Slovenian Energy Concept (SEC) in the light of 5th Report of IPCC.

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Content

- Introduction
- Overall World situation
- Energy situation in the World, USA and EU
- Energy in Slovenia
- Possible development directions
  - Sustainable energy system
- Conclusions

Energy concept –why ?

- At the beginning of this year Slovenian parliament accept the new energy law EZ-1 harmonizing with all EU directives.
- In this law two important planning documents are introduced:
  - Long term plan for 20 -30 years – **Slovenian Energy Concept**
  - Short term plan for investment in the infrastructure.
- Based on this requirement and general EU policy we prepare the new concept, based

Overall world situation

- Social development has not changed substantially during the last 40 years (1974÷2014);
- Population has doubled, from 3,5 billion to 7,4 billion in 2013;
- Reserves of resources are diminishing;
- With growing population also the energy needed for living is rising .
- „Added new value“ distribution is uneven and is approaching the critical level of

Population growth and energy use on the planet Earth

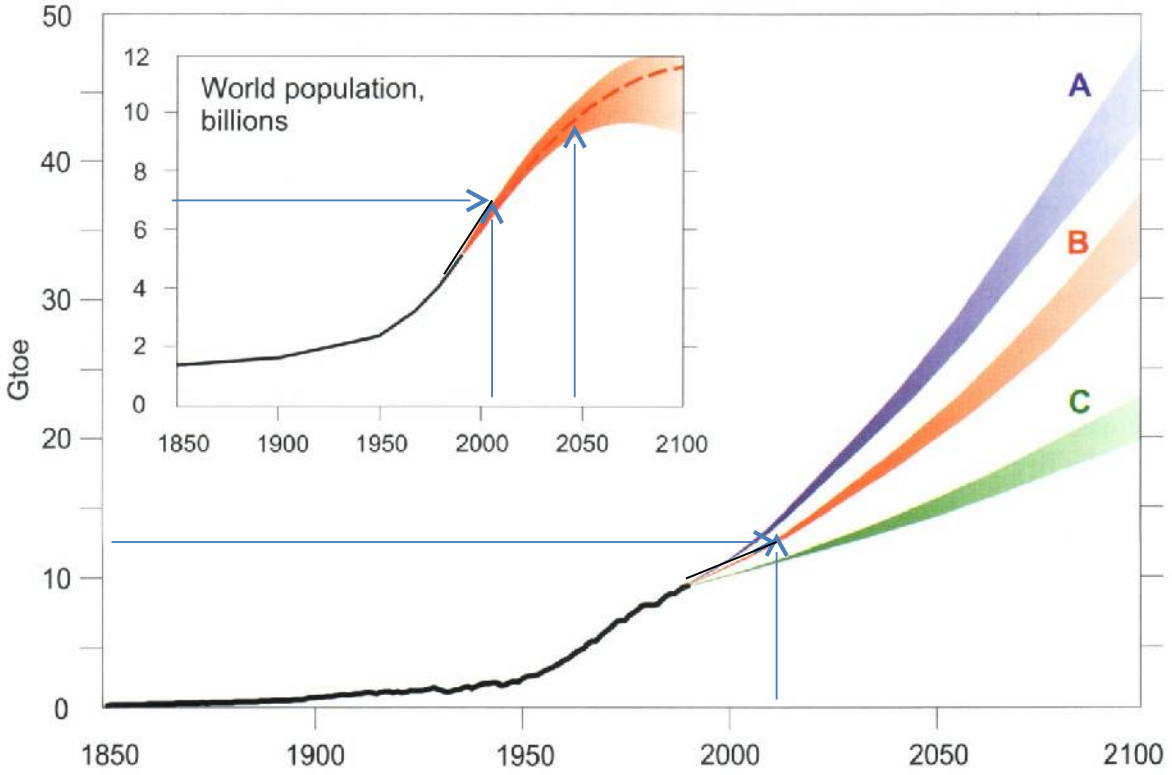


Figure 5.2: Global primary energy use, historical development from 1850 to 1990 and in the three cases to 2100, in Gtoe. The insert shows global population growth, 1850 to 1990 and projections to 2100, in billion people. Source: Bos *et al.*, 1992.

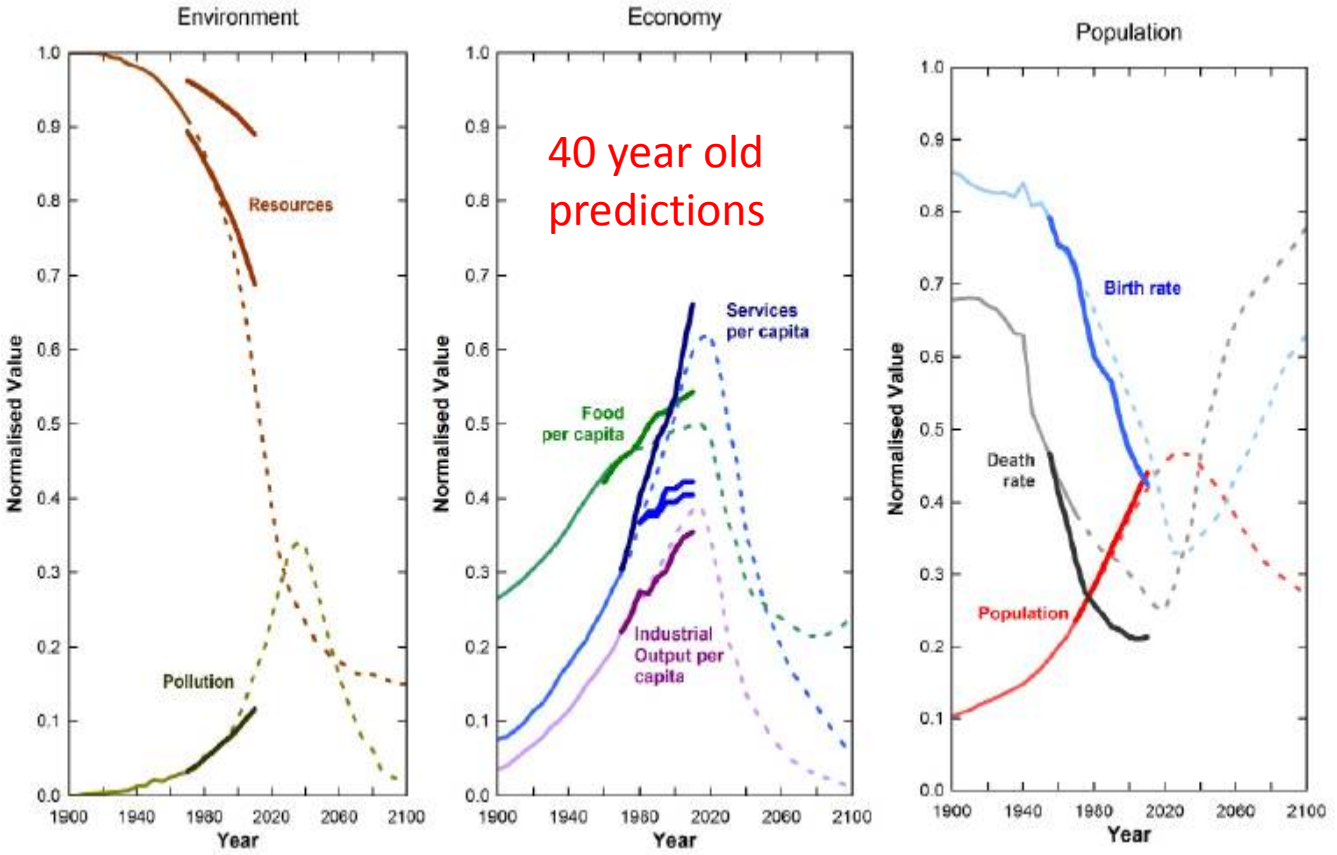
Population in 2014: ~7 bilions
Energy use in 2014: 550 EJ or ~13 Gtoe
Source :IEA-USA, 2014

What is important: predictions from year 1992 are very well in accordance with real development

20 years old!!

Environmental and economic situation on world

The proof of previous claims is the latest analysis carried out by MSSI, which compares the forecasts stated in the famous book “The Limits to Growth” (Club of Rome in 1972) and the actual data of the past 40 years based on the BAU (Business as Usual) model.



Basic question for everybody:

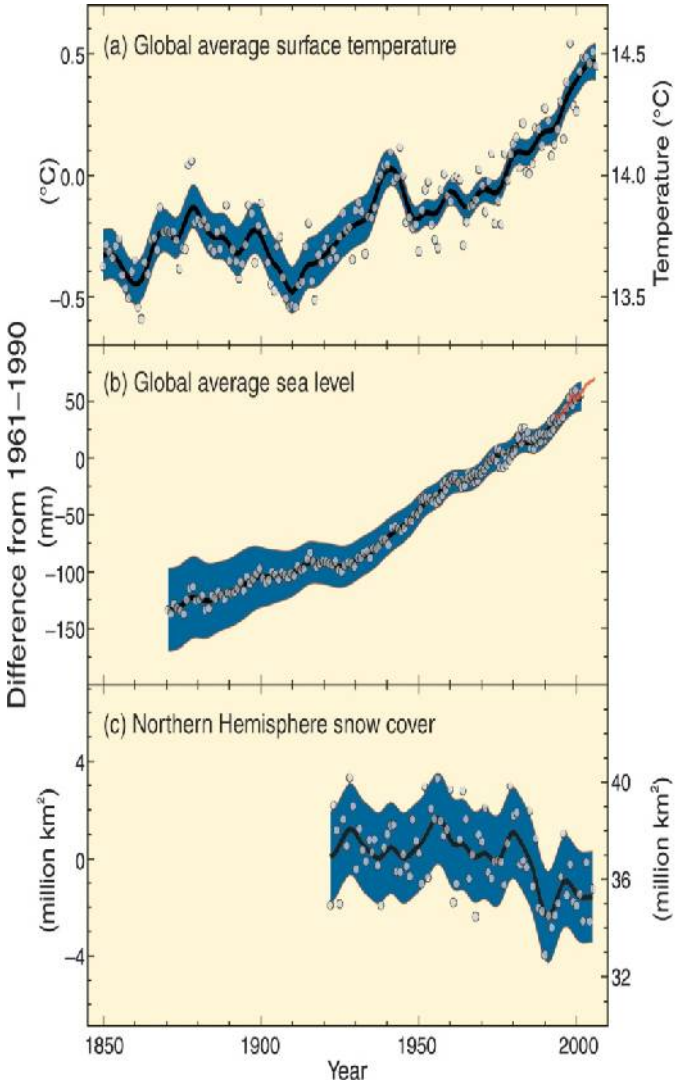
Do we go to the collapse?

