6.5 AFRICA

6.5.1 FINAL ENERGY DEMAND BY SECTOR

Combining the projections on population development, GDP growth and energy intensity results in future development pathways for Africa's final energy demand. These are shown in Figure 6.5.1 for the Reference and Energy [R]evolution scenarios. Under the Reference scenario, total final energy demand increases by 111% from the current 21,700 PJ/a to 45,700 PJ/a in 2050. In the basic Energy [R]evolution scenario, final energy demand increases at a much lower rate by 26% compared to current consumption and is expected to reach 27,300 PJ/a by 2050. The Advanced scenario results in some additional reductions due to a higher share of electric cars.

Under both Energy [R]evolution scenarios, due to economic growth, increasing living standards and electrification of the transport sector, overall electricity demand is expected to increase despite efficiency gains in all sectors (see Figure 6.5.2). Total electricity demand will rise from about 590 TWh/a to 2,890 TWh/a by 2050 in the basic Energy [R]evolution scenario. Compared to the Reference scenario, efficiency measures in the industry, residential and service sectors avoid the generation of about 360 TWh/a.

This reduction can be achieved in particular by introducing highly efficient electronic devices using the best available technology in all demand sectors. The transformation to a carbon free energy system in the Advanced scenario will further increase the electricity demand in 2050 up to 3,100 TWh/a. Electricity will become the major renewable 'primary' energy, not only for direct use for various purposes but also for the generation of synthetic fuels for fossil fuels substitution. Around 490 TWh are used in 2050 for electric vehicles and rail transport in 2050 in the Advanced scenario, around 560 TWh for hydrogen and 790 TWh for synthetic liquid fuel generation for the transport sector (excluding bunkers).

Efficiency gains in the heating sector are even larger than in the electricity sector. Under the Energy [R]evolution scenarios, consumption equivalent to about 3,600 PJ/a is avoided through efficiency gains by 2050 compared to the Reference scenario. As a result of the introduction of low energy standards and highly efficient technologies e.g. for industrial and commercial process heat, cooking and air conditioning, enjoyment of the same comfort and energy services will be accompanied by much lower future energy demand.

FIGURE 6.5.1 | **AFRICA: PROJECTION OF TOTAL FINAL ENERGY DEMAND BY SECTOR – REFERENCE, ENERGY [R]EVOLUTION, ADVANCED ENERGY [R]EVOLUTION SCENARIOS** WITHOUT NON-ENERGY USE AND HEAT FROM CHP AUTOPRODUCERS

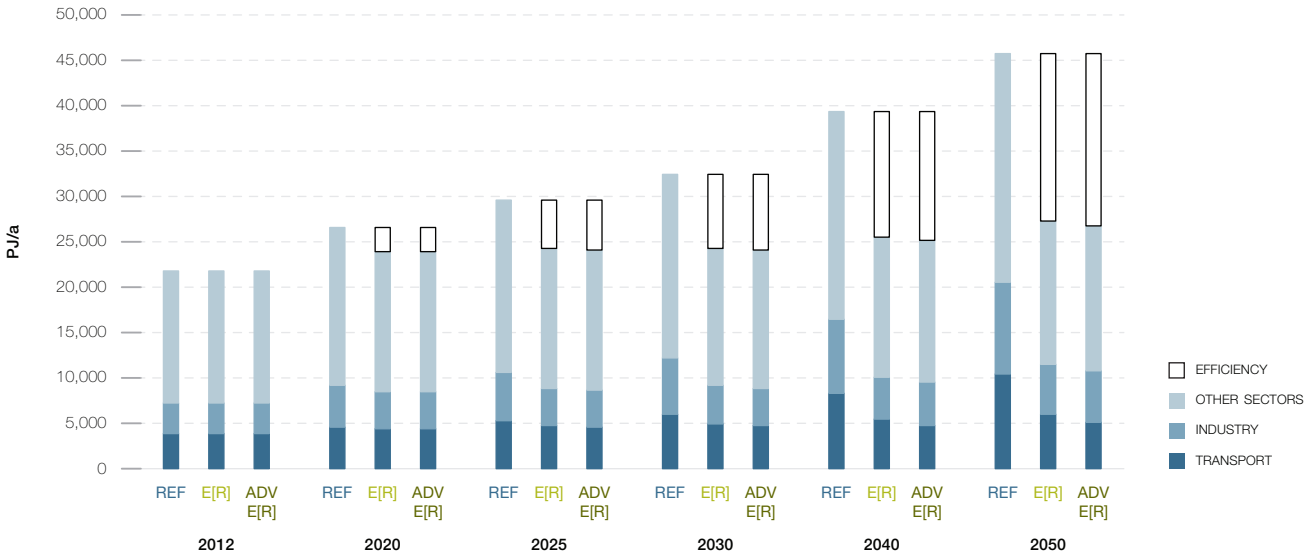


FIGURE 6.5.2 | AFRICA: DEVELOPMENT OF ELECTRICITY DEMAND BY SECTOR IN THE ENERGY [R]EVOLUTION SCENARIOS

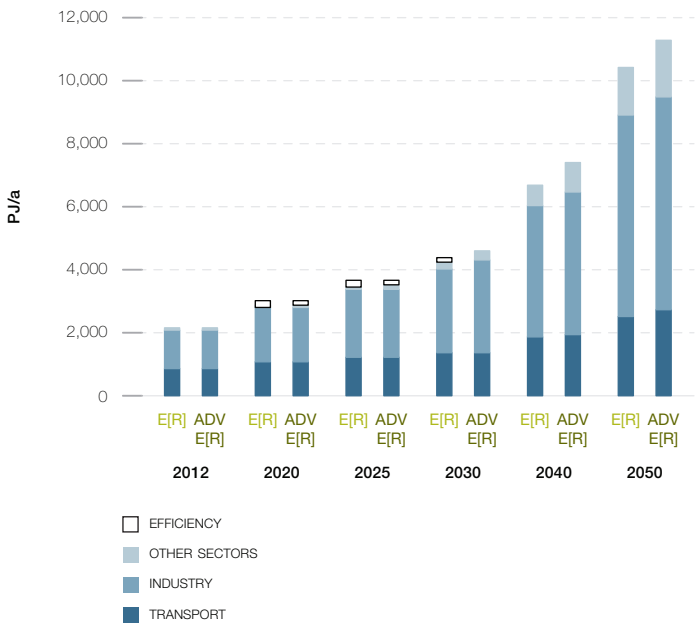


FIGURE 6.5.3 | AFRICA: DEVELOPMENT OF THE FINAL ENERGY DEMAND FOR TRANSPORT BY SECTOR IN THE ENERGY [R]EVOLUTION SCENARIOS

