Schweizerische Eidgenossenschaft
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The Swiss Energy Strategy 2050 and the Role of LCA in the Building and Transportation Sectors

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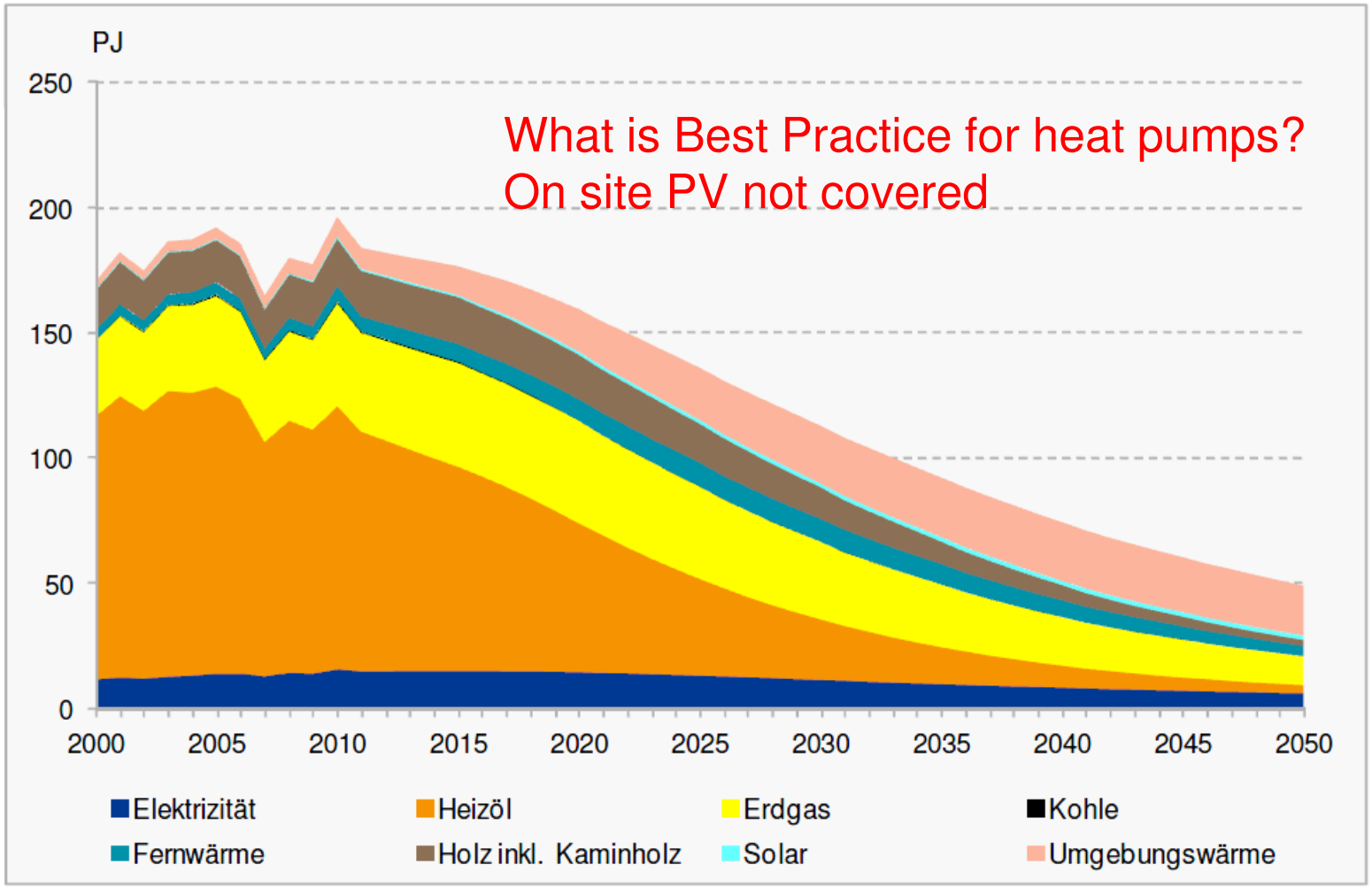
Energy Strategy 2050: Objectives given by Constitution
Possible Contribution by LCA to Policy Making

Overview Buildings

1. Swiss Energy Strategy 2050
2. EU Buildings directive: nearly zero energy building
3. Issue of Primary energy factors
4. Issue of grey energy in construction material

Energy sources to cover space heat demand
Swiss Energy Strategy 2050, scenario new energy policy



Quelle: Prognos 2012

EU: Energy Performance in Buildings Directive (EPBD)

