SRF, key for a sustainable cement industry

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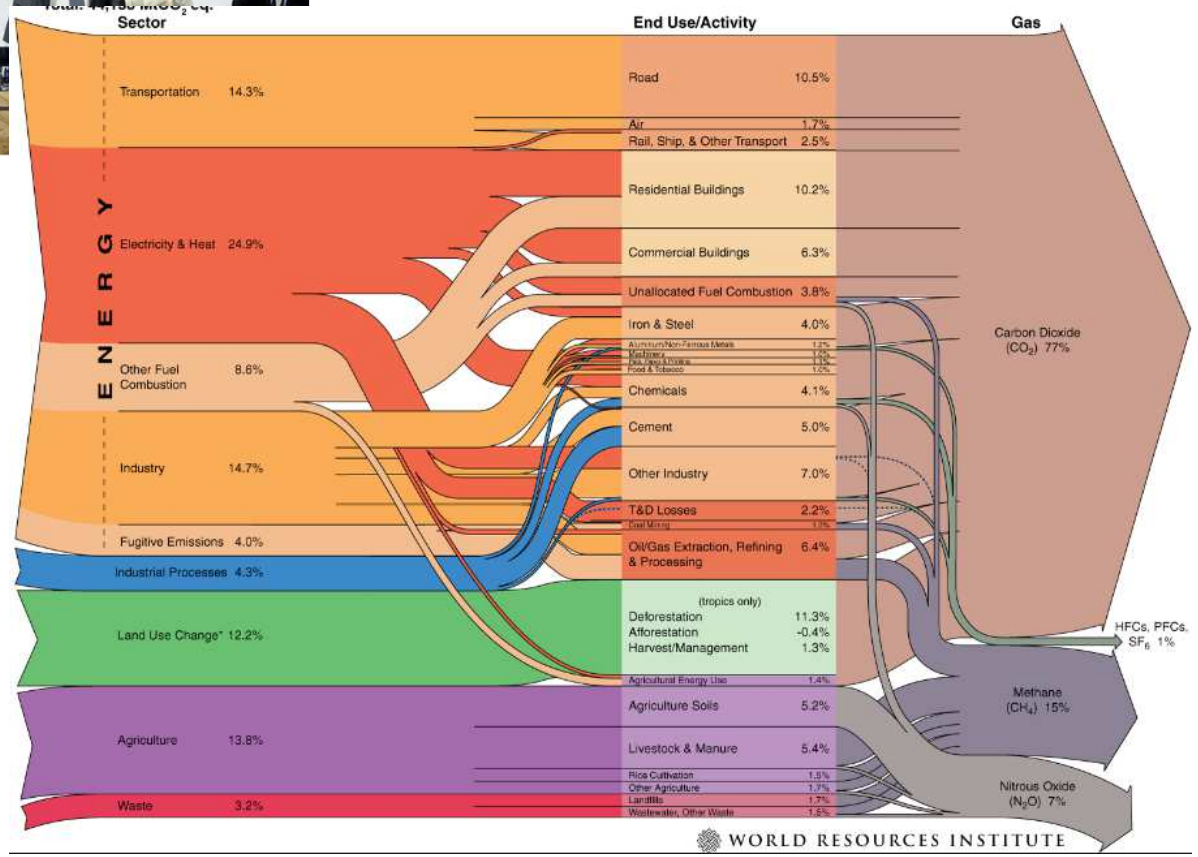
Climate change – impact on relevant sectors

- **Power**
- **Transport**
- **Industry**



What options available for these sectors?

