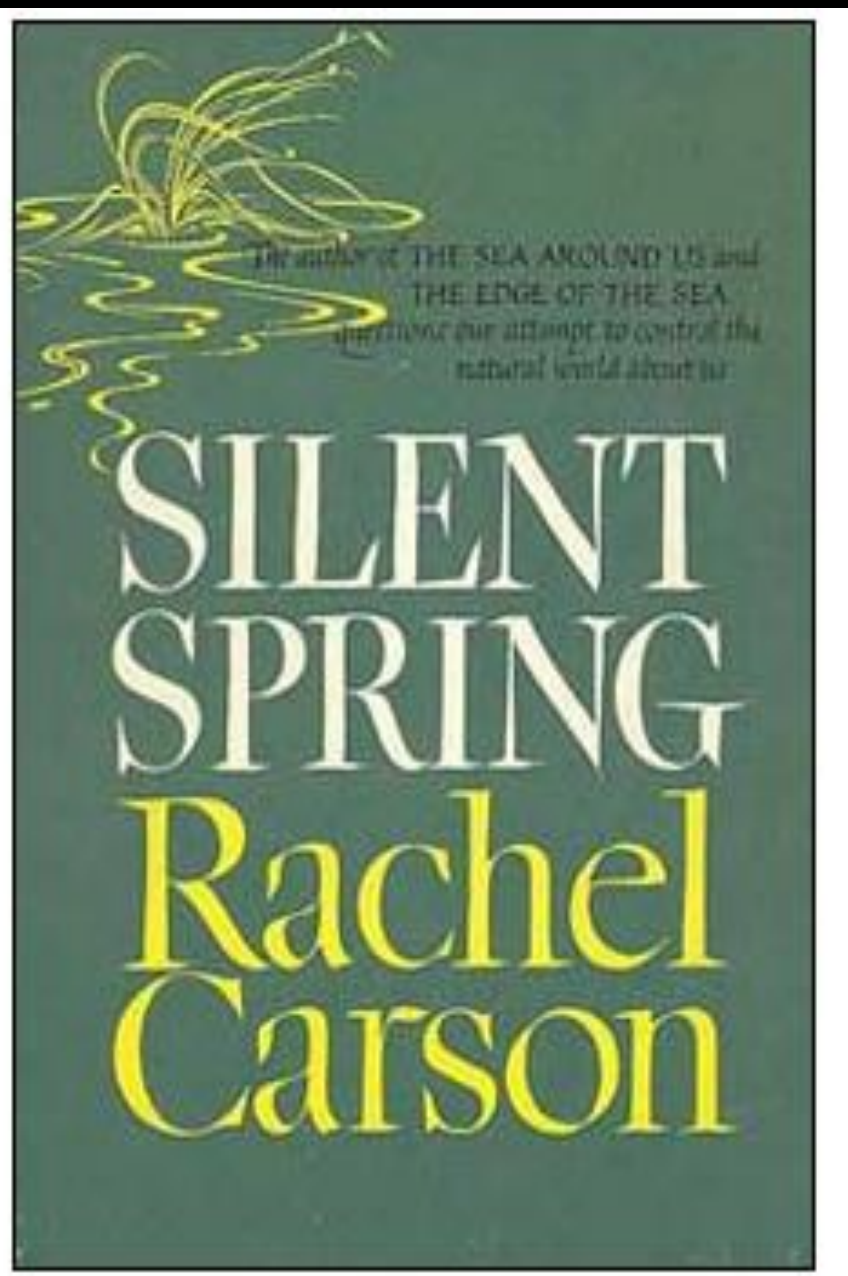


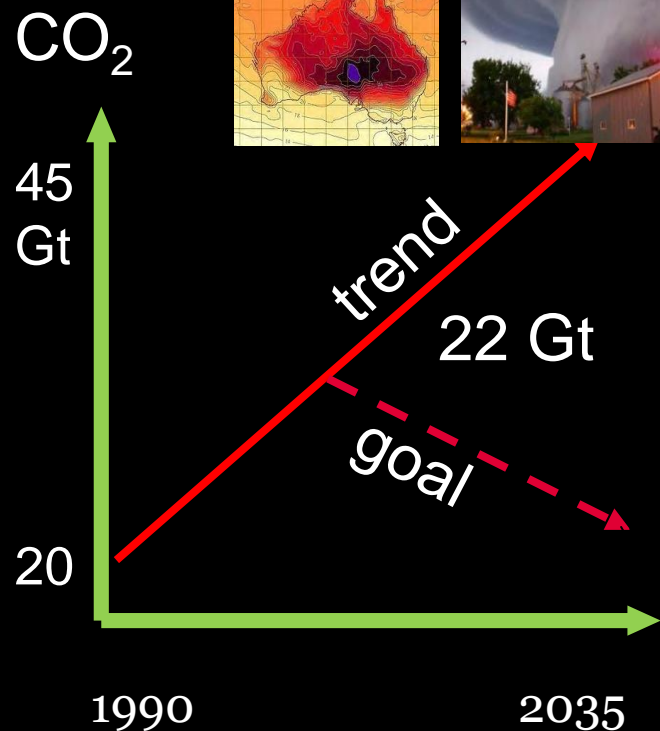
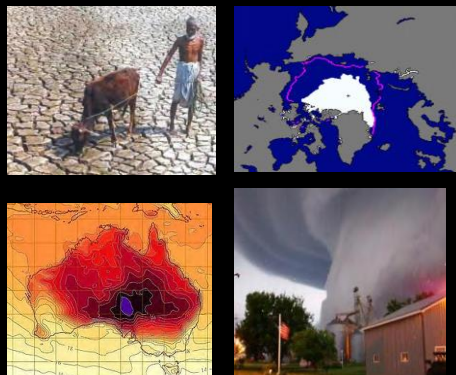
Low-carbon (bio)economy in Finland

Peter Lund
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peter.lund@aalto.fi

Above Final Seminar, Viikki, 30.10.2014



Human-driven environmental degradation continues



- I. 20% of population use 80% of all [energy] resources
- II. 1/2 of all people earn less than 2\$ a day

- I. Fossil fuels >80% of energy, oil>98% of traffic
- II. Coal (power) and oil (traffic) 80% of CO₂
- III. Goal: CO₂ down by 60% 2050, >80% in industrialized countries
- IV. 65% of energy used in cities(80% in2040)
- V. >80% of energy demand growth from emerging economies

The Economy is ...