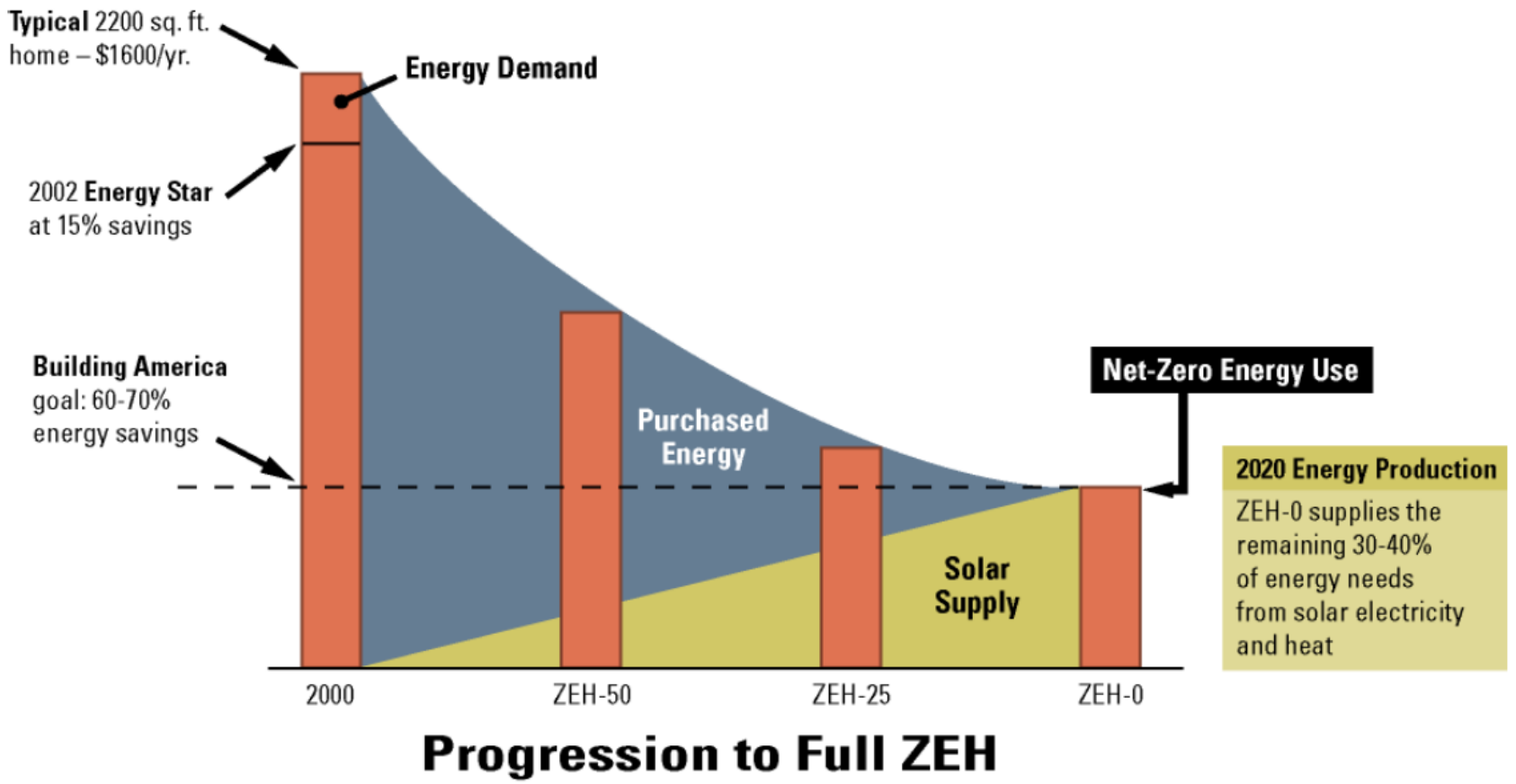
- Article 9 requires that "*Member States shall ensure that by 31 December 2020 all new buildings are* ***nearly zero-energy buildings***
- Member States shall furthermore "*draw up* ***national plans*** *for increasing the number of nearly zero-energy buildings*"

nearly zero energy buildings and primary energy factors

- A “nearly zero energy building” is a building that has a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.

- **Primary energy factors** used for the determination of the primary energy use may be based on national or regional yearly average values and may take into account relevant European standards.

Progression towards zero energy buildings goal: reduce purchased energy, more self-sufficiency



Source – Laustsen (IEA)

Capacity of installed heating system (Watt/m2 floor area) => heat pumps become more efficient

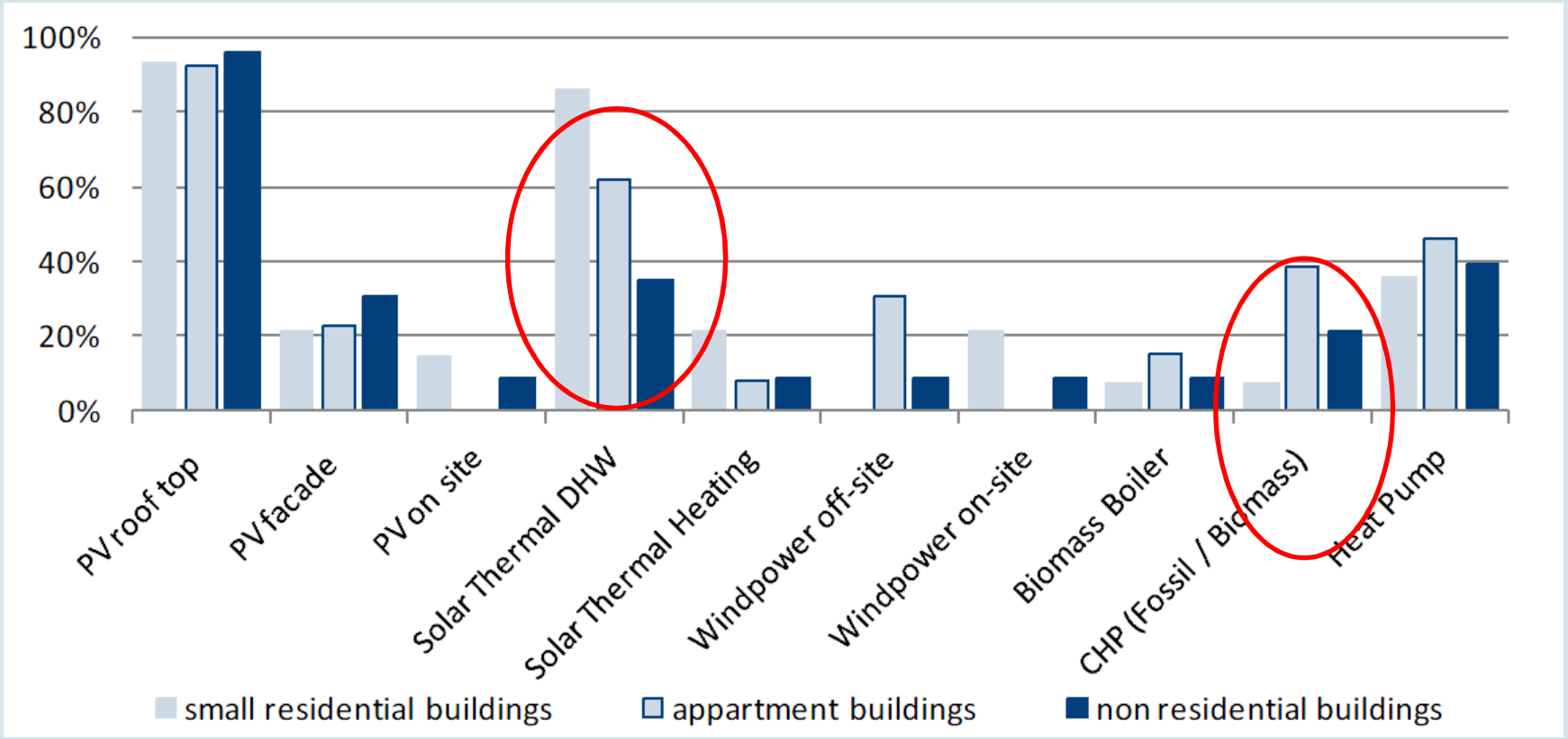
Tabelle 8-5: *Szenario „Neue Energiepolitik“, Private Haushalte Entwicklung der spezifischen Wärmeleistungsbedarfe bei Neubauten und Sanierungen; in Watt/m² EBF*

