RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
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ADEME
AGENCE DE LA TRANSITION ÉCOLOGIQUE

TRANSITION(S) 2050

CHOOSE NOW
ACT FOR THE CLIMATE

OFATE
24/05/2022

1. Presentation of the scénarios

4 carbon-neutral scenarios

S1 FRUGAL GENERATION

S2 TERRITORIAL COOPERATION

S3 GREEN TECHNOLOGIES

S4 RESTORATIVE BET

Levers:

	S1	S2	S3	S4
Sobriety:	+++	++	+	
Efficiency:	++	+++	++	
Governance:	Local → Global			
Env. impacts:	Avoid impacts → Repair impacts			

Scenarios narratives

S1 FRUGAL GENERATION

Constrained frugality

Medium cities and rural areas

Low-tech

Massive renovation

New indicators of prosperity

Localism

3 times less meat

S2 TERRITORIAL COOPERATION

Sustainable lifestyles

Sharing economy

Open Governance

Controlled mobility

Environmental taxation

Cooperation between territories

Targeted reindustrialization

S3 GREEN TECHNOLOGIES

Decarbonization technologies

Exploited Biomass

Hydrogene

Green consumerism

Minimal regulation

Metropolises

Deconstruction / Reconstruction

S4 RESTORATIVE BET

Mass consumption

Urban sprawl

Uncertain technologies

Globalised economy

Artificial intelligence

CO_2 capture in the air

Intensive farming

A decrease in energy demand

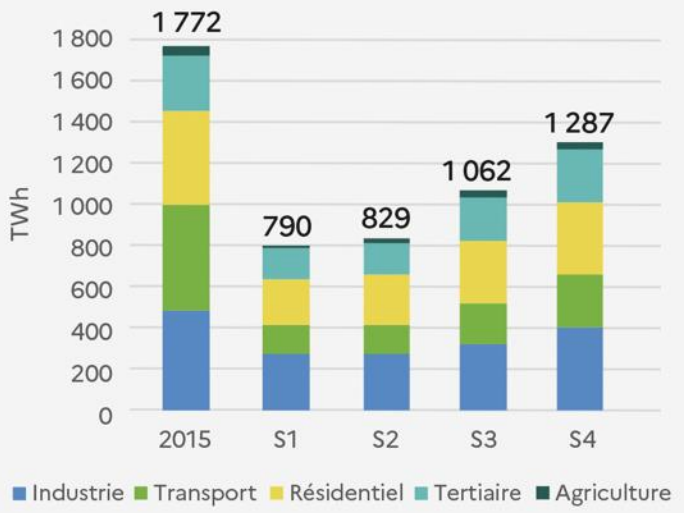
Reducing demand is the key factor in achieving carbon neutrality by:

- Sobriety
- Energy efficiency

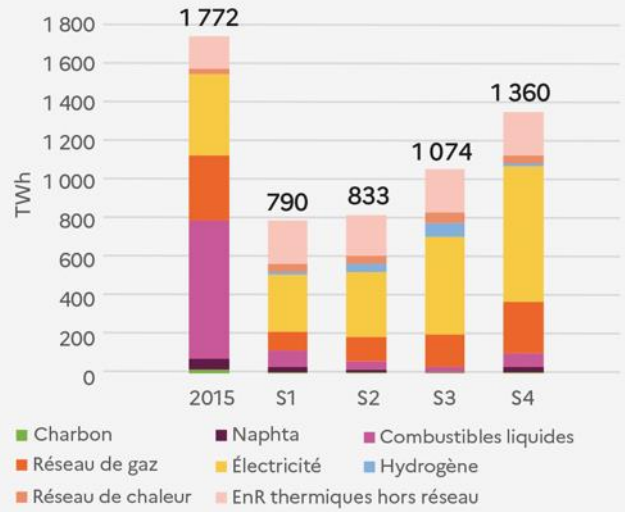
Need for a radical change in lifestyles and production systems

- The share of renewable energies in the mix varies between 88% in S1 and 70% in S4 vs 15% today
- Strong gas decarbonization is possible (82 to 88% in S1, S2, S3 if the gas demand drops sharply compared to 2020 (-50% to –66%)
- huge reduction in demand for liquid fuels 2020 (between -73% and -85%)

