

# Net-zero $CO_2$ emissions in 2050

## The Green Vision Scenario for Europe 2017

The first EU wide climate scenario  
compatible with the Paris Agreement



Summary for policy makers



## Why?

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In order to limit global warming well below 2 degrees and pursue the objective of 1,5°C, we need to respect a constrained emissions budget, which is 890 Gt of CO<sub>2</sub> globally. The EU's share, based on a per-capita approach and on recent historical data, is between 47,7-61,5 Gt of CO<sub>2</sub>

## How?

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The emissions cuts will be achieved mainly by maximising energy efficiency in all sectors and accelerating significantly the increase of renewable energy sources in the final energy consumption

## When?

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Prompt action needs to be taken now and not to rely on delayed action strategy proposed by the Commission and the Member States

*Commissioned by the Greens-EFA group in the European Parliament and realised by the Öko Institut Berlin under the supervision of Dr. Felix Matthes*



## Carbon budget as a new approach to set EU targets

The Vision Scenario is an illustrative and numerical long-term scenario analysis for the energy sector and the greenhouse gas emissions of the EU 28. The Vision Scenario is based on a carbon budget approach, which is the amount of CO<sub>2</sub> and other greenhouse gases that can be emitted globally in order to limit global warming well below 2 degrees (and even 1,5 degrees) in compliance with the Paris Agreement. The carbon budget is used as a new metrics for estimating necessary measures and targets for 2030 and 2050.

### The global carbon budget on a per-capita basis

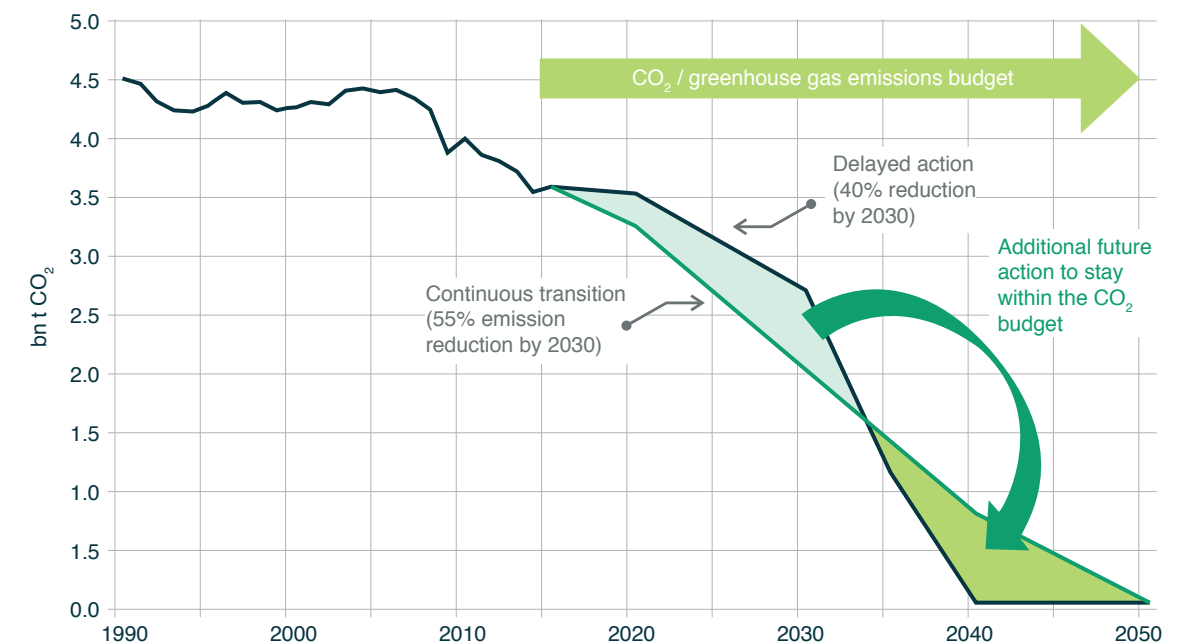
	CO <sub>2</sub> budget globally from 2015	CO <sub>2</sub> budget EU-28		
		Emissions share 2015	share in population	
			2015	2050
	Gt CO <sub>2</sub>	Gt CO <sub>2</sub>	Gt CO <sub>2</sub>	Gt CO <sub>2</sub>
1.5° C for 66% of model runs	240	21,7	16,6	12,9
1.5° C for 50% of model runs	390	35,2	27,0	20,9
1.5° C for 33% of model runs	690	62,2	47,7	37,1
2° C at 66% probability	890	80,2	61,5	47,7
2° C at 50% probability	1.000	90,1	69,1	53,6
2° C at 33% probability	1.290	116,2	89,2	69,2
3° C at 66% of model runs	2.240	202,0	154,9	120,2
3° C at 50% of model runs	2.640	238,0	182,6	141,7
3° C at 33% of model runs	3.090	278,6	213,7	165,9