Can the financial centres and politicians change the direction of the development in the sustainable society?

Answer in present social relationship is practically impossible.

Vir:Turner, G. (2014) »Is Global Collapse Imminent?«, MSSI Research Paper No.4, Melbourne Sustainable Society Institute, The University Melbourne

5. Asessment report of IPCC - findings



Global average temperature on the planet Earth is growing 0,85 °C from 1850 ÷2010.

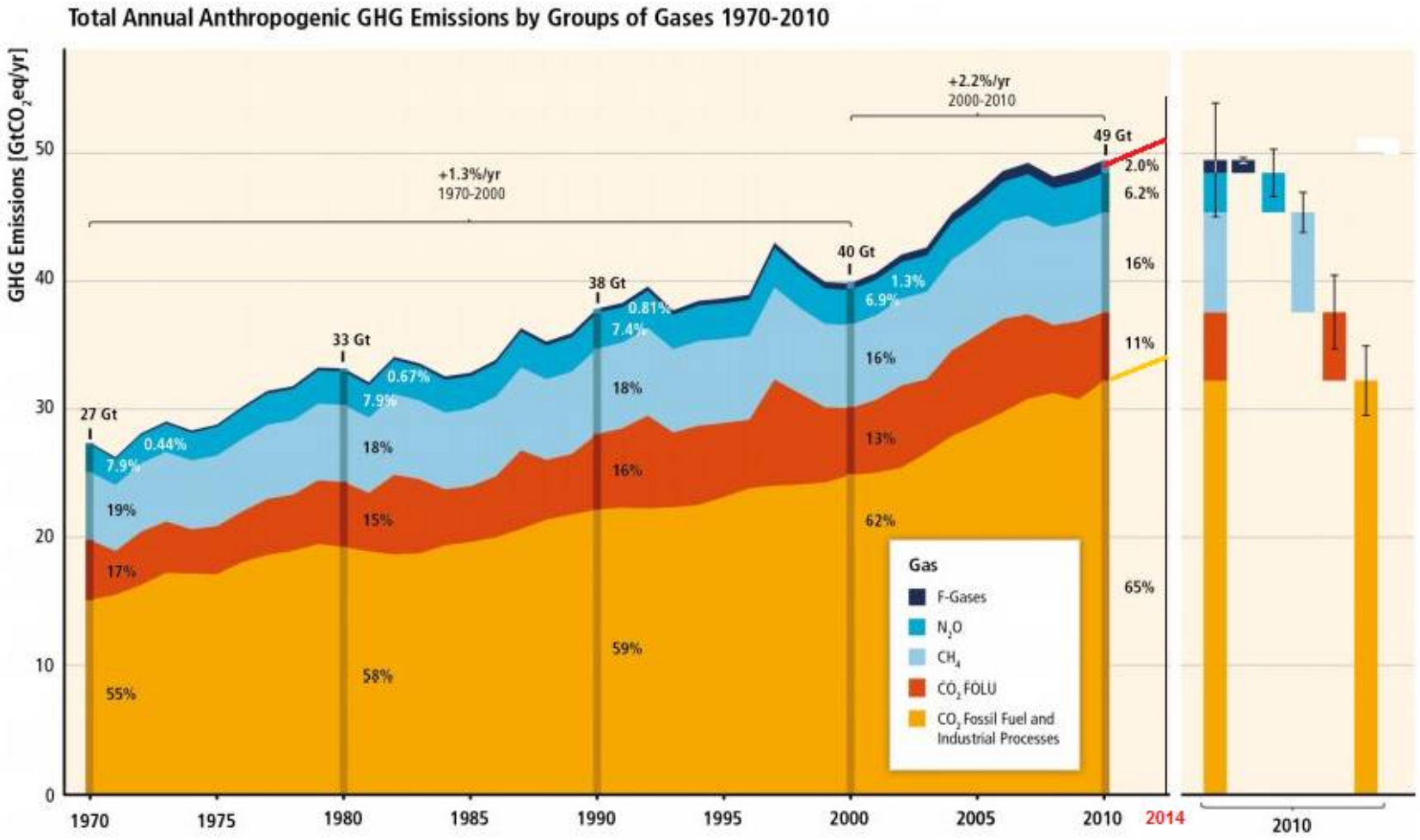
Global average sea level is slowly growing up to 19 cm.

Northern Hemisphere snow cover is diminishing.

Are these signals powerful enough for changes?

Answer to this question lies first of all in financial centres in the world. Without changes in money flow there will not be any societal or economic changes, except in revolutions.

Total emissions of GHG per year on the world, between 1970 ÷ 2010 with projection up to 2014



http://static.businessinsider.com/ 2013

New estimations of energy reserves and resources in the light of climate change

Scarcity adjusted values for energy resource depletion (ERD)

Fuel	Annual production	Reserves	Resources	Sum of reserves and resources	Years of production left as of 2005	Scarcity ratio (oil set at 1)	Adjusted ERD impact value
	EJ/yr	EJ	EJ	EJ	Years		€$_{2012}$ /kg oil equivalent
Oil	168.1	10930	18200	29130	173	1.00	0.15
Gas	99.4	49650	89100	138750	1 396	0.12	0.02
Coal	123.8	19150	363000	382150	3 087	0.06	0.01
Uranium	24.7	2400	7400	9800	397	0.44	0.07

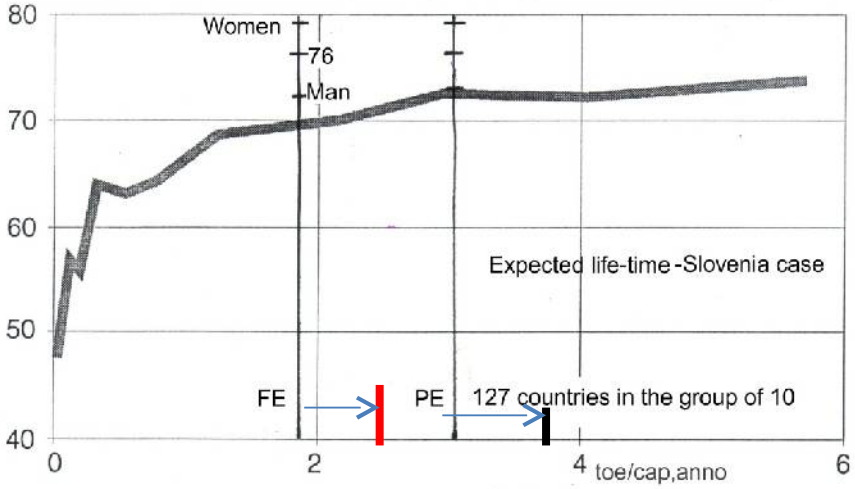
Source: Subsidies and costs of EU energy; © Ecofys 2014 by order of: European Commission; DESNL14583, October 2014

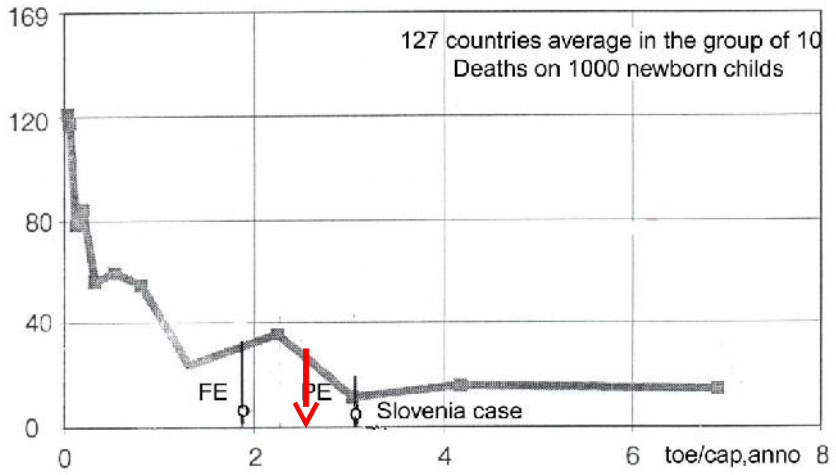
The latest estimates of world reserves and resources show, that we are far away from energy cliff. Problem is not in scarcity and prices of fossil fuels, but in expected negative impact on environment.

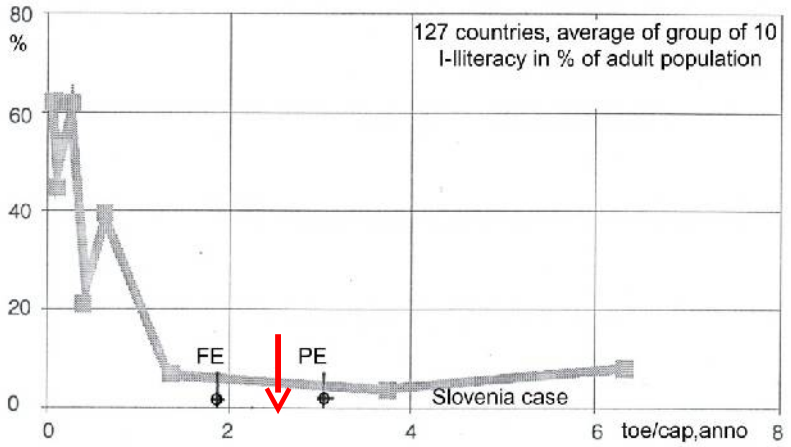
Investment in RE in 2013 in the world exceeds 249 billion $. Share of RE in the world TPES increased to 19% and more as 22% of world electricity is made from RE.