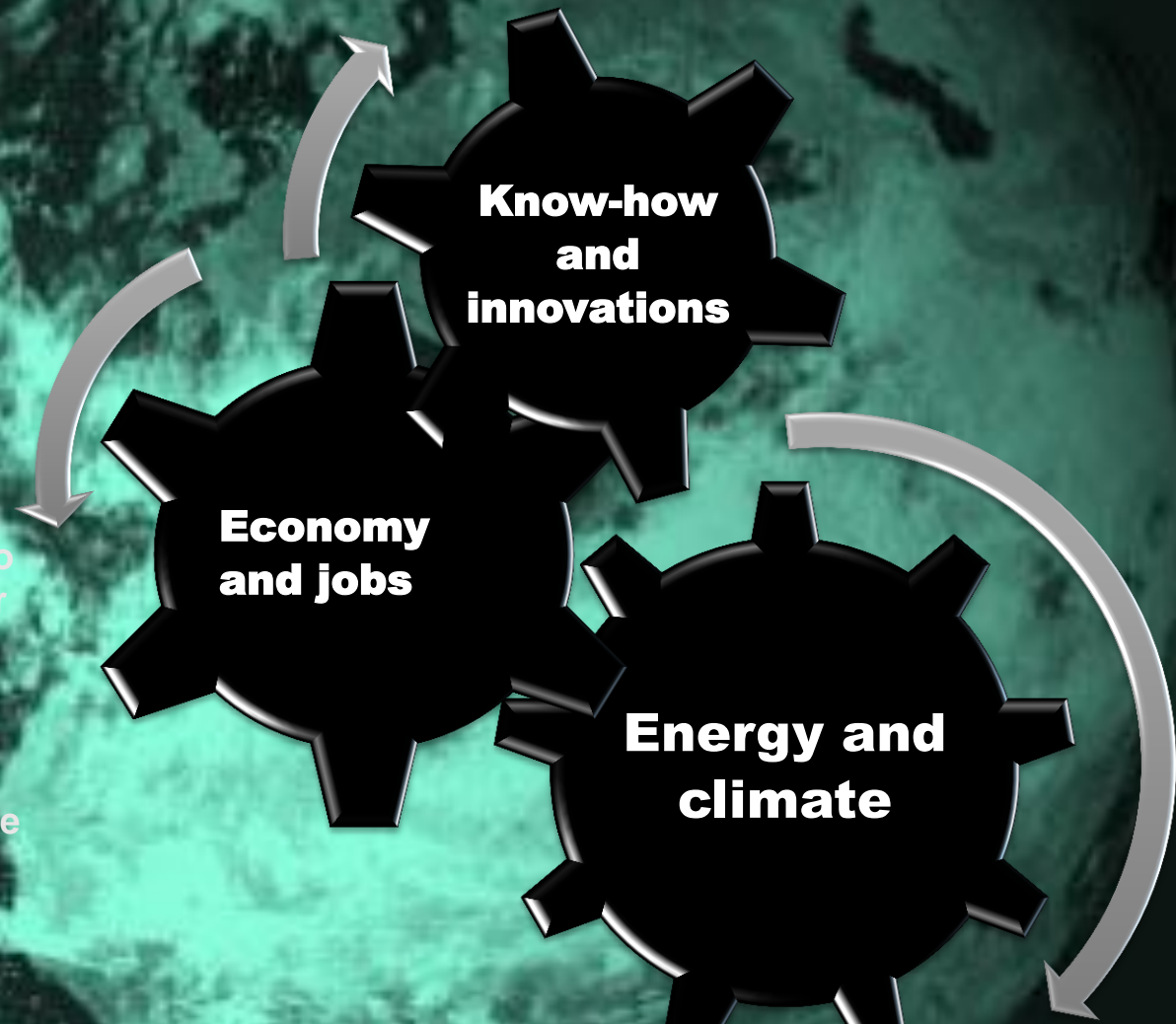
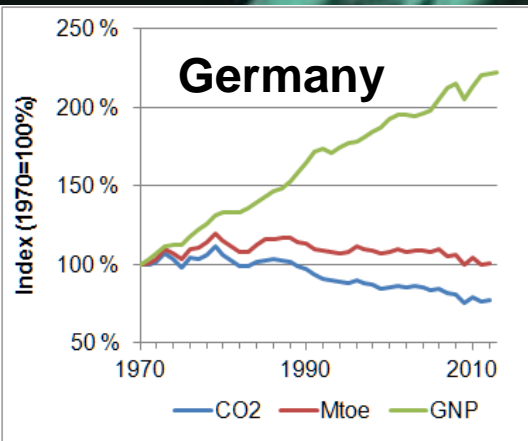
- Unsustainable
- Unfair
- Unstable
- Unhappiness



Ref: Stewart Walsh, 2013; LBS

Green [Energy] Economy

Consider economy, jobs, energy, climate, innovations, know-how as a whole



“ Shifting to a greener economy could generate up to 60 million additional jobs over the next two decades and lift millions of people out of poverty, UN agencies and trade unions said recently, urging governments to use the Rio+20 summit to turn this potential into reality.” [UNEP]

Future energy investments

Power (electricity) investment accounts for 46% of the expected \$37 trillion investment in global energy infrastructure to 2035.

Of the \$9.7 trillion of global investment in Power Generation, 71% will be in renewables or clean technologies.



Source: Citi Research

	Billions	%
Coal	\$1,608	17%
Gas	\$1,040	11%
Oil	\$74	1%
Nuclear	\$942	10%
Bioenergy	\$650	7%
Hydro	\$1,549	16%
Wind	\$2,129	21%
Solar PV	\$1,259	13%

Power generation is the largest and fastest growing component of primary energy consumption.