		Solar/ wind/ hydro	Bio-mass	rnwbl electr.	rnwbl H2	Biofuel (>3rd generation)	MSW and C&I waste		
							W-t-E	W-t-biofuel	W-t-SRF
Power	renewable	●	●						
	circular						●		
Transport	renewable			●	●	●			
	circular							◐	
Steel (heat)	renewable				●				
	circular								
Cement (heat)	renewable		●						
	circular								●

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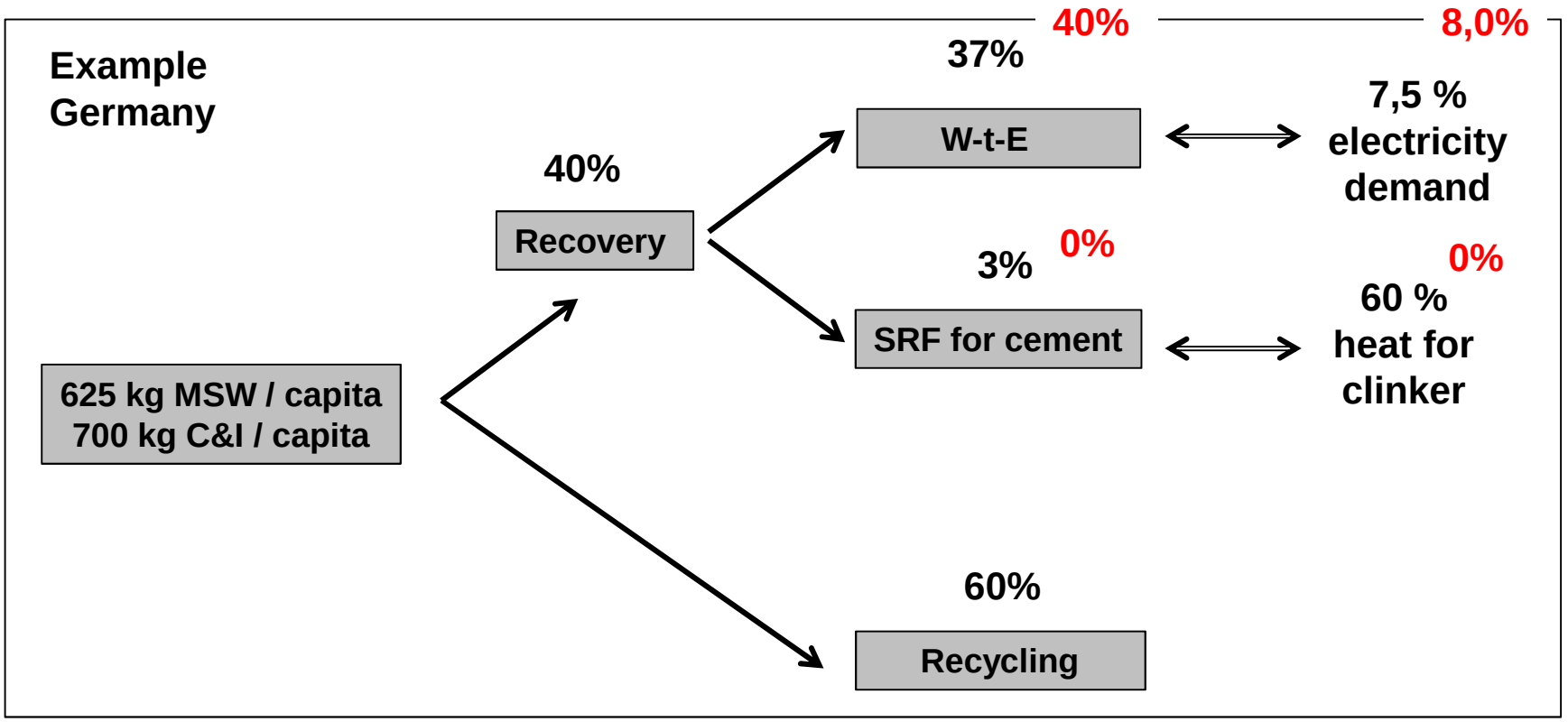
How important is MSW + C&I waste for Power or Cement?