This is an important signal, that world energy supply is slowly reversing to sustainability, using more RE.

How much energy do we need for high quality of







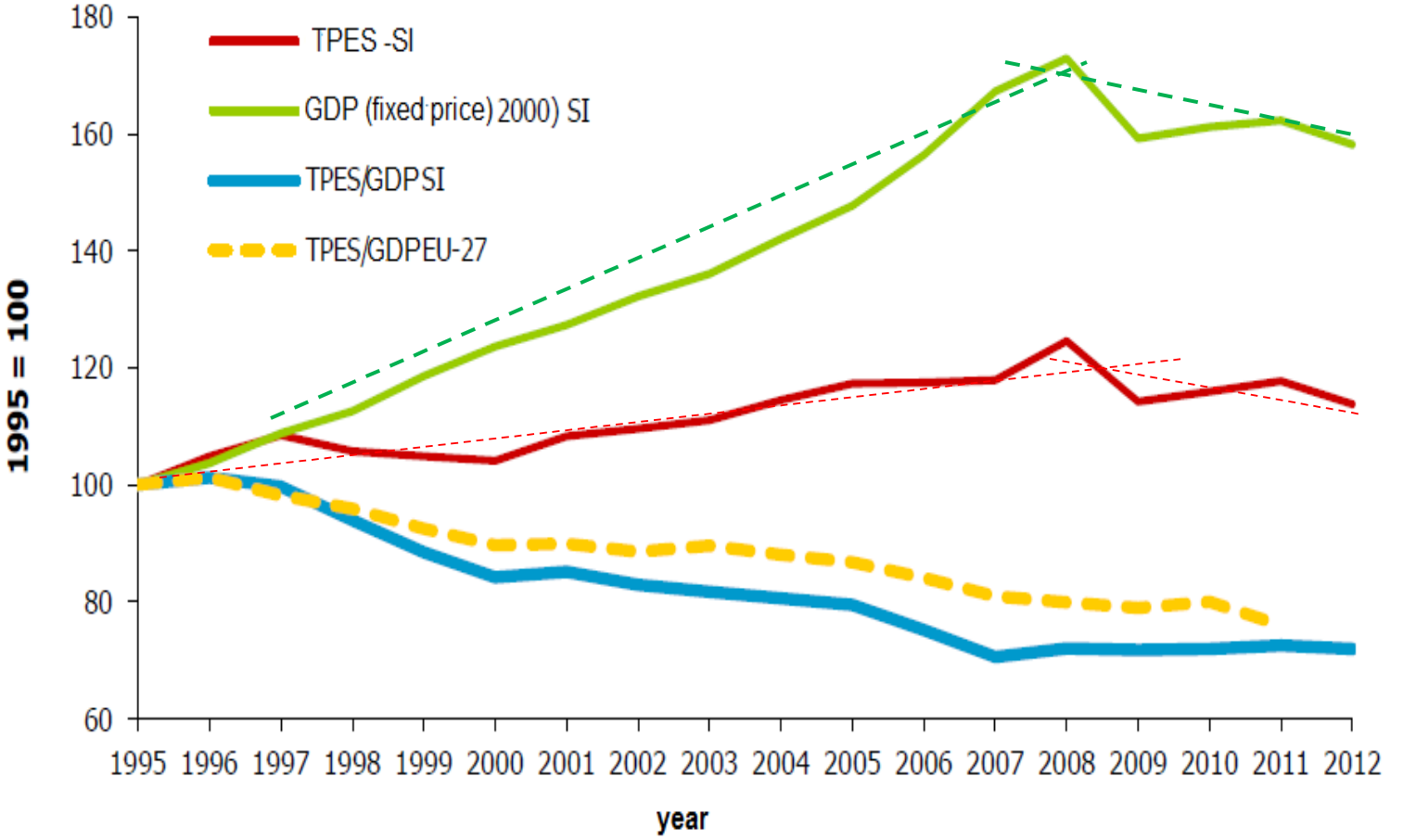
Basic conclusion: minimum energy supply for a normal prosperity and human well being taken from history is **2 - 3,0 toe/y (ton of oil equivalent per year) of PE.**

For seven billion population in 2014 on the world 14 to 21 Gtoe/y of primary energy will be enough.

With present use of ~12,5 Gtoe/y PE we can cover most of the needs, if distribution will be uniform.

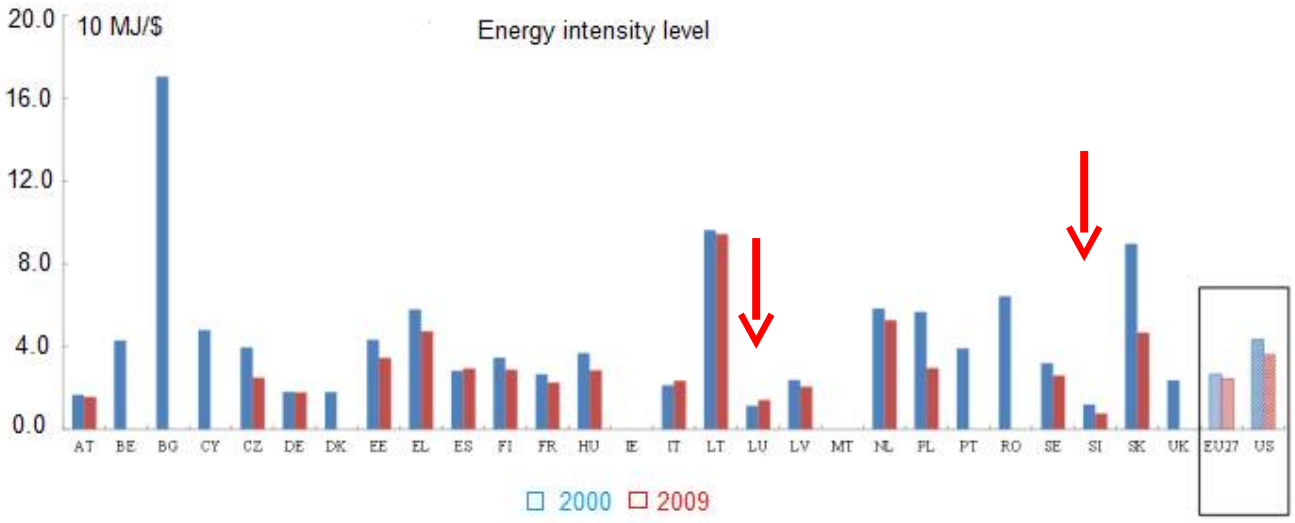
For Slovenia 2,3 toe/cap,y or 190 PJ/y of final energy fulfill all our needs.

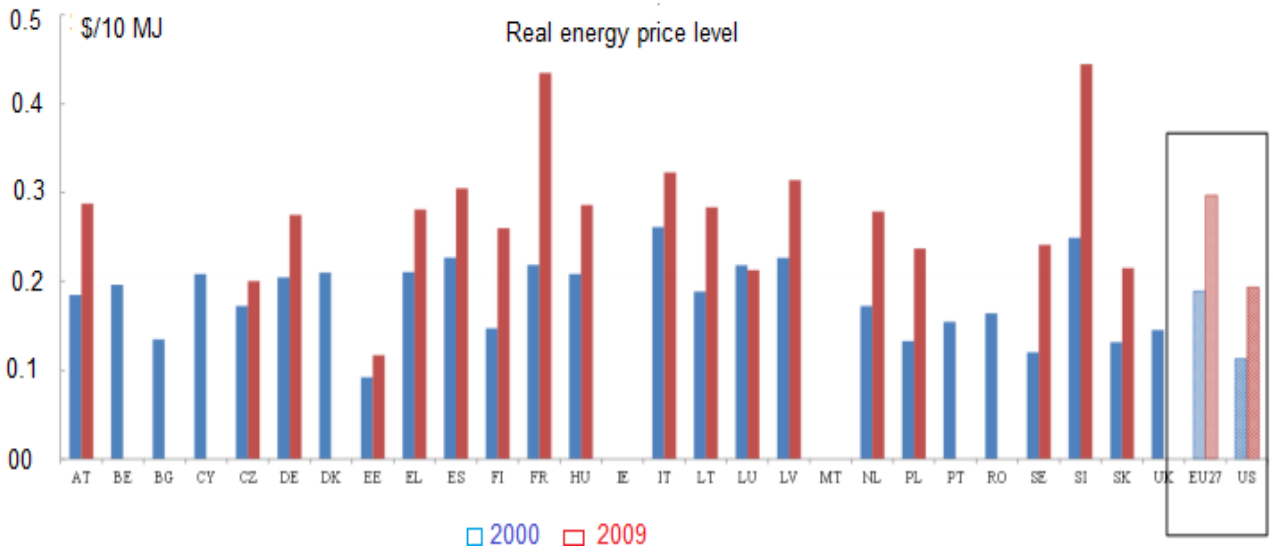
Development of energy use, GDP and energy intensitv in Slovenia from 1995 do 2012.