	2011	2030	Growth
Transport	2.2	2.8	25%
Industry	3.6	4.7	31%
Other	1.3	1.5	19%
Power Generation	5.2	7.7	49%

Billions Tonne of Oil Equivalent

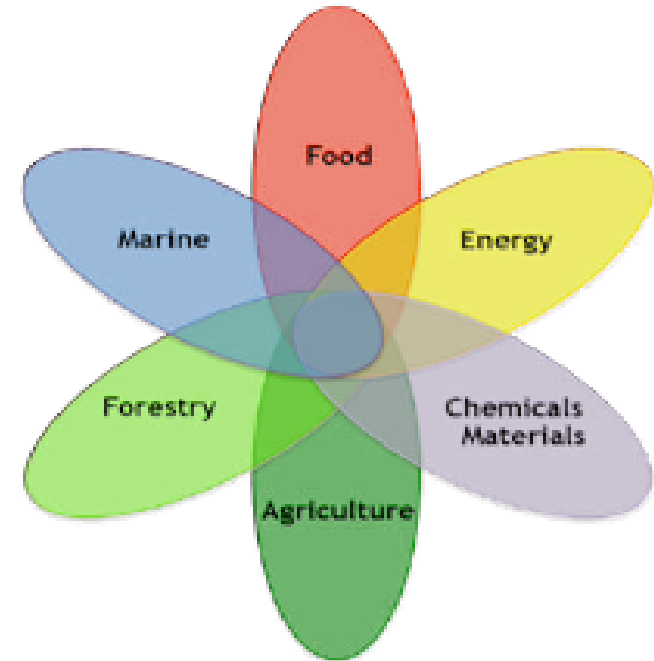
Source: Citi Research, BP Statistical Review

Source : Citi Group, October 2013

Peter Lund 2014

Bioeconomy

- Biological resources are renewable, local, wide-spread, rely on local know-how, etc.
- The value of Bioeconomy is €2trillion, 20 M jobs, 9% of EU employment (2009)
- €1 in R&D and innovation in bioeconomy could create €10 in value added
- Council calls for a 'greener' Europe 2020 strategy (28 Oct 2014)



Cleantech - Finland



Government goals (2018):

1. Finland should rank high(est)
2. 50 000 new jobs
3. Turn-over 2x (20→€40 B)

Lahti City

– clean tech cluster

- Municipality owned utility
 - 2.5 TWh/yr, \$220 million
 - 80% fossil fuels, 20% bioenergy
 - Waste-to-energy schemes
 - Strong clean tech cluster
-
- Waste-to-energy services
 - 96% of urban waste recycled
 - advanced gasification technology (CFB, multi-fuel 160 MW, \$240M)
 - 90% of city connected to District heating

Picture: Lahti City

Kotka City (Finland)

– a case for green energy strategy with CHP


- 
- **Municipality owned utility (1 TWh/year , \$140 mn)**
 - **Business idea: sales of district heat, CHP using RE sources and waste, co-operating with local industry**
 - **Local energy sources: bio- and recycling fuels and gas; waste-to-energy production, wind energy, biorefinery**

Photo: Kotka Energia

Peter Lund 2014

Rioranking 1972-2012

TCO GRANSKAR:

FÅ SNURR PÅ OMSTÄLLNINGEN

UTAN ATT LÄGGA PÅ ETT KOL

TCOs Rio Ranking 2012:2

#5/12

TJÄNSTEMÄNNENS CENTRALORGANISATION
LINNÉGATAN 14, 114 94 STOCKHOLM
TEL 08-782 91 00, TCO.SE

Reduction of energy supply per GDP (PPP) dollars from 1972 to 2007

ranking	country	reduction	energy/good ratio
1	China	-77%	2,35
2	Luxembourg	-75%	1,60
17	USA	-51%	2,30
18	Germany	-49%	1,70
19	Denmark	-49%	1,35 almost the lowest in the EU
27	India	-42%	1,70
37	Sweden	-37%	just below 2
42	Norway	-34%	1,75
44	Finland	-30%	2,60
45	Japan	-30%	1,65
87	Iceland	+40%	> 5

Reduction of carbon dioxide emissions per GDP (PPP) dollars from 1972 to 2007

ranking	country	reduction	emissions/good ratio
1	Luxembourg	-84%	0,37
2	Sweden	-72%	0,18
8	China	-67%	0,72
13	Germany	-63%	0,37
16	Norway	-61%	0,24
21	USA	-57%	0,49
22	Denmark	-56%	0,31
23	Iceland	-54%	0,33
32	Finland	-45%	0,41
35	Japan	-42%	0,36
63	India	-3%	0,37

Increase of share of renewable energy during the years 1972-2007

ranking	country	percentage points	progression
1	Iceland	+32	from 48 to 80
2	Zambia	+28	from 65 to 93
4	Denmark	+14	from 2 to 16
8	Sweden	+9	from 21 to 30
10	Germany	+6	from 1 to 7
28	Norway	+2	from 43 to 45
36	USA	+1	approaching 5
41	Japan	+1	just above 3
63	Finland	-1	from 25 to 24
96	China	-26	from 40 to 14
99	India	-34	from 63 to 29

The Finnish Challenge:

**Economy has stalled, it is spiraling down,
unemployment getting out of hands**

Can 'energy' help?

- Finnish energy self-sufficiency 30%, net energy imports **€8.5B yr**
- Public subsidies to inefficient energy and fossil fuel use **€2.5B yr**
- Domestic energy resource base is huge (2-3 x energy demand)
- Energy use efficiency improving less than in comparable countries

Kasvua ja työllisyyttä uudella energiapolitiikalla

- report by the “Professor Group”

Minna Halme, Janne Hukkinen, Jouko Korppi-Tommola, Lassi Linnanen, Matti Liski, Raimo Lovio, Peter Lund, Jyrki Luukkanen, Oskari Nokso-Koivisto, Jarmo Partanen, Markku Wilenius