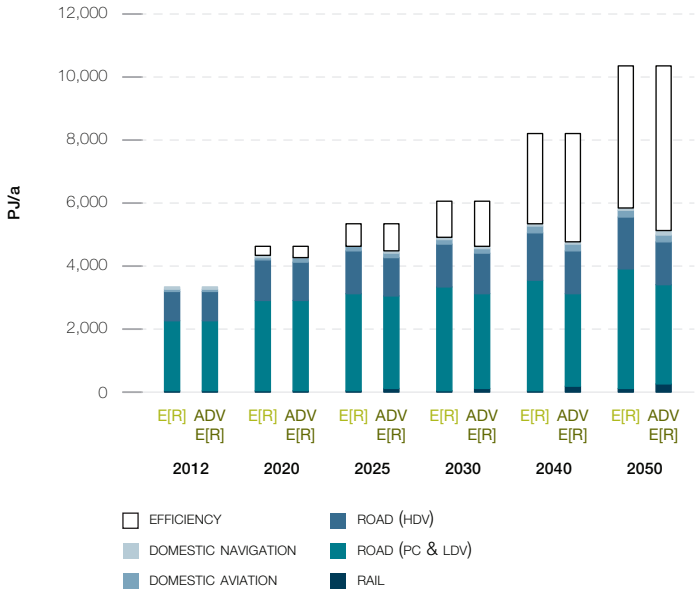
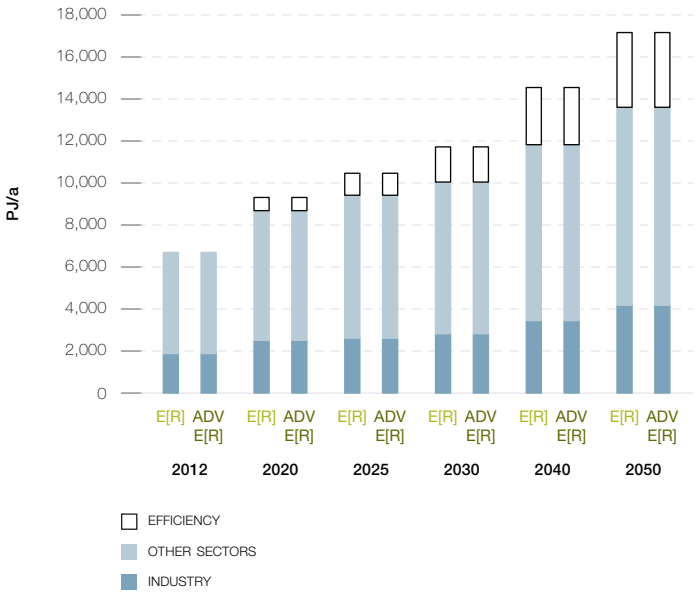


FIGURE 6.5.4 | AFRICA: DEVELOPMENT OF FINAL ENERGY DEMAND FOR HEAT BY SECTOR IN THE ENERGY [R]EVOLUTION SCENARIOS



6.5.2 ELECTRICITY GENERATION

The development of the electricity supply sector is characterised by a dynamically growing renewable energy market and an increasing share of renewable electricity. This trend will more than compensate for the phasing out of nuclear power production in the Energy [R]evolution scenarios, continuously reducing the number of fossil fuel-fired power plants as well. By 2050, 95% of the electricity produced in Africa will come from renewable energy sources in the basic Energy [R]evolution scenario. 'New' renewables – mainly wind, PV, CSP and geothermal energy – will contribute 80% to the total electricity generation. Already by 2020 the share of renewable electricity production will be 31% and 65% by 2030. The installed capacity of renewables will reach about 380 GW in 2030 and 1,390 GW by 2050.

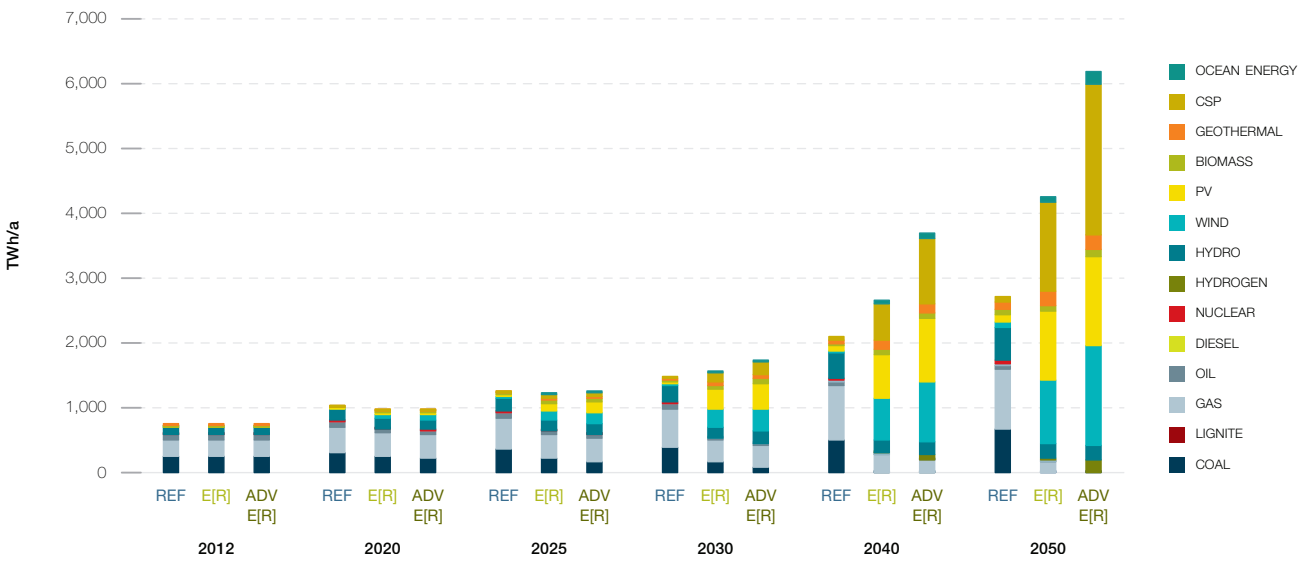
A 100% electricity supply from renewable energy resources in the Advanced scenario leads to around 2,000 GW installed generation capacity in 2050.