Relationship between economic activities, total primary energy supply and energy intensity in Slovenia and EU

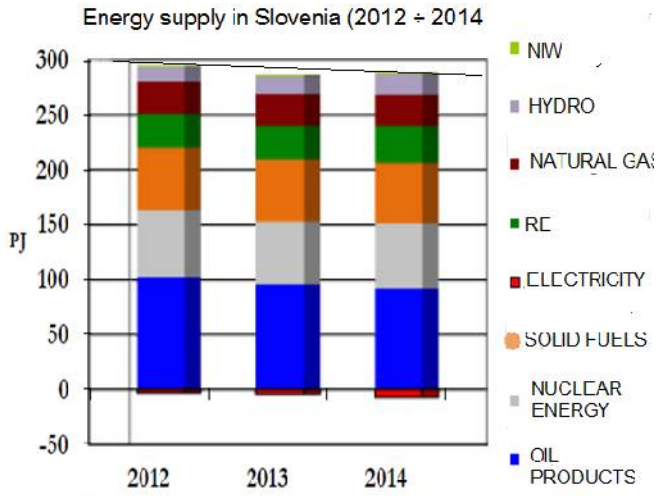
Energy intensity and real prices comparisons between EU 28 countries and USA



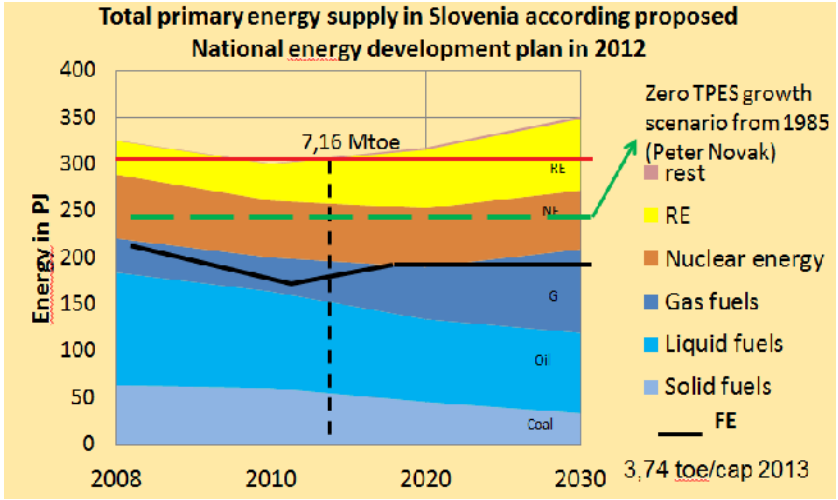


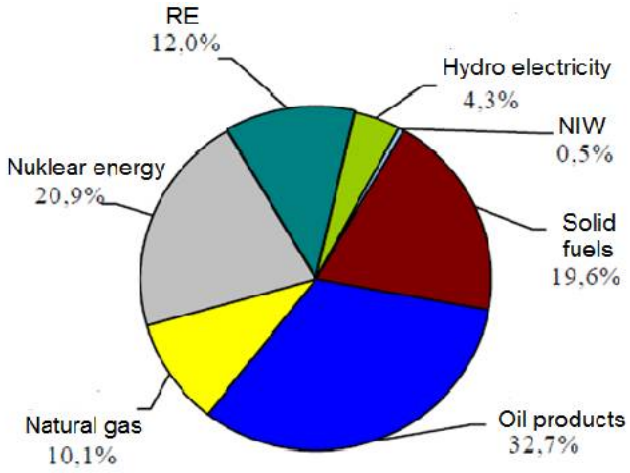
Source: Subsidies and costs of EU energy; © Ecofys 2014 by order of: European Commission; DESNL14583, October 2014

Energy in Slovenija 2014



Source: Ministry of infrastructure; STAT-SI (2012,2913); Energy supplier

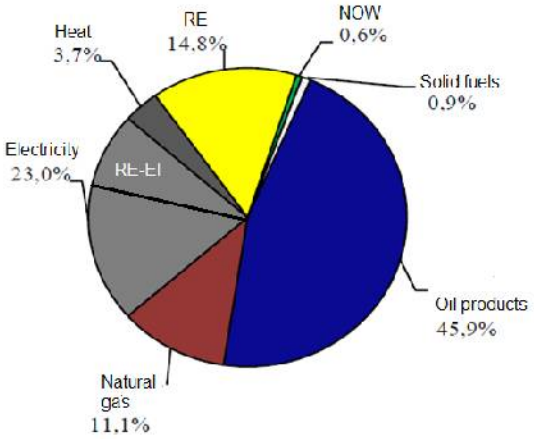




Source: Ministry for infrastructure; Energy supplier

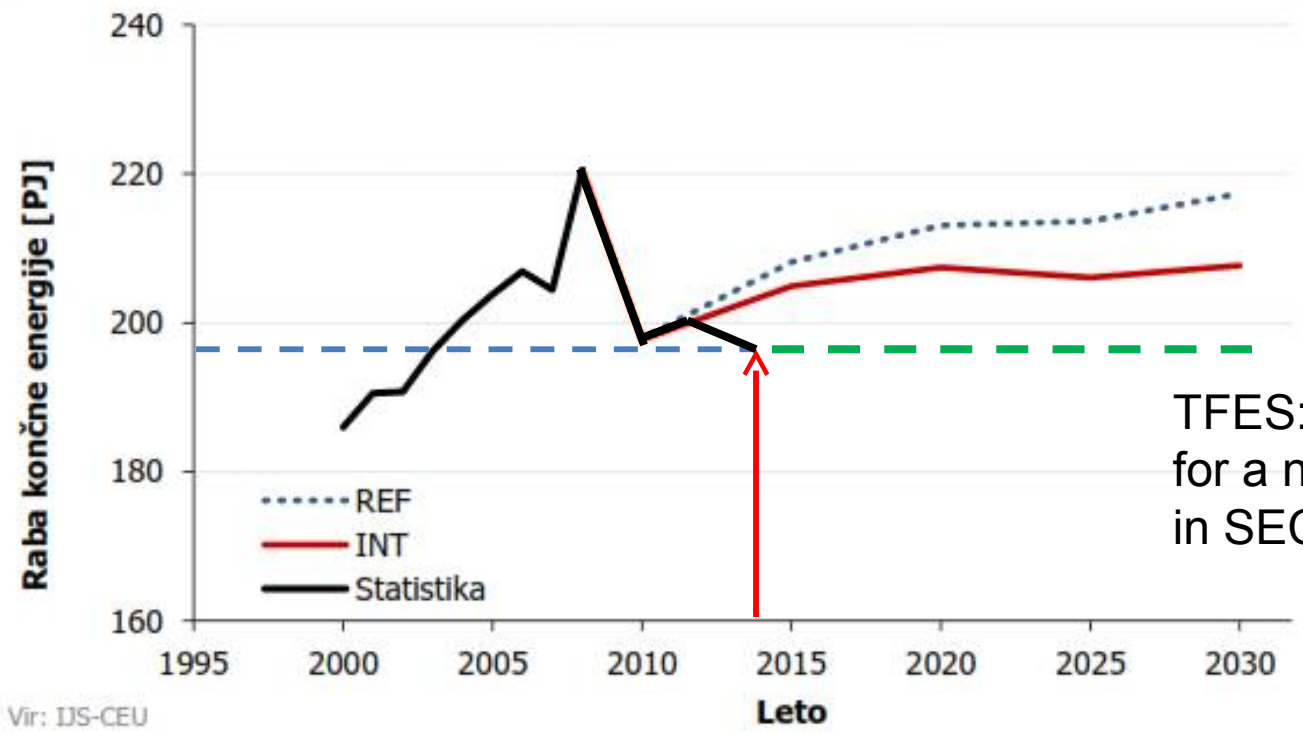
EBS 2015 - plan:
TPES: 282,2 PJ
RE ~21,7% (with HE)
Import dependency: 45,1%
Costs for imported energy 2013:
~ 2,9 bill. €/y

EBS 2015
Final energy: 199,3 PJ
Energy efficiency:
FE/TPESS = 0,71



Source: Ministry for infrastructure, Energy supplier

Final energy use according the NEP 2012



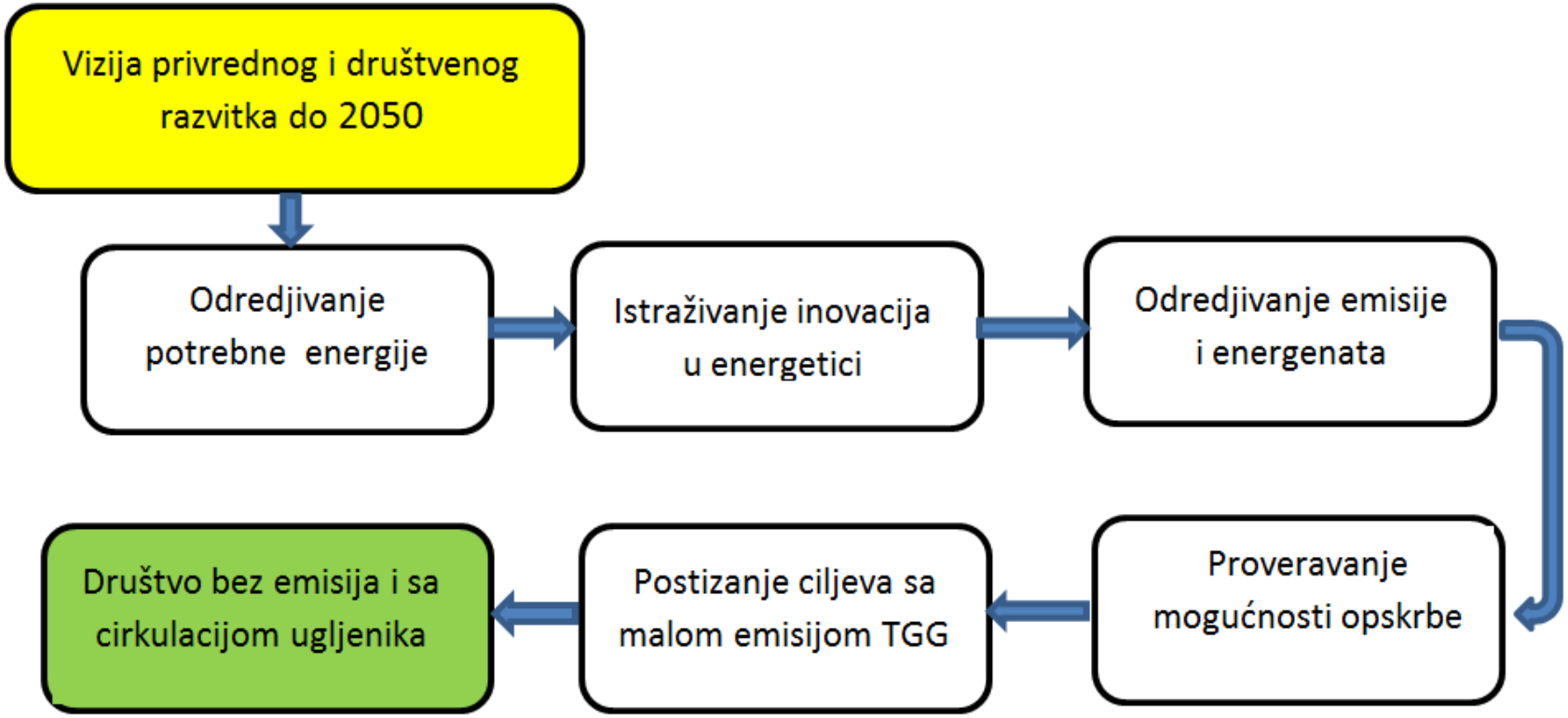
TFES: proposal for a new SES in SEC

Projekcija skupne rabe končne energije do leta 2030 v izbrani strategiji (INT) v primerjavi z referenčno strategijo (REF) ter potek v obdobju 2000-2008

