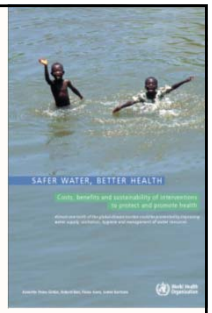
Vårt livsviktiga vatten
En ödesfråga för världen

Gustaf Olsson

Örnsköldsviks Senioruniversitet
24 sep. 2015

Burden of disease



Headlines

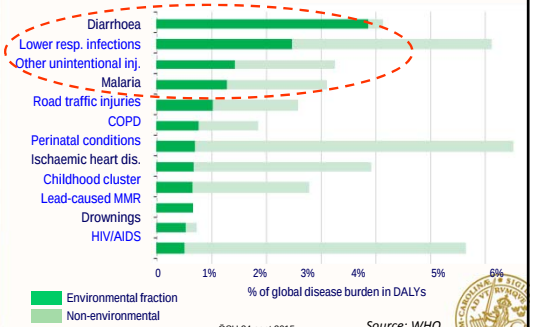
- **1.9 million attributable annual deaths from diarrhoea**
- **1.2 million malaria deaths each year**

Details

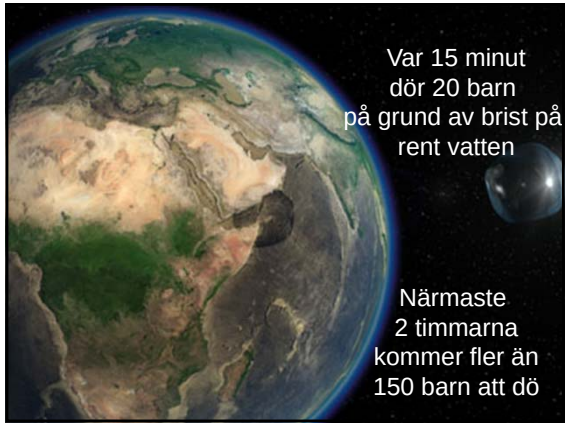
- **1.4 million preventable child deaths from diarrhoea**
- **Half a million malaria deaths that could have been prevented**

ÖSU 24 sept 2015 *Source: WHO*

Diseases with largest attributions to environmental determinants



ÖSU 24 sept 2015 *Source: WHO*



Detta är att jämföra med
10 jumbojet som kraschar varje dag

90 % av passagerarna är barn

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Hälften av alla sjukhussängar i låginkomstländer upptas av människor som lider av sjukdomar orsakade av smutsigt vatten, dålig sanitet och hygien.

(*UNDP Human Development Report, 2006)*

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Bristen på rent vatten, sanitet och hygien kostar länderna i Afrika söder om Sahara **mer i förlorad BNP än vad hela kontinenten får i bistånd**.

(*UNDP: Human Development Report, 2006*)

ÖSU 24 sept 2015

Varje krona som investeras i rent vatten och sanitet ger en avkastning på fyra kronor i ökad produktivitet.

(*WHO, Geneva, 2012*)

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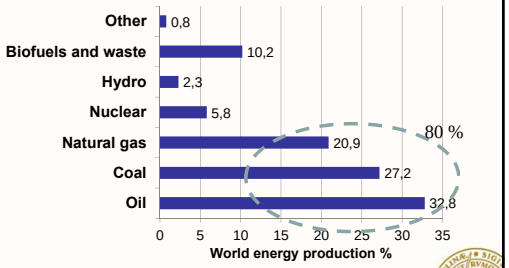
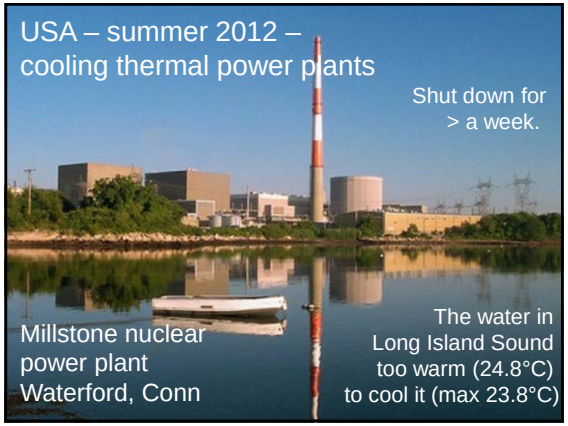
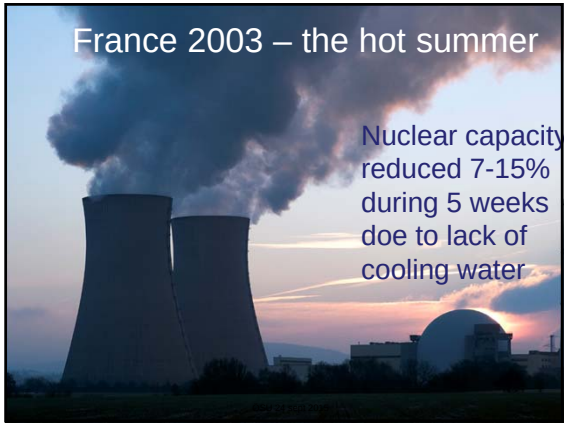
World energy production







Thermal power generation vs. water scarcity - China, 2010 and 2030

A 3-fold increase in water-intensive thermal power generation until 2030

Northern China
60% of China's thermal power capacity
20% of China's renewable freshwater supply

China's 'Big Five' power utilities (500 GW) are all located in water scarce regions

Source: Bloomberg New Energy Finance, National Bureau of Statistics of China.

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Planned dams in the Himalayas

Tibetan plateau, the source of the single largest collection of international rivers in the world.

- **Indus – Ganges – Brahmaputra (Zangbo) - Irrawati – Salween**
- **Megong (Lancang) – Yangtse – Huang He (Yellow river)**
- **The headwater of rivers on which nearly half the world depends**
- **Half of India's water comes directly from China**

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Planned dams in the Himalayas

- **China**
  - **The Tibetan plateau - the source of water for nearly 40% of the world's population**
  - **100 dams in Tibet**
- **India, Nepal, Bhutan, Pakistan:**
  - **>400 dams -- 160,000 MW**
- **Megong (Lancang) river:**
  - **60 dams from Tibet to SE Asia**
- **1 dam for every 32 km of river channel**

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Drought in China 2010

- **Around 50 million people faced water shortages in south-western China**
- **Damage to agriculture**
- **Damage to hydropower**

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Summer 2012 in USA –

worst drought since the 1950s - 80% of agricultural land was affected.

Price of corn soared

Corn for ethanol or for food?

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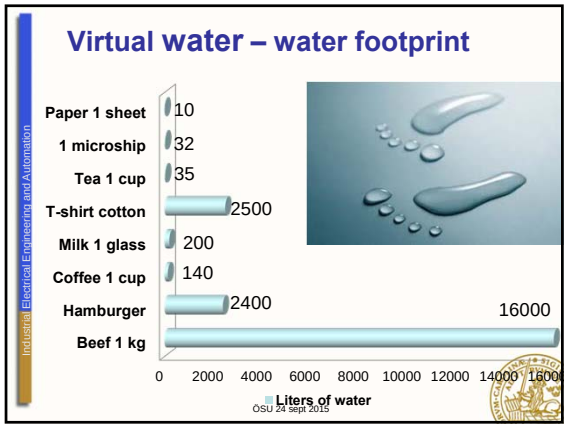
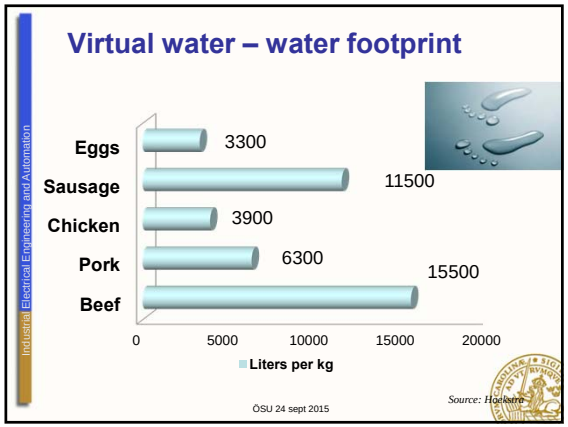
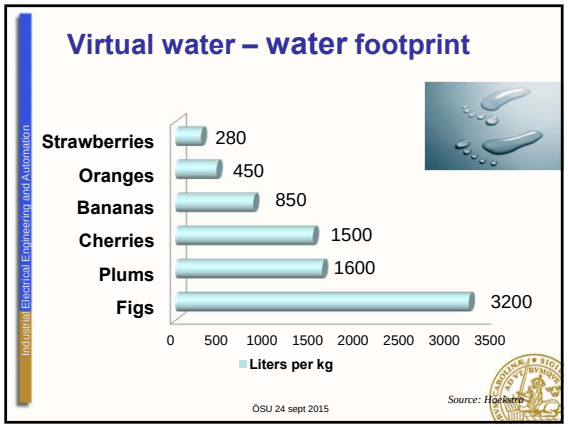
Virtual water – water footprint