Table 6.5.1 shows the comparative evolution of the different renewable technologies in Africa over time. Until 2020 hydro will remain the main renewable power source. By 2020 wind and PV overtake biomass, currently the second largest contributor to the growing renewable market. After 2020, the continuing growth of wind and PV will be complemented by electricity from solar thermal, geothermal and ocean energy. The Energy [R]evolution scenarios will lead to a high share of fluctuating power generation sources (PV, wind and ocean) of already 38% to 45% by 2030 and 50% 2050. Therefore, smart grids, demand side management (DSM), energy storage capacities and other options need to be expanded in order to increase the flexibility of the power system for grid integration, load balancing and a secure supply of electricity.

TABLE 6.5.1 | AFRICA: PROJECTION OF RENEWABLE ELECTRICITY GENERATION CAPACITY UNDER THE REFERENCE AND THE ENERGY [R]EVOLUTION SCENARIOS IN GW

		2012	2020	2030	2040	2050
HYDRO	REF	25	38	60	86	119
	E[R]	25	34	41	47	53
	ADV	25	34	41	47	53
BIOMASS	REF	0	2	6	9	14
	E[R]	0	4	13	15	17
	ADV	0	5	15	21	30
WIND	REF	1	5	12	19	30
	E[R]	1	23	102	220	333
	ADV	1	26	124	333	541
GEOTHERMAL	REF	0	1	4	9	18
	E[R]	0	1	10	20	34
	ADV	0	1	10	20	34
PV	REF	0	6	21	40	69
	E[R]	0	28	177	423	669
	ADV	0	31	250	598	847
CSP	REF	0	1	4	11	20
	E[R]	0	7	30	113	239
	ADV	0	7	48	199	411
OCEAN	REF	0	0	0	0	0
	E[R]	0	0	9	25	50
	ADV	0	0	9	45	90
TOTAL	REF	26	54	105	175	271
	E[R]	26	96	381	863	1,394
	ADV	26	104	497	1,264	2,004

FIGURE 6.5.5 | AFRICA: DEVELOPMENT OF ELECTRICITY GENERATION STRUCTURE – REFERENCE, ENERGY [R]EVOLUTION, ADVANCED ENERGY [R]EVOLUTION SCENARIOS



6.5.3 FUTURE COSTS OF ELECTRICITY GENERATION

Figure 6.5.6 shows that the introduction of renewable technologies under both Energy [R]evolution scenarios decreases the future costs of electricity generation compared to the Reference scenario by 2030. The difference in full cost of generation will be around 1.4 US$ct/kWh in the basic Energy [R]evolution and around 1.3 US$ct/kWh in the Advanced scenario, without taking into account integration costs for storage or other load-balancing measures. Because of increasing prices for conventional fuels, electricity generation costs will become economically favourable starting just after 2020 under the Energy [R]evolution scenarios. By 2050, the cost will be 2.8/2.1 US$ct/kWh, respectively, below those in the Reference case.

Under the Reference scenario, on the other hand, growth in demand and increasing fossil fuel prices result in total electricity supply costs rising from today's US$ 67 billion per year to more than US$ 277 billion in 2050, compared to US$ 326 billion in the basic and US$ 507 billion in the Advanced Energy [R]evolution scenario. Figure 6.5.6 shows that both Energy [R]evolution scenarios not only comply with Africa´s CO_2 reduction targets, but also help stabilise energy costs and relieve the economic pressure on society.

Increasing energy efficiency and shifting energy supply to renewables lead to long term total costs for electricity supply that are only 18% higher in the basic Energy [R]evolution scenario than in the Reference scenario, despite a 57% increase in electricity production. The Advanced scenario with 100% renewable power and more than a doubling of generation results in supply costs 83% higher than the Reference case.

6.5.4 FUTURE INVESTMENTS IN THE POWER SECTOR

Around US$ 3,410 billion is required in investment for the Energy [R]evolution scenario to become reality (including investments for replacement after the economic lifetime of the plants) - approximately US$ 87 billion per year, US$ 2,220 billion more than in the Reference scenario (US$ 1,190 billion). Investments for the Advanced scenario sum up to US$ 4,890 billion until 2050, on average US$ 125 billion per year. Under the Reference scenario, the levels of investment in conventional power plants add up to almost 42% while approximately 58% would be invested in renewable energies and cogeneration until 2050.

Under the Energy [R]evolution scenarios, however, Africa would shift almost 95%/96% of the entire investment towards renewables and cogeneration, respectively. By 2030, the fossil fuel share of power sector investment would be focused mainly on gas power plants.

Because renewable energy has no fuel costs, the fuel cost savings in the basic Energy [R]evolution scenario reach a total of US$ 2,500 billion up to 2050, US$ 64 billion per year. The total fuel cost savings therefore would cover 110% of the total additional investments compared to the Reference scenario. Fuel cost savings in the Advanced scenario are even higher and add up to US$ 2,670 billion, or US$ 68 billion per year. Renewable energy sources would then go on to produce electricity without any further fuel costs beyond 2050, while costs for coal and gas will continue to be a burden on national economies.

FIGURE 6.5.6 | AFRICA: DEVELOPMENT OF TOTAL ELECTRICITY SUPPLY COSTS & OF SPECIFIC ELECTRICITY GENERATION COSTS IN THE SCENARIOS