Final energy consumption by sector in 2015 and 2050

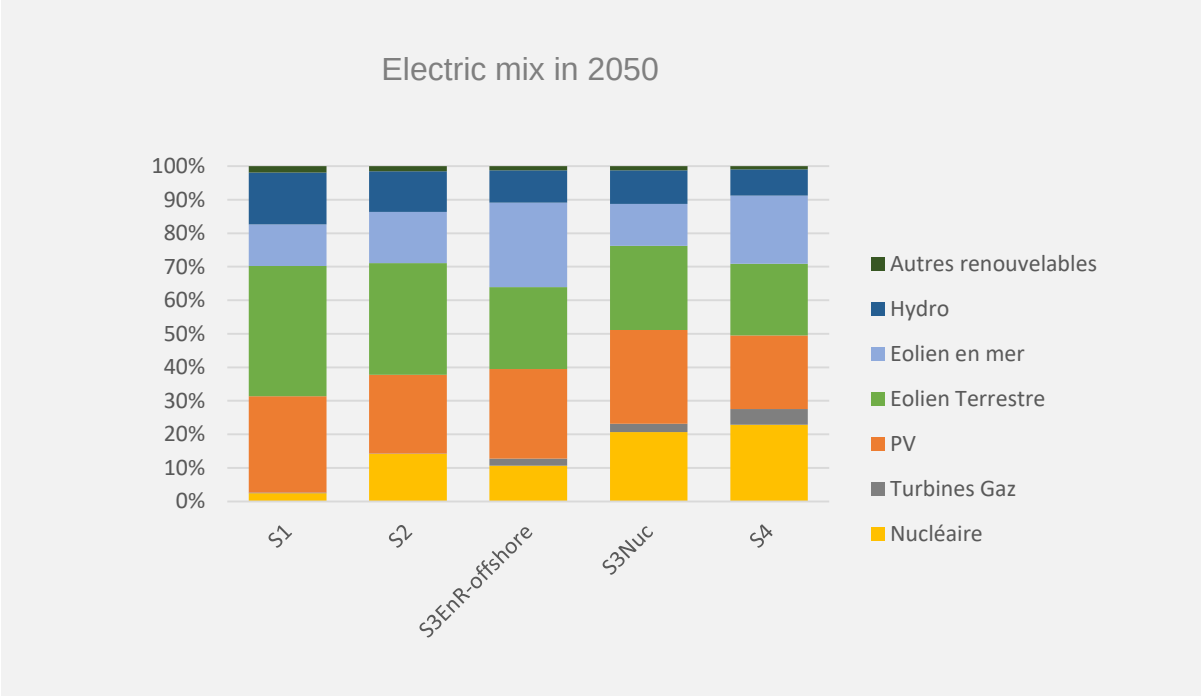


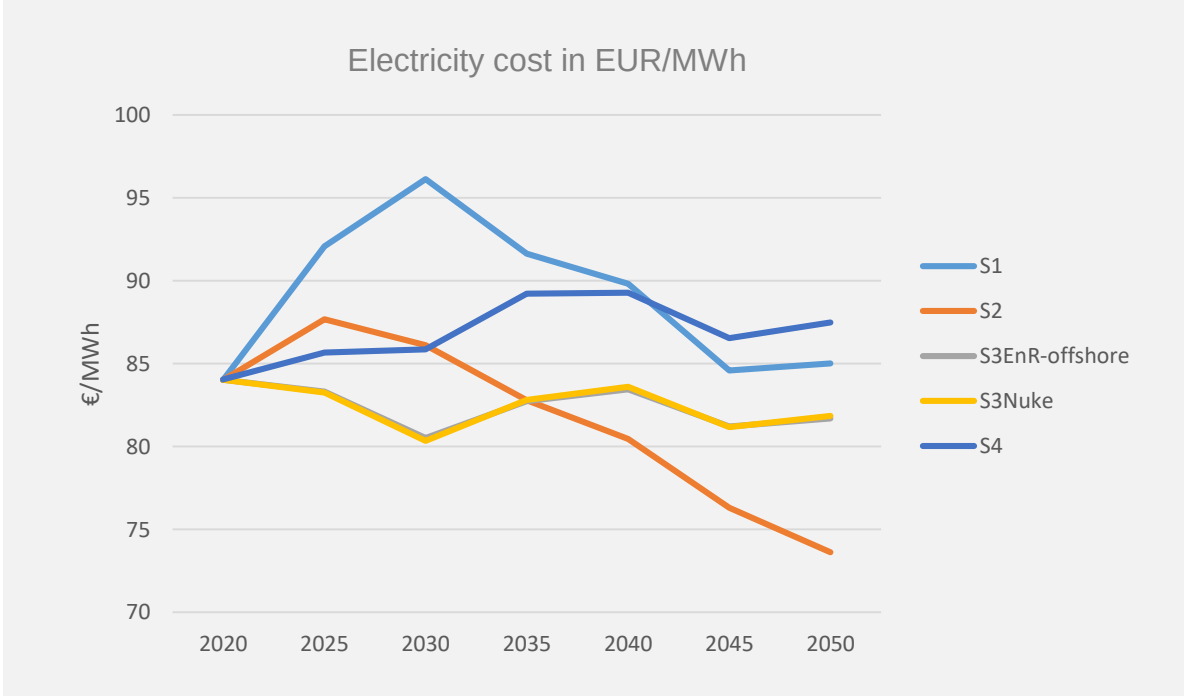
Final energy consumption by sources in 2015 and 2050



Electric mix

- Renewable energies represent more than 70% of electricity production in 2050: between 72% (S4) and 97% (S1)
- The cost of electricity remains relatively stable, even falling in S2 (-12% compared to 2020)
- In all scenarios, CO2 emissions related to electricity production decrease by nearly 13 millions tonnes between 2020 and 2050 (6 millions tonnes in S4)





2. The macroeconomic effects

3ME a neokeynesian model

Multi-sector Macroeconomic Model for the Evaluation of Environmental and Energy policies

Joint design between ADEME and OFCE since 2008

Macroeconomic multisectoral model of neo-keynesian inspiration

Comparable to models used in quarterly forecasting by Finance Ministry

A neo Keynesian model : Prices do not balance supply and demand instantaneously –

it is therefore possible to obtain underemployment equilibria

A mulitsectorial model : Detailed sectoral disaggregation in 37 sectors, with a focus on energy (17 sub-sectors)

This allows to analyze the effect of transfer of activities from one sector to another on employment, investment, energy consumption, and trade balance,

An hybrid model : Firms' maximize their profits by doing a tradeoff between capital and energy

Households choose between energy-intensive and energy-efficient investments among 7 energy performances classes (A through G) for housing and private vehicles

An assessment of the carbon neutrality (CN) scénarios in comparison to a BAU scénario

The CN scenarios include additional measures to the Trend, selected and calibrated in order to achieve the targets of the scenario:

Building: increase in aids for renovation, obligation to renovate buildings in tertiary sector, ban on oil-fired boilers (price signals), evolution of m²/inhabitant and m²/employee.

Calibrated, for each scenario, to achieve the targets for surface area/capita and energy mix of the building stock.

Transport: end of combustion engine sales in 2040 and changes in modal shares (price signals), penetration rate of biofuels and electricity, decline in car use (carpooling, telecommuting, road sharing)

Calibrated, for each scenario, to achieve sectoral targets of nb. of vehicles, energy efficiency, changes in traffic, the energy mix.

Industry: EE regulations (price signals), regulations on plastic packaging/timber-construction/nitrogen fertilizers (exogenous demand shocks), changes in production methods (substitution of steel by aluminum, for example).

Calibrated, for each scenario, to achieve sectoral targets for production levels, manufacturing costs and energy mix.

Energy: evolution of the energy mix, reinforcement of the carbon tax (see graph), ETS identical to the TEND except in S4 (growth 2 times slower).

S1 Results: Frugal Generation

S1 relies the most on sobriety:

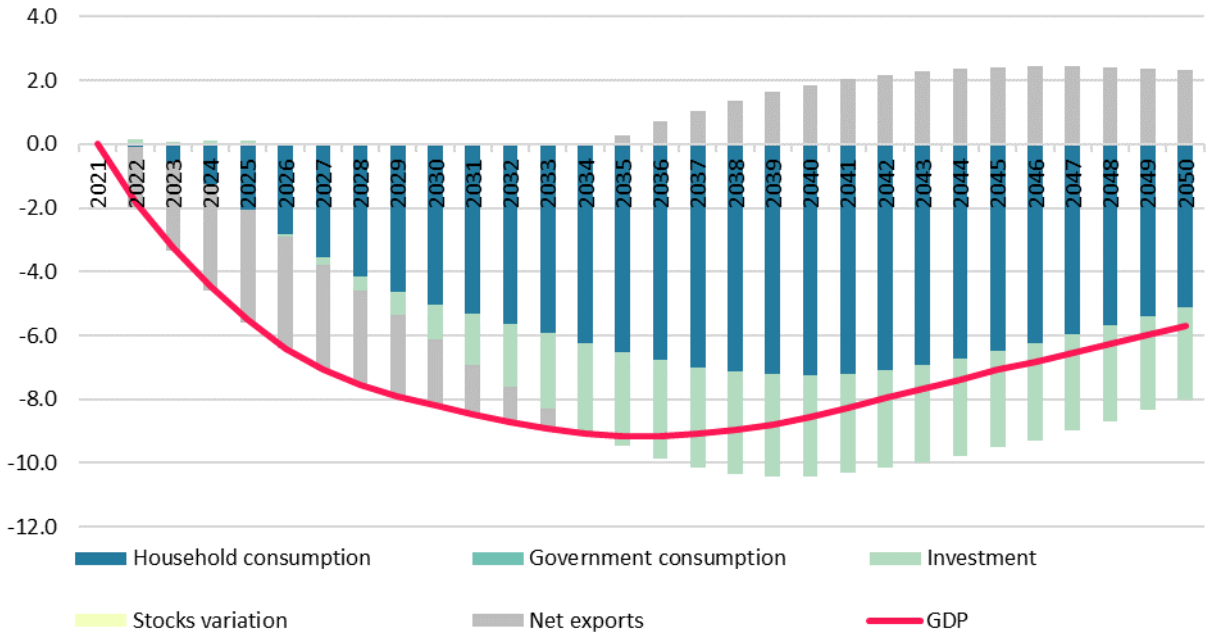
- Fall in the production of intensive-carbon goods
- Division by 2 of cars in circulation
- Contraction of new construction (residential/tertiary)

Decline in investment not compensated by the increase in energy efficiency investments Deterioration of the trade balance:

the decrease of energy imports does not compensate for the drop in exports

Decrease in the number of jobs compared to the trend (≈ 4%)

GDP and contributions of its components: S1/BAU deviations (%)