If new energy system is Based on RE, only final energy to be taken in account

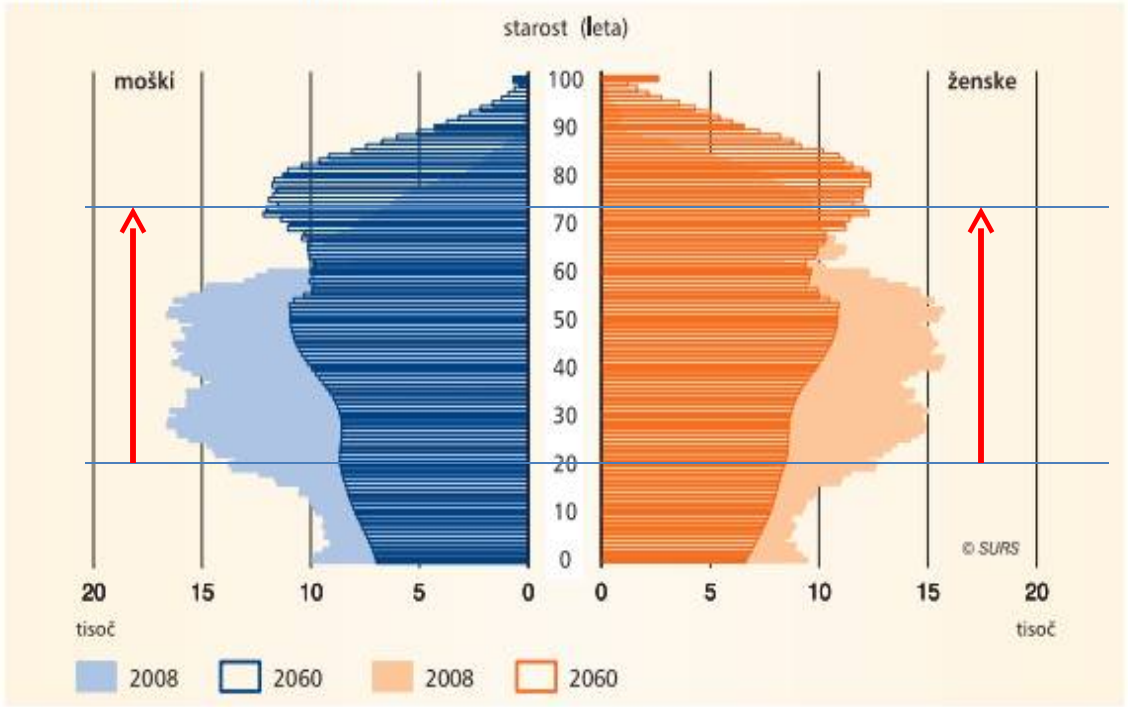
The philosophy of the new concept

7 steps before decisions on new energy concept



Stanovništvo Slovenije danas i sutra, Projekcije stanovništva EUROPOP2008 za Sloveniju u 2008 i2060 g. www.stat.si

Starostna sestava prebivalstva po spolu, projekcija prebivalstva EUROPOP2008, srednja varianta, Slovenija, 2008 in 2060



Vir: Eurostat, EUROPOP2008, konvergentni scenarij

Iz usporedbe g. 2008 i 2060 vidi se drastična promena, broja radno sposobnih stanovnika u Sloveniji.

Tome se mora prilagoditi i budući energetski koncepat.

Smanjenje broja radno sposobnih ljudi znaći povečanje energije u industriji, smanjenje u širokoj potrošnji (stariji ne troše mnogo, a mladi nemaju sredstava za trošenje.
Menjat će se i tehnologije mobilnosti (prilagodjavanje starima).
Dali je sadašnjih ~100 GJ/stan.,g. (~ 28 MWh/stan.,g.) konačne energije dovoljno i u 2050 godini?

Possible development directions

Energy supply and energetic systems are on the crossroad:

- Fossil fuels cause environmental problems
- Nuclear energy is in crisis because of the unsolved storage problem for HRW and accidents
- Renewable energy is expensive, but is sustainable

We need a transition to a new, sustainable energy system (SES), which will be durable and without GHG emissions. New system has to fulfill the following 6 criteria:

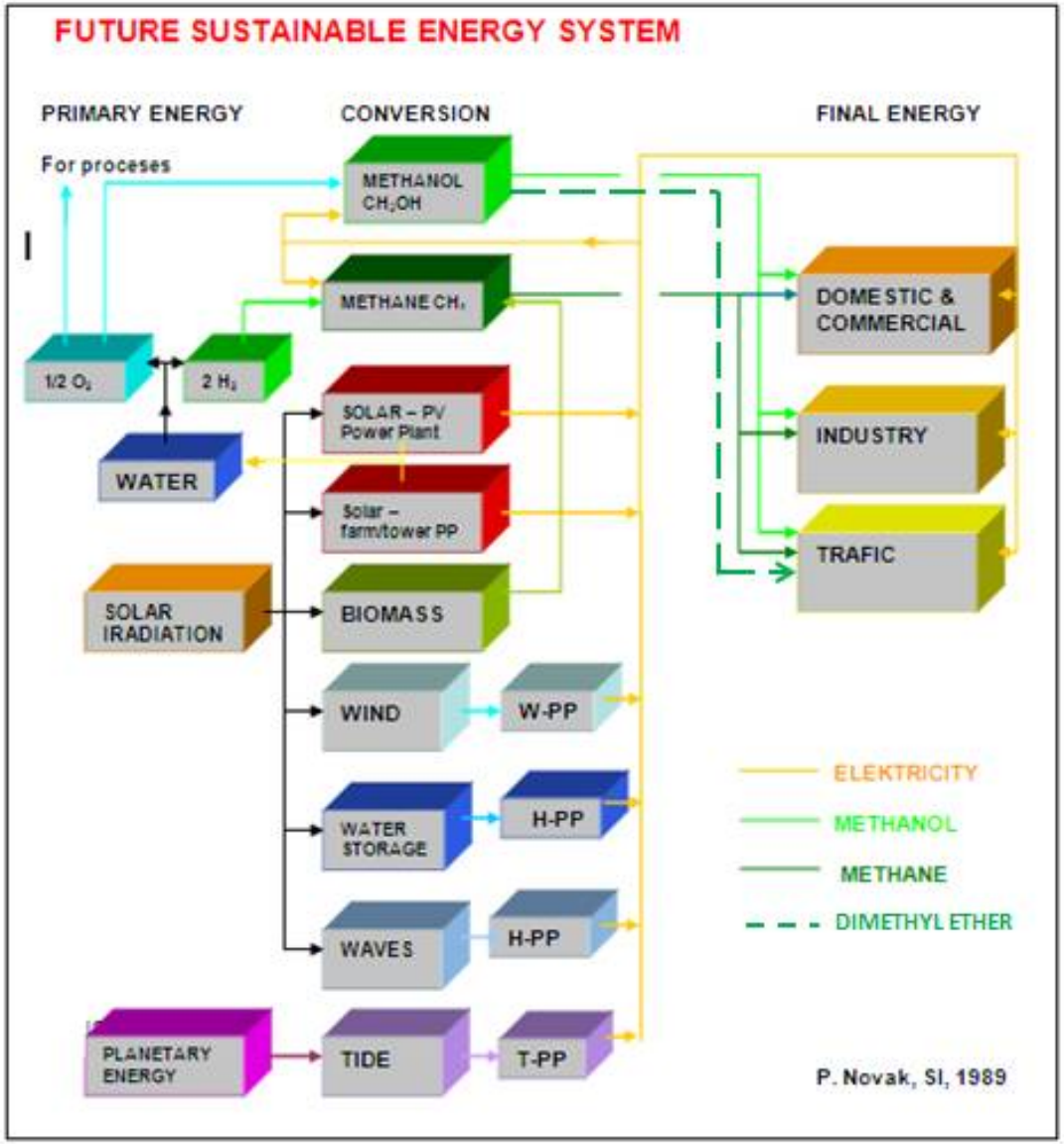
1. Energy source has to be unlimited and available everywhere on the planet Earth.
2. Energy carrier transformation should be without emissions of GHG.

Proposal for Slovenia?

Based on the analysis in 5 and 6 steps we decide in our proposal to create step by step a new sustainable energy system based on the RE with tree main energy carriers:

1. Elektricity from RE,
2. Synthetic metane CH4 and
3. Synthetic Metanol CH3OH, including in transition period dymetileter CH3OCH3

SUSTAINABLE ENERGY SYSTEM CONSISTS ONLY FROM (PN,1989):



2 energy sources:

- solar irradiation and
- planetary energy

4 secondary energy carriers

5 conversion technologies

3 final energy carriers:

1. **Electricity**
2. **Methane** CH4 (gaseous fuel)
3. **Methanol** CH3(OH) (liquid fuel)

The last two energy carriers use only 1 carbon to carry 4 hydrogen atoms.