	2000	2010	2020	2030	2035	2040	2050
New buildings							
Single family bldgs	57.6	32.3	17.1	8.7	8.5	8.3	8.1
Multi dwellings	40.8	21.1	9.5	6.8	6.6	6.5	6.3
Refurbished buildings							
Single family bldgs	60.3	48.4	27.3	13.0	12.7	12.5	12.1
Multi dwellings	44.5	30.6	15.3	10.2	9.9	9.7	9.4

NWG: Nichtwohngebäude mit Wohnungen *Quelle: Prognos 2012*

Conclusion: energy efficient building envelope is crucial for NZEB

Renewable Technologies applied in different buildings
Analysis of 280 zero energy buildings worldwide



Source: Musall et al (Wuppertal)

Conclusion: self sufficiency is more difficult for large buildings

Issue: Primary Energy Factor for Electricity (Ecofys 2011)

According to the national building regulations of seven countries, the following Primary Energy Factors (PEFs) for delivery of electricity apply:

	France	Germany	NL	Poland	Spain	Sweden	UK
PEF	2.58	2.6	2.56	3	2.6	2	2.92
% RE	12.8%	10.3%	4.2%	2.7%	22.3%	50.2%	4.7%

The higher the RE share, the lower the PEF

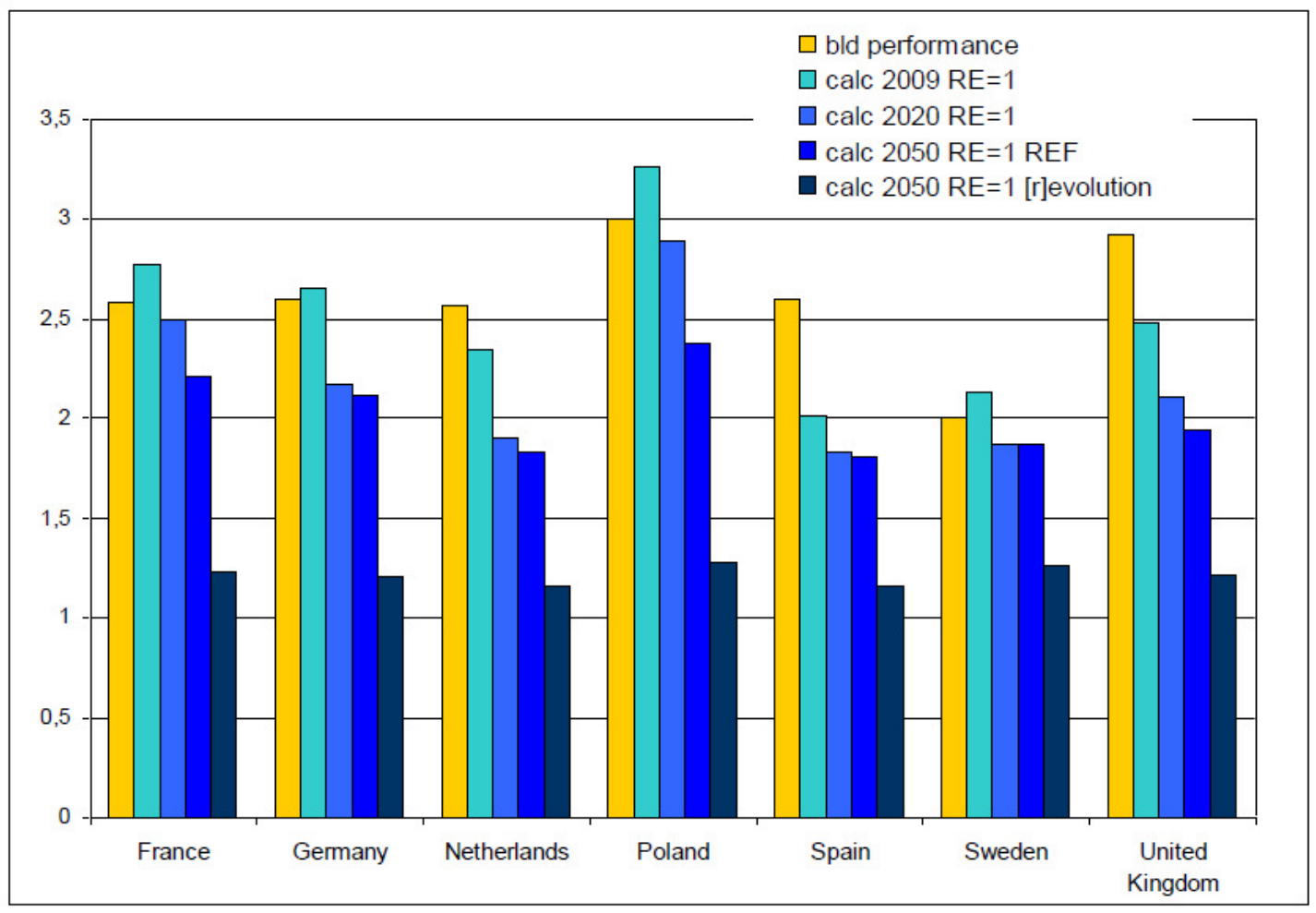
Lower PEF => stimulus for fuel shift from fossil to heat pumps
Lower PEF => smaller incentive for efficient equipment (ventilation, light etc.)