Household disposable income is therefore lower than in the BAU despite disinflation and the drop of energy bill
Decline in purchasing power and therefore consumption
Decline in the average annual GDP growth rate (1.1% against 1.3% in the trend)

S2 Results: Territorial Cooperation

S2 relies on a more restrained sobriety than S1:

- production of manufactured goods: +15 pts vs. S1
- vehicle sales: +25% vs. S1
- contraction new construction limited vs. S1

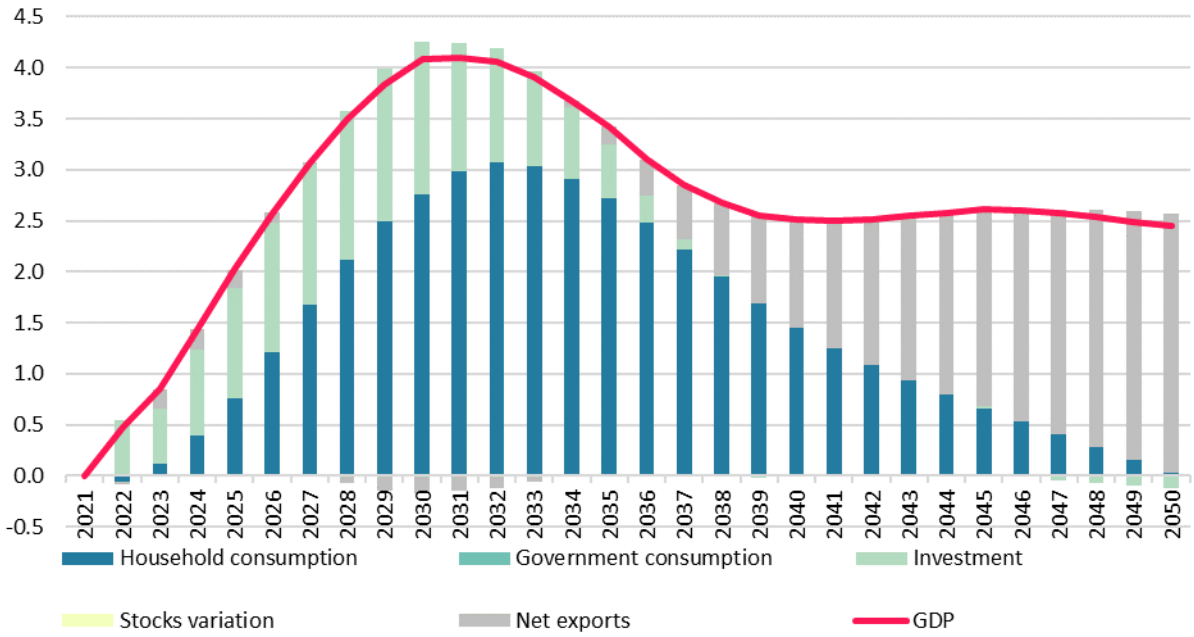
Increase in EE investments which compensates for the fall in productive investments

Improvement of the trade balance through the drop in imports

Increase in employment relative to trend (≈ 0.7%)

Increase in household disposable income compared to the TREND via improvement in employment

GDP and contributions of its components: S1/BAU deviations (%)



Increase in purchasing power and therefore consumption
Rise in the average annual GDP growth rate (GDP in H2 higher by 2.4% than that of the TEND in 2050)

S3 Results: Green Technologies

S3 is closer to the TREND than S1 and S2:

- industrial production index closer to the BAU (index 84 vs. 104)
- vehicle fleet: 32 M in S3 vs. 39 M in BAU

More limited training effect of the balance commercial than in S2, in particular due to the imports of vehicles which remain substantial

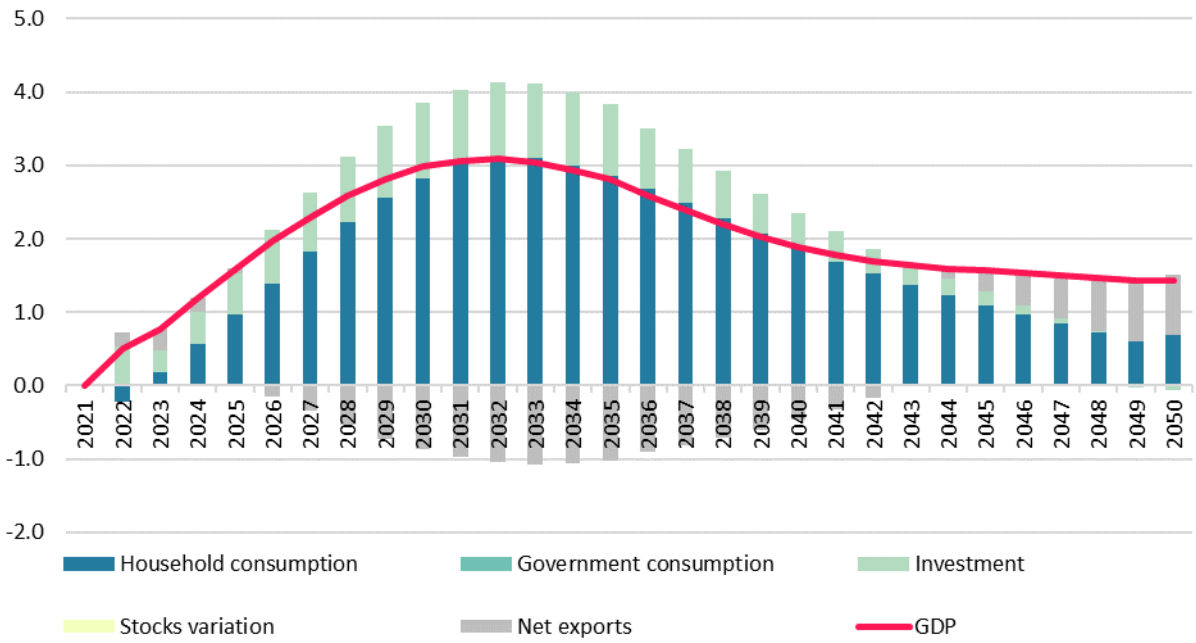
Increase in the number of jobs compared to the trend (≈ 0.6%)

Increase in household disposable income compared to BAU

Rise in purchasing power and consumption

Increase in the average annual growth rate of GDP (GDP of S3 higher by 1.4% than that of the BAU in 2050)

GDP and contributions of its components: S1/BAU deviations (%)