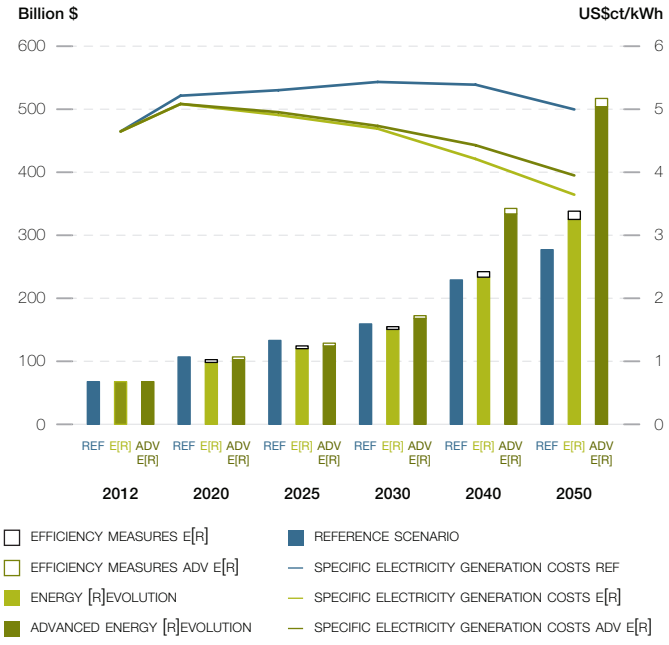
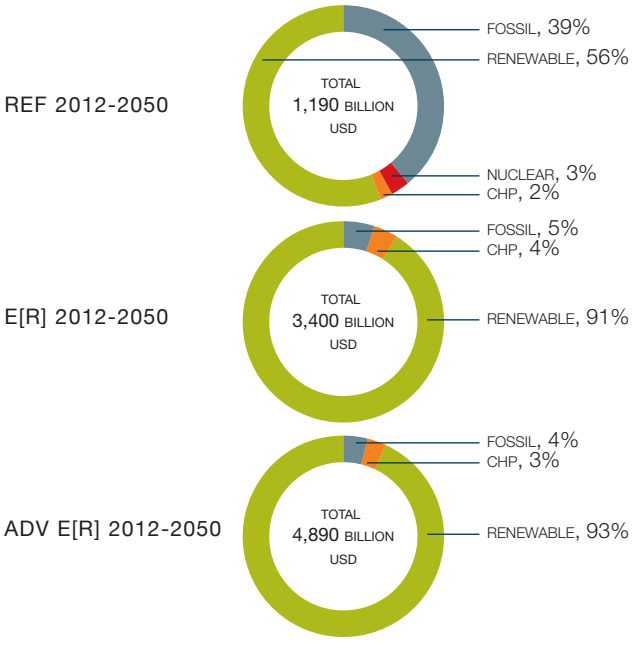


FIGURE 6.5.7 | AFRICA: INVESTMENT SHARES - REFERENCE VERSUS ENERGY [R]EVOLUTION SCENARIOS



6.5.5 ENERGY SUPPLY FOR HEATING

Today, traditional biomass use meets around 60% of Africa's energy demand for heat. Incentives to move to improved and modern biomass technologies are vital to enhance efficiency and to keep biomass consumption in check. Dedicated support instruments are required to ensure a dynamic development in particular for renewable technologies for buildings and renewable process heat production. In the basic Energy [R]evolution scenario, renewables already provide 68% of Africa's total heat demand in 2030 and 91% in 2050.

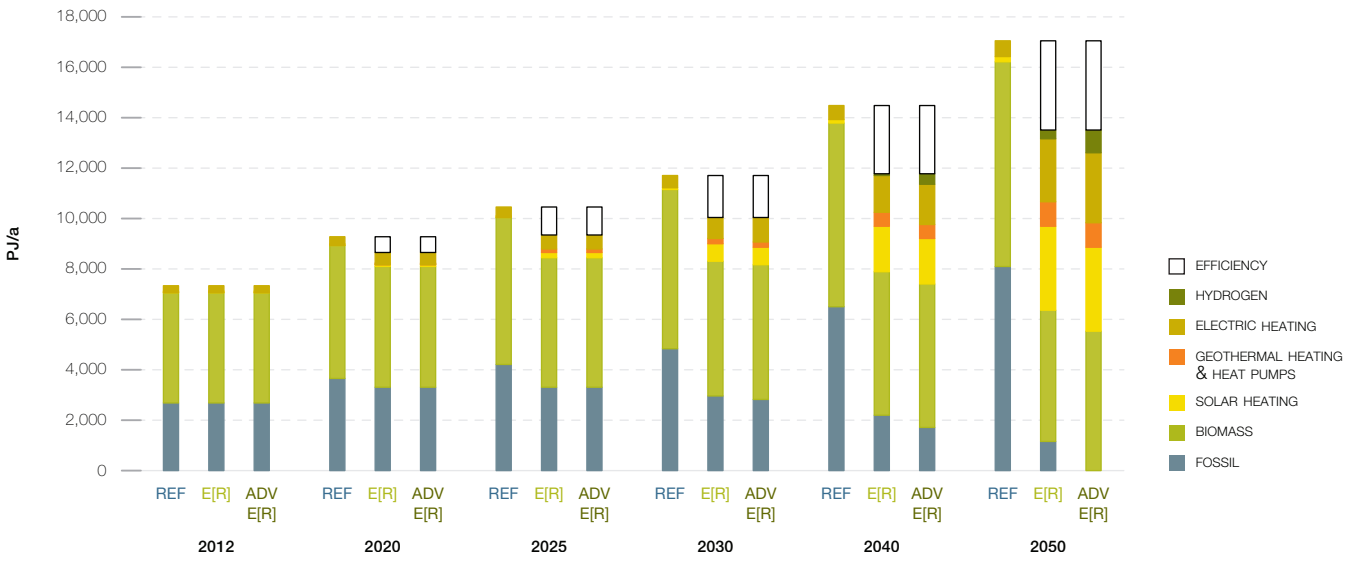
- Energy efficiency measures help to reduce the currently growing energy demand for heating and cooking by 21% in 2050 (relative to the Reference scenario), in spite of improving living standards and economic growth.
- In the industry sector solar collectors, geothermal energy (incl. heat pumps) as well as electricity and hydrogen from renewable sources are increasingly substituting for fossil fuel-fired systems.
- A shift from coal and oil to natural gas in the remaining conventional applications leads to a further reduction of CO_2 emissions.

Table 6.5.8 shows the development of different renewable technologies for heating in Africa over time. Although biomass remains the main contributor, its market share is decrasing and with it unefficient traditional biomass. After 2030, the continuing growth of solar collectors and a growing share of geothermal and environmental heat as well as heat from renewable hydrogen will further reduce the dependence on fossil fuels. The Advanced scenario results in a complete substitution of the remaining gas consumption by hydrogen generated from renewable electricity.