NL, FR, SE: political arguments rather than scientific algorithm only

Comparison of low energy building standards: applied primary energy factors in CH, F and D

Référentiel / Marque		Minergie®	Effinergie®	Passivhaus®	
Label(s) bâtiments basse consommation énergétique		Minergie® Minergie-P®	BBC-Effinergie®	Passivhaus®	
Pays		Suisse Application en France MINERGIE® MINERGIE-P®	France effinergie	Allemagne Application en France	
Energie		Primaire	Primaire	Primaire	Utile (Besoin)
Rapport énergie primaire / énergie finale	Electricité	2	2,58	2,7	
	Fossile*	1	1	1,1	
	Bois	0,5	0,6	0,2	
	PV**	2	2,58	0,7	

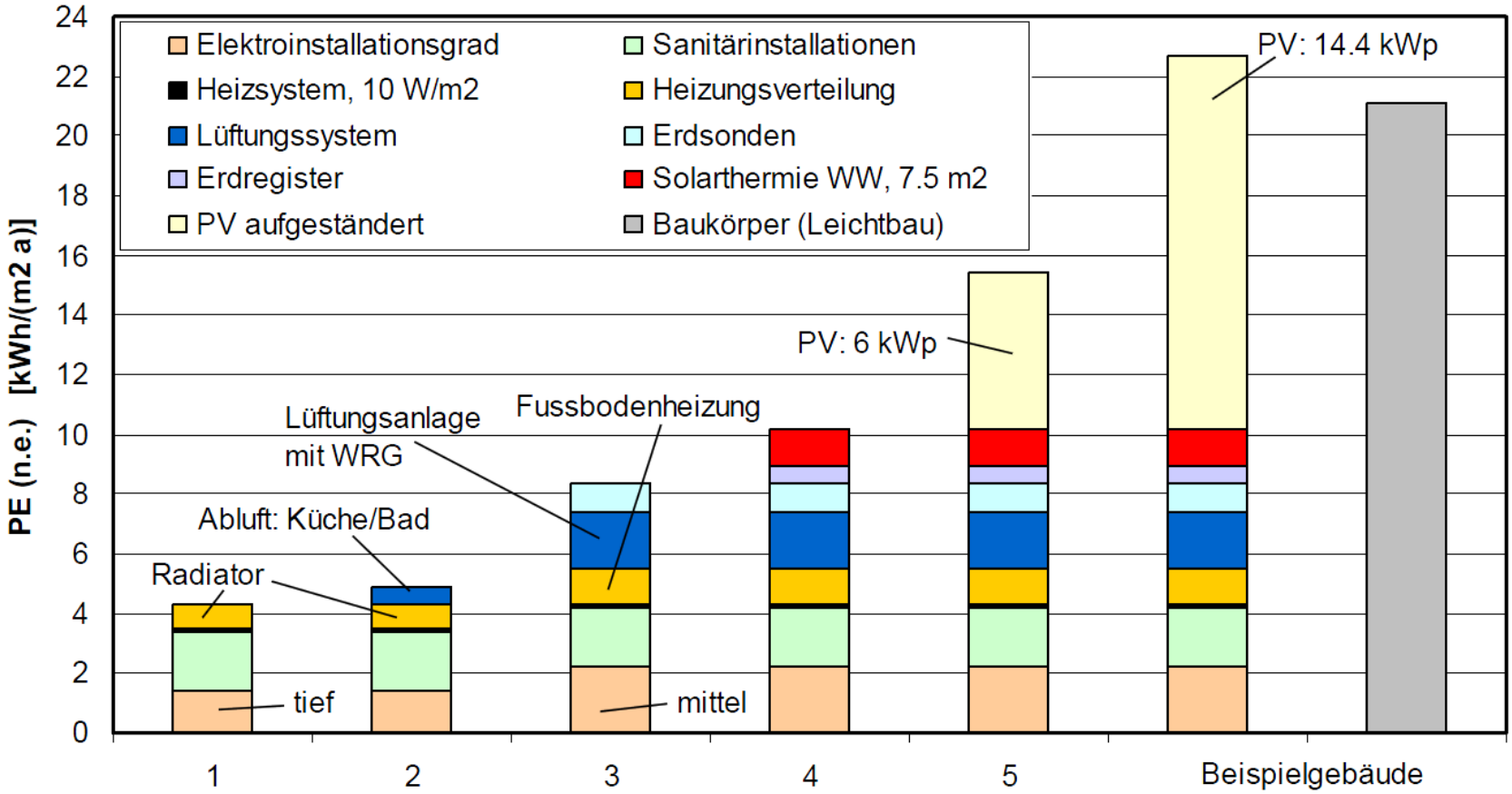
Evolution of PEF in Low Carbon Road Map Scenarios until 2050 (Ecofys based on EREC/Greenpeace)



Issue: Primary Energy Factor for Electricity (Ecofys 2011)

- There is no unified approach in European regulations regarding how to calculate primary energy when assessing energy performance of buildings.
- Different national electricity mixes, calculation methodologies, and a constantly evolving share of renewable electricity raise questions regarding how primary energy factors influence political and building design decisions.
- It is worthwhile to take a closer look at calculation methods for zero energy buildings, as they may provide new ways of calculating a building‘s energy performance that do not have the negative effects of lower PEFs. For non-ZEBs, special care is necessary to ensure that low PEFs do not lead to lower energy efficiency.
- **=> trade off between RES and Efficiency**