<http://www.energiapolitiikka.fi>

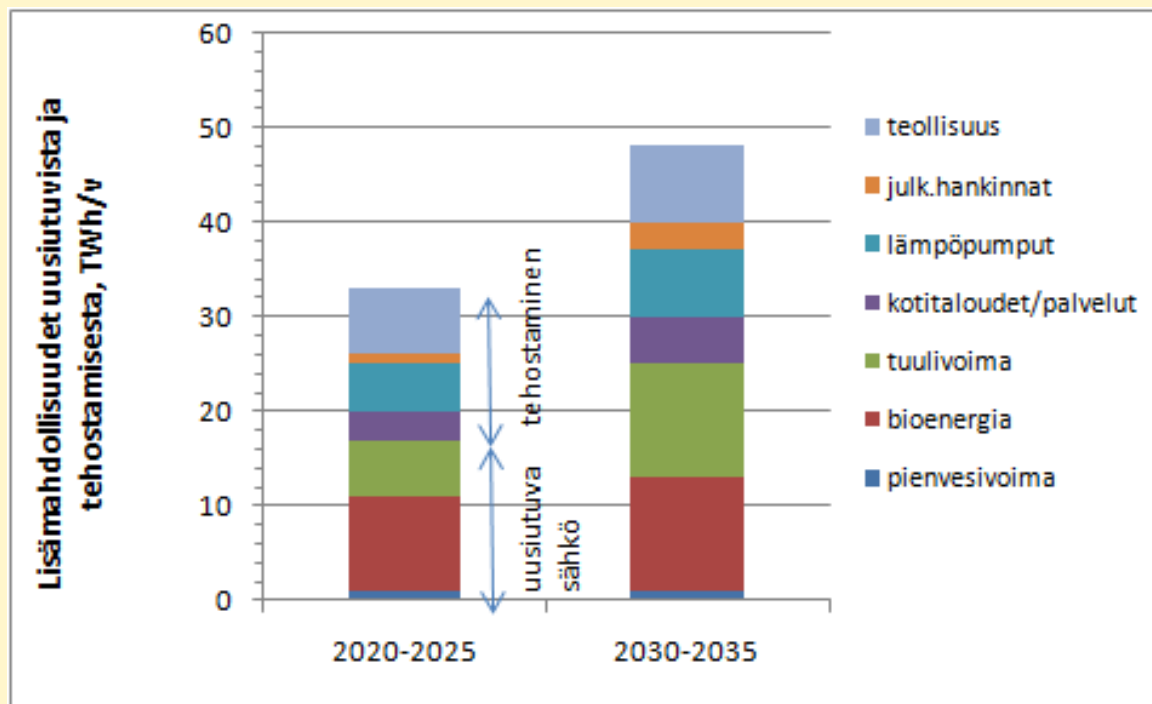
<https://t.co/rkqfHlxRE2>



The Finnish Solution:

Rely more on own energy resources, know-how and technology

- **How: more renewables (1/2) and more energy efficiency (1/2)**
- **Finnish energy self-sufficiency 30% → 50% → 80..100% (2050)**
- **New jobs 0→30,000 (2020) → 50,000 (2030) → 90,000 (2050)**
- **Energy imports €8.5B yr → -20% (2020), -50% (2035), -100% (2050)**



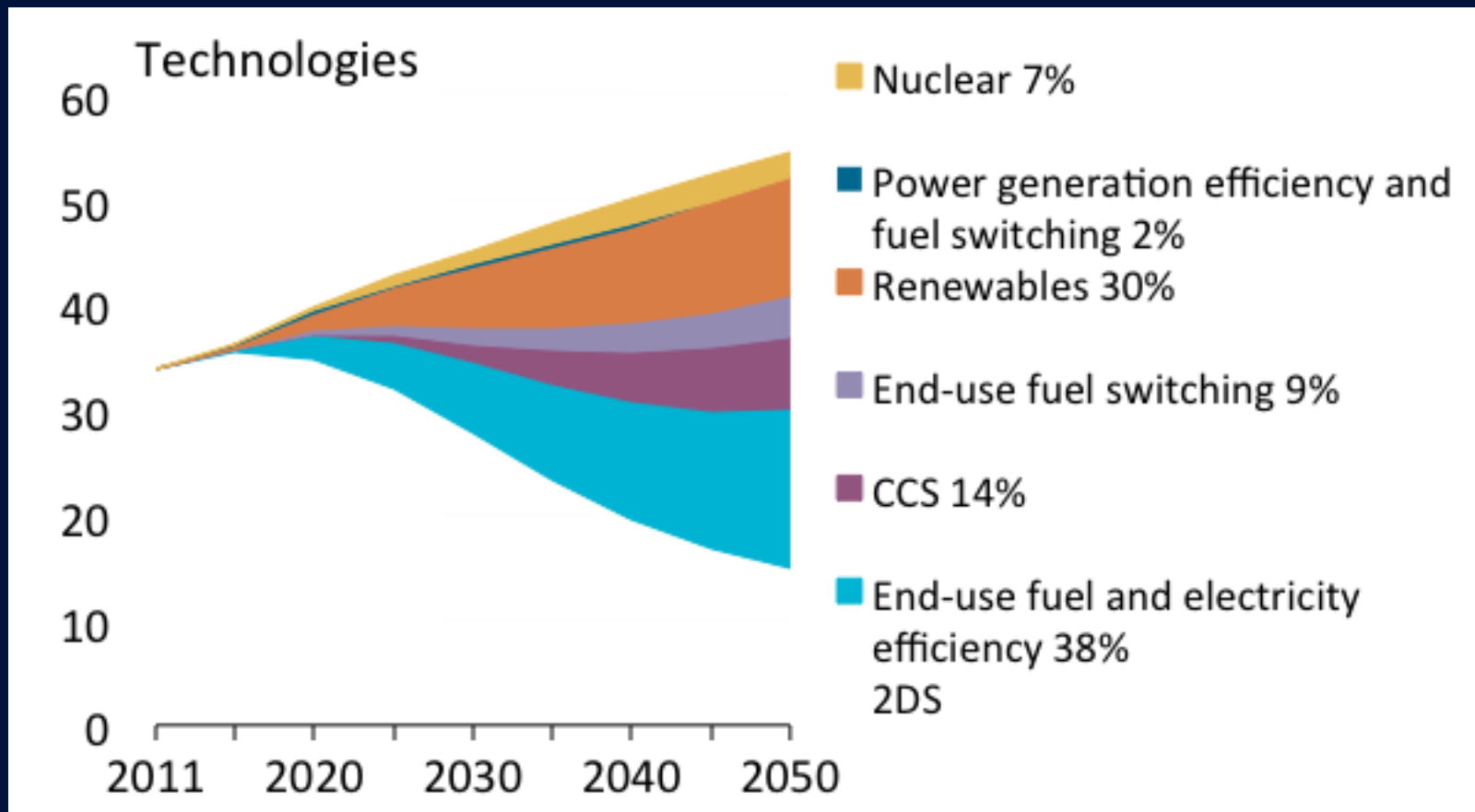
Extras

Council calls for a 'greener' Europe 2020 strategy (28 Oct 2014)