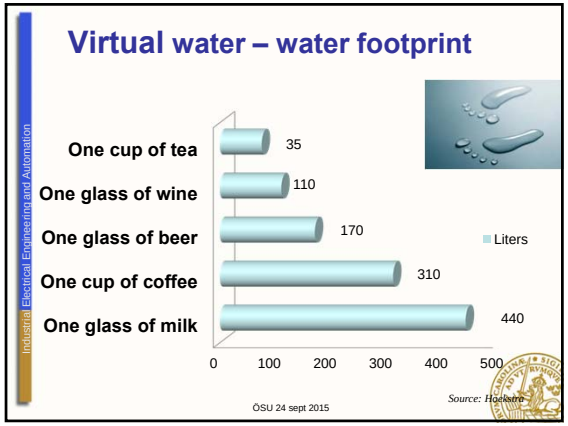
Virtual water – water footprint



Virtual water – water footprint



Virtual water – water footprint



Water to get energy

We eat 2000-3000 kcal
every day to get energy

For this food water is required:

1 m^3 to survive
2,6 m^3 for a vegetarian
5 m^3 for an American diet based on meat

Källa: World Water Council

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Food versus Feed and Fuel

Of the world food-crop calories:

- **55% to directly nourish people**
- **36% goes to feed cattle**
- **9% goes to fuel**
  (biofuel and industrial products)

We get another 4% indirectly by eating meat, dairy or eggs

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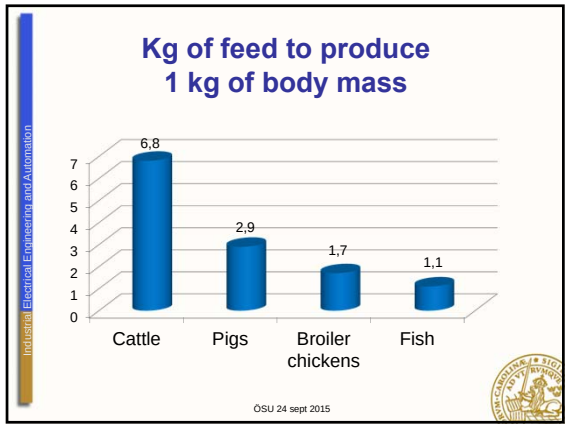
Kg of feed to produce
1 kg of body mass
6,8
2,9
1,7
1,1
Cattle
Pigs
Broiler chickens
Fish
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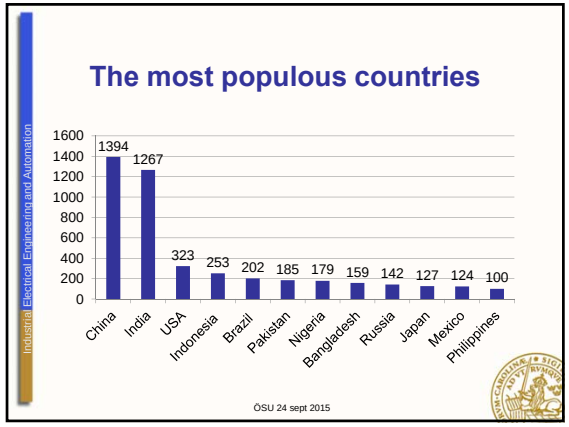
Abengourou, Ivory Coast
Population growth
We will be 9 billion in 2050
1 more million every week
Source: Yann Arthus-Be


Food production
More meat consumption
Sanitation
Water supply


The most populous countries
1394
1267
323
253
202
185
179
159
142
127
124
100
China
India
USA
Indonesia
Brazil
Pakistan
Nigeria
Bangladesh
Russia
Japan
Mexico
Philippines
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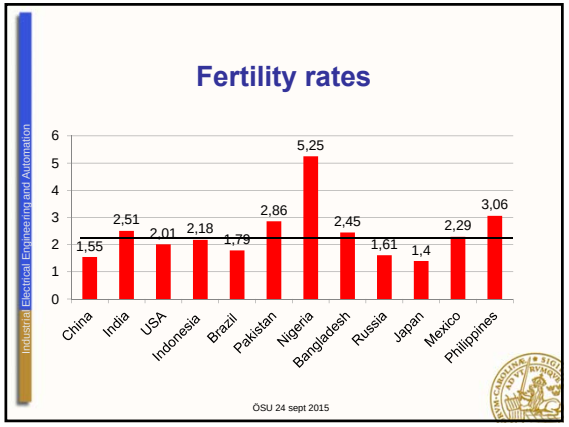
Fertility rates
1,55
2,51
2,01
2,18
1,79
2,86
5,25
2,45
1,61
1,4
2,29
3,06
China
India
USA
Indonesia
Brazil
Pakistan
Nigeria
Bangladesh
Russia
Japan
Mexico
Philippines
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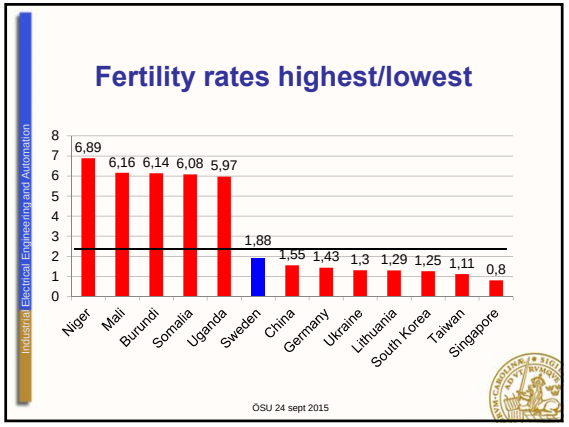
Fertility rates highest/lowest
6,89
6,16
6,14
6,08
5,97
1,88
1,55
1,43
1,3
1,29
1,25
1,11
0,8
Niger
Mali
Burundi
Somalia
Uganda
Sweden
China
Germany
Ukraine
Lithuania
South Korea
Taiwan
Singapore
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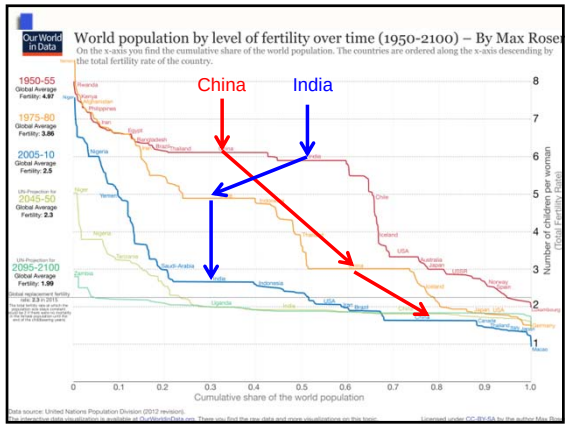


World population now

http://www.worldometers.info/watch/world-population/

http://populationpyramid.net/northern-america/2015/

9 miljarder år 2050 betyder…..