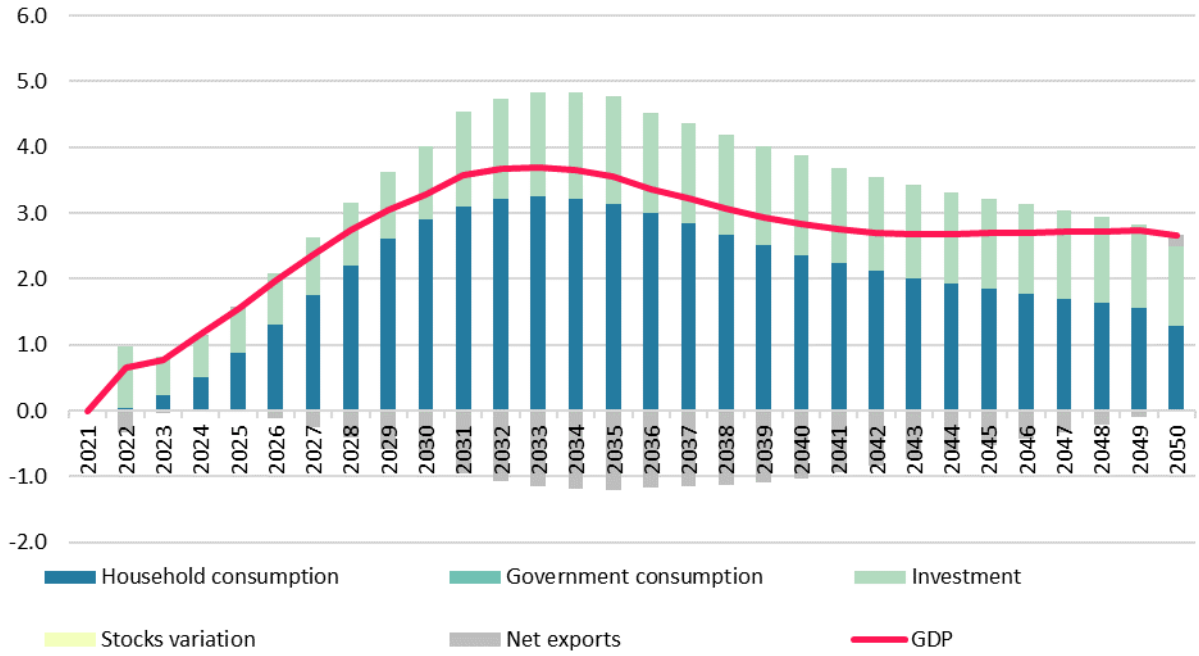
The choice of nuclear or offshore wind has no impact on macroeconomic aggregates

S4 Results: Restorative Bet

S4 excludes all sobriety and relies on technical progress:

- industrial production slightly higher than TREND
- vehicle fleet: comparable to TREND
- new construction comparable to TREND
- massive investments in decarbonization and CO2 capture of factories (CCS), but less profitable than previously (increasing marginal abatement cost)

GDP and contributions of its components: S1/BAU deviations (%)



Increase in the number of jobs compared to the TREND (≈ 2.8%)

Lower growth than in S2 in household disposable income net of energy bills and the cost of renovation

Increase in the average annual GDP growth rate (S4 GDP 2.7% higher than the TREND in 2050)

3. Financing needs of transition

Gaël Callonnec, Coordinateur des travaux de modélisation économique

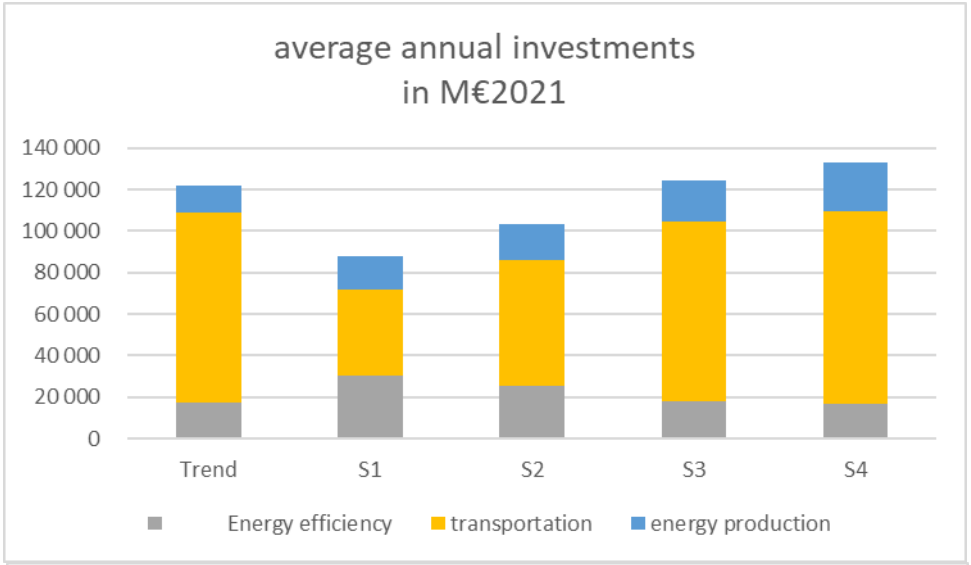
Contrasting investment needs

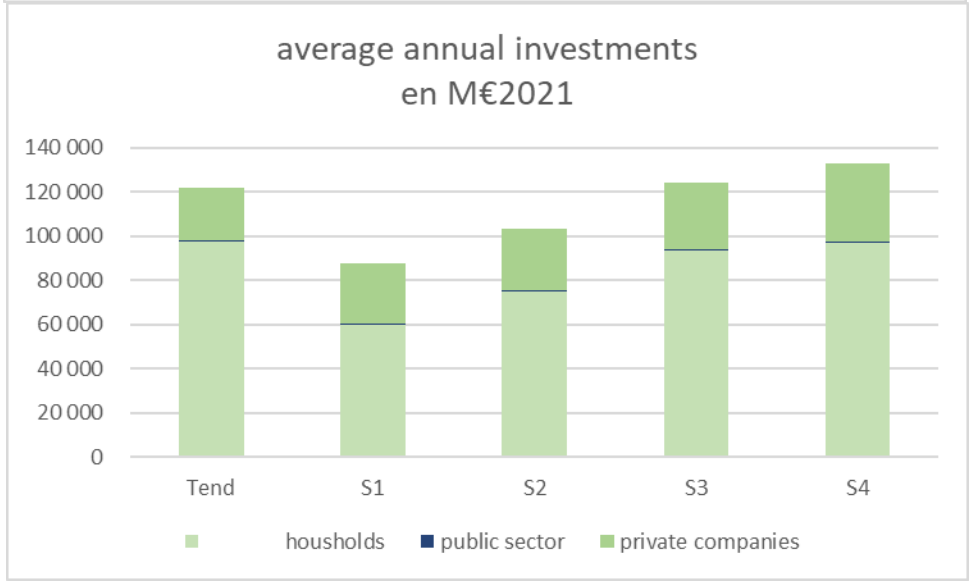
The transition involves increased investment in green sectors to the detriment of energy-intensive sectors.

The balance is negative in S1 and S2 but positive in S3 and S4.

These direct investments have a positive impact on the business. The effect is multiplier.

A macroeconomic loop is therefore necessary to measure the overall evolution of the demand for capital.





Financing need in S1

Investments decrease in industry (decline in production)

Investments in the building sector are falling due to the decrease in new construction, despite the increase in energy efficiency expenditures carried out by households and the tertiary sector.

Reduced investment in transport (except train).

The drop in industrial production has a negative impact on employment, which negatively affects the activity of the tertiary sector, which also limits its investments.

This explains the decline in GDP level between 2020 and 2030.

The investments necessary for energy production decrease, because the needs for heating and transport fall.

Spending on thermal and nuclear energy plummets

Investments in renewable energies rise except for renewable heat

INVESTMENTS (M€ 2021)	Average annual Invt	Cumulative Invt
TOTAL GREEN INVESTMENTS	**85 005**	**2 550 136**
of which energy efficiency	29 401	882 028
of which transports	40 055	1 201 649
of which energy	15 549	466 459

INVESTMENTS (M€ 2021)	Average annual Invt	Cumulative Invt
Total Energy	**18 518**	**555 544**
Coal	0	10
Fuels	418	12 528
of which fossil fuels	258	7 752
of which biofuels	159	4 777
Gaz	5 189	155 684
of which natural gas	151	4 523
of which biogas	2 562	76 852
of which heat (wood, biomass)	2 477	74 308
Electricity	12 911	387 322
of which nuclear	2 222	66 653
of which fossil	338	10 147
of which wind	5 654	169 607
of which solar	2 733	81 986
of which hydraulic	1 386	41 570
of which cogeneration	579	17 359

Financing need in S2

The additional investment in industry and services amounted to nearly €26.3 billion on average per year over the period. Or 0.9% of current GDP.