- **“The conclusions recognize that a greener economy contributes to long term prosperity, and highlight the need for a transition towards a resource efficient circular economy.”**
- Keywords: resource efficiency, circular economy, green employment

Energy Technology Perspectives Scenario (IEA 2014)

Gt CO₂

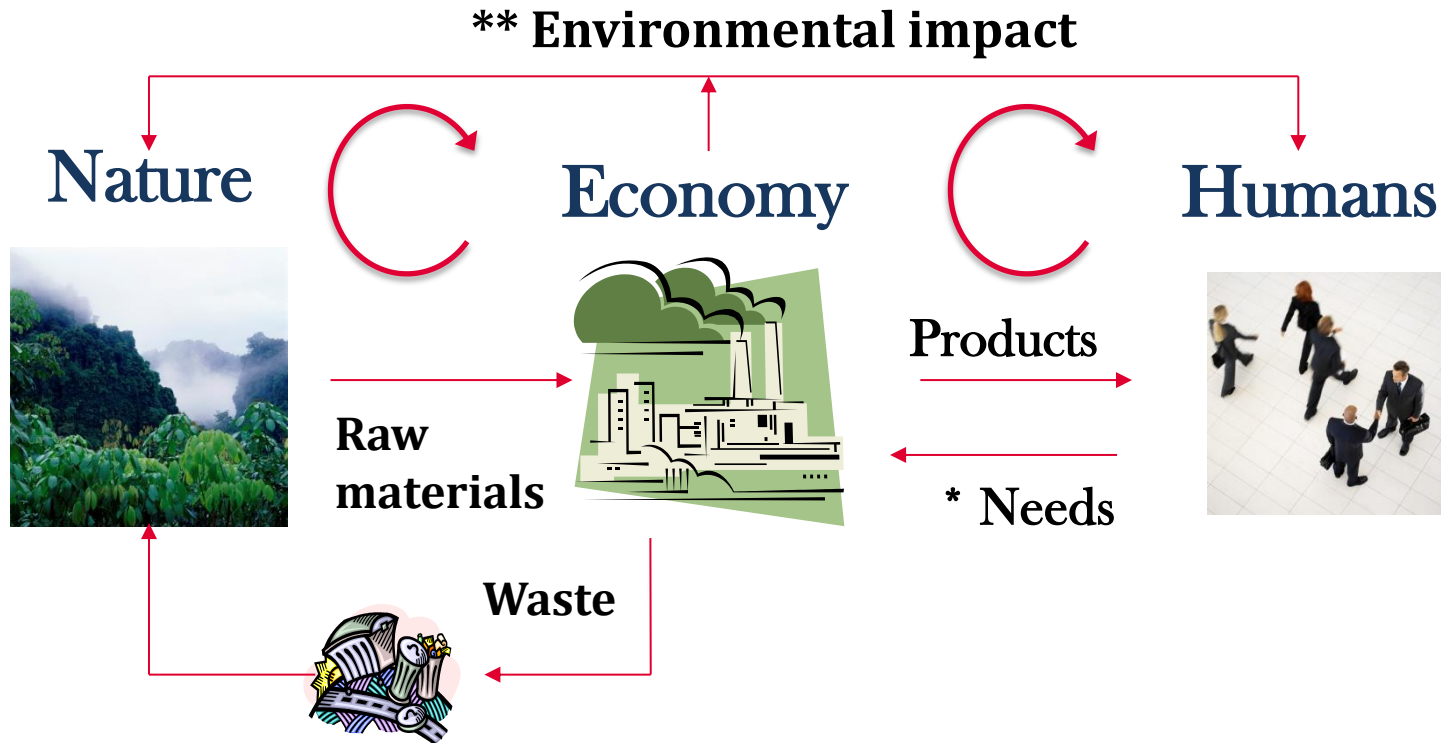


Renewable energy ranking-list (2012)