145 000 nya innevånare – varje dag

1 000 000 [illegible] – varje vecka

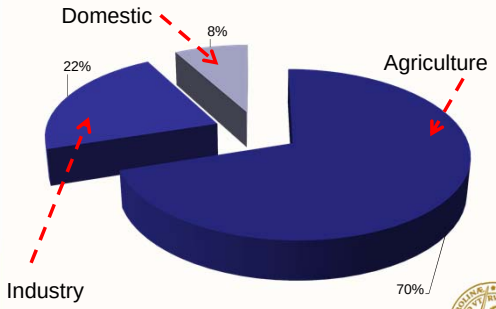
Hela Övik på cirka 8 timmar

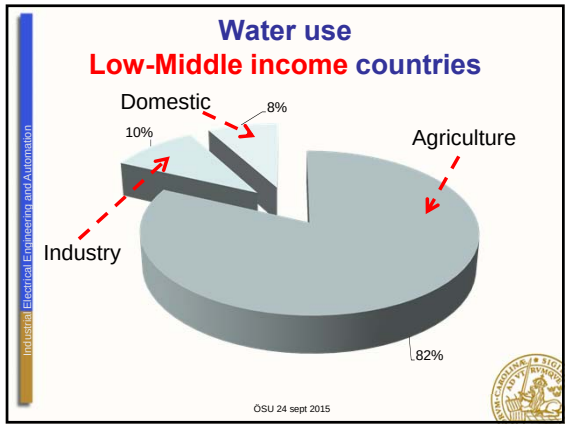
Därav

800 000 nya stadsbor – varje vecka under kommande 40 år

Vattenanvändning

Water use in the world




Water use
Low-Middle income countries
Domestic
8%
10%
Agriculture
Industry
82%
Industrial Electrical Engineering and Automation
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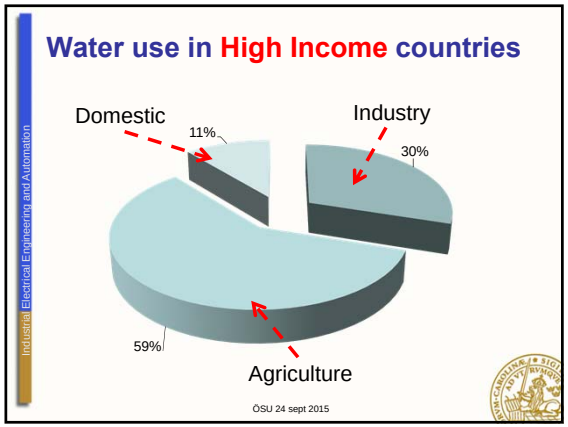
Water use in High Income countries
Domestic
11%
Industry
30%
59%
Agriculture
Industrial Electrical Engineering and Automation
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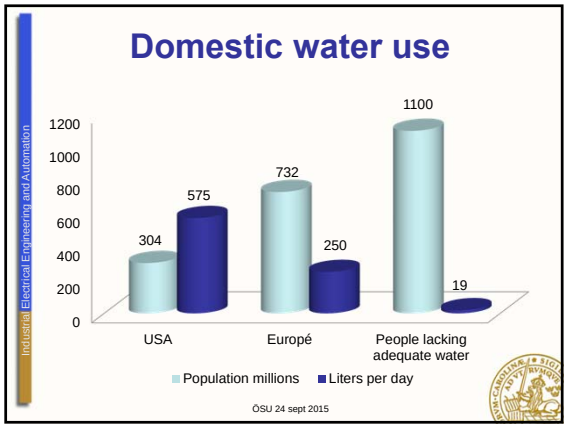
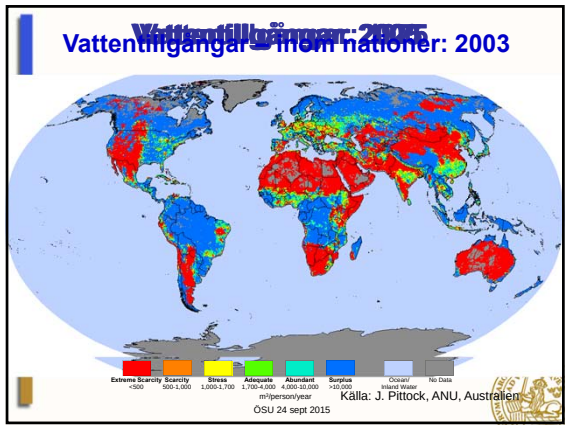
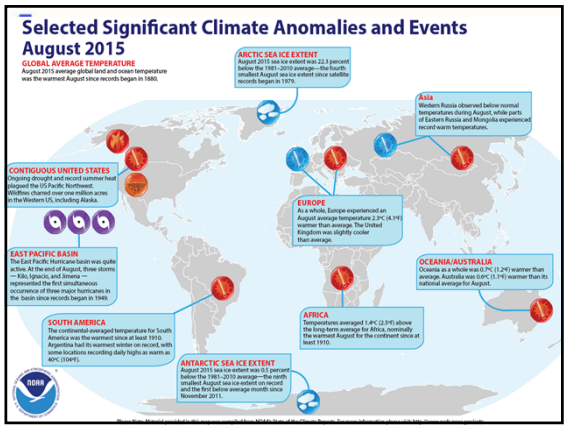
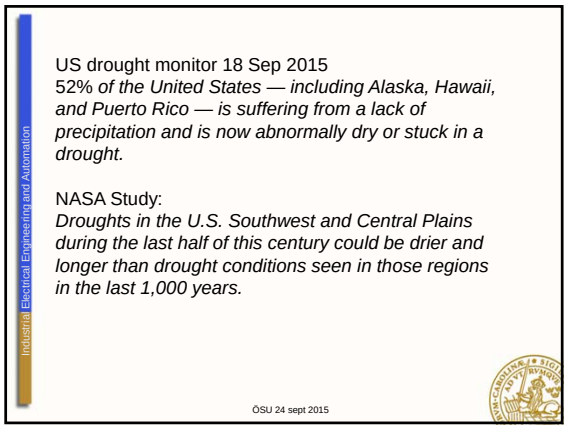
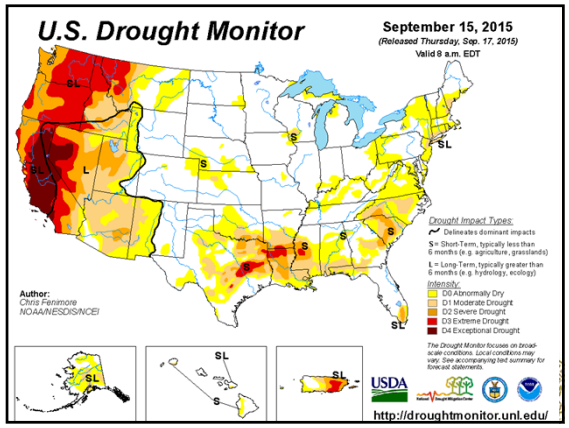

Domestic water use
1200
1000
800
600
400
200
0
304
575
732
250
1100
19
USA
Europé
People lacking adequate water
Population millions
Liters per day
Industrial Electrical Engineering and Automation
ÖSU 24 sept 2015


Vattentillgångar: 2003
Extreme Scarcity <500
Scarcity 500-1,000
Stress 1,000-1,700
Adequate 1,700-4,000
Abundant 4,000-10,000
Surplus >10,000
Ocean/ Inland Water
No Data
m³/person/year
Källa: J. Pittock, ANU, Australien
ÖSU 24 sept 2015

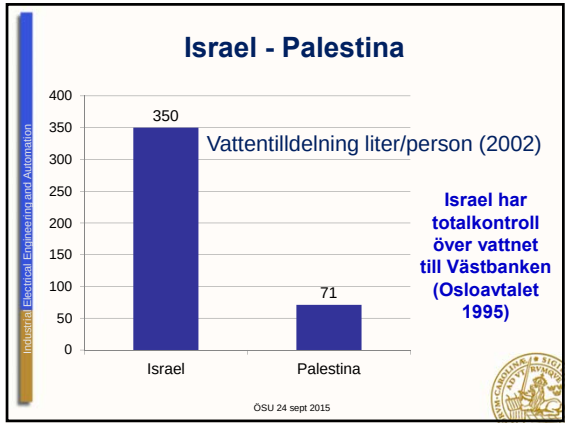

Selected Significant Climate Anomalies and Events
August 2015
GLOBAL AVERAGE TEMPERATURE
ARCTIC SEA ICE EXTENT
Asia
CONTIGUOUS UNITED STATES
EUROPE
EAST PACIFIC BASIN
OCEANIA/AUSTRALIA
SOUTH AMERICA
AFRICA
ANTARCTIC SEA ICE EXTENT
NOAA


US drought monitor 18 Sep 2015
52% of the United States — including Alaska, Hawaii, and Puerto Rico — is suffering from a lack of precipitation and is now abnormally dry or stuck in a drought.
NASA Study:
Droughts in the U.S. Southwest and Central Plains during the last half of this century could be drier and longer than drought conditions seen in those regions in the last 1,000 years.
Industrial Electrical Engineering and Automation
ÖSU 24 sept 2015

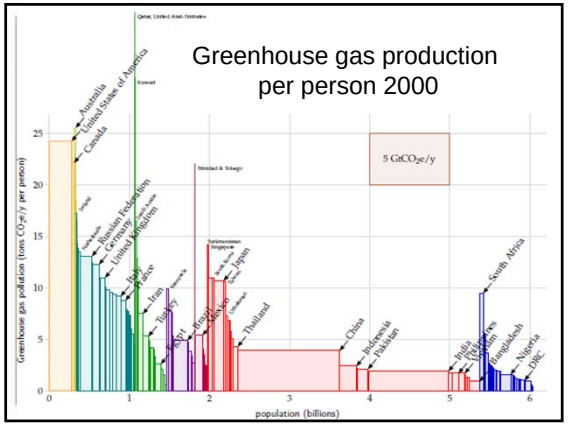

U.S. Drought Monitor
September 15, 2015
(Released Thursday, Sep. 17, 2015)
Valid 8 a.m. EDT
Drought Impact Types:
Intensity:
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought
Author:
Chris Fenimore
NOAA/NESDIS/NCEI
USDA
http://droughtmonitor.unl.edu/

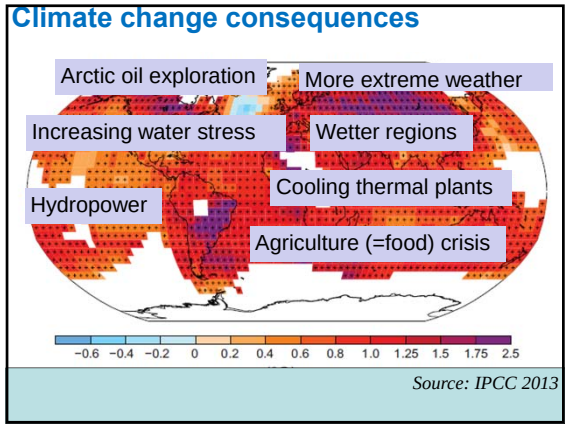

Industrial Electrical Engineering and Automation
Vatten som konfliktorsak
ÖSU 24 sept 2015