MSW + C&I waste is a dominant factor for decarbonizing cement, but not for decarbonizing the power sector

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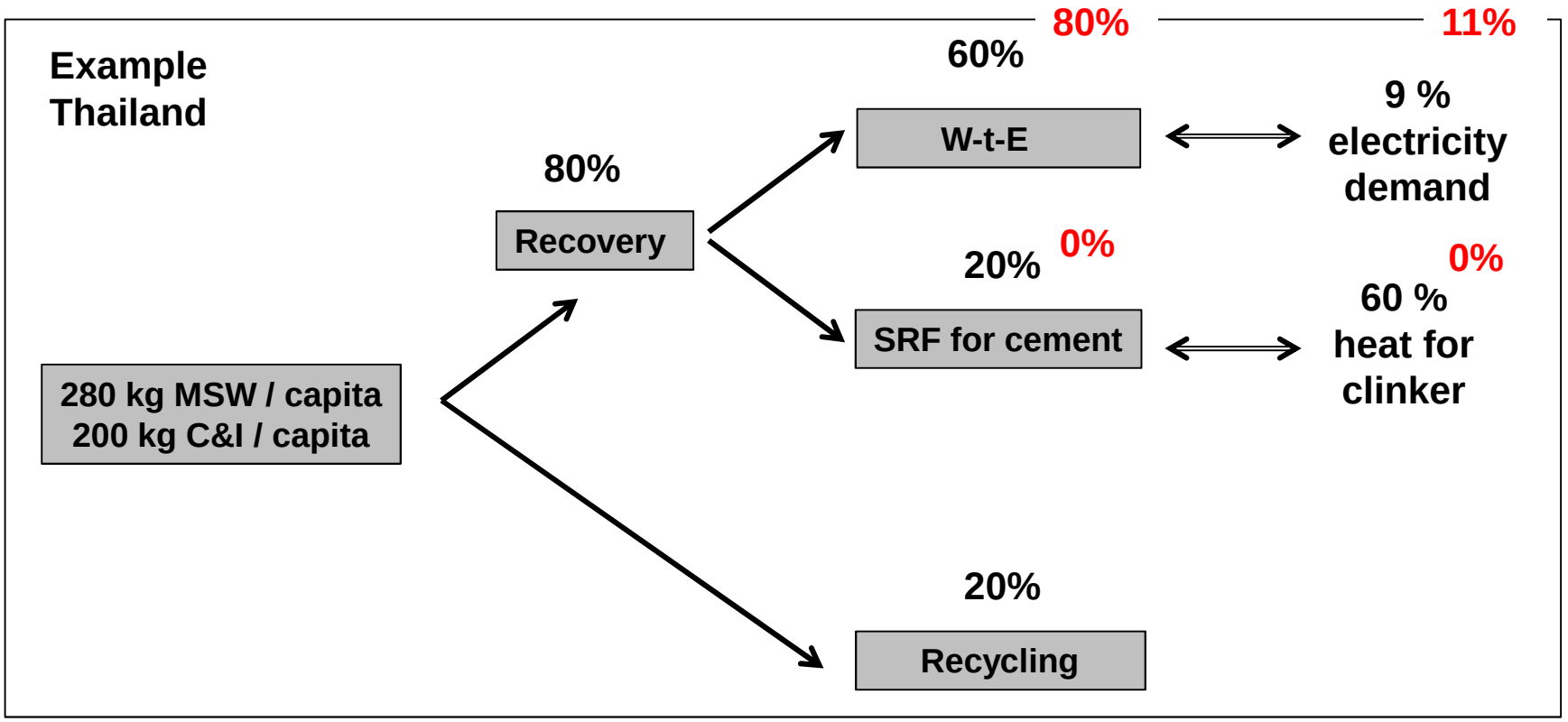