Map highlighting CAI countries and their respective Issue 34 rankings



The link between economy, environment and humans



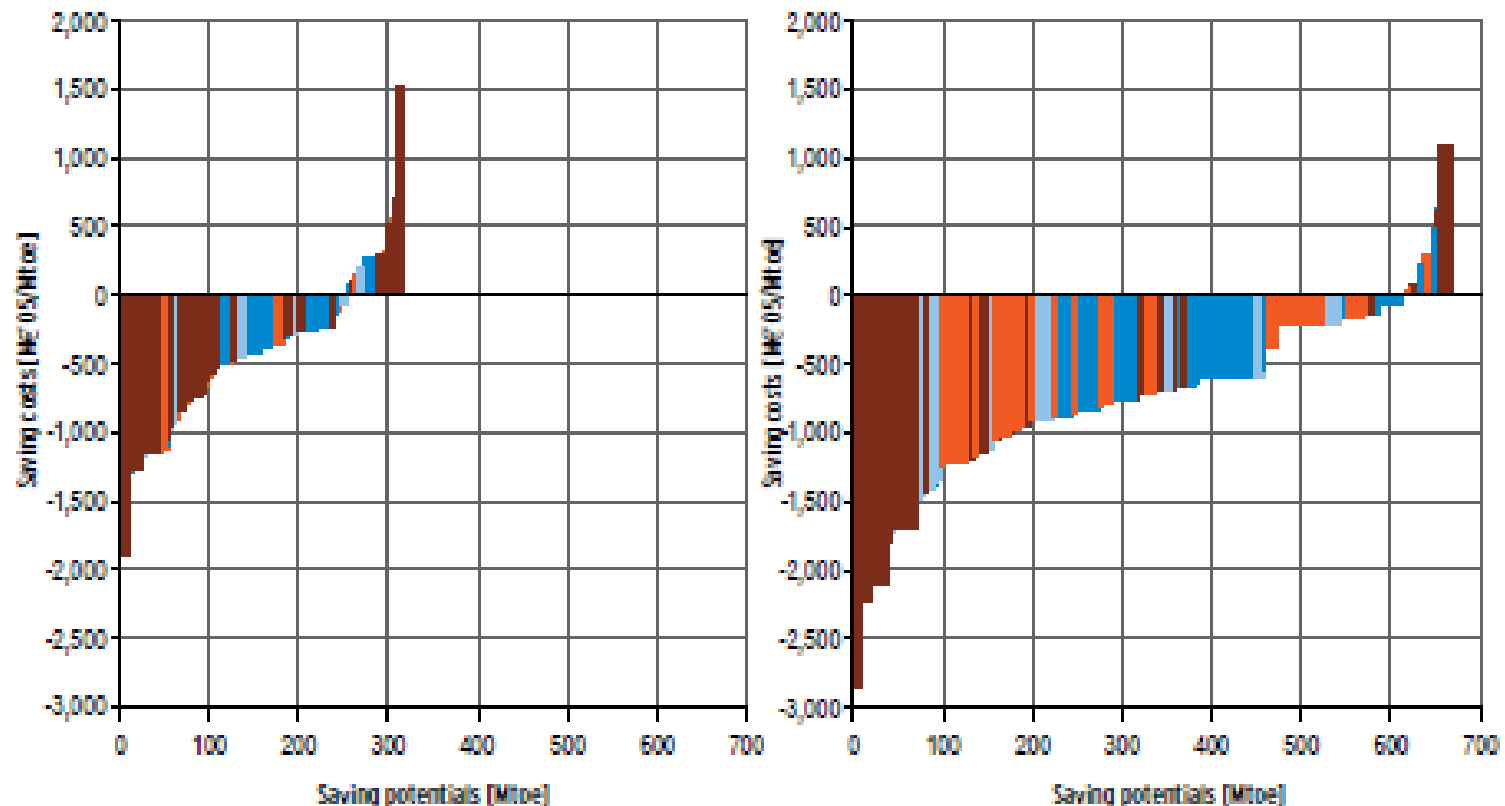
*** Resource needs = growth x structure x technology**

**** Emissions = demand x specific emissions**

Energy efficiency saves money!!!