This budget includes direct investments related to the transition and indirect investments related to the additional activity it generates.

Investments in energy management alone amount to 48 billion on average per year in S2 against 35 in the trend, i.e. a difference of 13 billion.

This is a relatively modest sum, equivalent to 0.5% of current GDP

INVESTMENTS (M€ 2021)	Average annual Invt	Cumulative Invt
TOTAL GREEN INVESTMENTS	**103 605**	**3 108 138**
of which energy efficiency	25 728	771 837
of which transports	60 110	1 803 292
of which energy	17 767	533 009

INVESTMENTS (M€ 2021)	Average annual Invt	Cumulative Invt
Total Energy	**21 184**	**635 510**
Coal	0	8
Fuels	505	15 139
of which fossil fuels	238	7 141
of which biofuels	267	7 999
Gaz	6 580	197 413
of which natural gas	271	8 135
of which biogas	3 546	106 386
of which heat (wood, biomass)	2 763	82 892
Electricity	14 098	422 951
of which nuclear	2 283	68 498
of which fossil	624	18 720
of which wind	6 969	209 069
of which solar	2 299	68 979
of which hydraulic	1 345	40 344
of which cogeneration	578	17 341

Financing need in S3

Additional investment in industry and services of €18 billion on average per year, or 0.7% of current GDP. Green investments alone amount to 42.7 billion on average per year in S3 against 34.9 in the trend, i.e. 0.3% of current GDP.

With the decrease in fuel-efficient vehicle purchases, the gap in green investments between the trend and S3 is now only €2.5 billion/year,

Energy efficiency expenditures are lower than in previous scenarios:

- buildings consume more energy (27 mtoe of consumption in the residential sector versus 20 in S1).
- Destruction and reconstruction of the most energy-intensive buildings.

Investments in the energy production of S3 are higher than those of the trend:

- The number of vehicles in circulation is higher.
- Increased consumption of biogas and biomass for heat production.
- Electricity demand close to trend. However, the average capital cost of renewable energies is higher than that of nuclear (unlike the cost of labour).

INVESTMENTS (M€ 2021)	Average annual Invt	Cumulative Invt
TOTAL GREEN INVESTMENTS	**124 208**	**3 726 254**
of which energy efficiency	18 066	541 986
of which transports	86 691	2 600 724
of which energy	19 451	583 545

INVESTMENTS (M€ 2021)	Average annual Invt	Cumulative Invt
Total Energy	**25 093**	**752 785**
Coal	0	6
Fuels	518	15 533
of which fossil fuels	225	6 753
of which biofuels	293	8 780
Gaz	6 633	199 001
of which natural gas	279	8 368
of which biogas	1 541	46 241
of which heat (wood, biomass)	4 813	144 392
Electricity	17 941	538 245
of which nuclear	4 584	137 535
of which fossil	553	16 578
of which wind	6 893	206 802
of which solar	3 862	115 856
of which hydraulic	1 471	44 133
of which cogeneration	578	17 340

Financing need in S4

The S4 scenario is the most investment-intensive because :

- the estimated final energy demand is close to the trend (113 Mtp vs 126 in the trend).
- The number of vehicles in circulation and new constructions are closed to the trend. T
- The industrial production index is 103 in 2050 versus 102 in 2050 in the trend (base 100 in 2022).

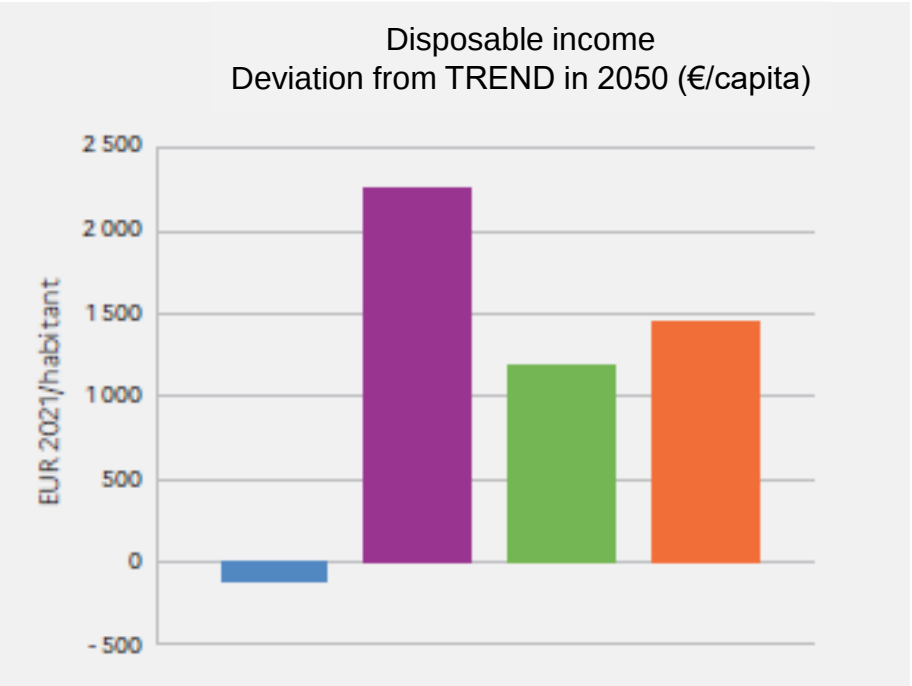
Industry invests less in energy efficiency, on the other hand, it invests more in substitution between energies to reduce the share of oil and natural gas in its mix.

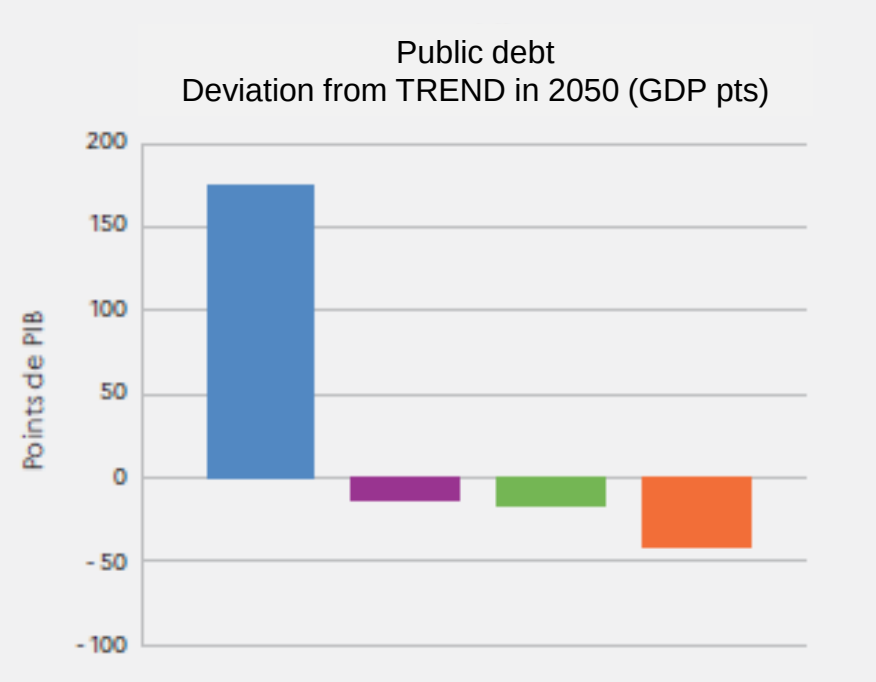
Green investments by companies amount to 32 billion per year on average (compared to 26 in S2). These expenses are less lucrative than in the previous scenarios.