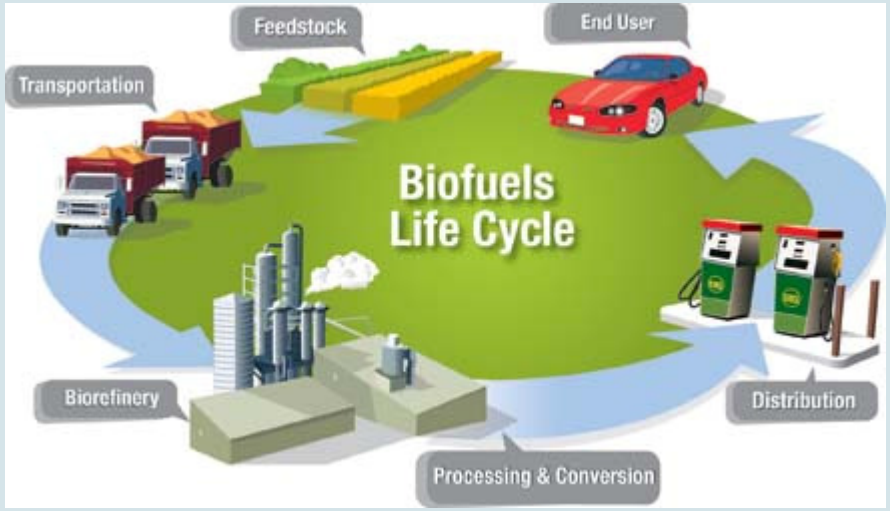
Grey Energy for different combinations of Building Technologies; increase through RES



Source: M. Hall (FHNW)

Conclusions

- The “EU benchmark” regarding energy in buildings is the NZEB
- Energy performance of building envelopes seems more important than local renewable energy supply, especially in urban areas where the roof surface per resident is limited.
- The share of RES and thus PEF are changing quickly, building standards evolve slowly. Sense of PEF in building standards?
- Many issues remain open, such as system boundaries regarding electricity storage in the grid, decreasing primary energy factors and increasing grey energy.

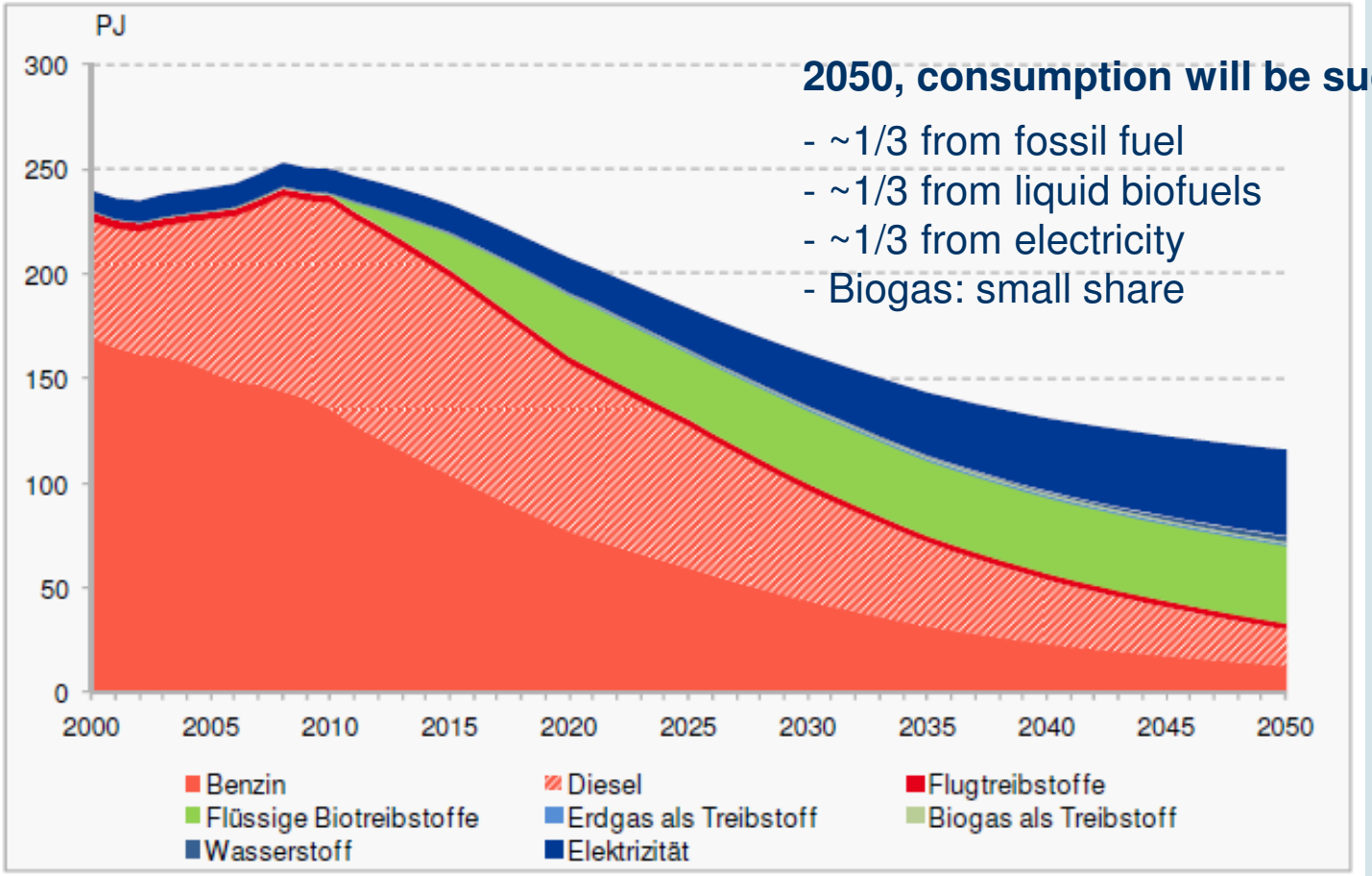


TRANSPORTATION SECTOR

Overview Transportation

1. Swiss Energy Strategy 2050
2. Future Role of Electric Vehicles
3. Past and future EU Policy regarding biofuels
4. Market situation of biogas, biofuels from waste