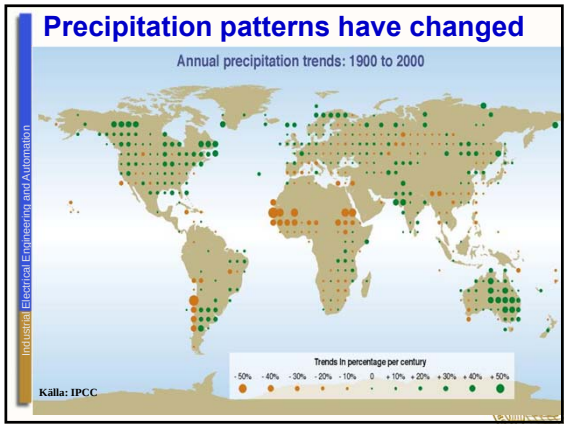

Industrial Electrical Engineering and Automation
Vatten som en potentiell konfliktrisk
• Vatten är inte likformigt distribuerat i världen.
• Vatten är en konfliktorsak varhelst vattenresurser delas mellan grannländer. Betydande konsekvenser för internationella relationer (t.ex. i Mellanöstern)
• Globalt finns det 215 floder och 300 grundvattentäkter som delas mellan 2 eller flera länder
Dr. Allan R. Hoffman
U.S. Department of Energy
ÖSU 24 sept 2015

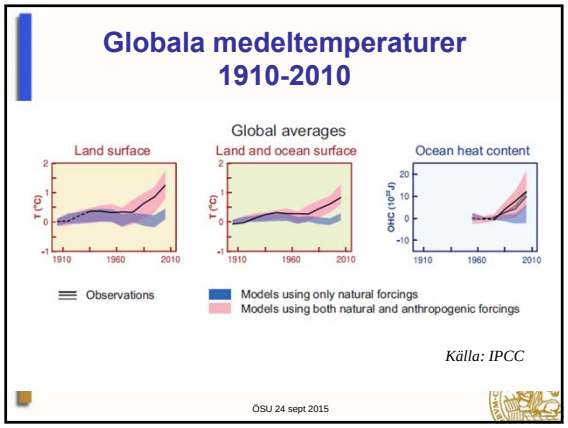

Industrial Electrical Engineering and Automation
Israel - Palestina
400
350
300
250
200
150
100
50
0
350
71
Israel
Palestina
Vattentilldelning liter/person (2002)
Israel har totalkontroll över vattnet till Västbanken (Osloavtalet 1995)
ÖSU 24 sept 2015


Klimat-förändringarna
ÖSU 24 sept 2015


Greenhouse gas production per person 2000
5 GtCO2e/y
population (billions)


Climate change consequences
Arctic oil exploration
More extreme weather
Increasing water stress
Wetter regions
Cooling thermal plants
Hydropower
Agriculture (=food) crisis
−0.6 −0.4 −0.2 0 0.2 0.4 0.6 0.8 1.0 1.25 1.5 1.75 2.5
Source: IPCC 2013


Precipitation patterns have changed
Annual precipitation trends: 1900 to 2000
Trends in percentage per century
Källa: IPCC


Globala medeltemperaturer 1910-2010
Global averages
Land surface
Land and ocean surface
Ocean heat content
Observations
Models using only natural forcings
Models using both natural and anthropogenic forcings
Källa: IPCC
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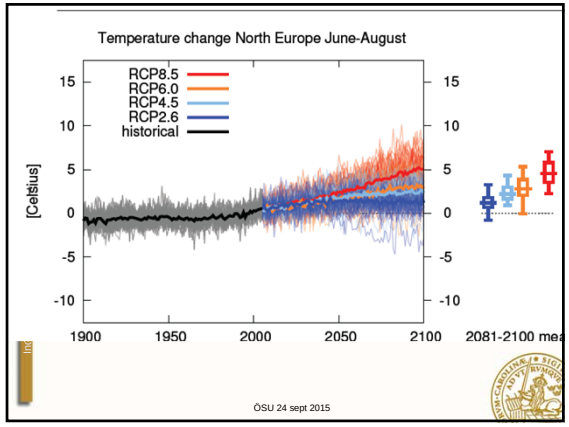
Temperature change North Europe June-August
RCP8.5
RCP6.0
RCP4.5
RCP2.6
historical
[Celsius]
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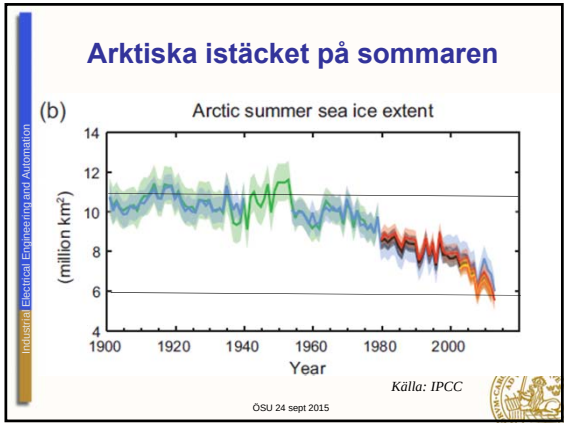
Arktiska istäcket på sommaren
(b)
Arctic summer sea ice extent
(million km²)
Year
Källa: IPCC
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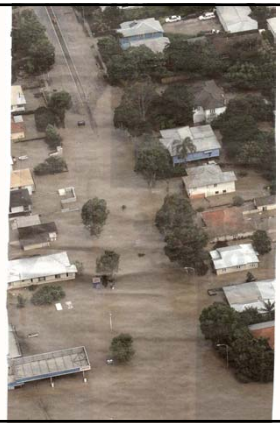
Typhoon Haiyan 2013 Philippines



Brisbane
Queensland
Jan. 2011

Flooding Assam, India June 2012

Assam, India, June 2012

Assam India June 2012

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Global warming is not a theory.
It is a measurement,
known to the climate science community
for more than 100 years.

Climate change as a result of global warming
is a physical phenomenon.
Certain air masses become weaker, others stronger,
the circulation changes,
the sea currents change, etc.
It is just physics.

Dr. David Vernon

The CO_2 hypothesis was first presented by
Svante Arrhenius in 1896

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"We use 30 percent of all the energy ....
That isn't bad; that is good.
That means that we are the richest,
strongest people in the world
and that we have the highest
standard of living in the world.
This is why we need so much energy,
and may it always be that way."

President Richard Nixon to Seafarers International Union,
Washington DC, Nov 26, 1973.
(The Union contributed with $ 100,000
to the presidential campaign in 1972)

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- *No more than 1/3* of the proved reserves of fossil fuels should be used by 2050 to limit global warming to 2°C.
- Energy-related carbon-dioxide emissions are leaving the world on track for a long-term average temperature increase of 3.6 °C, compared to pre-industrial levels.

Source: IEA World Energy Outlook 2013

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Klimatkrisen

- Jag känner väldigt få forskare som uppriktigt tror att 2°-målet är möjligt
  (Björn-Ola Linnér, klimatforskare Linköpings Univ.)
- 2°C syftar på jordens medeltemperatur. Det betyder 3°C på land, 4-5°C i Arktis
- 4°C medeltemperatur innebär 6°C på land och över 8°C i Arktis.