INVESTMENTS (M€ 2021)	Average annual Invt	Cumulative Invt
TOTAL GREEN INVESTMENTS	**132 802**	**3 984 062**
of which energy efficiency	16 785	503 552
of which transports	92 596	2 777 870
of which energy	23 421	702 640

INVESTMENTS (M€ 2021)	Average annual Invt	Cumulative Invt
Total Energy	**31 607**	**948 197**
Coal	0	7
Fuels	492	14 757
of which fossil fuels	267	8 016
of which biofuels	225	6 741
Gaz	7 413	222 376
of which natural gas	739	22 172
of which biogas	1 566	46 988
of which heat (wood, biomass)	5 107	153 216
Electricity	23 702	711 058
of which nuclear	6 162	184 845
of which fossil	1 017	30 517
of which wind	10 524	315 709
of which solar	3 934	118 009
of which hydraulic	1 488	44 637
of which cogeneration	578	17 340

Profitable Investments





These expenses should not be considered as a cost, since they are lucrative thanks in particular to the increase fuel prices. Positive NPV: the sum of the profits is greater than the repayment of the loan (interest included)

Rise in private debt but it is sustainable. It generates strong value creation: Decrease in the debt/GDP ratio

Accommodative monetary policy is needed

Assumption that real interest rates remain fixed by the Central Bank

They do not instantly balance savings and investment (money is not neutral: the evolution of the stock of capital is endogenous. Hence, it influences long-term GDP)

Investment demand is satisfied by a supply of bank credit if their NPV is positive (money creation: the crowding out effect is very low)

In reality, companies are financed by bank credits, bonds and stocks issues. In the event of strong demand for capital, interest rates could rise on the bond market.

This could have a recessive effect on investment and GDP (a negative financial return effect)

An expansive monetary policy would be appropriate (rediscount at subsidized rates on green bonds)

Agrégats macroéconomiques (base 100 en 2021)

	TEND		S1		S2		S3		S4	
	2030	2050	2030	2050	2030	2050	2030	2050	2030	2050
PIB	109	144	100	136	114	148	113	147	113	148
Consommation des ménages	114	152	106	138	120	151	119	153	119	156
publiques	113	145	113	145	113	145	113	145	113	145
Investissement	112	142	106	121	120	141	117	141	118	150
dont entreprises privées	*116*	*169*	*103*	*149*	*123*	*176*	*123*	*173*	*123*	*181*
ménages	*100*	*72*	*112*	*45*	*115*	*53*	*105*	*64*	*107*	*79*
public	*113*	*148*	*110*	*132*	*114*	*142*	*113*	*143*	*113*	*146*
Exportations	90	97	58	64	85	85	86	86	91	99
Importations	105	124	80	80	100	101	103	109	108	125
Revenu disponible réel par habitant	109	138	101	130	114	140	113	140	113	143
Emplois	98	103	90	96	101	103	101	103	101	105
Solde public	380	503	980	1172	257	582	268	574	211	336
Dette publique	145	319	193	566	138	309	137	304	134	256

Agrégats macroéconomiques : S1 en écart au TEND

	Unité	2021	2022	2023	2024	2025	2030	2035	2040	2045	2050
PIB	%	0.0	-1.8	-3.3	-4.5	-5.5	-8.2	-9.2	-8.6	-7.1	-5.7
VA du secteur marchand	%	0.0	-2.3	-4.1	-5.6	-6.9	-10.0	-10.8	-9.9	-8.1	-6.3
Conso des ménages	%	0.0	-0.2	-1.0	-2.2	-3.5	-8.5	-10.7	-11.7	-10.4	-8.2
dont conso automobile	*%*	0.0	-7.7	-16.8	-24.1	-29.8	-47.8	-53.1	-58.8	-62.8	-65.8
Conso des APU	%	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Investissement	%	0.0	0.8	0.3	0.6	0.5	-5.2	-14.1	-15.6	-14.8	-14.6
dont entreprises privées	*%*	*0.0*	*-0.2*	*-3.9*	*-5.3*	*-6.5*	*-11.7*	*-14.0*	*-14.3*	*-12.5*	*-11.7*
ménages	*%*	*0.0*	*4.0*	*11.8*	*16.7*	*19.9*	*11.6*	*-22.0*	*-29.0*	*-32.6*	*-36.6*
public	*%*	*0.0*	*-0.1*	*-0.3*	*-0.6*	*-0.9*	*-2.9*	*-5.1*	*-7.3*	*-9.2*	*-10.8*
Exportations	%	0.0	-10.3	-17.8	-23.4	-27.6	-35.9	-36.0	-34.6	-34.1	-34.5
Importations	%	0.0	-3.9	-7.7	-10.7	-13.4	-23.4	-29.9	-33.6	-34.9	-35.0
Revenu dispo réel des ménages	%	0.0	0.4	-0.5	-1.7	-3.0	-7.2	-9.7	-10.0	-8.3	-6.1
Revenu dispo réel des ménages	Mds EUR 2021	0	6	-8	-31	-54	-137	-199	-222	-197	-153
Revenu dispo réel par emploi	%	0.0	1.4	2.0	2.1	2.0	1.3	-0.3	-1.4	-1.2	-0.2
Variation du taux d'épargne	Pts de revenu	0.0	1.0	0.3	0.0	-0.2	0.8	2.0	2.9	3.3	3.3
Prix à la conso des ménages	%	0.0	-0.4	-0.9	-1.6	-2.6	-10.2	-17.5	-21.5	-22.1	-20.7
Prix à la prod marchande	%	0.0	-0.5	-1.2	-2.0	-3.2	-11.6	-19.4	-23.5	-24.0	-22.3
Prix des exportations	%	0.0	-0.5	-1.0	-1.5	-2.1	-7.9	-15.1	-19.5	-20.7	-19.8
Prix des importations	%	0.0	0.0	0.0	0.0	0.0	-0.4	-1.0	-1.4	-2.0	-2.5
Salaire net réel	%	0.0	0.3	0.1	-0.5	-1.5	-7.4	-11.2	-12.8	-11.9	-9.6
Coût réel du travail	%	0.0	0.5	0.6	0.2	-0.5	-3.9	-5.8	-6.9	-6.4	-5.1
Emplois	%	0.0	-1.0	-2.4	-3.7	-4.9	-8.4	-9.4	-8.7	-7.3	-6.0
Emplois	Milliers	0	-258	-588	-912	-1 206	-2 046	-2 313	-2 195	-1 831	-1 510
Ecart du taux de chômage	Pts pop. active	0.0	0.7	1.5	2.4	3.3	5.7	6.4	6.1	5.0	4.1
Ecart de la balance commerciale	Pts de PIB	0.0	-2.1	-3.3	-4.1	-4.6	-5.3	-5.0	-4.1	-3.2	-2.4
BC énergétique	*Pts de PIB*	*0.0*	*0.1*	*0.2*	*0.3*	*0.4*	*0.9*	*1.1*	*1.3*	*1.4*	*1.5*
BC non énergétique	*Pts de PIB*	*0.0*	*-2.2*	*-3.4*	*-4.4*	*-5.0*	*-6.3*	*-6.1*	*-5.4*	*-4.6*	*-3.9*
Ecart du solde public primaire	Pts de PIB	0.0	-0.8	-1.8	-2.7	-3.5	-6.0	-7.0	-6.9	-5.9	-4.9
Ecart du solde public	Pts de PIB	0.0	-0.9	-1.8	-2.8	-3.6	-5.4	-6.5	-8.8	-11.1	-12.6
Ecart de la dette publique	Pts de PIB	0.0	2.9	6.6	11.2	16.8	54.2	94.1	127.5	153.2	175.6