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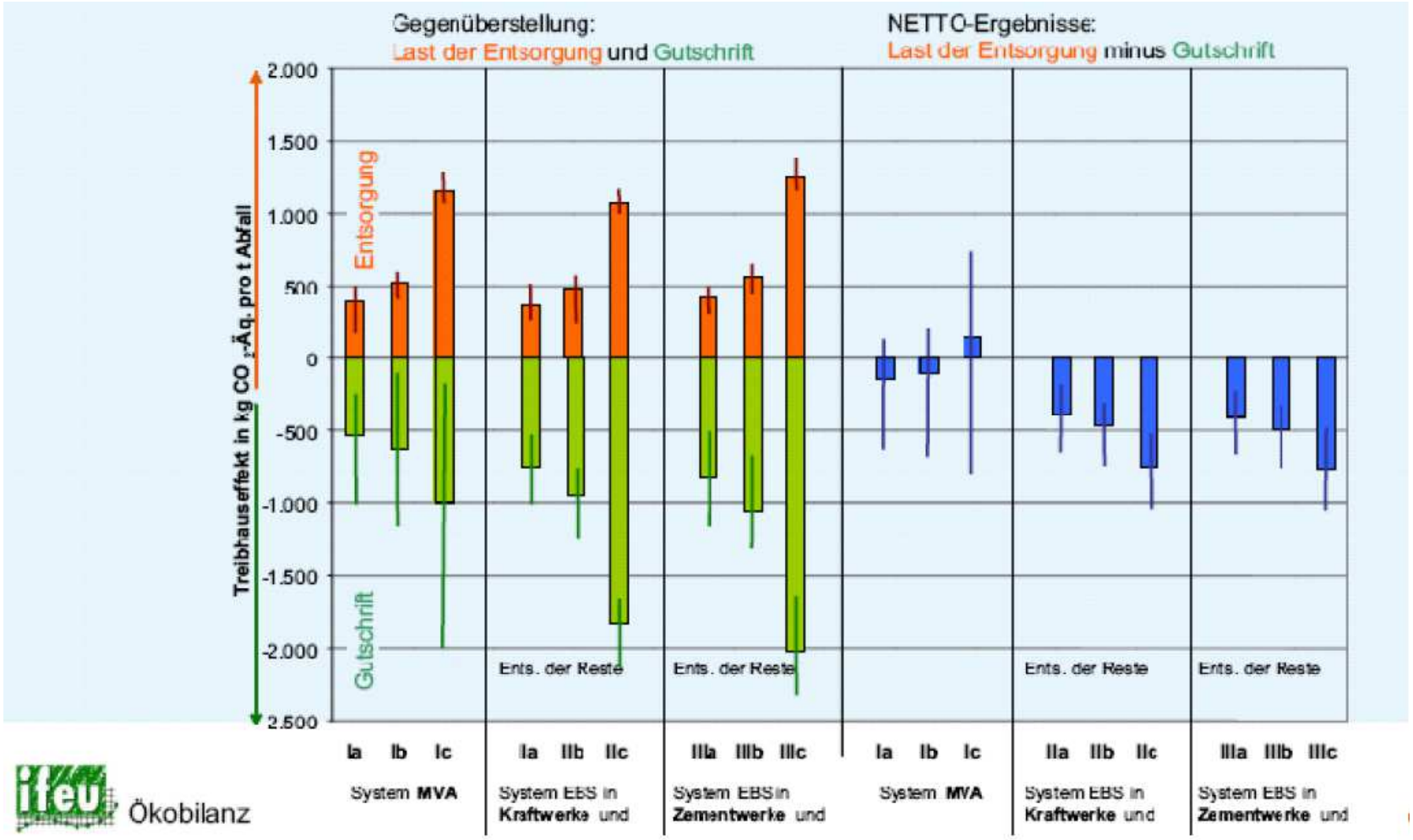
Netto CO_2-balance of MSW-to-SRF better than W-t-E