- Negative costs
- Savings could be equal to all EU's energy import

Figure 15: Multi-sectoral cost curves for 2020 and 2050

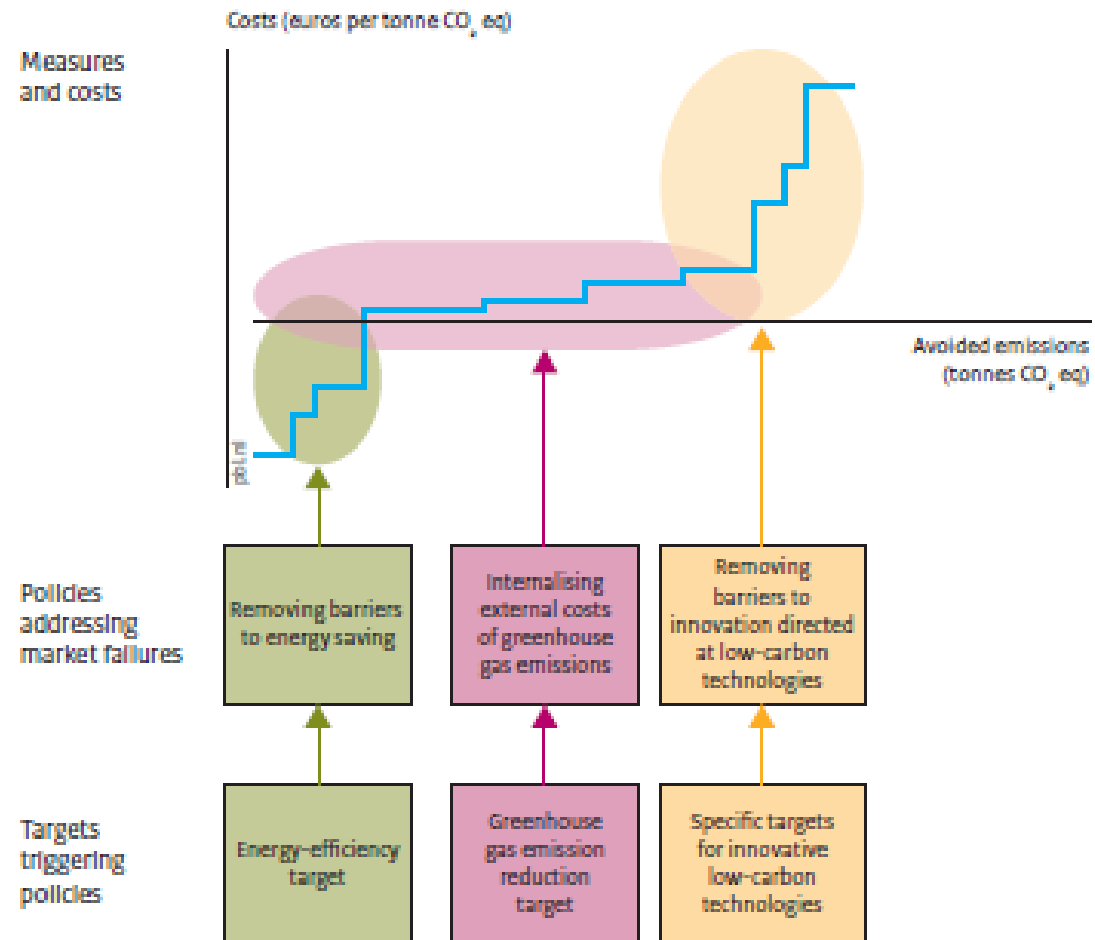


Decarbonizing economy

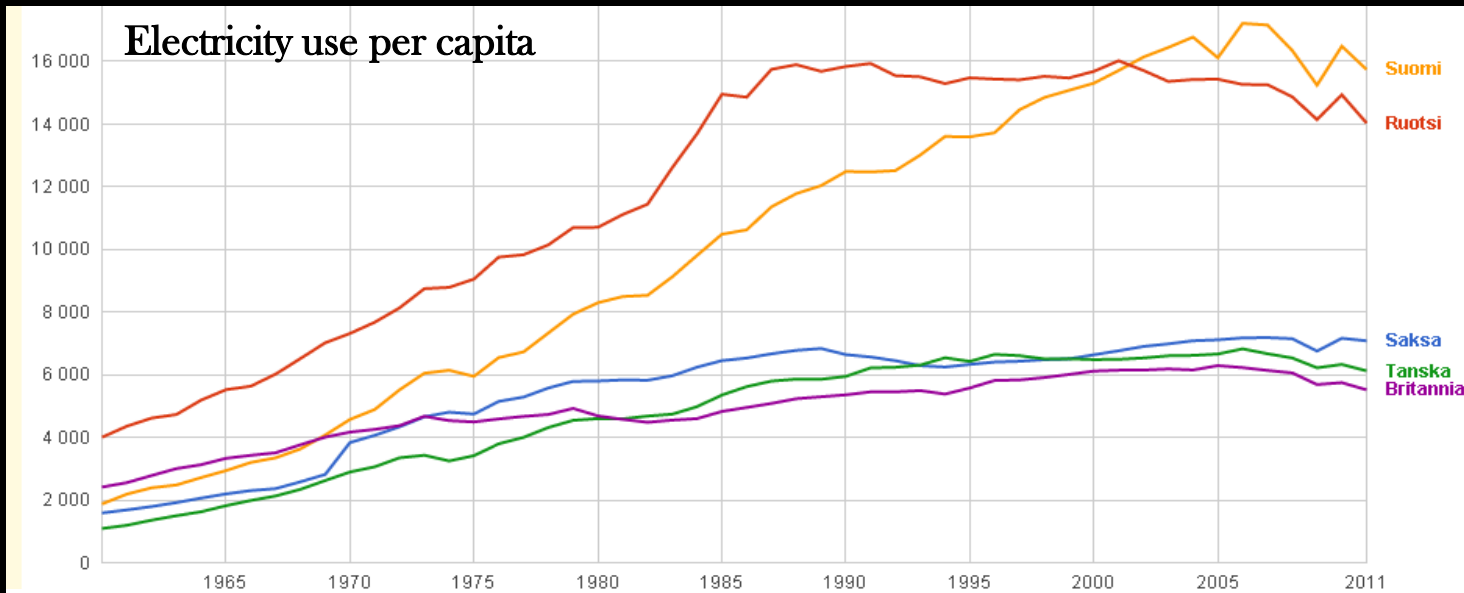
- Link to Policies & Business

Figure S.1

Relation between emission reduction measures, policy instruments and targets



Finland in comparison



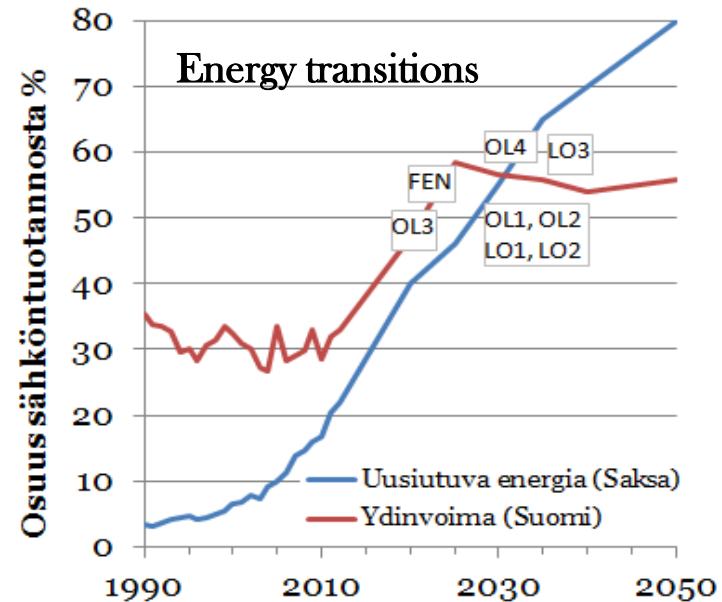
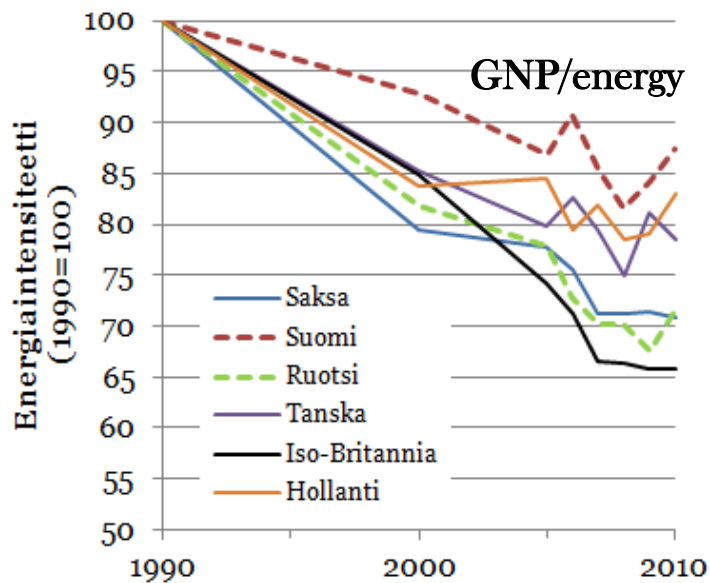
Finland