Agrégats macroéconomiques : S2 en écart au TEND

	Unité	2021	2022	2023	2024	2025	2030	2035	2040	2045	2050
PIB	%	0.0	0.5	0.9	1.4	2.0	4.1	3.4	2.5	2.6	2.4
VA du secteur marchand	%	0.0	0.6	1.1	1.8	2.5	5.1	4.5	3.6	3.8	3.6
Conso des ménages	%	0.0	-0.1	0.2	0.7	1.3	4.6	4.5	2.3	1.1	0.0
dont conso automobile	*%*	0.0	-8.2	-12.0	-14.1	-15.0	-17.8	-28.9	-41.3	-49.0	-54.3
Conso des APU	%	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Investissement	%	0.0	2.6	2.6	4.0	5.1	7.2	2.5	0.0	0.1	-0.6
dont entreprises privées	*%*	*0.0*	*3.0*	*0.3*	*1.1*	*2.0*	*6.2*	*6.2*	*5.3*	*5.0*	*4.4*
ménages	*%*	*0.0*	*3.5*	*10.1*	*14.4*	*16.9*	*14.7*	*-8.0*	*-21.1*	*-20.7*	*-25.5*
public	*%*	*0.0*	*0.1*	*0.1*	*0.2*	*0.3*	*0.8*	*0.6*	*-0.5*	*-1.9*	*-3.6*
Exportations	%	0.0	-0.5	-1.0	-1.5	-2.0	-5.5	-8.9	-10.6	-11.3	-12.1
Importations	%	0.0	-0.4	-1.6	-2.0	-2.4	-4.0	-7.7	-12.0	-15.6	-18.7
Revenu dispo réel des ménages	%	0.0	0.4	0.9	1.4	2.0	4.7	4.4	2.7	2.0	1.3
Revenu dispo réel des ménages	Mds EUR 2021	0	7	16	25	36	90	90	60	46	33
Revenu dispo réel par emploi	%	0.0	0.2	0.5	0.7	1.0	2.1	2.3	1.8	1.2	0.6
Variation du taux d'épargne	Pts de revenu	0.0	0.6	0.4	0.2	0.2	0.1	0.8	1.5	1.8	2.2
Prix à la conso des ménages	%	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.8	-3.4	-6.5	-8.8
Prix à la prod marchande	%	0.0	0.0	-0.1	-0.2	-0.2	0.0	-0.5	-3.3	-6.9	-9.4
Prix des exportations	%	0.0	-0.1	-0.2	-0.2	-0.2	0.2	-0.4	-3.1	-6.6	-9.3
Prix des importations	%	0.0	-0.1	-0.1	-0.3	-0.5	-1.5	-2.2	-2.8	-3.2	-3.6
Salaire net réel	%	0.0	0.0	0.0	0.1	0.3	2.4	3.7	2.7	1.5	0.9
Coût réel du travail	%	0.0	0.0	0.1	0.2	0.4	1.8	2.7	2.2	1.8	1.7
Emplois	%	0.0	0.2	0.4	0.7	1.1	2.6	2.0	0.8	0.8	0.7
Emplois	Milliers	0	41	88	166	258	635	497	209	200	177
Ecart du taux de chômage	Pts pop. active	0.0	-0.1	-0.2	-0.4	-0.7	-1.7	-1.4	-0.6	-0.5	-0.5
Ecart de la balance commerciale	Pts de PIB	0.0	0.0	0.3	0.3	0.4	0.7	1.1	1.3	1.5	1.6
BC énergétique	*Pts de PIB*	*0.0*	*0.1*	*0.3*	*0.4*	*0.5*	*1.2*	*1.4*	*1.5*	*1.5*	*1.5*
BC non énergétique	*Pts de PIB*	*0.0*	*-0.1*	*0.0*	*-0.1*	*-0.1*	*-0.5*	*-0.3*	*-0.1*	*-0.1*	*0.1*
Ecart du solde public primaire	Pts de PIB	0.0	-0.1	0.0	0.1	0.3	1.1	0.8	0.1	-0.2	-0.4
Ecart du solde public	Pts de PIB	0.0	-0.1	0.0	0.2	0.4	1.5	1.4	1.3	1.3	0.8
Ecart de la dette publique	Pts de PIB	0.0	-0.4	-0.7	-1.4	-2.3	-9.5	-13.7	-12.8	-11.8	-10.3

Agrégats macroéconomiques : S3 en écart au TEND

	Unité	2021	2022	2023	2024	2025	2030	2035	2040	2045	2050
PIB	%	0.0	0.5	0.8	1.2	1.6	3.0	2.8	1.9	1.6	1.4
VA du secteur marchand	%	0.0	0.7	1.0	1.5	2.0	3.7	3.5	2.6	2.3	2.2
Conso des ménages	%	0.0	-0.4	0.3	1.0	1.7	4.7	4.7	3.0	1.8	1.1
dont conso automobile	*%*	0.0	-17.1	-12.4	-8.5	-4.8	6.2	-1.0	-12.6	-19.8	-19.2
Conso des APU	%	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Investissement	%	0.0	2.5	1.4	2.1	2.7	4.9	4.7	2.3	0.9	-0.3
dont entreprises privées	*%*	*0.0*	*3.8*	*1.2*	*1.9*	*2.6*	*6.3*	*6.8*	*4.9*	*3.8*	*2.2*
ménages	*%*	*0.0*	*0.8*	*2.7*	*4.1*	*4.8*	*4.7*	*1.6*	*-5.4*	*-9.8*	*-11.2*
public	*%*	*0.0*	*0.1*	*0.1*	*0.2*	*0.2*	*0.4*	*0.2*	*-0.6*	*-1.8*	*-3.2*
Exportations	%	0.0	-0.2	-0.5	-0.9	-1.4	-5.0	-8.5	-10.6	-11.5	-11.8
Importations	%	0.0	-0.8	-1.4	-1.5	-1.5	-1.4	-3.3	-6.7	-9.9	-12.1
Revenu dispo réel des ménages	%	0.0	0.3	0.7	1.1	1.6	3.6	3.8	2.7	1.8	1.2
Revenu dispo réel des ménages	Mds EUR 2021	0	4	12	19	28	69	79	61	43	30
Revenu dispo réel par emploi	%	0.0	0.0	0.2	0.4	0.6	1.5	1.7	1.5	1.1	0.5
Variation du taux d'épargne	Pts de revenu	0.0	0.6	0.2	0.0	-0.2	-1.0	-0.6	0.1	0.5	0.4
Prix à la conso des ménages	%	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	-1.5	-3.9	-6.1
Prix à la prod marchande	%	0.0	0.0	-0.1	-0.1	-0.1	0.1	0.2	-1.3	-4.0	-6.6
Prix des exportations	%	0.0	0.0	0.0	0.1	0.1	0.6	0.5	-1.1	-3.9	-6.6
Prix des importations	%	0.0	-0.1	-0.2	-0.4	-0.6	-1.7	-2.5	-3.1	-3.6	-4.0
Salaire net réel	%	0.0	0.0	0.0	0.1	0.3	1.7	2.8	2.6	1.7	0.9
Coût réel du travail	%	0.0	0.0	0.1	0.2	0.3	1.2	1.7	1.7	1.4	1.3
Emplois	%	0.0	0.3	0.4	0.7	1.0	2.1	2.1	1.2	0.8	0.6
Emplois	Milliers	0	62	110	173	239	514	511	294	194	162
Ecart du taux de chômage	Pts pop. active	0.0	-0.2	-0.3	-0.5	-0.6	-1.4	-1.4	-0.8	-0.5	-0.4
Ecart de la balance commerciale	Pts de PIB	0.0	0.3	0.4	0.4	0.4	0.1	0.2	0.4	0.5	0.4
BC énergétique	*Pts de PIB*	*0.0*	*0.1*	*0.3*	*0.4*	*0.6*	*1.1*	*1.4*	*1.5*	*1.5*	*1.5*
BC non énergétique	*Pts de PIB*	*0.0*	*0.1*	*0.1*	*0.0*	*-0.2*	*-1.0*	*-1.2*	*-1.1*	*-1.0*	*-1.1*
Ecart du solde public primaire	Pts de PIB	0.0	0.0	0.2	0.3	0.4	1.0	0.9	0.3	-0.1	-0.4
Ecart du solde public	Pts de PIB	0.0	0.0	0.2	0.4	0.5	1.3	1.4	1.2	1.2	0.9
Ecart de la dette publique	Pts de PIB	0.0	-0.5	-1.0	-1.7	-2.6	-9.1	-14.2	-14.8	-13.6	-11.7