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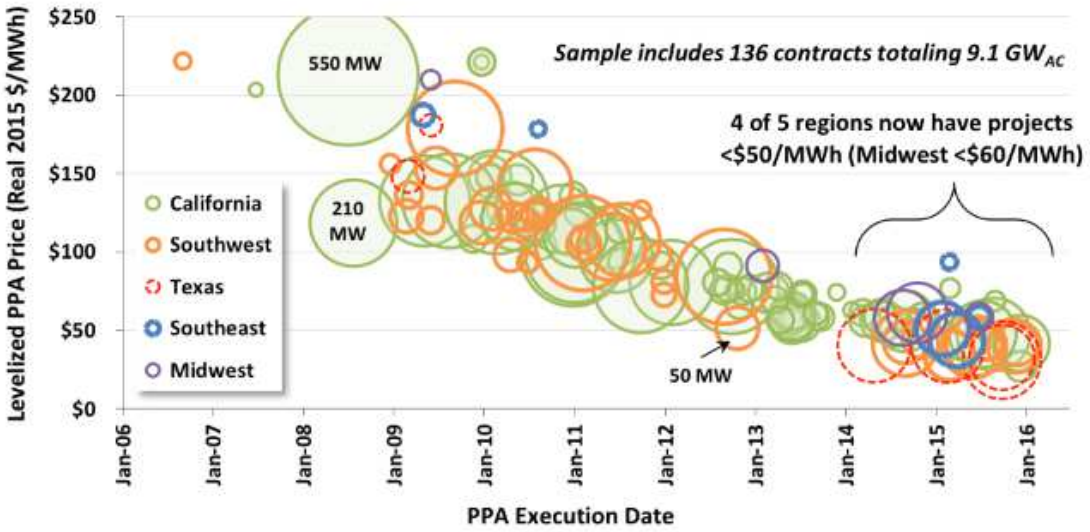
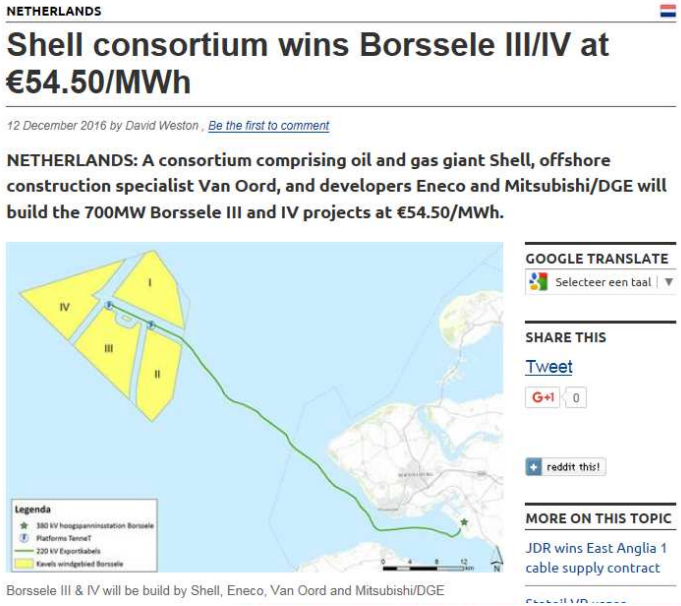
How does cost-price PV and Wind compare to W-t-E ?



- **PV-price drops to 50 $/ MWh in US**

The price paid for long-term solar power purchase agreement (PPA) contracts in 2015 fell be
50 dollars per megawatt-hour (or 5 cents per kilowatt-hour) in 4 of the 5 regions analyzed. C
LBNL

- **Wind-off shore drops to 55 €/ MWh in NL**



NETHERLANDS

Shell consortium wins Borssele III/IV at €54.50/MWh

12 December 2016 by David Weston , Be the first to comment

NETHERLANDS: A consortium comprising oil and gas giant Shell, offshore construction specialist Van Oord, and developers Eneco and Mitsubishi/DGE will build the 700MW Borssele III and IV projects at €54.50/MWh.