TABLE 6.5.2 | AFRICA: PROJECTION OF RENEWABLE HEAT SUPPLY UNDER THE REFERENCE AND BOTH ENERGY [R]EVOLUTION SCENARIOS IN PJ/a

		2012	2020	2030	2040	2050
BIOMASS	REF	4,334	5,796	6,354	7,349	8,180
	E[R]	4,334	5,185	5,346	5,664	5,213
	ADV	4,334	5,185	5,346	5,690	5,540
SOLAR HEATING	REF	5	33	50	104	186
	E[R]	5	203	701	1,819	3,336
	ADV	5	203	701	1,819	3,315
GEOTHERMAL HEAT	REF	0	0	0	0	0
AND HEAT PUMPS	E[R]	0	94	213	558	944
	ADV	0	94	213	570	992
HYDROGEN	REF	0	0	0	0	0
	E[R]	0	0	0	56	379
	ADV	0	0	0	387	914
TOTAL	REF	4,339	5,830	6,403	7,454	8,366
	E[R]	4,339	5,482	6,260	8,098	9,871
	ADV	4,339	5,482	6,260	8,464	10,760

FIGURE 6.5.8 | AFRICA: PROJECTION OF HEAT SUPPLY BY ENERGY CARRIER – REFERENCE, ENERGY [R]EVOLUTION, ADVANCED ENERGY [R]EVOLUTION SCENARIOS



6.5.6 FUTURE INVESTMENTS IN THE HEATING SECTOR

Also in the heating sector the Energy [R]evolution scenarios would require a major revision of current investment strategies in heating technologies. In particular, solar thermal, geothermal and heat pump technologies need an enormous increase in installations if these potentials are to be tapped for the heating sector. The use of biomass for heating purposes - often traditional biomass today - will be substantially reduced in the Energy [R]evolution scenarios and replaced by more efficient and sustainable renewable heating technologies.

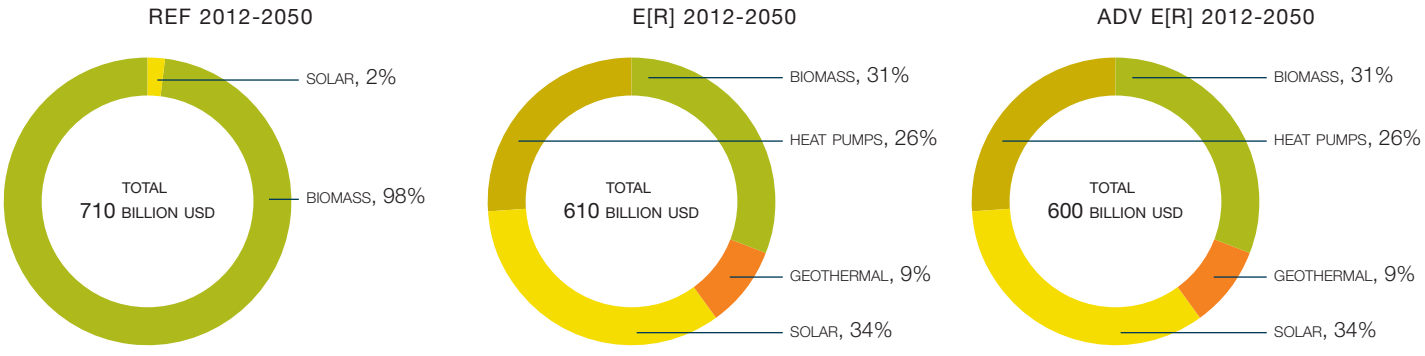
Renewable heating technologies are extremely variable, from low tech biomass stoves and unglazed solar collectors to very sophisticated enhanced geothermal and solar systems. Thus, it can only be roughly estimated that the Energy [R]evolution scenario in total requires around US$ 610 billion to be invested in renewable heating technologies up to 2050 (including investments for replacement after the economic lifetime of the plants) - approximately US$ 16 billion per year. The Advanced scenario assumes an equally ambitious expansion of renewable technologies, while the main strategy in the scenario is the substitution of the remaining natural gas amounts with electricity, hydrogen or other synthetic fuels.

TABLE 6.5.3 | AFRICA: INSTALLED CAPACITIES FOR RENEWABLE HEAT GENERATION UNDER THE SCENARIOS IN GW

		2012	2020	2030	2040	2050
BIOMASS	REF	3,736	4,297	4,635	4,640	4,550
	E[R]	3,736	3,697	3,259	2,874	2,124
	ADV	3,736	3,697	3,259	2,874	2,245
GEOTHERMAL	REF	0	0	0	0	0
	E[R]	0	2	8	13	18
	ADV	0	2	8	13	18
SOLAR HEATING	REF	1	4	10	21	38
	E[R]	1	9	144	374	685
	ADV	1	9	144	374	685
HEAT PUMPS	REF	0	0	0	0	0
	E[R]	0	0	13	44	88
	ADV	0	0	13	44	88
TOTAL*	REF	3,736	4,300	4,645	4,661	4,588
	E[R]	3,736	3,708	3,425	3,305	2,917
	ADV	3,736	3,708	3,425	3,304	3,033

* Excluding direct electric heating.

FIGURE 6.5.9 | AFRICA: DEVELOPMENT OF INVESTMENTS FOR RENEWABLE HEAT GENERATION TECHNOLOGIES – REFERENCE, ENERGY [R]EVOLUTION, ADVANCED ENERGY [R]EVOLUTION SCENARIOS



6.5.7 FUTURE EMPLOYMENT IN THE ENERGY SECTOR

The Advanced Energy [R]evolution scenario results in more energy sector jobs in Africa from 2025 onwards.

- At 2020, there are 7.9 million energy sector jobs in both the Advanced Energy [R]evolution and the Reference scenario.
- In 2025, there are 9.5 million jobs in the Advanced Energy [R]evolution scenario, and 8.4 million in the Reference scenario.
- In 2030, there are 10.5 million jobs in the Advanced Energy [R]evolution scenario and 8.8 million in the Reference scenario.

Figure 6.5.10 shows the change in job numbers under both scenarios for each technology between 2015 and 2030. Jobs in the Reference scenario increase by 24% by 2030. Bionergy accounts for by far the largest share of jobs in both scenarios.

The non-biomass renewable energy grows strongly in the Advanced Energy [R]evolution scenario. Until 2020 this offsets declines in bioenergy, so job levels at are very close to the Reference scenario. Non-biomass renewable energy continues to grow strongly until , when to 48% above 2015. Renewable energy accounts for 98% of energy sector jobs by 2030.