Sweden

Germany

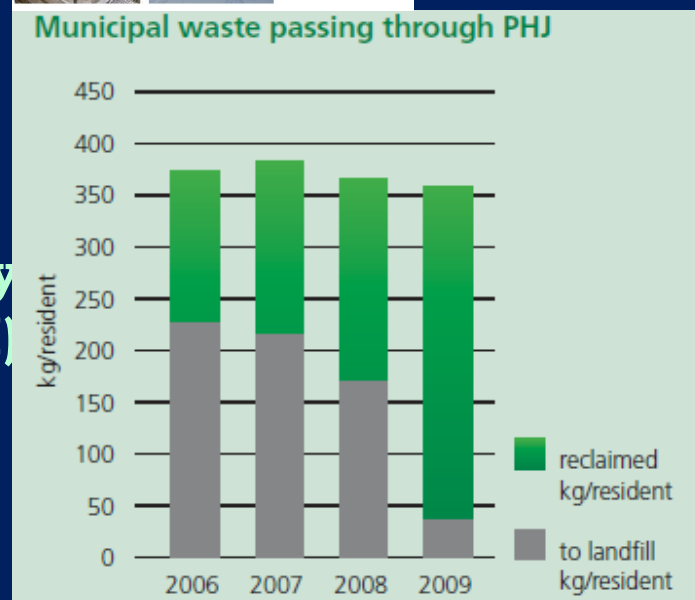
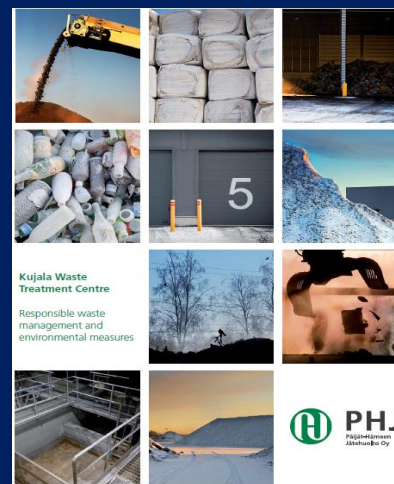
Denmark

UK



Lahti Green City Plan

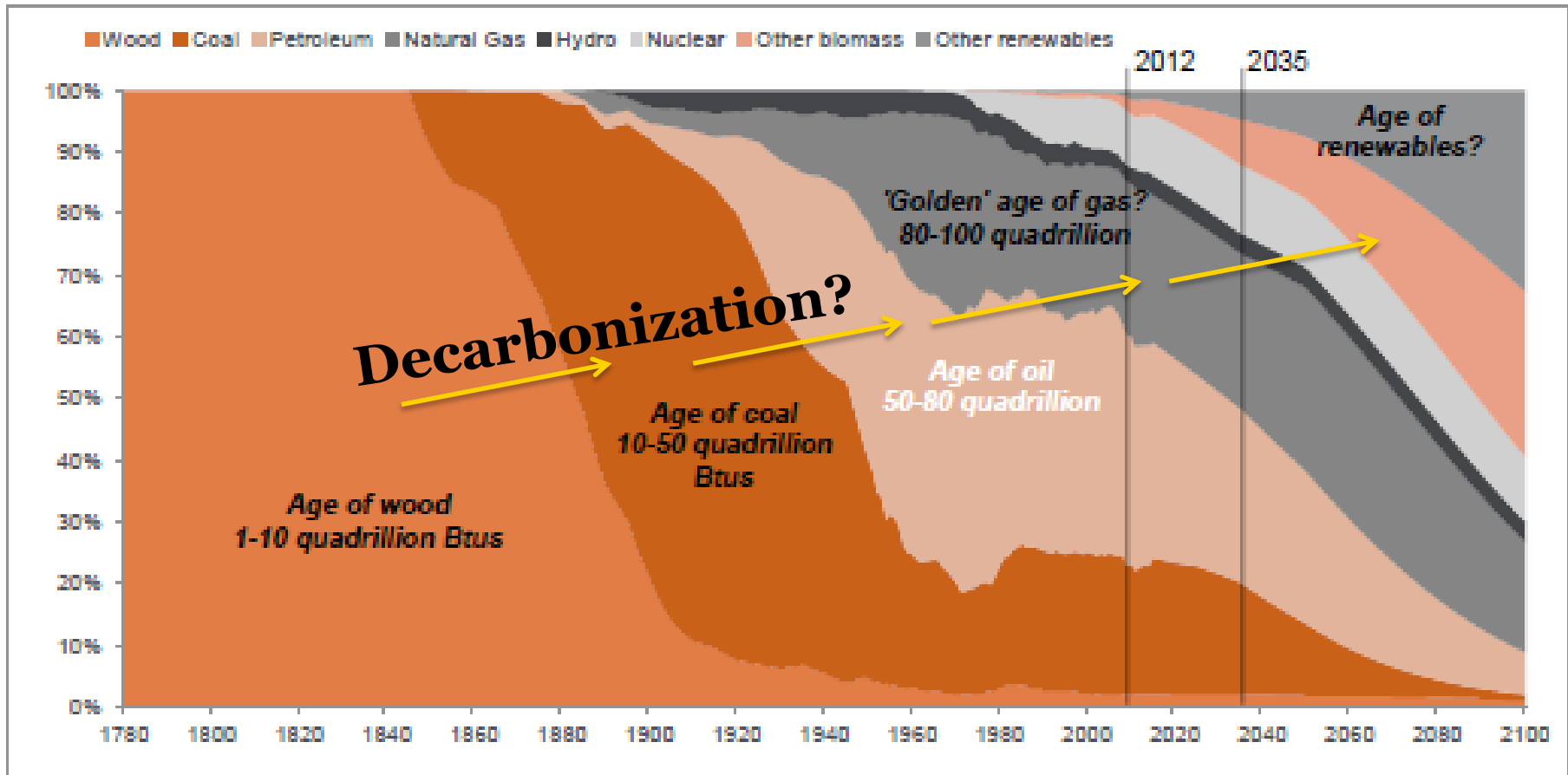
- **Goal: 15-25% less energy by 2015; by 2025 halving CO₂ emissions**
- **How: RES, eco-efficient urban structures; public transport**
- **Economy : supporting local energy and clean tech cluster; technology development and piloting**
- **Waste-to-energy services**
 - **96% of urban waste recycled**
 - **advanced gasification technology (CFB, multi-fuel 160 MW, \$240M)**
 - **90% of city connected to DH**



Photos: Lahti City, Päijät-Hämeen JäteHuolto Ltd
Peter Lund 2014.

The Big Energy Transitions

Figure 4. The ages of energy: History suggests a process of substitution



Source: IEA, EIA, Citi Research

Source :Citi Group, October 2013

Alternative paths for power generation in Finland (2030)

