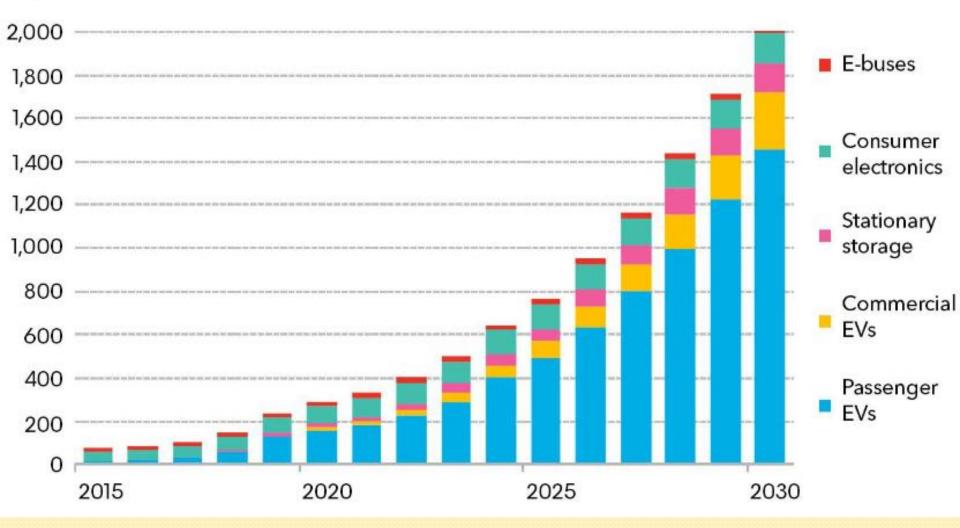
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Energy can be stored as hydrogen gas

Annual lithium-ion battery demand

GWh Energy can be stored in batteries



Source: Bloomberg NEF 2019 Electric Vehicle Outlook

Energy efficiency

Energy conservation: Insulation of pipes and covers on containers Building a passive energy house





A passive energy house

Improved technology

Torraca, Italy, has LED for all street lights

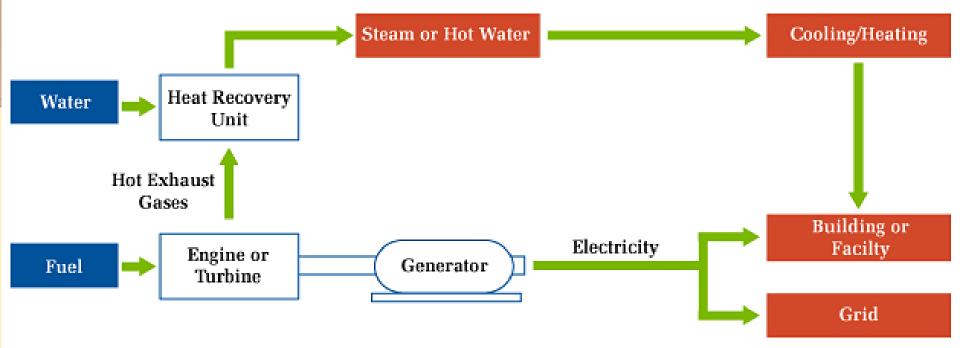




Improved technology

Electric cars

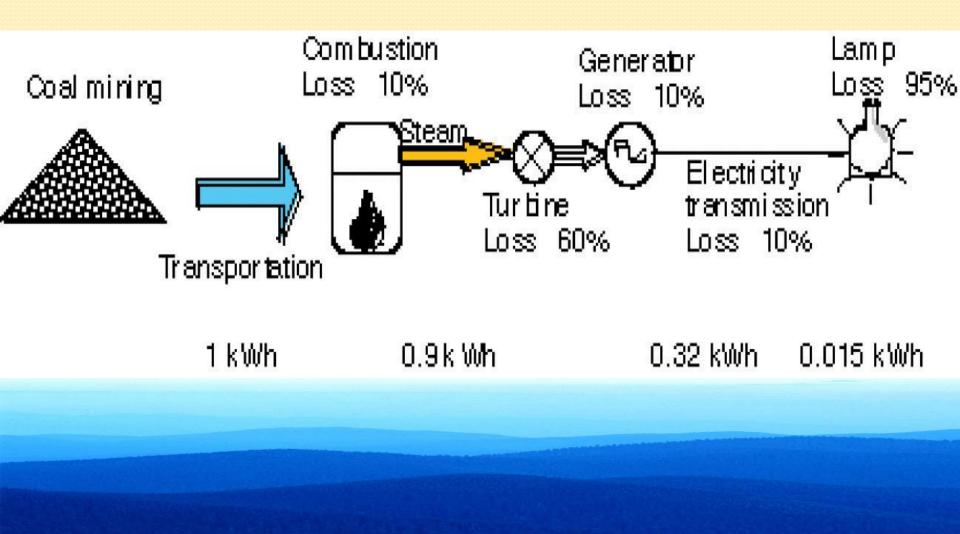
Combustion engine: 15 % of energy comes to the wheels Electric engine: 90 % of the energy comes to the wheels