## More ambitious targets for emission reduction, renewable energy and energy efficiency

The targets proposed by Heads of States in October 2014 (before the Paris Climate Agreement) and by the Commission in the Clean Energy Package are not compatible with the objectives agreed in the Paris Agreement in December 2015. With the Vision Scenario, early action is key: greenhouse gas emission reductions are not delayed nor postponed to a later stage but follow a linear path (green line in the graph below). This scenario, the targets of which are more ambitious and which proposes a continuous transition of the system will ease future adjustments whereas a softer approach (black line) results in necessary sharper cuts later on in order to stay within the carbon budget. The targets agreed by the Heads of States and Governments in 2014 – 40% domestic emission reduction in greenhouse gas emissions, 27% renewable energy in the total energy consumption at EU level and 27% improvement of energy efficiency – constitute a delayed action strategy for the decade 2020-2030, leading to a very steep and unrealistic decarbonisation pathway during the following decade.

### The EU targets proposed by the Commission and Heads of States in October 2014 are not Paris-compatible

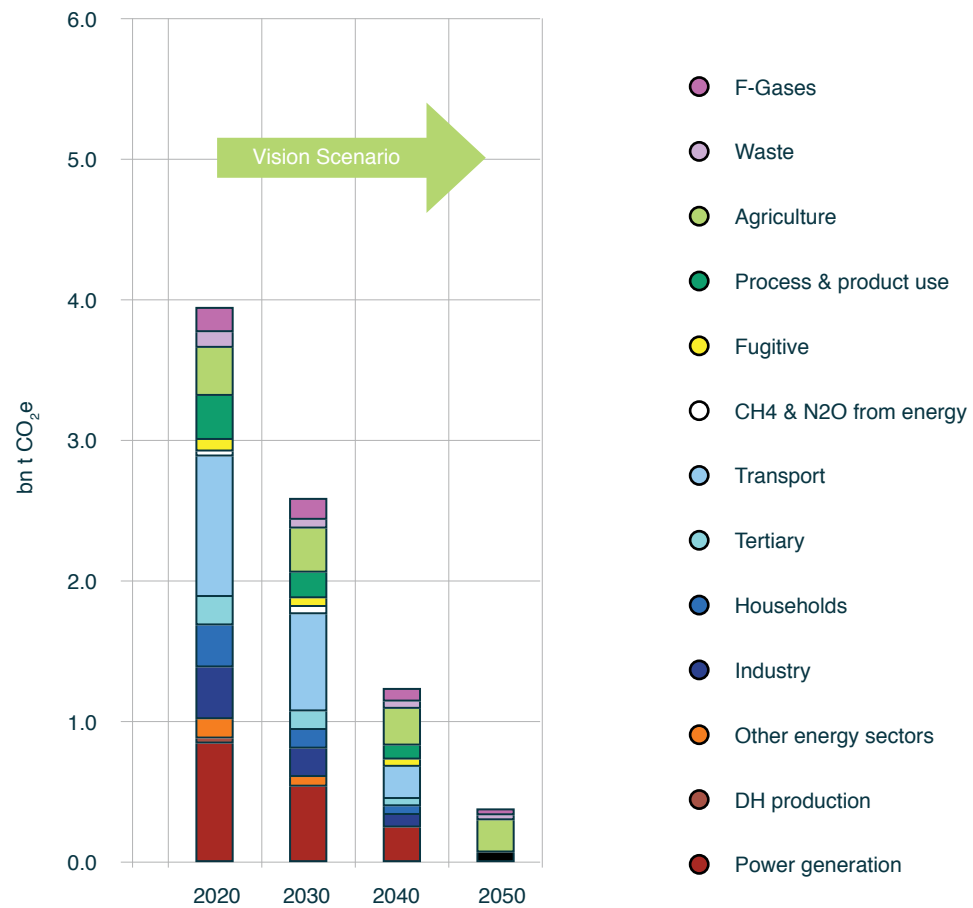




## Full decarbonisation of all sectors

The Vision Scenario proposes deep decarbonisation in all sectors. This means contributing to massive emission reductions mainly by focusing on energy efficiency, electrification and renewable energy. Although action in all sectors is required, the key actors are power generation, transport, buildings and industry.