Energy Strategy 2050: Final Energy Demand by Energy source in Transport Sector

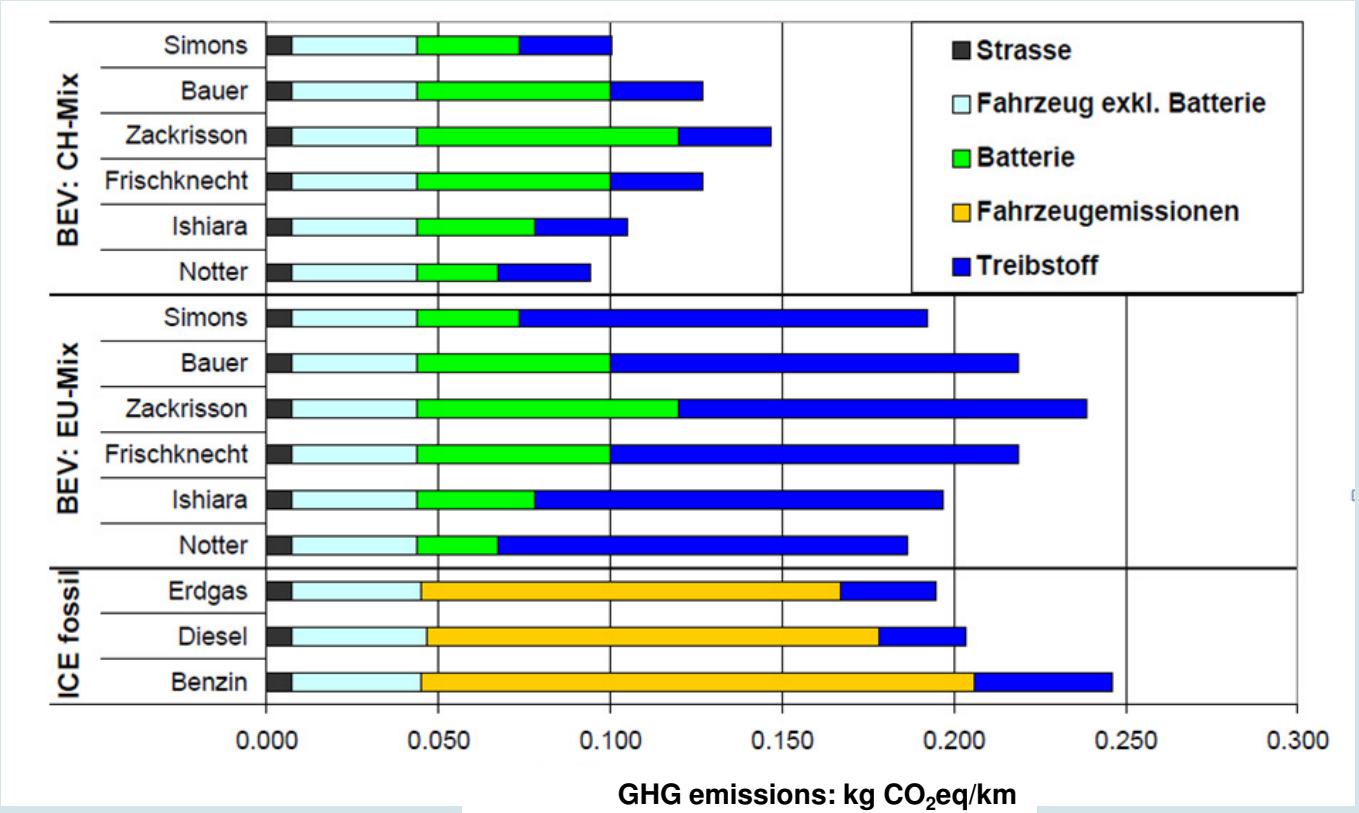


2050, consumption will be such that:

- ~1/3 from fossil fuel
- ~1/3 from liquid biofuels
- ~1/3 from electricity
- Biogas: small share

Quelle: Infras 2012

Electric Vehicles: GHG Emissions according to LCA Comparison of Studies; Influence of Electricity Mix



Source: Gegenüberstellung verschiedener aktueller Schweizer Ökobilanzstudien im Bereich Elektromobilität, 2011, H.-J. Althaus, C. Bauer

COMPARISION OF ELECTRICITY MIX SWITZERLAND VS EU

- Results show that **fuel** (electricity) can play a major role in GHG emission

Electricity-mix	CH-mix (2011)*	EU-mix (2011)
Hydropower plants	53,7%	12%
Nuclear plants	40,7%	27%
Coal	-	25%
Gas	-	23%
Renewables	-	10%
Conventional thermals power plants and others	5,6% (2% renewable)	1%
Oil	-	2%

**Schw. Elektrizitätstatistik, 2011, BFE*
***Observation de l'industrie via Eurostat, 2011*

- According to NREAPs under RES Directive, more than 30% of electricity generation in EU will be renewable by 2020

BIOFUEL: DEFINITIONS

- **GENERAL DEFINITON**
  - Fuel produced from **Biomass** (animal, vegetal matter or waste)
- **1ST GENERATION BIOFUELS**
  - Biofuels made from food crops such as rape seed, sugar beet, corn, wheat, etc
- **2ND GENERATION BIOFUELS**
  - Biofuels produced from **non-food crops**, such as cellulosic biofuels and waste biomass
    - Vegetable oils, biodiesel, bioalcohols, biogas, solid biofuels, and syngas
    - Current Research on biohydrogen, biomethanol, DMF, Bio-DME, Fischer-Tropsch diesel, biohydrogen diesel, mixed alcohols and wood diesel
- **3RD GENERATION BIOFUELS**
  - Biofuels produced from extracting oil of algae ("oilgae")
  - Low cost and high-yielding production