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Klimatkrisen

”En 2°-värld kan hanteras, med mycket möda och global solidaritet.
Jag tror inte att en 4°- värld kan hanteras.
Det innebär i klartext att flera områden på jorden kommer att bli obeboeliga. Det skulle kasta in hela världen i en mörk era. Skillnaden är enorm”
(Hans Schellnhuber,
chef för Klimatinstitutet i Potsdam)

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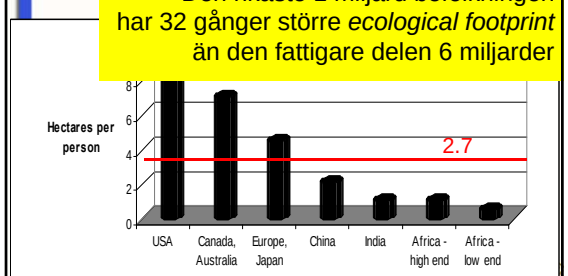
Ecological footprints

Den rikaste 1 miljard befolkningen har 32 gånger större *ecological footprint* än den fattigare delen 6 miljarder



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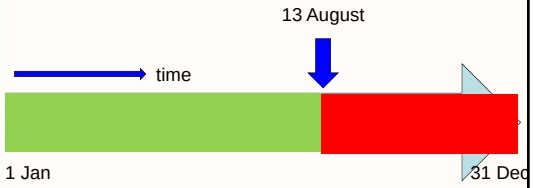
Global overshoot day



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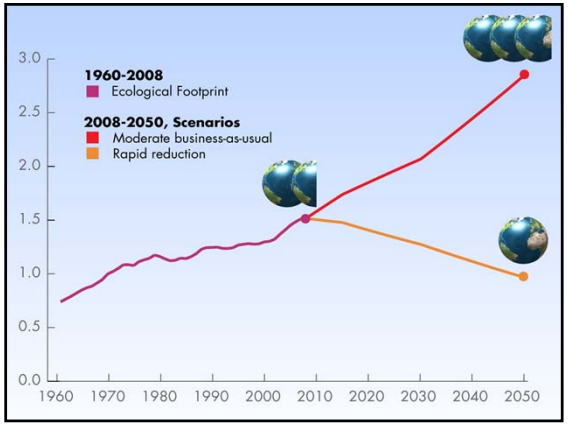
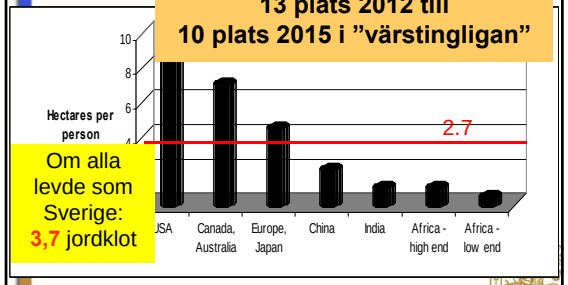


Ecological footprints

Sverige har klättrat från 13 plats 2012 till 10 plats 2015 i ”värstingligan”



Om alla levde som Sverige: 3,7 jordklot

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The footprint of Sweden = 3.7 Earths

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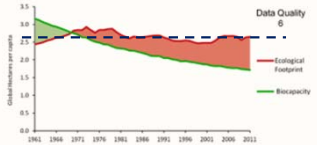
The global ecological footprint



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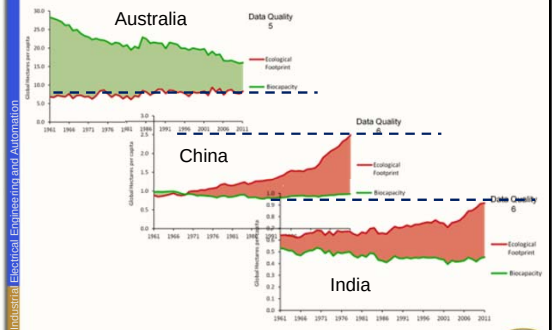

www.footprintnetwork.org
UN statistical sources

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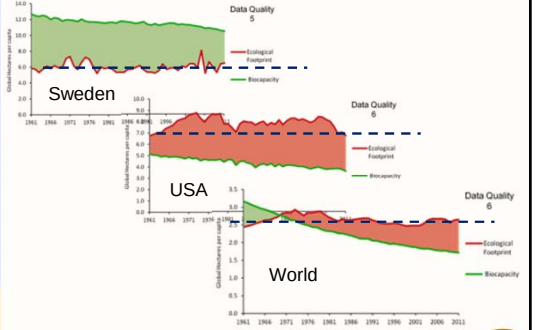

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Den stora motsägelsen….

- **President Obama 2015: ”Climate change can no longer be denied . . . and action can no longer be delayed.”**
- **Obama administration 2015: gives Royal Dutch Shell permission to move ahead with plans for Arctic offshore drilling**
- **Conclusion: the decision is about energy policy — promoting U.S. self-sufficiency and creating jobs — rather than climate policy.**

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The issue is the inconvenience of the truth

Dr. David Vernon

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- Population growth
- Climate change
- Urbanization

- Water for energy
- Water for food

- Energy for water
- Energy for food

Water | Energy

Food | Land

- Agriculture impact on water quantity and quality

- Land use for energy
- Land use for food

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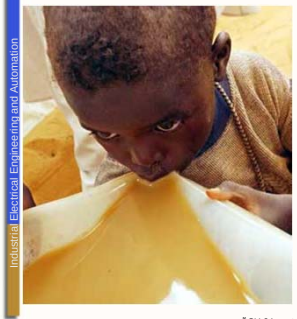
Energy - treating impaired water



Requires more advanced technology and more energy

Reused, brackish, sea water

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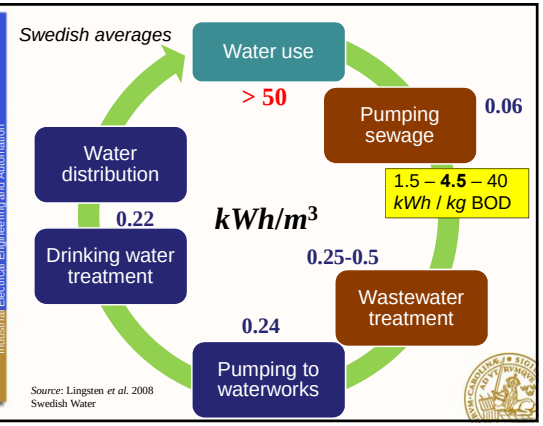
Swedish averages



Source: Lingsten *et al.* 2008
Swedish Water

Energy cost to produce cold water

	kWh / m³
Surface water	0.5 - 4
Recycled water	1 - 6
Desalination	4 - 8
Bottled water	1000 - 4000

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Water and Energy – inextricably linked

Demand for more energy

Demand for more water

Demand for more energy

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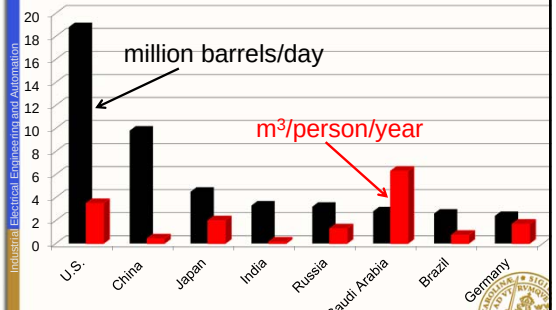
Primary energy extraction

Oil consumption



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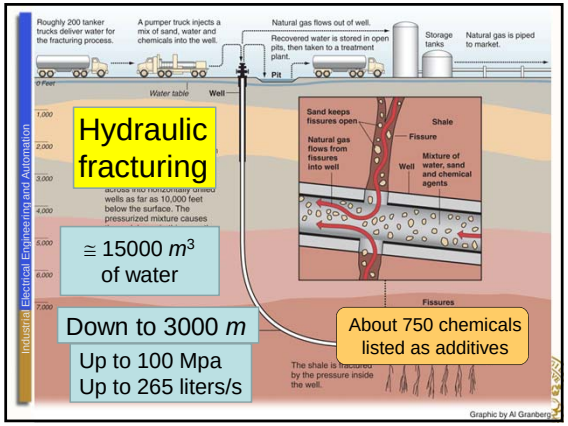
Hydraulic fracturing

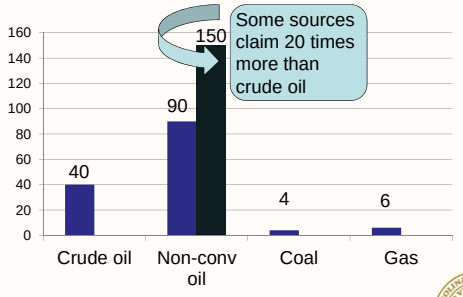
The New Oil Landscape

Source: National Geographic - N. Dakota

Hydraulic fracturing



Water consumption per *liter* or *kg*



Source: World Energy Council, 2010

Fracking facts

- The fracking fluid
  - 80% water
  - 19% proppant – natural quartz + man made ceramics
  - 0.5% chemicals – additives (many toxic) – to inhibit bacterial growth, minimize friction, increase viscosity
- Volumes (during a life time of a well)
  - Up to 8000 m^3 water
  - Up to 2000 tons of proppant
  - 50+ m^3 (or 300+ barrels) of chemicals

Risks in fracking (1)

- Cement-casing failures may allow methane and other hazardous chemicals to migrate to water sources and water wells
- Fracking fluid contains known carcinogens and air pollutants - can leak into ground and surface water during the fracking process
- BTEX - benzene, toluene, xylene, ethylbenzene (harmful effects on the central nervous system), have been found in hydraulic fracturing products

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Risks in fracking (2)

Water contamination:

- accidental spills during truck transportation
- leakages through cracked or corroded cement casing of the wells
- fugitive gas through the rock fractures

Wastewater ("produced water") **- serious risks:**

- 20-40% will be returned back to the surface

Bringing

- chemicals, traces of oil-laced drilling mud,
- iron, chromium, salt,
- radioactive materials including Radium 226

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Fracking often in dry regions

- Groundwater is sold to the oil company instead of being used for irrigation
- Conflict between energy and food!