4. ***Dimethyl ether CH3OCH3*** (liquid fuel)

Dimethyl ether can be a transition fuel for diesel engines)

For synthetic methane:

Hydrogen – water electrolysis

Carbon: ***from waste biomass***

For methanol:

synthetic methane

oxygen – w. Electr.; wasted CO2

This is a system with carbon recycling

Fulfilling the required criteria for SES

Proposed system fulfills all 6 criteria and is applicable for all countries on the world. The main point of the system is enabling the circulation of the carbon and hydrogen through the combined natural and artificial processes and can become integral part of the circular economy.

SES enables:

- Continuous transition to the full use of RE, using the existing infrastructure (power lines, gas pipelines, oil pipelines) including modernization and adaptations.
- Use of new high tech transmission lines for electricity.
- Stepwise introduction of distributed electricity production with short term capital return.
- Creating of a number of new workplaces for the next 30 years.
- Solving the chemical storage of electricity.
- Transportation transition to a new system is easy, no need for new engines with minor adaptations
- Unlimited supply of energy locally, regionally or inter-continentaly for industry, commercial, households use and transportation.

What is going on ?

In connection to the EU obligations, the following documents are adopted

- Action plan for RE: AN OVE 2010 ÷2020. Slovenian obligation to the year 2020 is 25% of RE in TPES. At present we achieve in 2014 21,7%.
- Second Action plan for energy efficiency AN URE 2020 is send to verification in Brussels, with energy saving of 20% until 2020 with public and private investment of 1.052,2 million EUR.
- Proposal for energy efficient refurbishment of the buildings is in discussion, including the subsidies for NZEB.

New SEC and emissions of GHG

New SEC has to enable also the reduction of GHG emissions from fossil fuels:

from 15.452 kt/a CO2ekv to 4.040 kt/a CO2ekv up to year 2050 do 2055.

In this period of time the TPP TEŠ 6 and NPP Krško will be retired.

This mean that we have to replace 950 MW in TPP with the new RE PP.

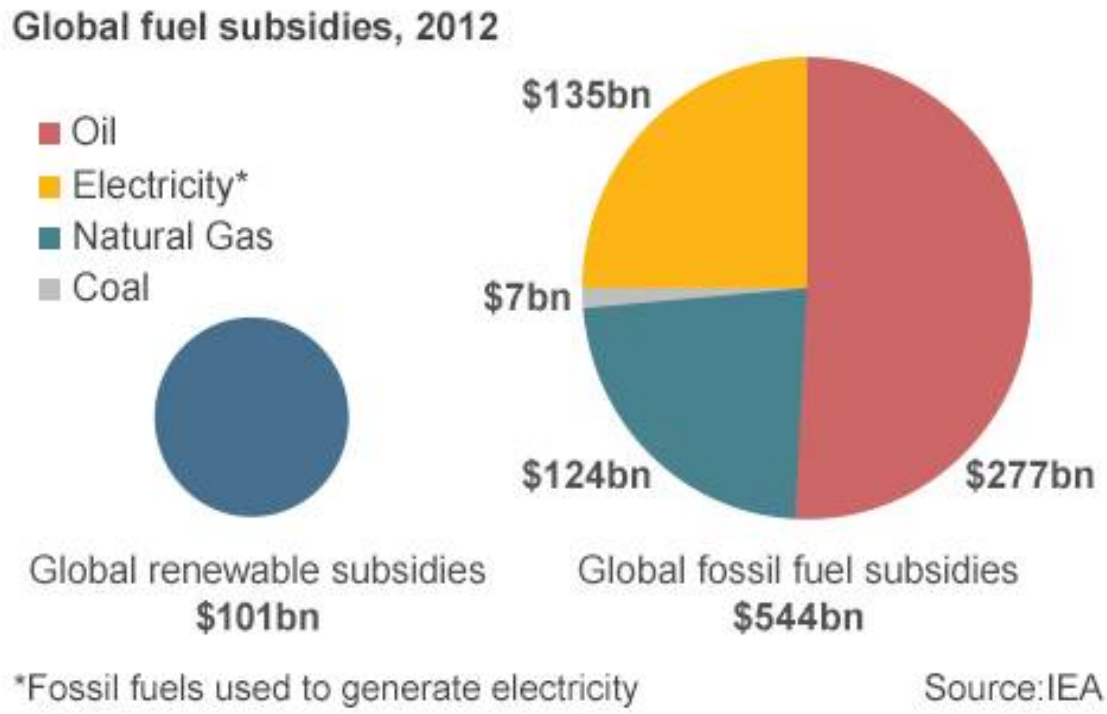
With regard the nominal working hours this mean to build approximately 4.000 - 6.000 MW installed power in solar, geothermal or hydro PP, including energy storage capacities.

Costs and price of energy?

- Costs of new energy carriers will be higher.
- Can we use the subsidies?
- How much the new infrastructure will be needed?
- Is this a new deal for society?
- How many new jobs will bring?

There is no answers for all of this questions, but decision should be taken.

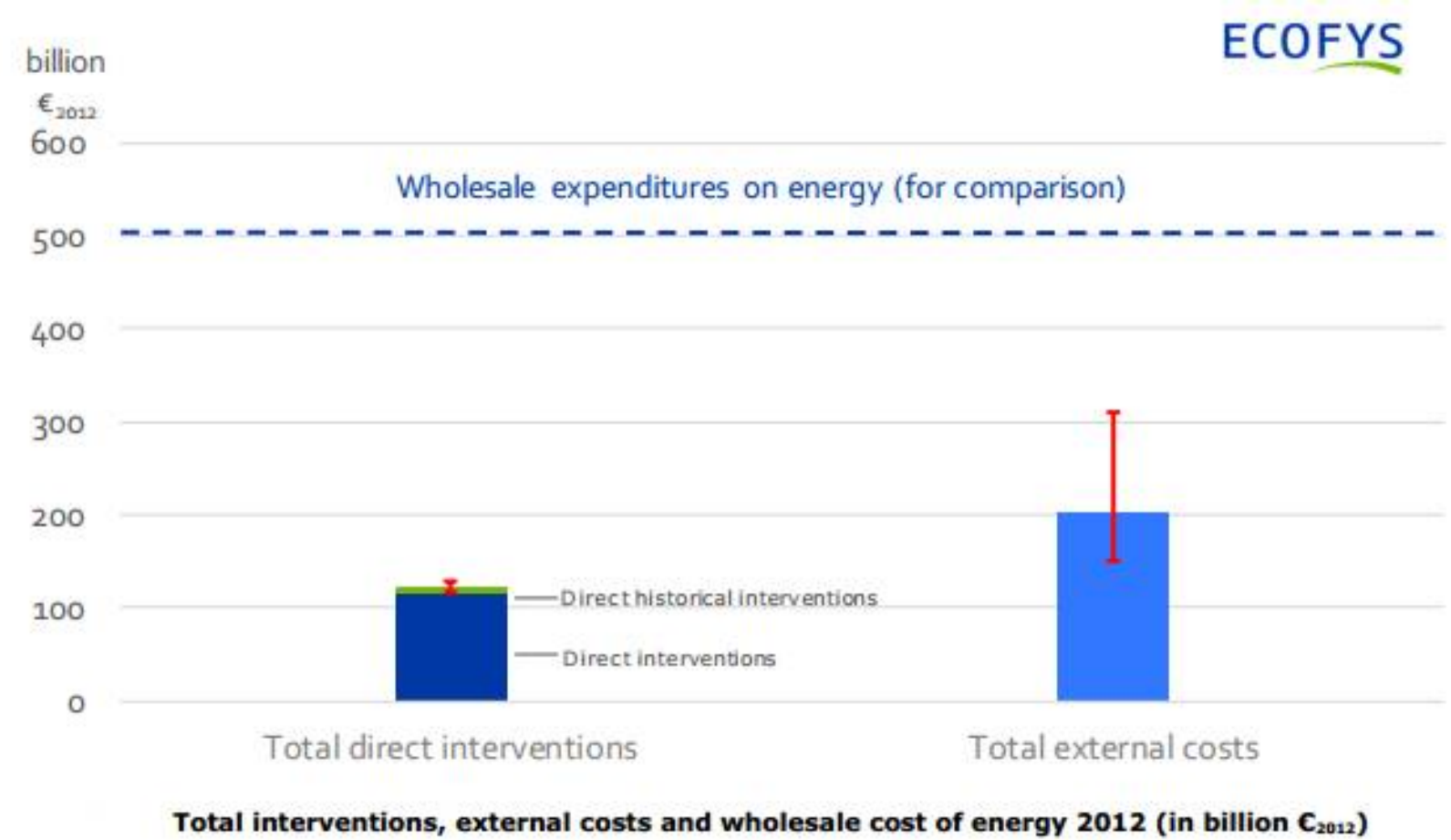
Fuel subsidies in the world



Source: (http://www.bbc.com/news/business-27142377)

Government subsidies for renewable energy cause great consternation to those who believe in the sanctity of free markets.
" If they can't stand on their own feet, then why support them?" the argument goes. But in actual fact, most energy sources are subsidised, and none more so than fossil fuels.