Borssele III & IV will be build by Shell, Eneco, Van Oord and Mitsubishi/DGE

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What are the costs of W-t-E in various countries?

Waste - to- Electricity		Germany exist	Estonia exist	Bangkok exist	Jakarta on HOLD
tipping fee raw MSW	€/t	-70	-45	-25	-35
tipping fee raw MSW	€/MWh	87.5	100	56	130
additional fee via Feed-In-Tariff	€/MWh	0	44	67	93
net sales price	€/MWh	50	50	50	50

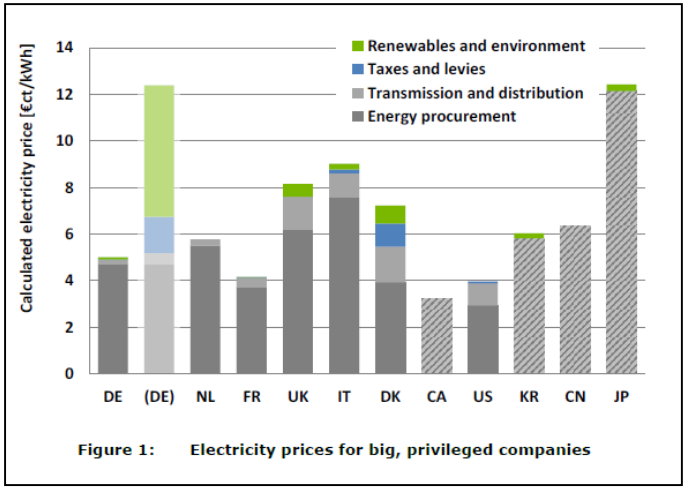

Figure 1: Electricity prices for big, privileged companies

- **Net sales price is kept artificially on market level**
  - Or by high gate fee (Germany, UK)
  - Or by high feed-inn-tariffs
- **Indonesia has put W-t-E on HOLD due to high financial support / kWh**

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	circular								

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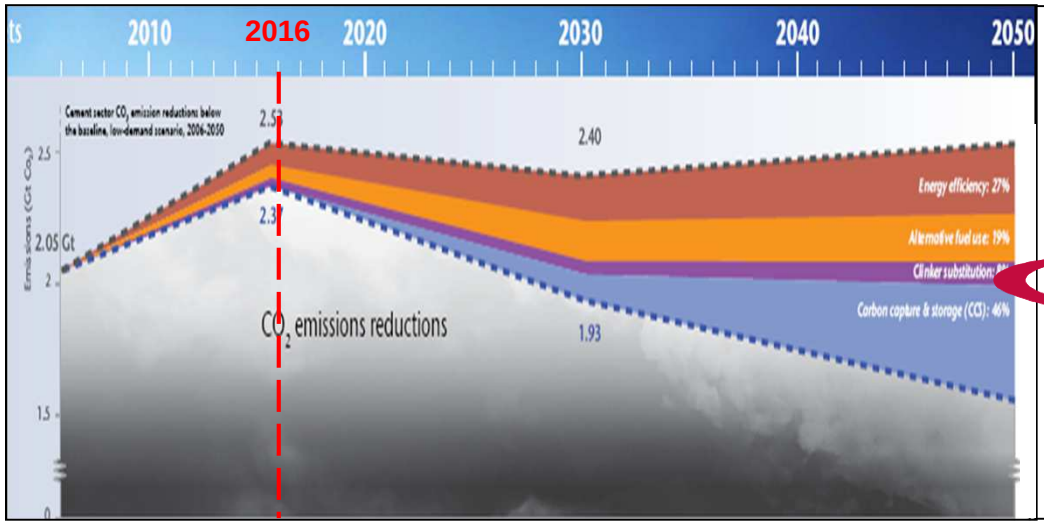
All cement companies count on AF to reduce CO_2…



4 levers to reduce CO_2

Energy efficiency	27%
Alternative fuels	**19%**
Clinker substitution	9%
Carbon Capture & S/U	46%