FIGURE 6.5.10 | AFRICA: EMPLOYMENT IN THE ENERGY SECTOR UNDER THE REFERENCE AND ADVANCED ENERGY [R]EVOLUTION SCENARIO

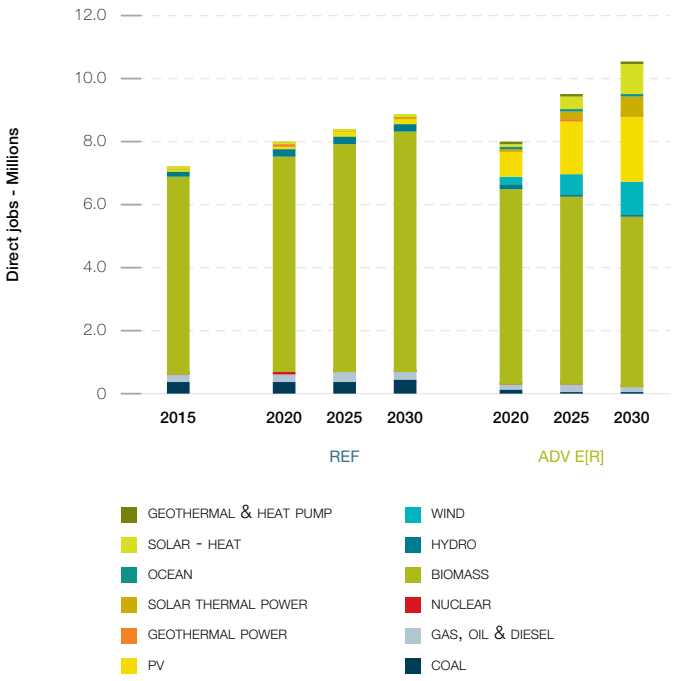


TABLE 6.5.4 | AFRICA: TOTAL EMPLOYMENT IN THE ENERGY SECTOR IN THOUSAND JOBS

		REFERENCE			ADVANCED ENERGY [R]EVOLUTION		
	2015	2020	2025	2030	2020	2025	2030
COAL	376	391	391	420	111	79	42
GAS, OIL & DIESEL	223	247	263	278	171	183	169
NUCLEAR	16	23	27	29	8	9	8
RENEWABLES	6,521	7,264	7,702	8,096	7,628	9,197	10,309
TOTAL JOBS	**7,134**	**7,925**	**8,383**	**8,823**	**7,918**	**9,468**	**10,528**
CONSTRUCTION AND INSTALLATION	380	456	448	477	1,012	2,119	2,902
MANUFACTURING	165	184	185	204	253	644	1,105
OPERATIONS AND MAINTENANCE	235	308	384	413	453	787	1,213
FUEL SUPPLY (DOMESTIC)	6,315	6,930	7,313	7,668	6,174.5	5,900	5,298
COAL AND GAS EXPORT	40	46	53	60	25	18	10
TOTAL JOBS	**7,134**	**7,925**	**8,383**	**8,823**	**7,918**	**9,468**	**10,528**

6.5.8 TRANSPORT

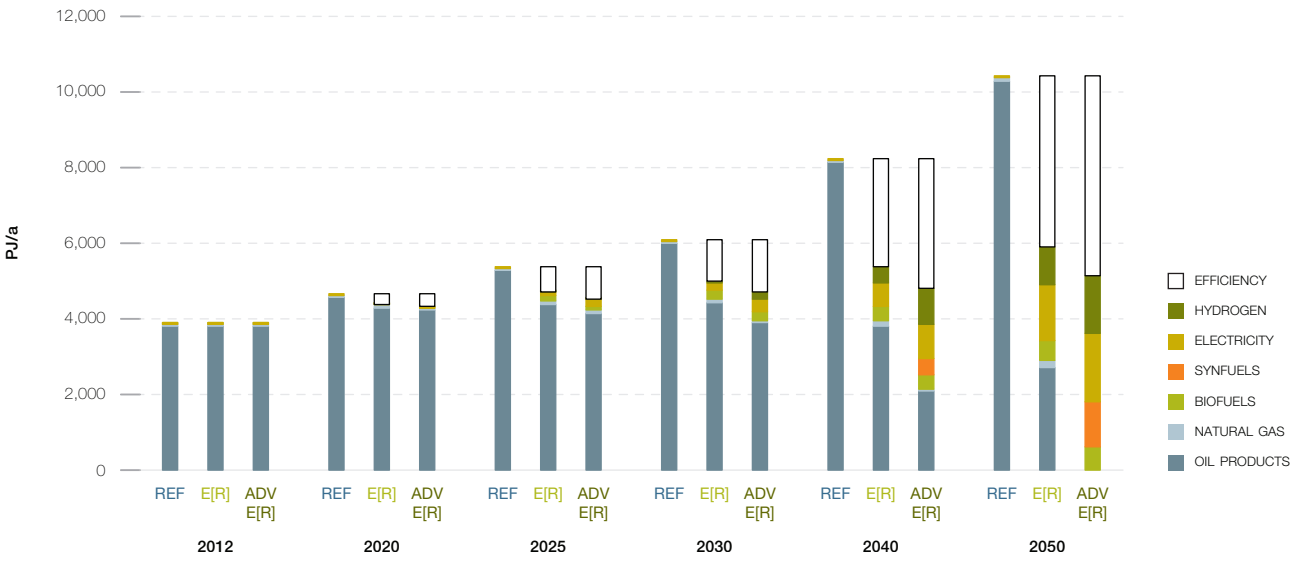
In 2050, the car fleet in Africa will be significantly larger than today. Today, a large share of old cars are driven in Africa. With growing individual mobility, an increasing share of small efficient cars is projected in the Energy[R]evolution scenarios. Due to population increase, GDP growth and higher living standards, energy demand from the transport sector is expected to increase in the Reference scenario by around 170% to 10,400 PJ/a in 2050. In the basic Energy [R]evolution scenario, efficiency measures and modal shifts will save 43% (4,500 PJ/a) in 2050 compared to the Reference scenario.