The fracking controversy

Pennsylvania, USA 2011
Source: Nat. Geographic

Gasflammor i Texas – Eagle Ford

Oil accidents

One drop of oil ….

…..can make 25 liters of water undrinkable

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Remember some oil accidents

- **Exxon Valdez, Alaska 1979 – 43 000 m^3**
- **Mexican Gulf, Deepwater Horizon 2010 – 780 000 m^3**
- **Nigeria, the Niger Delta during 50 years – 1.4 – 2.1 million m^3**

(one Exxon Valdez every year….)

Niger Delta wetland

Sivibilagbara swamp before oil spill

International Herald Tribune 31 Jan 2013

Shell cleared over most claims in Nigeria spills

Court finds one instance where company should have prevented pollution

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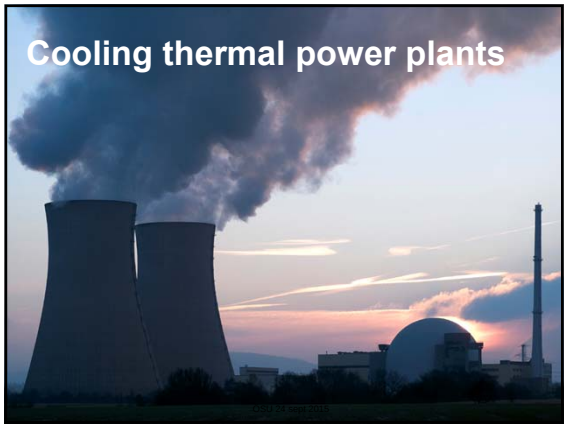
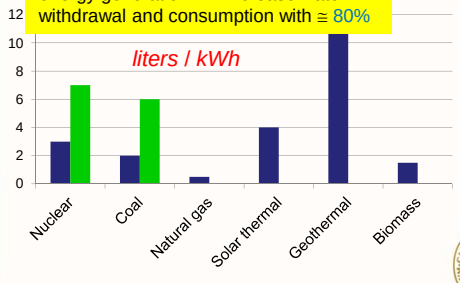
Cooling thermal power plants



Water consumption in electrical generation

Carbon sequestration for fossil energy generation will increase water withdrawal and consumption with ≅ 80%



Water withdrawal - once-through cooling

- **Nuclear power plants**
  - **Typical temp. increase USA 16.5°C**
  - **1000 MWe requires 33 m^3/s**
  - **Rule of thumb for 1000 MWe: 25 – 43 m^3/s**
- **Coal fired plants**
  - **Typical temp. increase USA 9.5°C**
  - **1000 MWe requires 50 m^3/s for ΔT=10°C**

*Source: Richard Bozek, Edison Electric Initiative, 2011

Av de 33 m^3/s konsumeras (avdunstar) cirka 0.5 m^3/s

Vi svenskar använder cirka 150 liter/dag/person

Det avdunstade kylvattnet skulle räcka till cirka 300 000 personer

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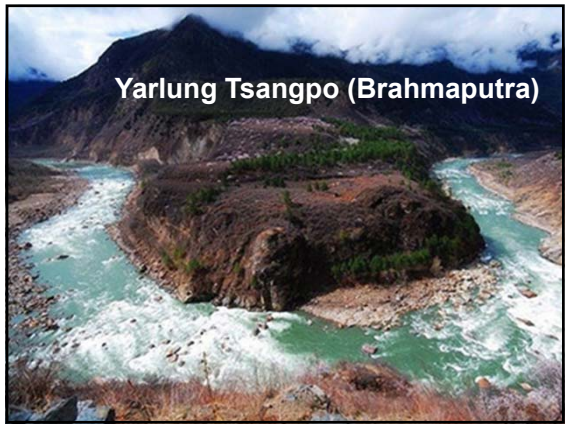

Planned dams in the Himalayas

- China
  - The Tibetan plateau - the source of water for nearly 40% of the world's population
  - 100 dams in Tibet
- India, Nepal, Bhutan, Pakistan:
  - >400 dams -- 160,000 MW
- Megong (Lancang) river:
  - 60 dams from Tibet to SE Asia
- 1 dam for every 32 km of river channel

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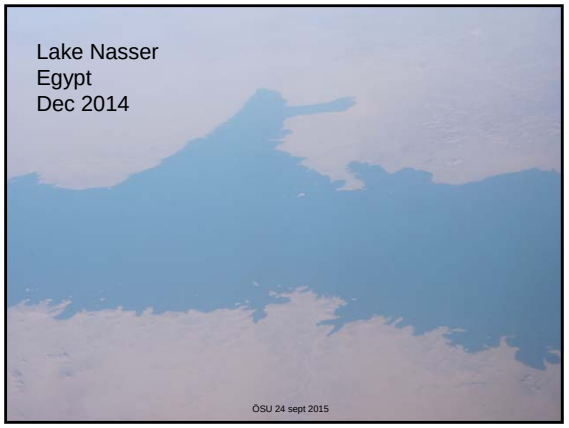
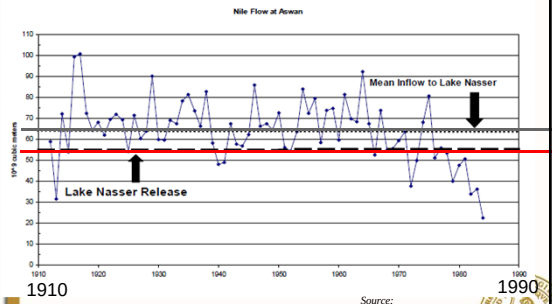


Nile flow at Aswan



Source: Strzepek et al. 2013

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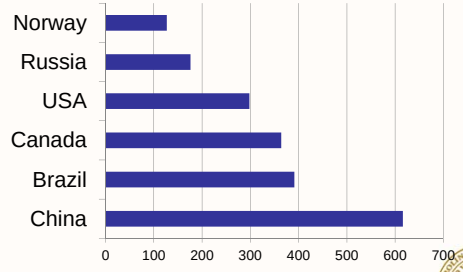
Top producers of hydro power (TWh)



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Large dams – impacts to consider 1

- Flooded area
  - Persons requiring resettlement
    - Number of peoples displaced/MW
  - Cultural property affected
  - Biomass flooded
  - Critical natural habitats affected
  - Floating aquatic vegetation

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Large dams – impacts to consider 3

- **Reservoir sedimentation**
  - Useful reservoir life - before ”dead storage” is filled
  - Reduction in sedimentation reaching the mouth
  - A growing risk of landslides and reservoir induced seismicity

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Hydropower – environmental impact

- The severity of environmental impacts from a hydroelectric project is largely determined by the dam site
- In general, the most environmentally benign hydroelectric dam sites are on upper tributaries, while the most problematic ones are on the large main stems of rivers

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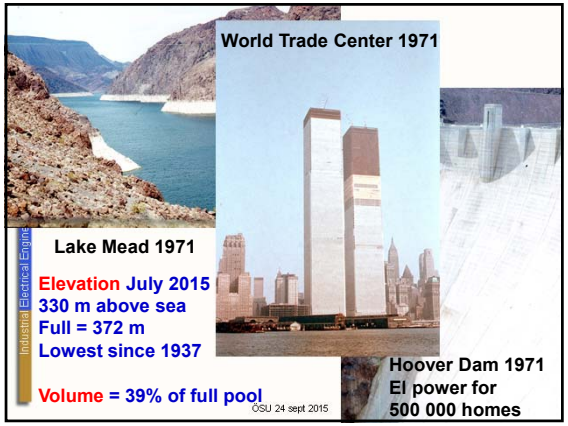
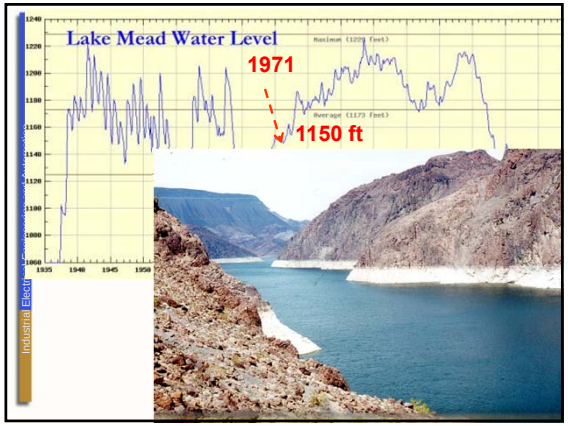
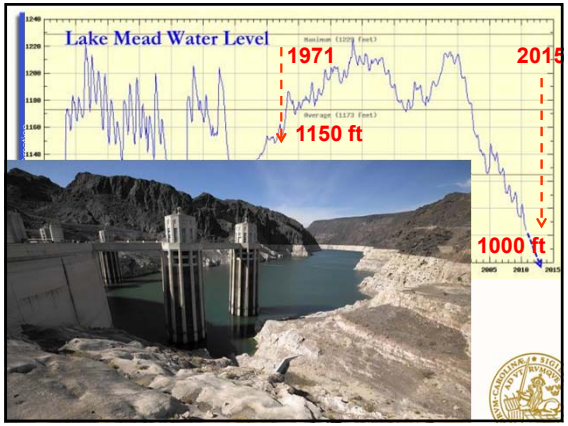
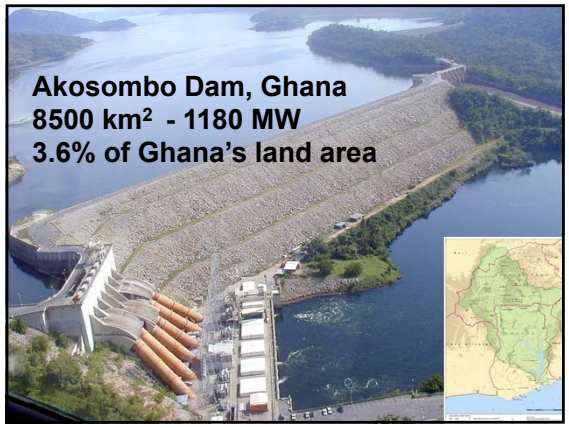
Hydro – integrated systems analysis