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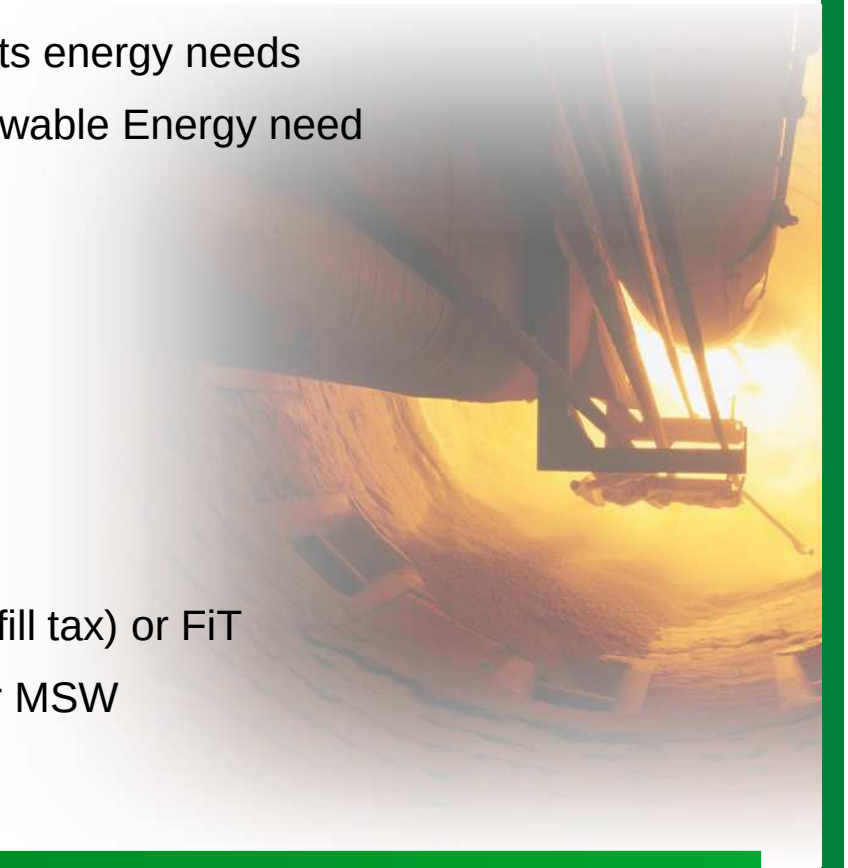
Conclusion:

- **MSW + C&I waste has the better perspective for use as SRF**
  - From availability perspective
    - Cement Industry can solve majority of its energy needs
    - while it contributes only limited to Renewable Energy need
  - From ecological perspective
    - Better energy-efficiency
    - Better CO_2-equivalent footprint
  - From financial perspective
    - Solar / PV / hydro cheaper than W-t-E
    - W-t-E needs support by gate fee (landfill tax) or FiT
    - SRF profitable at moderate gate fee for MSW
    - Use of existing infrastructure



So in a normal world potential Cement Industry would be used First

Yet, what is the real world……

- Mechanical Biological Treatment for transforming MSW to SRF
- 0 €/ton MSW tipping fee
- Recycling + SRF for cement

- 50 m€ invested in 2010
- Struggled for 6 years and went bankrupt

- Waste-to-Energy plant
- 40-50 €/ton (?) MSW tipping fee
- Generating electricity and heat

Client	**Istanbul Metropolitan Municipality (IMM)**
Start-up	**2020**
Technology	
Furnace	Grate furnace (air-cooled)
Energy recovery	4-pass vertical boiler, turbine
Flue gas treatment	Hitachi Zosen Inova System
Technical Data	
Fuel	Municipal and industrial waste
Waste capacity	1'000,000 t/a in 3 lines
Thermal Capacity	3 * 87 MW
Energy recovery	70 MW net electricity

We should strive for a level playing field !!

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