Expenditures on energy in EU, subsidies and external costs

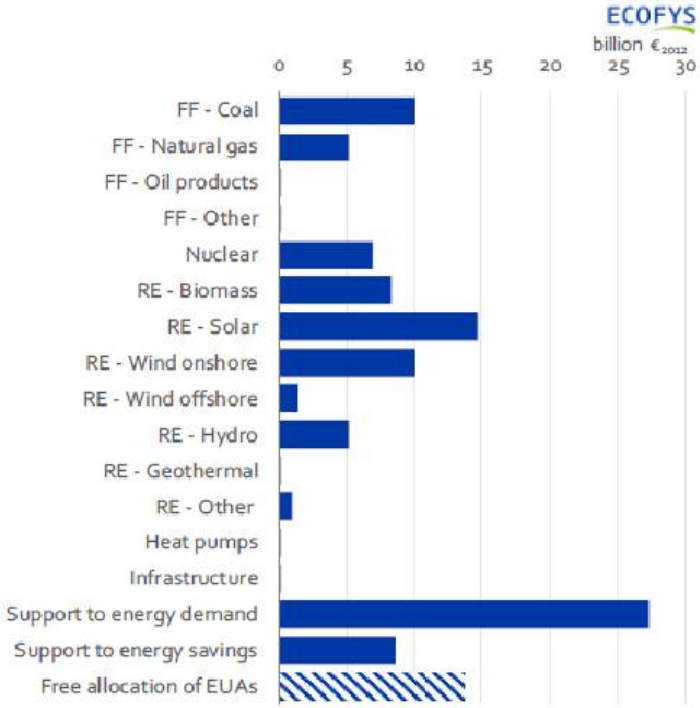


Total interventions, external costs and wholesale cost of energy 2012 (in billion $€_{2012}$)

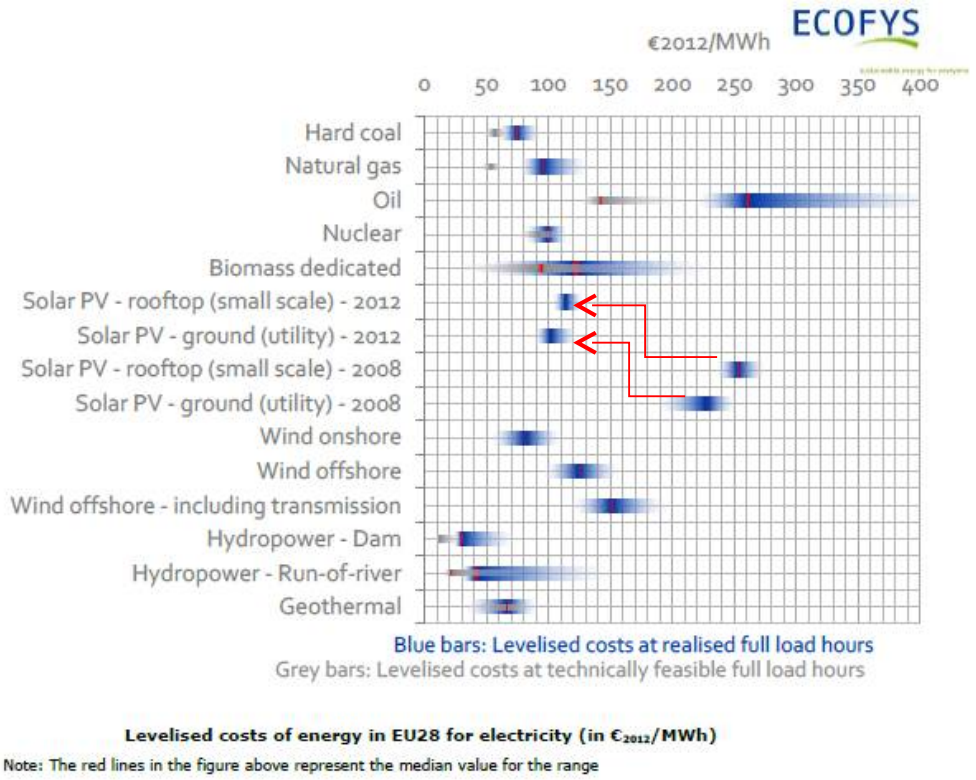
The direct historic support is shown as a range on top of the total interventions. Total interventions include the EU ETS free allocations.

Source: Subsidies and costs of EU energy; © Ecofys 2014 by order of: European Commission; DESNL14583, October 2014

Latest data on energy subsidies in EU 28 countries and levelized price of electricity for different technologies



All subsidies in 28 EU countries for fuels and RE in billions €, including the EU interventions in 2013. Historical subsidies are not included.



Levelised costs of energy in EU28 for electricity (in €2012/MWh)

Note: The red lines in the figure above represent the median value for the range

Red lines shows the extreme large change in PV electricity costs in last 4 years. The costs has been falling for more than 2,5 time.

Source: Subsidies and costs of EU energy; © Ecofys 2014 by order of: European Commission; DESNL14583, October 2014

What is awailable in Slovenia from RE?

- Solar irradiation: average measured irradiation on Slovenia area:
- **E = 2,67 ÷ 3,21 TWy/y or 84.120 PJ** **(**23,380.000 GWh/a or 2.000 Mtoe)
- **Theoretical potential of solar irradiation is in comparison with the present energy use ~ 290 time larger from TPES up to ~440 larger from TFES.**
- According to previous analysis we will not need more than 190 PJ/y of final energy up to 2050 or only 0,23% of solar irradiation

Proposal of energy use in different part of economy

Final energy is needed in industry, traffic and domestic, commercial and public use, with common designation „others“).

Based on the predictions od economic and social development in Slovenia the division of final energy supply in this tree sectors is as follow (P. Novak, EKS 2014):

- **industry 75 PJ/a present 50 PJ/a +**

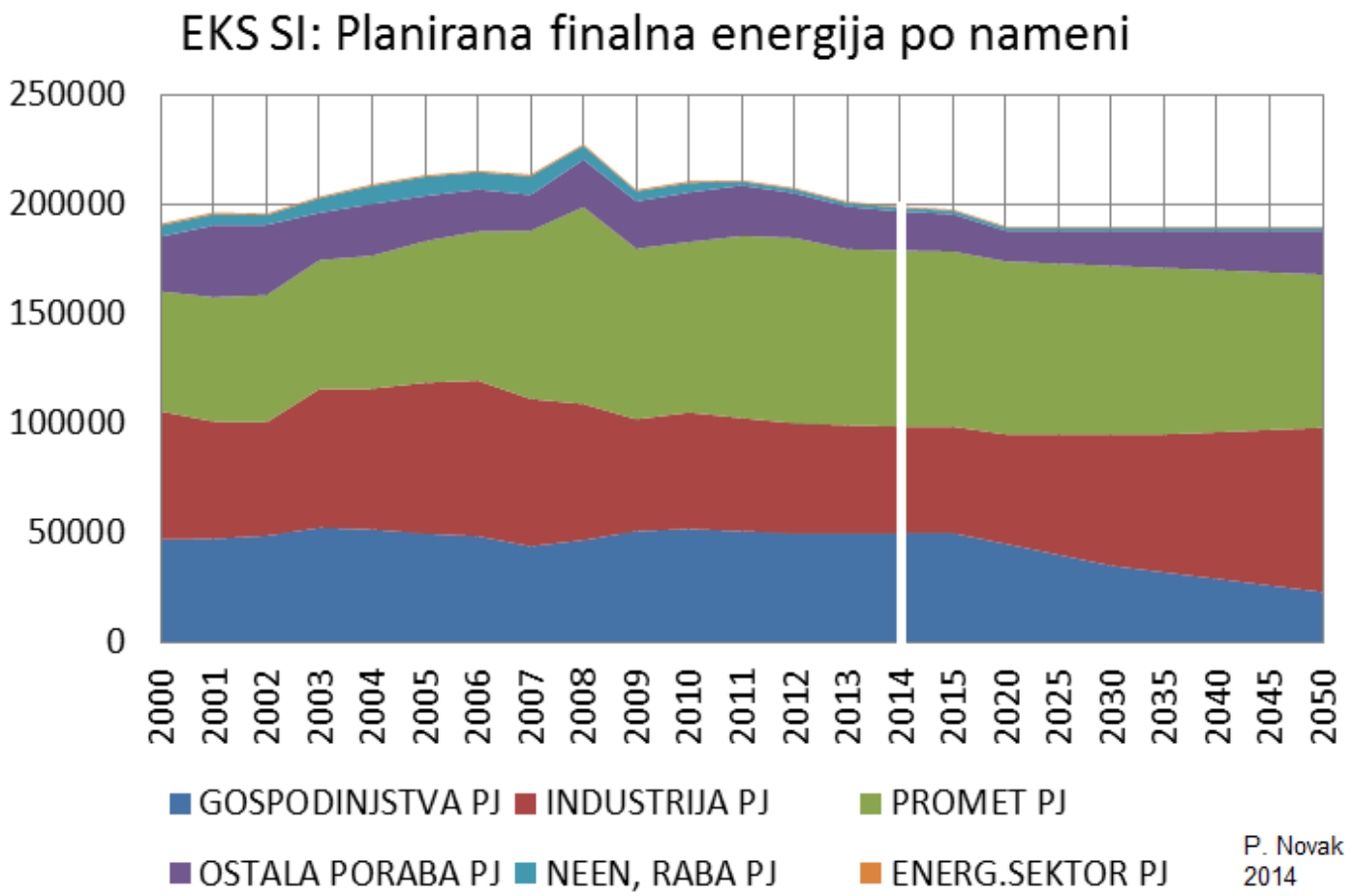
How we can cover those needs? 1

- 145,4 PJ/y from RE in Slovenia can be covert on the end of year 2050) with investment in the following infrastructure:
- HE on Sava, Mura and other smal rivers with final power of ~ 650 MW and average yearly production of 2,275 TWh/y or **8,19 PJ/y**
- wind PP 200 MW and yearly production of 0,4 TWh/y or **1,44 PJ/y**
- 500 MW of geothermal PP with yearly