Biofuel in european Policy

Past and Current Policy

- **Directive 2003/30/EC** of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels.
- **2008:** Switzerland is the first country to introduce LCA in biofuels policy
- **European Directive 2009/28/CE:** 10% biofuel component in vehicle fuel by 2020

  Rules:

  – Minimum of **35% GHG emission saving** from the use of biofuels (50%, 60% resp. from 2017 and 2018)

  – Biofuels shall not be made from raw material obtained from land with **high biodiversity value** nor **high carbon stock**

  – Biofuels shall not be made from raw material obtained **from peatland**

  – **Commission will present reports on competition with feedstocks for food.**

Further Issues

- Renewable Energy Directive vs. Emission Trading System: biofuels count fully carbon free in aviation!
  - if first generation biofuels are not welcome on the road, they flow into the aviation sector
- "Jatropha Story" in 2008: competition not only for food but for water resources
- In the past: Palm oil goes into "green electricity" generation
- Issue of land use change

Biofuel in european Policy

PROPOSAL for Fuels Quality Directive: Counting of different Feedstocks towards the target referred to in Article 3(4) (10/17/2012) (October 2012)

- **Share of first generation biofuels count max 5% towards 10% target**
- **shall be considered to be four times their energy content:**
  - Algae; Biomass fraction of mixed municipal waste; Biomass fraction of industrial waste; Straw; Animal manure and sewage sludge; Palm oil mill effluent and empty palm fruit bunches; Tall oil pitch; Crude glycerin; Bagasse; Grape marcs and wine lees; Nut shells; Husks; Cobs; Barks, branches, leaves, saw dust and cutter shavings
- **shall be considered to be twice their energy content:**
  - Used cooking oil; Animal fats; Non-food cellulosic material; Ligno-cellulosic material except saw logs and veneer logs.

BIOGAS AS A FUEL

TECHNOLOGIES

- Created by **anaerobic digestion** of organic wastes (methanisation)
- **gasification** of lignocellulosic (wood), lignocellulosic feestocks (ex: straw) with pre-treatment

BIOGAS USE IN EU DIRECTIVE: 2009/28/CE

- ***Art. 21, al.2*** "…the contribution made by biofuels produced from wastes, residues, non-food cellulosic material, and ligno-cellulosic material shall be considered to be twice that made by other biofuels."

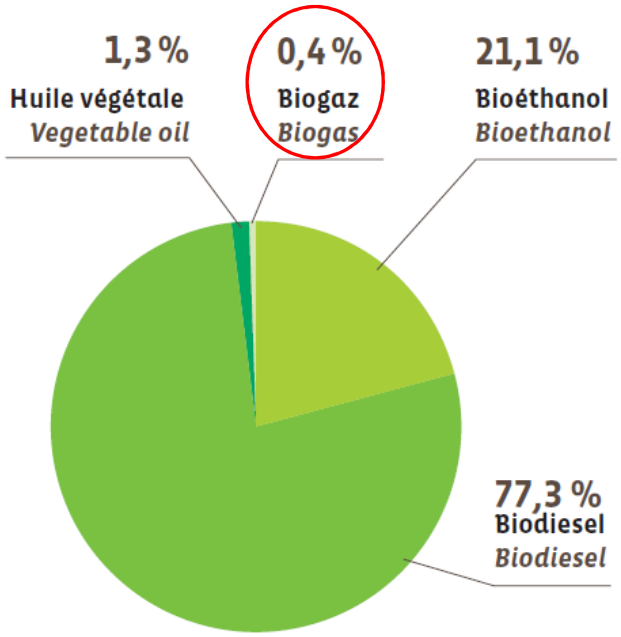
ELECTRIC VEHICLES IN EU DIRECTIVE: 2009/28/CE

- ENERGY USE BY EV IS MULTIPLIED BY 2.5 AND WEIGHTED BY RES SHARE IN ELECTRICITY MIX

Biogas as a Fuel: Europe 2010-2011

*Part de chaque type de biocarburant dans la consommation de biocarburants dédiés aux transports de l'UE en contenu énergétique en 2010**

Breakdown of total EU 2010 biofuel consumption for transport by biofuel type and energy content*



Source: EurObserv'ER 2011.

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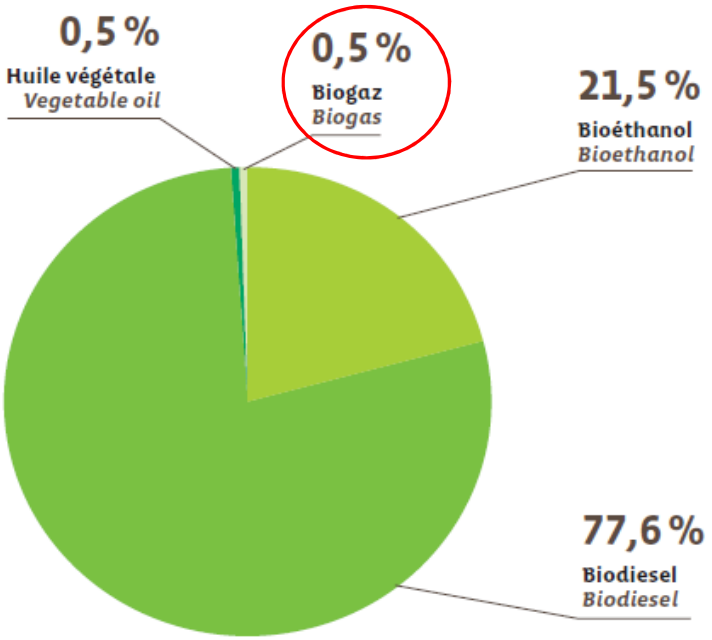

** Estimation. Estimate.*

Sources: EurObserv'ER 2012.