Power stations

Careful use of energy: Combined heat and power cogeneration

Why demand management is better than increased production



PFE - Energy Efficiency in Large Companies Swedish Energy Authority

- 100 companies took part
- All made a complete energy use mapping
- All introduced a certified energy management system
- 1247 projects and 1.47 TWh less electricity annually
- 708 MSEK in investments
- 400 MSEK less energy costs annually
- Average return of investments 1.5 year
- Tax reductions 150 MSEK annually



Mapping Energy use, project proposals

- 1. Background
- 2. Photos
- 3. Energy efficiency proposals
- 4. Drawbacks of each
- 5. Calculations kWh, Investments,

Return on investements

2018-42 Usang Veloverk 383-By \$1557 **booffiging**

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Silve ingles

May map till at 12 oct advertigt och 1990 och förstanspirale i förfaren. Lader i vedstatet at 1990 och antibilten förfaren har star ved at sätte starapyeitenen i satisfering för beitatte star at sosieren satisf te en på di um filesta efficient om tening på hefter i fulleren i net ors

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52 projects during 2 years

Primary improvements

- Temperature adjustments Heat recovery New valves Insulation Changed routines New lighting Toilets Secondary improvements
 - Reduced water useDecreased fire risksLess air pollutantsLess noise

Results after 2 years

Accomplished 19 304 MWh /year Under planning 32 942 MWh /year



Increased use of renewable resources

- promoting local development
- creates new jobs
- combats climate change
- requires competence
- creates social capital
- promotes sustainable development

The power plant in Enköping produces heat and electricity to the town using forest rest Products.

Yield: ca 90 % Emissions: 2,99 g CO2/kwh https://www.enae.se/

S Henrik von Klopp

Biofuel - waste

Uppsala biogas station use organic waste, including food waste from households etc to produce biogas, methane. All citybuses in Uppsala are running on locally produced Biogas.

Similar in many Swedish cities.



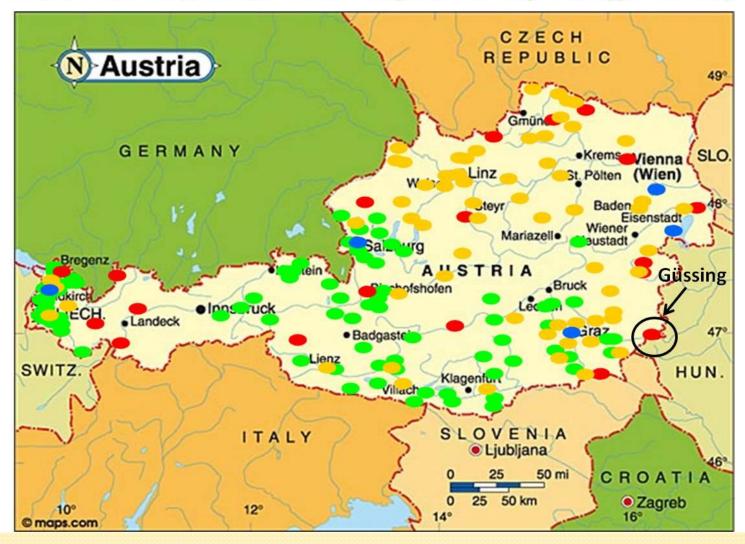
Güssing, Austria

From 1992 and in 11 years, Güssing became selfsufficient in electricity, heating, and transports. In the process 60 new companies with more than 1,500 new "green jobs" were created and commuting decreased to 40 %. On top of this Güssing now sells green energy outside the municipality to \$28 million yearly and emissions of CO2 decreased by more than 80%.

https://www.100-percent.org/gussing-austria/

Energy Independence Growing on Regional Level

Regions Independent in Electricity, Heat and/or Transportation E-Mobility Pilot Projects Regions with growing Energy Independence Regions with high Energy Efficiency standards



Networks of fossil-free municipalities in the world

- Post carbon cities, USA based
- *Local Renewables Initiative* run by ICLEI (local authorities for sustainability)
- Solar Cities network Australia
- 52 cities in Japan develops energy autonomy
- *Transition Towns* A network for munciplities with local transition initiatives to tackle the double challenge of peak oil and climate change.
- And many more!

To read

- Energy and Climate. Chapter 1 *Energy and Sustainable Development*. pp 11-22.
- Energy and Climate. Chapter 2 How much energy do we use – energy statistics. pp 23-34.

30 minutes

- Discuss which kind of energy you use
- Discuss which kind of energy your university uses
- Discuss how can you save energy

After 10 minutes we meet and talk together!