- Hydropower - can the income compensate for the cost of moving people and using the land?
- Benefit of flood control and water storage compared to the cost of losing the fertilizing capability of silt downstream?
- Cost related to the settling of silt?
  - Hydropower generation potential?
  - Can any silt be removed?









Evaporation

	ha/MW	Evaporation mm/year	Evaporation Gm³/year	liters/kWh
Akosombo **Ghana**	720	2185	19	3000
Sobradinho, **Brazil**	400	2841	12	1430
Bayano, **Panama**	233	2156	0.75	1370
Itezhi Tezhi, **Zambia**	62	2572	0.95	338
Robert Bourossa, **Canada**	36	586	1.7	30
San Carlos, **Colombia**	0.26	1726	0.01	1

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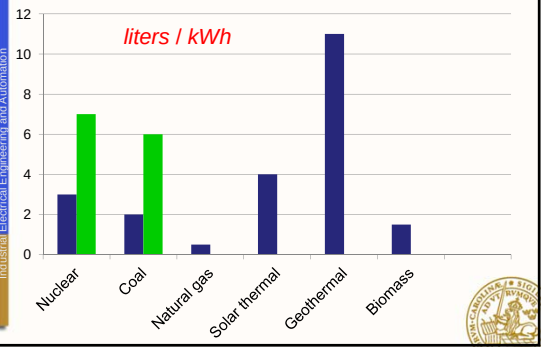
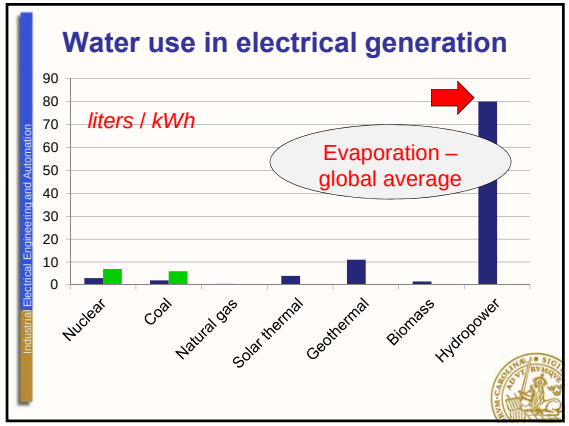
Source: Mekonnen & Hoekstra 2012

Water use in electrical generation



Water use in electrical generation



Hydro – integrated systems analysis

- Increasing **water temperature**
  - ecological balance in the river?
  - risk of unwanted harmful bacteria?
- Is the loss of water due to **evaporation** causing measurable losses for the irrigation of farmlands?
- Thermal power plants downstream?
  - warmer **cooling water**

Biofuels

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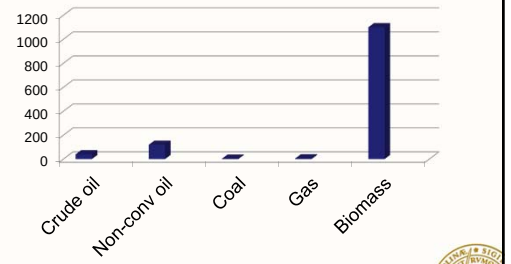
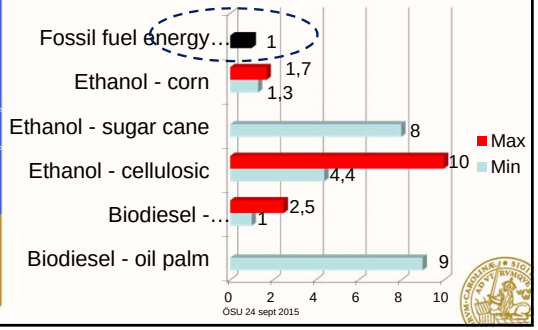
Water consumption per *liter* or *kg*



Energy balance for biofuels



Biofuels in EU

Int. Institute for Sustainable Development (2013):

- **The CO_2 and climate benefits from replacing petroleum fuels with biofuels like ethanol are *basically zero***
- **Much more effective, much less costly, to significantly *reduce vehicle emissions* through more stringent standards.**
- ***20-100 times cheaper* than the average CO_2 abatement cost for biofuels**

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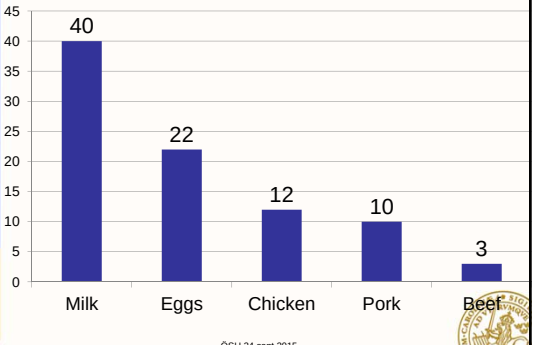
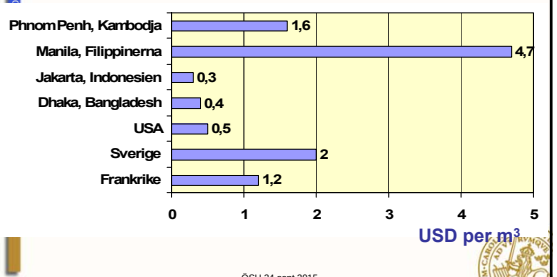
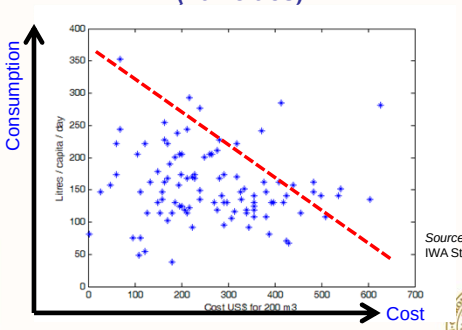
Given 100 calories of grain to animals



Kostnad för vatten



Water consumption vs. cost for 200 m^3 (104 cities)



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För 200 kronor kan vi förse en människa med en varaktig tillgång till vatten, förbättrad hygien och till sanitet.

(*WaterAid, 2011*)

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Kosmetika

- **Sverige**
  - **Vi handlar kosmetika för 11 miljarder/år**

För 2 miljarder kan vi säkra vattentillgången för cirka **10 miljoner** människor

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Kostnaden för dåligt vatten..

Kostnaden för Afrika på grund av brist på rent vatten and sanitet:
28 miljarder US$ eller 5% av BNP

Länder söder om Sahara har råd att utnyttja 4% av sina förnyelsebara vattenresurser. 70-90% i industriländer.

”Fattigdom och svält måste bekämpas. Då kan man också lösa vattenfrågan”

Källa: Världsbanken

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Utbildning och levnadsvillkor

- 440 miljoner skoldagar förloras varje år på grund av vattenrelaterade sjukdomar
- 11% fler flickor går i skolan om det finns sanitetsmöjligheter
- 40 miljarder arbetstimmar (25 miljoner heltidsarbeten) används varje år för att bära vatten i Afrika
- Hushåll på landsbygden i Afrika använder 26% av sin tid för att hämta vatten. Det är vanligen kvinnornas roll

Källa: Wateraid statistics

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Varje krona som investeras i rent vatten och sanitet ger en avkastning på fyra kronor i ökad produktivitet.