### Greenhouse gas emissions - deep and fast decarbonisation of all sectors



### Power

- Phasing out coal at latest by 2030
- Accelerated deployment of wind & solar: 70% of electricity from renewable sources in 2030
- No new nuclear power plants and limiting existing nuclear plants to 40 year lifetime



### Transport

- Modal shift
- Efficiency
- Electrification
- Novel fuels such as hydrogen and synthetic fuels based on 100% new renewables



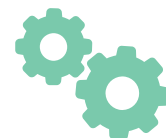
### Buildings

- Near-zero energy new buildings
- Deep renovation of existing buildings
- Biomass waste and residues & solar heat notably in district heating networks
- Electrification



### Industry

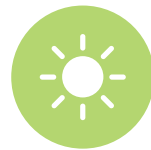
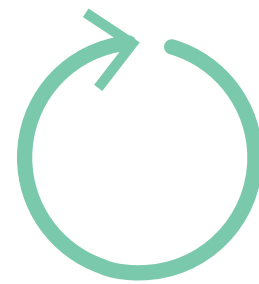
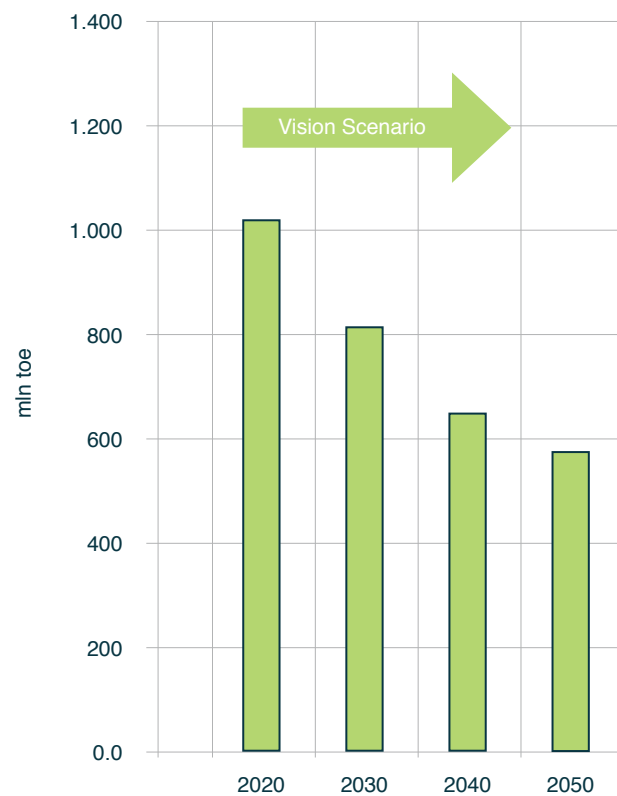
- Efficiency
- Electrification with 100% new renewable energy power purchase agreements
- Minimising fossil fuels
- Increasing sustainable biomass & hydrogen



## Continued reduction of energy consumption

By implementing the Vision Scenario, final energy consumption will be massively reduced. The study shows that the Energy Efficiency First principle will remain a key policy instrument, and energy consumption will decrease despite the rapid growth in renewable energy sources. This is needed in order to keep infrastructure investment as low as possible, notably on the gas network, and avoid a situation of carbon lock-in, which means the self-perpetuating inertia created by large fossil fuel-based energy systems, infrastructure and cultural norms that inhibit efforts to develop alternative energy technologies. As the next decade is essential to keep a chance to stay well below 2 degrees (and even 1,5°C), the 2030 efficiency targets need to be revised upwards.