Agrégats macroéconomiques : S4 en écart au TEND

	Unité	2021	2022	2023	2024	2025	2030	2035	2040	2045	2050
PIB	%	0.0	0.6	0.8	1.2	1.6	3.3	3.6	2.8	2.7	2.7
VA du secteur marchand	%	0.0	0.7	0.9	1.4	1.8	3.9	4.3	3.6	3.4	3.5
Conso des ménages	%	0.0	0.1	0.4	0.9	1.5	4.9	5.1	3.8	3.0	2.1
dont conso automobile	*%*	0.0	-1.7	-1.3	0.4	2.8	13.3	2.1	-9.1	-15.4	-24.1
Conso des APU	%	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Investissement	%	0.0	4.5	2.8	3.0	3.3	5.3	7.9	7.4	6.8	6.0
dont entreprises privées	*%*	*0.0*	*4.6*	*1.7*	*2.0*	*2.5*	*6.1*	*10.0*	*9.0*	*8.0*	*7.0*
ménages	*%*	*0.0*	*7.5*	*7.6*	*7.6*	*7.4*	*6.6*	*7.1*	*8.2*	*9.3*	*9.8*
public	*%*	*0.0*	*0.0*	*0.1*	*0.1*	*0.2*	*0.5*	*0.6*	*0.2*	*-0.3*	*-0.9*
Exportations	%	0.0	-0.6	-0.1	0.5	0.9	1.1	-0.1	-0.6	0.1	1.5
Importations	%	0.0	0.5	0.1	0.4	0.8	3.3	4.0	3.1	2.0	0.6
Revenu dispo réel des ménages	%	0.0	0.2	0.6	1.0	1.4	3.8	4.6	4.1	3.6	3.3
Revenu dispo réel des ménages	Mds EUR 2021	0	3	10	17	25	73	95	90	86	83
Revenu dispo réel par emploi	%	0.0	-0.1	0.1	0.2	0.4	1.1	1.2	1.2	0.9	0.5
Variation du taux d'épargne	Pts de revenu	0.0	-0.5	-0.4	-0.5	-0.6	-1.2	-0.6	0.0	0.4	0.9
Prix à la conso des ménages	%	0.0	0.2	0.3	0.4	0.5	1.4	3.1	3.9	3.2	2.1
Prix à la prod marchande	%	0.0	0.1	0.1	0.2	0.3	1.6	3.7	4.6	3.7	2.4
Prix des exportations	%	0.0	0.1	0.2	0.4	0.6	2.0	3.7	4.3	3.4	2.0
Prix des importations	%	0.0	0.0	-0.1	-0.2	-0.4	-1.2	-1.6	-2.0	-2.5	-3.0
Salaire net réel	%	0.0	-0.3	-0.3	-0.2	0.0	1.6	3.5	4.1	3.9	3.6
Coût réel du travail	%	0.0	-0.1	-0.1	0.0	0.1	1.1	1.9	2.2	2.2	2.2
Emplois	%	0.0	0.3	0.5	0.7	1.0	2.7	3.4	2.8	2.7	2.8
Emplois	Milliers	0	71	117	180	256	650	833	713	675	697
Ecart du taux de chômage	Pts pop. active	0.0	-0.2	-0.3	-0.5	-0.7	-1.8	-2.3	-2.0	-1.8	-1.9
Ecart de la balance commerciale	Pts de PIB	0.0	-0.3	0.1	0.3	0.4	0.5	0.7	1.1	1.5	1.9
BC énergétique	*Pts de PIB*	*0.0*	*0.0*	*0.2*	*0.3*	*0.4*	*0.8*	*1.0*	*1.0*	*1.1*	*1.1*
BC non énergétique	*Pts de PIB*	*0.0*	*-0.3*	*-0.1*	*0.0*	*0.0*	*-0.3*	*-0.2*	*0.1*	*0.4*	*0.8*
Ecart du solde public primaire	Pts de PIB	0.0	0.2	0.3	0.4	0.6	1.5	1.7	1.4	1.2	1.2
Ecart du solde public	Pts de PIB	0.0	0.2	0.3	0.4	0.7	1.8	2.1	2.2	2.7	3.0
Ecart de la dette publique	Pts de PIB	0.0	-1.0	-1.4	-2.3	-3.4	-12.3	-22.4	-29.3	-35.7	-42.8

3ME a neokeynesian model

Multi-sector Macroeconomic Model for the Evaluation of Environmental and Energy policies

Joint design between ADEME and OFCE since 2008

Macroeconomic multisectoral model of neo-keynesian inspiration

Comparable to models used in quarterly forecasting by Finance Ministry

Prices do not balance supply and demand instantaneously – **it is therefore possible to obtain underemployment equilibria**

Firms apply a mark up on unit production costs

Wages are driven by price inflation, productivity and unemployment (WS curve)

Real interest rates are fixed : savings and investment depend on demand in addition to interest rates

Money is not neutral. The capital stock is endogenous. this influences the level long-term GDP

A multisectorial model

Detailed sectoral disaggregation in 37 sectors, with a focus on energy (17 sub-sectors)

This allows to analyze the effect of transfer of activities from one sector to another on:

Employment, due to different labor intensity

Investment, due to different capital intensity

Energy consumption, due to different energy intensity

Trade balance, due to different propensity to import and export

ThreeME allows the emergence of a double dividend

For example, an increase in investments in renewable energies:

leads to an overall increase in investment (the crowding-out effect is partial)

which generates an increase in employment and consumption (supply influences demand)

which in turn leads to an increase in production (demand influences supply)

and a drop in unemployment (possible in the event of an equilibrium of underemployment at the outset)

A hybrid model: Agents face several energy-related tradeoffs

Firms maximize their profits given demand (CES production function)

Firms' investments are impacted by the tradeoff between capital and energy

- Substitution when the relative price of energy increases.
- Substitution between energy sources

Households choose between energy-intensive and energy-efficient investments

- 7 energy performances classes (A through G) for housing and private vehicles
- Market shares evolve according to the user costs (purchase price net of public subsidies, and energy consumption actualized over the vehicles' lifecycle)
- Penetration rate of electric vehicles is endogenous

Energy prices induce energy sufficiency :Households reduce heating and gasoline expenditures when energy prices increase