GHG Emissions per Person Km for various Biogas Feedstocks

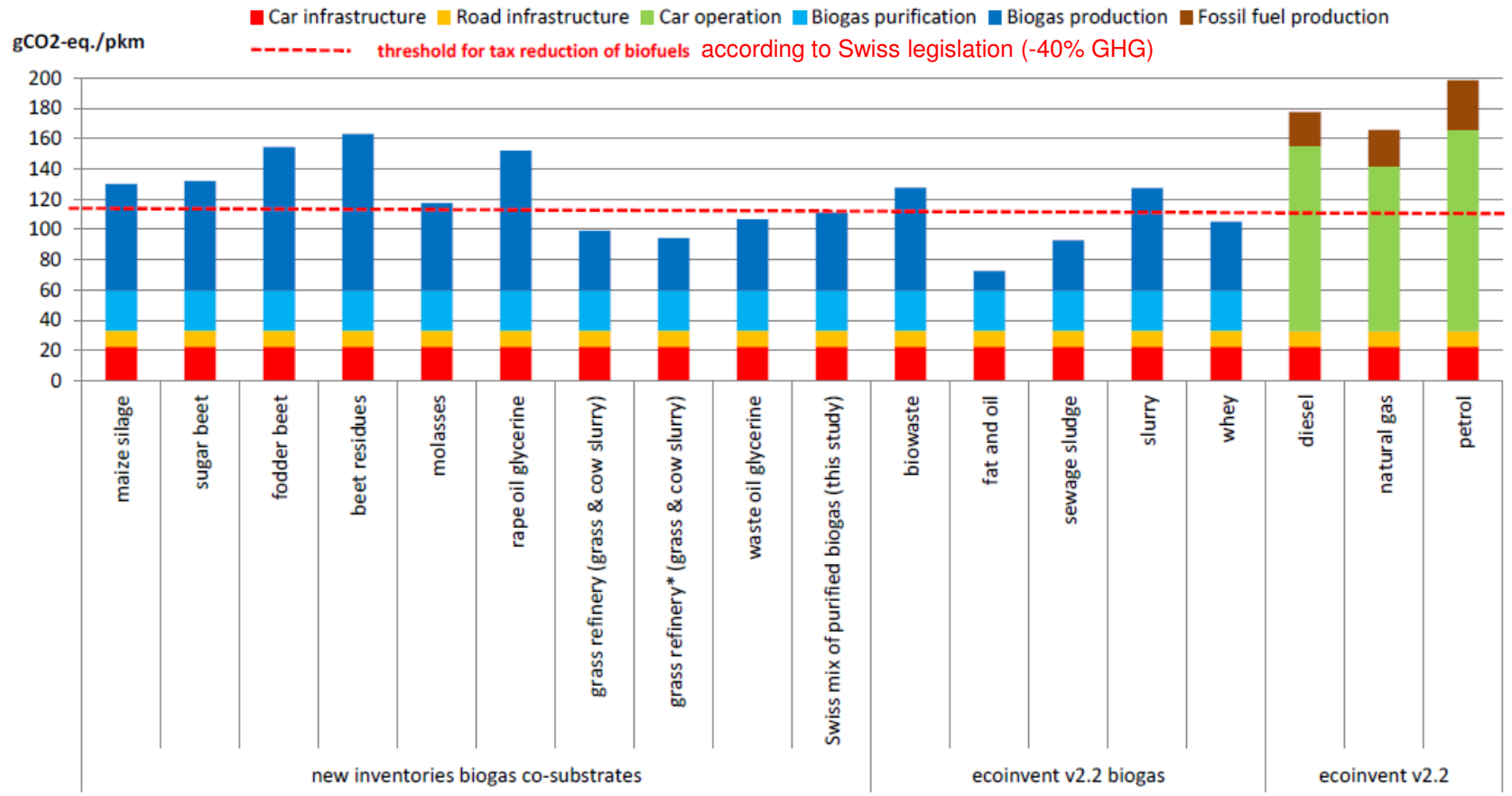

Fig. 4.2 **Global warming potential over a time horizon of 100 years (IPCC 2007) of transport services (g CO2-eq per pkm) with an average load of 1.6 passengers**

Sources: Life Cycle Assessment of Biogas Production from Different Substrates, 2011

Gas Vehicles and Biogas Share in Gas Fuel

	Countries	Share of NG vehicles in fleet	Biomethane share in total gas (M Nm3)	Year
	Switzerland	0.22%	21%	Dec. 2011
Neighboring countries	Germany	0.20%	10%	June 2012
	France	0.04%	3%	Dec. 2011
	Austria	0.14%	0%	June 2012
	Italy	1.83%	0%	Dec. 2011
Biomethane top scorers	Sweden	0.87%	60%	June 2012
	Finland	0.03%	4%	June 2012
	Hungary	0.01%	1%	June 2012

Sources: NGVA europe

PROJECTED TOTAL OTHER BIOFUELS IN TRANSPORT (KTOE)

Countries	2005	2010	2015	2020	% of total sector RES 2020	% of all sectors RES 2020	% of total sector cons. (2020)	% of all sectors cons. (2020)
Germany	177	102	35	173 to 261	2.8-4.2*	04.-0.7*	0.4-0.5*	0.1*
France	0	0	30	160	3.9	0.4	0.4	0.1
Austria	8	63	71	94	11	1	1.1	0.3
Italy	0	5	27	50	1.7	0.2	0.1	0
Sweden	13	40	67	94	9.3	0.5	1.2	0.2
Finland	0	0	0	0	0	0	0	0
Hungary	0	0	1	5	0.9	0.2	0.1	0

*self-calculations
Shares are calculated according to additional energy efficency scenario
Art. 21 taken into account

Sources: ECN, 2011

CONCLUSION

- The fuel mix in transportation will change drastically until 2050
- LCA regarding biofuels has been important in the past and will remain important while shifting to second generation biofuels and electric vehicles EV, see EU proposals for double counting of second generation biofuels.
- Biogas is “first” second generation biofuel technically and economically available but not much attention has been given to its promotion in transport across EU countries. Strong competition with green electricity resp. feed-in tariffs.
- LCA regarding EVs has to take into account a future shift in electricity generation in Europe!