### Energy Efficiency First: why efficiency remains the number 1 policy?



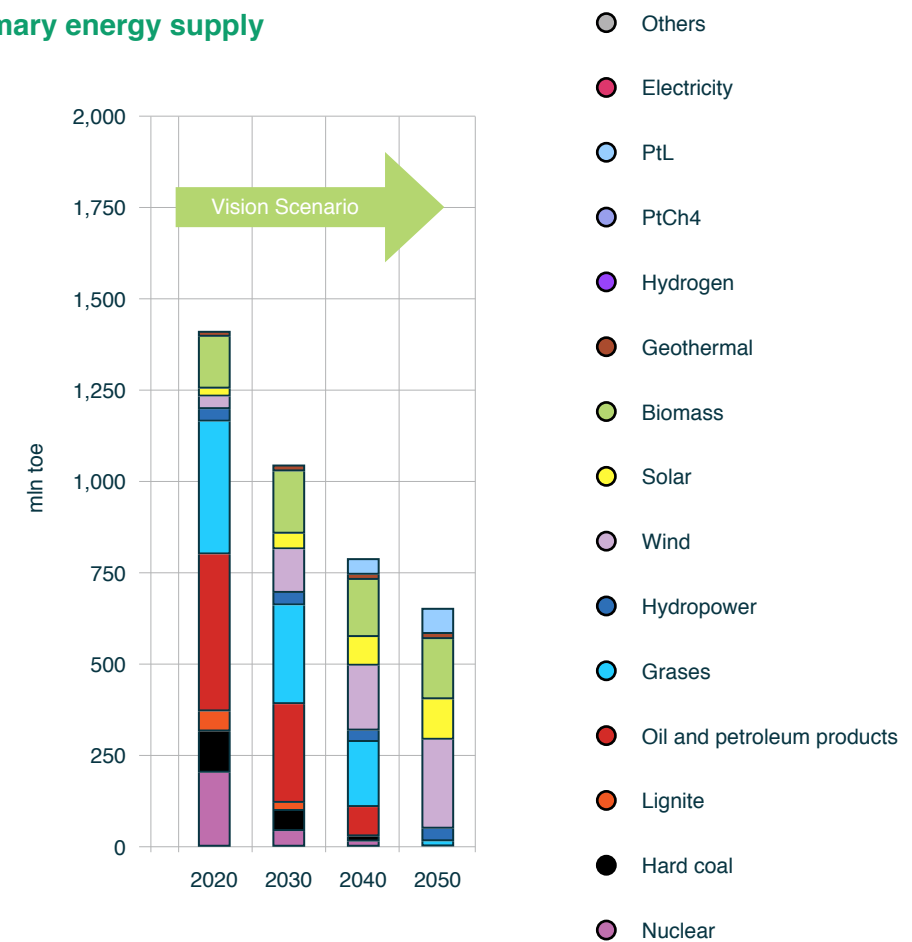
## Towards a fully renewable energy system

The EU's energy supply needs to be fully decarbonised by 2050 at the latest. To achieve this objective, the whole system needs to be transformed and rely fully on renewable energy sources. Fossil fuels will be phased out, while wind, solar and biomass waste and residues will deliver almost all primary energy in 2050. In order to make the early phase-out of coal possible and to enable green electrification policies (notably in new electricity usages like electromobility, high efficiency heat pumps, cooling for data centers etc.), the EU needs to reach a share of renewables as high as 70% in the power mix (compared to 45% proposed by the Commission). The massive cost-reduction observed on solar PV and wind, including off-shore wind, reinforce cost-effectiveness of this proposal.

In order to limit the security and safety threats related to an aged nuclear fleet, nuclear power will also be phased out in line with a maximum plants lifetime of 40 years. For aviation, shipping and heavy good vehicles, imports of synthetic fuels are considered as a long-term option. Biomass use has been kept to 15 GJ per capita, in order to keep space for other industrial uses, and also taking into account that from a climate perspective only forest waste and residues should be going to bioenergy and that agricultural land should be used to produce food and animal feed instead of biofuels. Natural gas consumption will continue to decrease despite of some more use of gas in the power sector. Gas infrastructure will progressively be used with green gas, an asset in balancing variable renewable electricity generated from solar and wind.