(*WHO, Geneva, 2012*)

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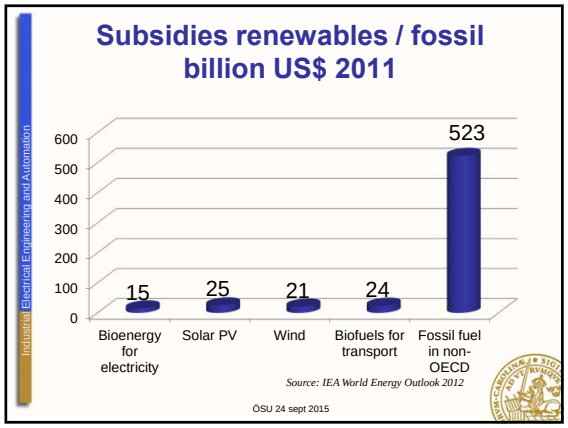
Renewable energy


Subsidies renewables / fossil billion US$ 2011
600
500
400
300
200
100
0
15
25
21
24
523
Bioenergy for electricity
Solar PV
Wind
Biofuels for transport
Fossil fuel in non-OECD
Source: IEA World Energy Outlook 2012
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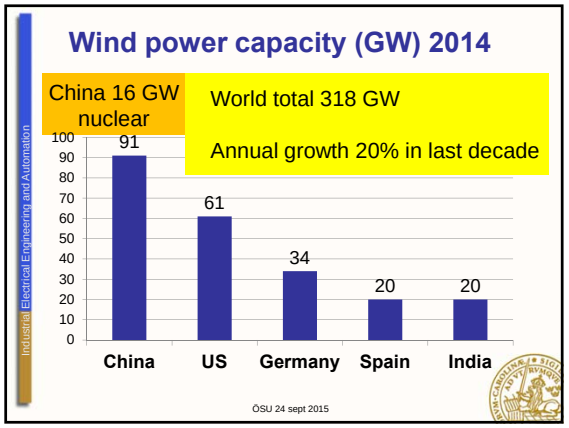
Wind power capacity (GW) 2014
China 16 GW nuclear
World total 318 GW
Annual growth 20% in last decade
100
90
80
70
60
50
40
30
20
10
0
91
61
34
20
20
China
US
Germany
Spain
India
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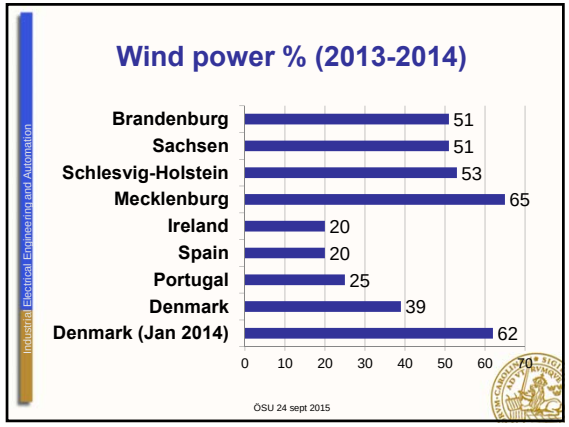
Wind power % (2013-2014)
Brandenburg 51
Sachsen 51
Schlesvig-Holstein 53
Mecklenburg 65
Ireland 20
Spain 20
Portugal 25
Denmark 39
Denmark (Jan 2014) 62
0 10 20 30 40 50 60 70
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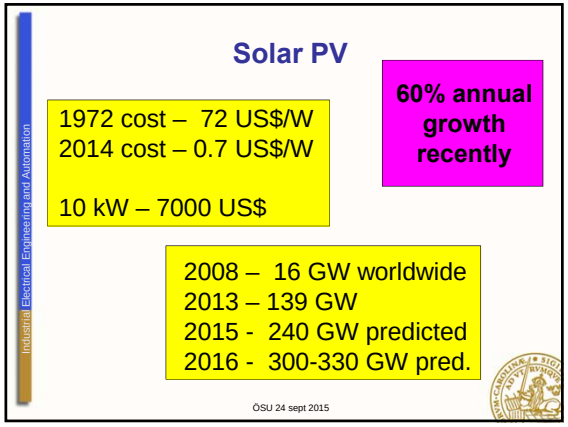
Solar PV
1972 cost – 72 US$/W
2014 cost – 0.7 US$/W
10 kW – 7000 US$
60% annual growth recently
2008 – 16 GW worldwide
2013 – 139 GW
2015 - 240 GW predicted
2016 - 300-330 GW pred.
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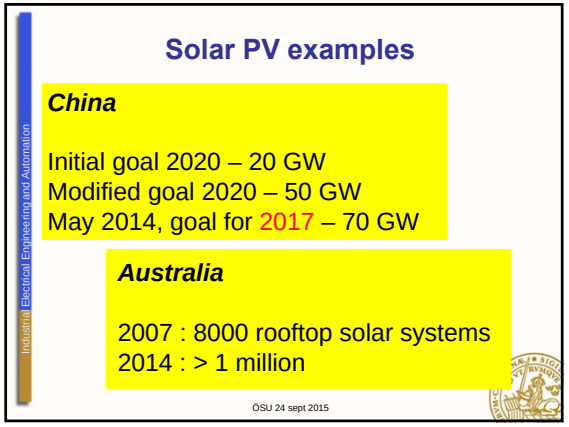
Solar PV examples
China
Initial goal 2020 – 20 GW
Modified goal 2020 – 50 GW
May 2014, goal for 2017 – 70 GW
Australia
2007 : 8000 rooftop solar systems
2014 : > 1 million
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Land use and water consumption

Hydropower

0.08 – 17 MW/km^2
1 – 3000 l /kWh

Wind

On-Shore: 3 MW/km^2
Off-Shore: 8 MW/km^2

Biofuel

Corn ethanol ~ 1 MW/km^2
0.5 - 90 l /kWh

Palm oil biodiesel
0.08 – 0.5 l/kWh

Solar PV

Up to: 100 MW/km^2

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Wind

Solar PV

→ No cooling water

→ No air pollution

→ No water pollution

Water available for other purposes

Power for production?
Power payback time?

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Powering the world

- **1.3 billion people not connected to any grid**
- **Cheaper, quicker and more efficient to install solar PV or wind instead of a central power plant and a transmission grid**
- **Example, India and Bangladesh:**
  - **Replace kerosene with solar PV**
  - **Payback time 3 years**
  - **1.5 billion kerosene lamps in the world**

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New system structures

- **Energy economy is localizing**
- **Water systems will be more decentralized**
- **Two developments of electric power**
  - **Local generation without a power grid**
  - **Local generation connected to a grid**
- ***Controlling the smart power grid***
- ***Controlling the smart water grid***

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Så – vad kan du o jag göra...

Nyckelordet: minska konsumtionen!

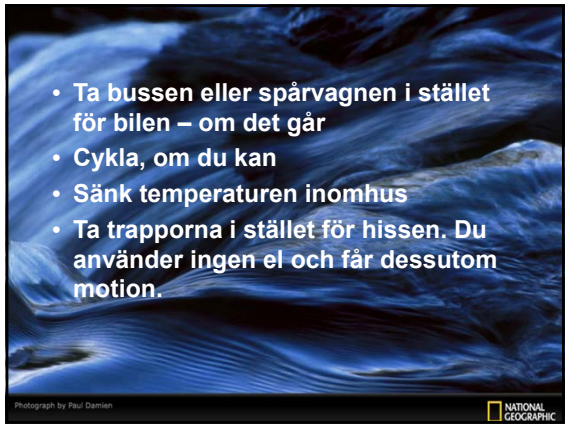
Minska mängden
- **bränsle (bil, resor, innetemperatur)**
- **elenergi**
- **animaliska produkter**
- **bomullskläder?**

Varifrån kommer köttet, frukten, bomullen ….. ?

Photograph by Paul Damien NATIONAL GEOGRAPHIC

- **Minska varmvattenförbrukningen**
- **Hur mycket vatten importerar du från torra länder?**
- **Drick kranvatten – inte flaskvatten!**

Photograph by Paul Damien NATIONAL GEOGRAPHIC



Vi kan påverka klimatet!

- Konsumenten måste göra något – inte bara producenten
- Hur fungerar vi?
  - Vanor o attityder
  - Livsstil
  - Prissättning

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…och ….

- Använd tygkassar i stället för plast. Du sparar olja.
- Plantera ett träd
- Skaffa en effektivare tvättmaskin, kyl o frys
- Använd snålspolande dusch o duscha kortare
- Stäng av datorn på natten
- Kom ihåg: stand-by (TV, CD, datorer, laddare….) kräver tillsammans mycket energi – stäng av!

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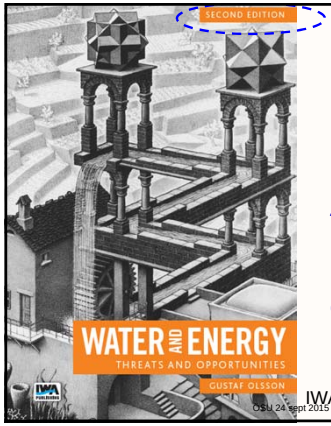
…och ….

- Tacka Gud för maten!
- Släng inte så mycket mat!
- Lärdom från japanska shinto *itadakimasu*: ”Jag accepterar ödmjukt gåvan från ditt liv”

Industrial Electrical Engineering and Automation



Thank you!

gustaf.olsson@iea.lth.se