Additional modal shifts and technology switches lead to even higher energy savings in the Advanced scenario of 51% (5,260 PJ/a) in 2050 compared to the Reference scenario. Highly efficient propulsion technology with hybrid, plug-in hybrid and battery-electric power trains will bring about large efficiency gains. By 2030, electricity will provide 3% of the transport sector's total energy demand in the Energy [R]evolution, while in 2050 the share will be 25% (35% in the Advanced scenario). Hydrogen and other synthetic fuels generated using renewable electricity are complementary options to further increase the renewable share in the transport sector. In 2050, up to 1,540 PJ/a of hydrogen is used in the transport sector for the Advanced Energy [R]evolution scenario.

TABLE 6.5.5 | AFRICA: PROJECTION OF TRANSPORT ENERGY DEMAND BY MODE IN THE REFERENCE AND THE ENERGY [R]EVOLUTION SCENARIOS IN PJ/a

		2012	2020	2030	2040	2050
RAIL	REF	30	35	37	39	42
	E[R]	30	45	56	64	94
	ADV	30	56	113	162	283
ROAD	REF	3,143	5,110	5,786	7,839	9,881
	E[R]	3,143	4,131	4,663	4,991	5,436
	ADV	3,143	4,072	4,324	4,323	4,501
DOMESTIC AVIATION	REF	107	140	170	275	389
	E[R]	107	125	150	194	244
	ADV	107	125	148	190	229
DOMESTIC NAVIGATION	REF	28	30	31	31	32
	E[R]	28	45	62	81	89
	ADV	28	45	62	81	89
TOTAL	REF	3,307	5,315	6,023	8,184	10,345
	E[R]	3,307	4,346	4,931	5,330	5,863
	ADV	3,307	4,298	4,648	4,757	5,103

FIGURE 6.5.11 | AFRICA: FINAL ENERGY CONSUMPTION IN TRANSPORT UNDER THE SCENARIOS



6.5.10 DEVELOPMENT OF CO_2 EMISSIONS

Whilst Africa`s emissions of CO_2 will increase by 149% between 2012 and 2050 under the Reference scenario, under the Energy [R]evolution scenario they will decrease from 1,050 million tonnes in 2012 to 363 million tonnes in 2050. Annual per capita emissions will drop from 1 tonne to 0.2 tonne. In spite of the abstinence of nuclear power production and increasing power demand, CO_2 emissions will decrease in the electricity sector. In the long run efficiency gains and the increased use of renewable electricity in vehicles strongly reduce emissions in the transport sector as well. With a 57% share of CO_2, the Transport sector will be the largest source of emissions in 2050 in the basic E[R] scenario. By 2050, Africa´s CO_2 emissions are 33% below 1990 levels in the Energy [R]evolution scenario while energy consumption is fully decarbonised in the Advanced case.

6.5.11 PRIMARY ENERGY CONSUMPTION

Taking into account the assumptions discussed above, the resulting primary energy consumption under the Energy [R]evolution scenarios is shown in Figure 6.5.12. Under the basic Energy [R]evolution scenario, primary energy demand will increase by 19% from today's 30,970 PJ/a to around 37,000 PJ/a Compared to the Reference scenario, overall primary energy demand will be reduced by 44% in 2050 under the Energy [R]evolution scenario (Reference: around 367,000 PJ in 2050). The Advanced scenario results due to additional conversion losses in a primary energy consumption of around 39,500 PJ in 2050.

The Energy [R]evolution scenarios aim to phase out coal and oil as fast as technically and economically possible by expansion of renewable energies and a fast introduction of very efficient vehicle concepts in the transport sector to replace oil based combustion engines. This leads to an overall renewable primary energy share of 56% in 2030 and 81% in 2050 in the basic Energy [R]evolution and of more than 97% in 2050 in the Advanced case (incl. non-energy consumption). In contrast to the Reference scenario, no new nuclear power plants will be built in Africa in the Energy [R]evolution scenarios.

FIGURE 6.5.13 | AFRICA: DEVELOPMENT OF CO_2 EMISSIONS BY SECTOR UNDER THE ENERGY [R]EVOLUTION SCENARIOS

'SAVINGS' = REDUCTION COMPARED TO THE REFERENCE SCENARIO

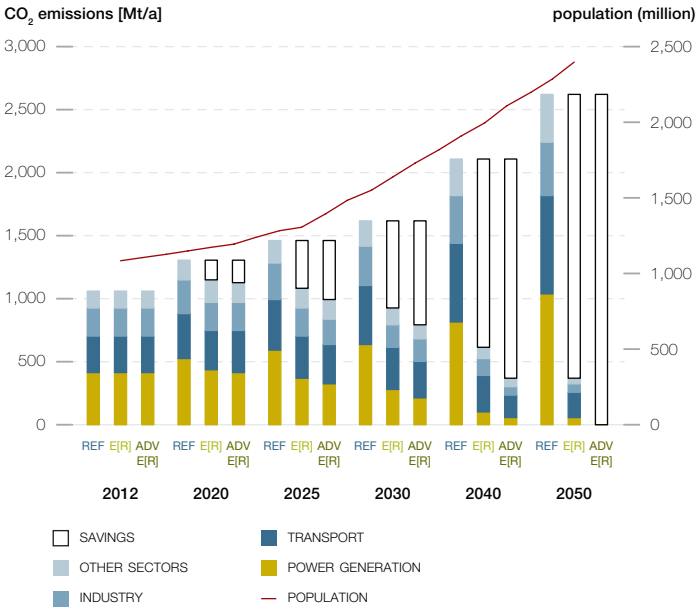


FIGURE 6.5.12 | AFRICA: PROJECTION OF TOTAL PRIMARY ENERGY DEMAND (PED) BY ENERGY CARRIER INCLUDING ELECTRICITY INCLUDING ELECTRICITY IMPORT BALANCE – REFERENCE, ENERGY [R]EVOLUTION, ADVANCED ENERGY [R]EVOLUTION SCENARIOS