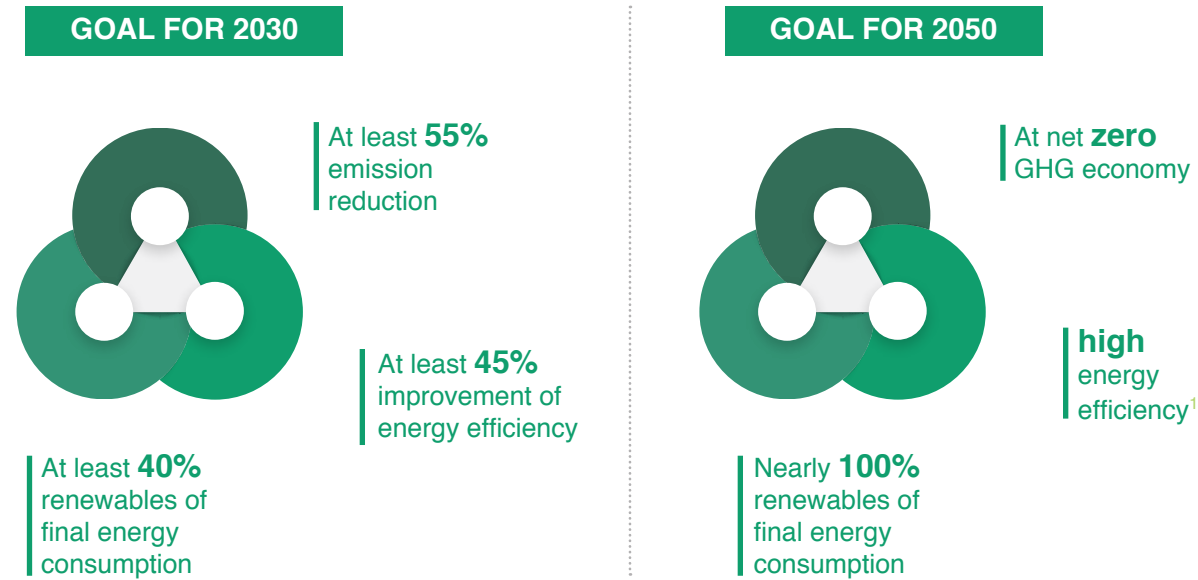
### Primary energy supply







## Green Vision Scenario: targets for 2030 that are compatible with the objectives of the Paris Agreement



	Reference Scenario					Vision Scenario			
	2015	2020	2030	2040	2050	2020	2030	2040	2050
Share of renewables									
Power generation	29%	37%	43%	45%	53%	39%	70%	84%	100%
District heat*	26%	24%	23%	22%	22%	27%	60%	84%	96%
Final energy*	15%	19%	22%	24%	27%	19%	37%	65%	96%
Industry	18%	24%	30%	34%	38%	24%	47%	67%	88%
Tertiary	18%	23%	28%	31%	36%	23%	48%	69%	99%
Households	25%	28%	29%	30%	33%	29%	55%	78%	100%
Transport	4%	7%	7%	8%	9%	7%	14%	57%	99%
Primary energy	15%	17%	19%	21%	13%	20%	40%	70%	98%
Energy Efficiency	Change from Primes Baseline 2007**								
Primary energy	-	-18%	-23%	-	-	-23%	-44%	-	-
Primary energy imports***	17%	13%	13%	14%	17%	13%	10%	7%	7%
GHG emissions	Change from 1990								
Total****	-21%	-24%	-32%	-37%	-42%	-30%	-54%	-78%	-93%
CO <sub>2</sub> ****	-21%	-22%	-30%	-35%	-42%	-28%	-55%	-82%	-99%

<sup>1</sup> The PRIMES baseline which underpins the energy efficiency target calculation is only running until the year 2035  
<sup>\*</sup> The share of renewable energy sources includes indirect contributions from electricity, heat, hydrogen & syngas. The statistically unaccounted ambient heat delivered by pumps represents additional contributions to the final energy supply from renewables.  
<sup>\*\*</sup> The 2007 Primes Baseline projection for the EU-27 was adjusted for Croatia.  
<sup>\*\*\*</sup> Excluding primary energy for non-energy uses, nuclear fuel was fully considered as imported primary energy.  
<sup>\*\*\*\*</sup> Including international aviation and excluding LULUCF.

## What's next?

The Vision Scenario, based on a 64 Gt carbon budget, is a starting point but is not enough to limit global warming to 1.5°C. The Vision Scenario explores all technologies that reduce the societal risk of climate change and it is mainly based on technical analysis, economic optimisation on a qualitative basis with a very limited reflection of behavioural changes. Besides the implementation of this Vision Scenario, the “carbon gap” would need to be filled by some additional measures which go well beyond of what was possible to model in the present exercise.

In particular, we should quantify:

- 1 the possible effects of a truly circular economy**  
(according to a study of Club of Rome<sup>2</sup>, a circular economy would generate less than one-third of the carbon emissions compared to a “business-as-usual economy” of the same size)
- 2 the impact of lifestyle changes**  
(flying less, recycling household waste, reducing meat consumption)
- 3 the impact of land use change in agriculture and forestry**  
The Greens/EFA group will soon be looking at additional sectorial studies, such as on transport and agriculture.



The Greens-EFA are the first political group in the European Parliament to put forward a scenario compatible with the objective of the Paris Agreement, justifying more ambition on the 2030 targets and 2050 objectives with academic evidence. Alternative proposals underpinning the political statement that lower targets for 2030 and 2050 are more adequate and yet to be put forward by other political groups.



<sup>2</sup> Wijkman, A., & Skånberg, K. (2015). The Circular Economy and Benefits for Society: Jobs and Climate Clear Winners in an Economy Based on Renewable Energy and Resource Efficiency: a Study Pertaining to Finland, France, the Netherlands, Spain and Sweden. Club of Rome.



**The Greens | EFA**  
in the European Parliament