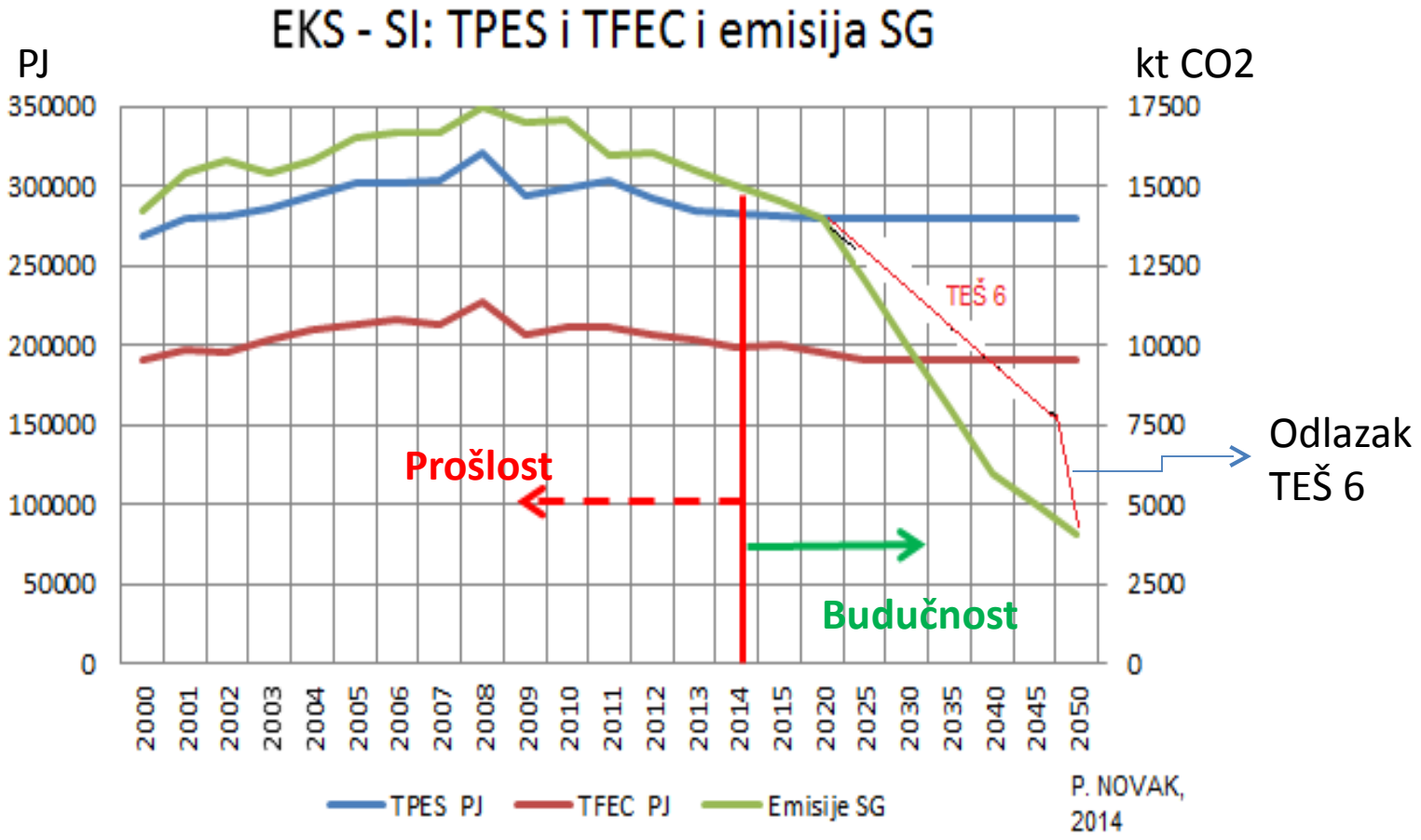
How we can cover those needs?

- Using bio waste from forest and fields in amount of 2 Mt/y and energy content of **28,5 PJ**
- Investment in 6 Mm2 SC (160.000 m2/y, total area of ~4 km2) and yearly heat production of **15 PJ/y**
- Investment in geothermal heat, with recovery of **15 PJ/y**
- Using energy from environment with heat pumps with recovery of **21,6 PJ/y**

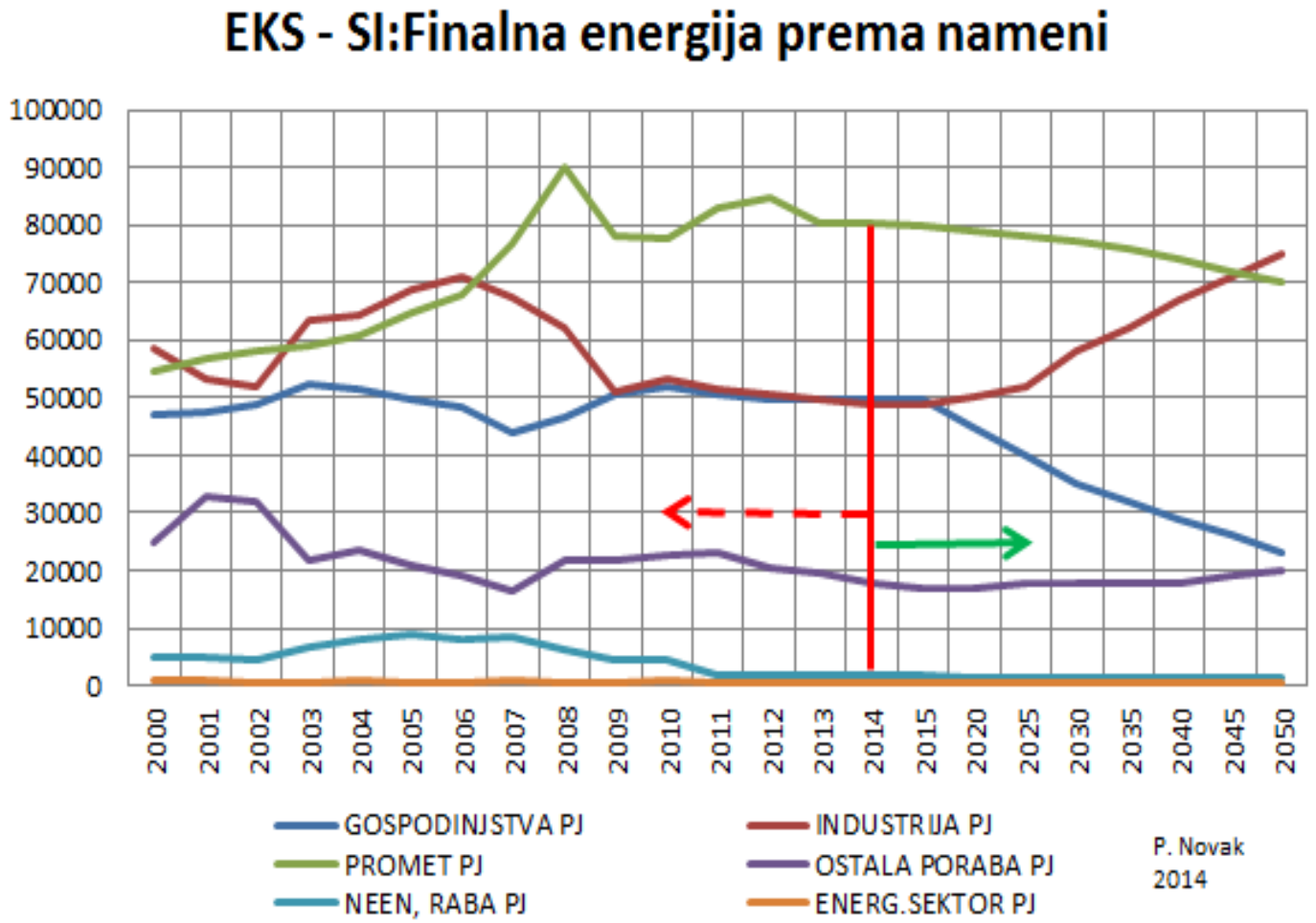
Energy use distribution



Kretanje potrebne primarne (TPES), finalne (TFEC) energije kao i emisije stakleničkih gasova od 2000 do 2014 g. sa predlogom do 2050 g. u Sloveniji (vremenska skala na diagramu je posle 2015 g. skračena u razmeru 1:5) [P. Novak, EKS; 2014]



Final energy distribution change in different sectors



Conclusions -1

- We are living in the period of big societal and economic changes.
- Approaching to the collapse point of human development, we have the possibility to direct the development into a new sustainable cycle or the global collapse.
- Available time to change is in the upcoming decades.
- We have to remember, that after the collapse of economically and socially well-organized Roman Empire in a. d. 400, it took more than 1000 years of development to reach the renaissance.
- We needed additional 200 years to reach the industrial revolution, running on energy from coal, oil and gas,

Conclusions -2

- Negative impact of this development is expressed in climate change.
- We are approaching to the moment when we have to turn back to Sun and use its energy to preserve the achievements of all preceding civilizations.
- Sustainable energy system proposed is one of many possibilities.
- All technologies for step-vise implementation of SES are available.
- Capital is not a limitation; the limitation is in our brains, courage and recognition, that we in Slovenia, if we would like, can have SES and be more progressive than others,.

Zaključci -1

- Predstavljen je predlog prelaza Slovenije na 100% snabdevanje iz OIE do 2050 godine.
- Sistem je održiv i obezbedjuje upotrebu organskog ugljenika iz odpadne biomase i vodonika iz vode za proizvodnju dva nosioca energije: metana i metanola, koja mogu koristiti svu postojeću infrastrukturu u Sloveniji sa manjom dopunom.
- Predvidja se konstantna potrebna finalna energija u obsegu 190 PJ/a.
- Kako se već sada pokriva 44,6 PJ iz OIE, planira

Zaključci - 2

- Koristi se sve razpoložive obnovljive izvore energije u Sloveniji i ne predvidja se više uvoz energije.
- Investicije se planiraju u obsegu 1,25 milijarde EUR godišnje, koje će istovremeno obezbedjivati oko 50.000 radnih mesta za sledečih 36 godina.
- Predloženi program je predmet dalje diskusije medju stručnim krugovima i stanovništva u dve variante, od koje druga predvidja upotrebu 15% prirodnog plina i posle 2050

Thanks for your attention.

Questions and comments are welcome.