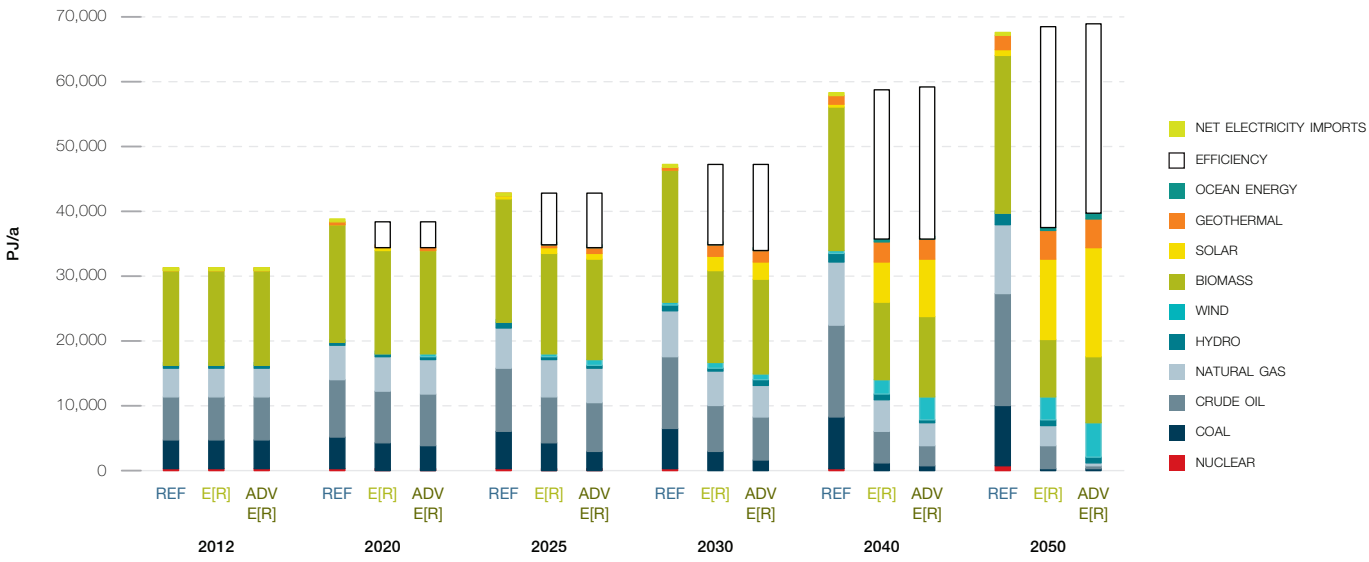


TABLE 6.5.6 | AFRICA: ACCUMULATED INVESTMENT COSTS FOR ELECTRICITY GENERATION AND FUEL COST SAVINGS UNDER THE ENERGY [R]EVOLUTION SCENARIO COMPARED TO THE REFERENCE SCENARIO

ACCUMULATED INVESTMENT COSTS DIFFERENCE REF MINUS E[R]	UNIT	2012-2020	2021-2030	2031-2040	2041-2050	2012-2050	2012 - 2050 AVERAGE PER YEAR
CONVENTIONAL (FOSSIL + NUCLEAR)	BILLION $	31.6	73.7	102.9	123.4	331.5	8.5
RENEWABLES (INCL. CHP)	BILLION $	-85.8	-514.8	-839.3	-1,116.8	-2,556.6	-65.6
TOTAL	BILLION $	-54.2	-441.0	-736.4	-993.4	-2,225.1	-57.1
ACCUMULATED FUEL COST SAVINGS SAVINGS CUMULATIVE E[R] VERSUS REF							
FUEL OIL	BILLION $	17.0	88.0	124.9	130.5	360.4	9.2
GAS	BILLION $	7.6	153.0	477.6	831.7	1,470.0	37.7
HARD COAL	BILLION $	8.6	87.5	209.6	340.9	646.6	16.6
LIGNITE	BILLION $	0.0	0.0	0.0	0.0	0.0	0.0
NUCLEAR ENERGY	BILLION $	0.2	2.6	6.5	12.4	21.7	0.6
TOTAL	BILLION $	33.3	331.0	818.7	1,315.5	2,498.6	64.1

TABLE 6.5.7 | ACCUMULATED INVESTMENT COSTS FOR RENEWABLE HEAT GENERATION UNDER THE ENERGY [R]EVOLUTION SCENARIO COMPARED TO THE REFERENCE SCENARIO

ACCUMULATED INVESTMENT COSTS DIFFERENCE REF MINUS E[R]	UNIT	2012-2020	2021-2030	2031-2040	2041-2050	2012-2050	2012 - 2050 AVERAGE PER YEAR
RENEWABLES	BILLION $	-156.6	-186.9	81.7	158.1	-103.7	-2.7

TABLE 6.5.8 | AFRICA: ACCUMULATED INVESTMENT COSTS FOR ELECTRICITY GENERATION AND FUEL COST SAVINGS UNDER THE ADVANCED ENERGY [R]EVOLUTION SCENARIO COMPARED TO THE REFERENCE SCENARIO

ACCUMULATED INVESTMENT COSTS DIFFERENCE REF MINUS ADVANCED E[R]	UNIT	2012-2020	2021-2030	2031-2040	2041-2050	2012-2050	2012 - 2050 AVERAGE PER YEAR
CONVENTIONAL (FOSSIL + NUCLEAR)	BILLION $	35.7	82.8	81.8	92.9	293.3	7.5
RENEWABLES (INCL. CHP)	BILLION $	-103.5	-707.9	-1,450.7	-1,734.6	-3,996.7	-102.5
TOTAL	BILLION $	-67.7	-625.1	-1,368.9	-1,641.7	-3,703.3	-95.0
ACCUMULATED FUEL COST SAVINGS SAVINGS CUMULATIVE ADVANCED E[R] VERSUS REF							
FUEL OIL	BILLION $	17.0	88.0	124.9	130.5	360.4	9.2
GAS	BILLION $	7.6	153.0	518.1	921.6	1,600.3	41.0
HARD COAL	BILLION $	10.5	110.3	226.0	338.9	685.6	17.6
LIGNITE	BILLION $	0.0	0.0	0.0	0.0	0.0	0.0
NUCLEAR ENERGY	BILLION $	0.2	2.6	6.5	12.4	21.7	0.6
TOTAL	BILLION $	35.2	353.9	875.6	1,403.4	2,668.0	68.4

TABLE 6.5.9 | AFRICA: ACCUMULATED INVESTMENT COSTS FOR RENEWABLE HEAT GENERATION UNDER THE ADVANCED ENERGY [R]EVOLUTION SCENARIO COMPARED TO THE REFERENCE SCENARIO

ACCUMULATED INVESTMENT COSTS DIFFERENCE REF MINUS ADVANCED E[R]	UNIT	2012-2020	2021-2030	2031-2040	2041-2050	2012-2050	2012 - 2050 AVERAGE PER YEAR
RENEWABLES	BILLION $	-156.6	-186.9	80.9	152.3	-110.3	-2.8