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Metodologia e risultati principali

settembre 2015

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La “logica della transizione” nello scenario

Energy [R]evolution di *Greenpeace*

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I 7 passi della “logica della transizione” dell’Energy [R]evolution:

1. Definire i limiti naturali:

    1. CO_2 - Emissioni > verso lo zero
    2. Combustibili fossili – Valutazione delle risorse

2. Definire i limiti delle risorse rinnovabili:

    1. Solare, eolico, geotermico, idroelettrico, oceani
    2. Bioenergie sostenibili

3. Identificare i determinanti della domanda:

    1. Popolazione
    2. Sviluppo economico

4. Definire l’evoluzione delle intensità energetiche:

    a. Edifici e residenziale and (e “altri settori”)
    b. Industria
    c. Trasporti

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La “logica della transizione” dell’Energy [R]evolution:

5. Stabilire i tempi di realizzazione:

1. Sviluppo del mercato delle centrali di generazione elettrica
2. Proiezione futura del mercato

6. Identificare le infrastrutture richieste :

1. Reti elettriche – e del gas
2. Stoccaggio,trasporto elettrico e “Smart-Grids”

7. Identificare le politiche necessarie :

1. Obiettivo climatico (< 2°C)
2. Target rinnovabili (verso il 100%)
   - FiT o simili politiche per FER
   - Connessione obbligatoria alla rete
   - Priorità di dispacciamento

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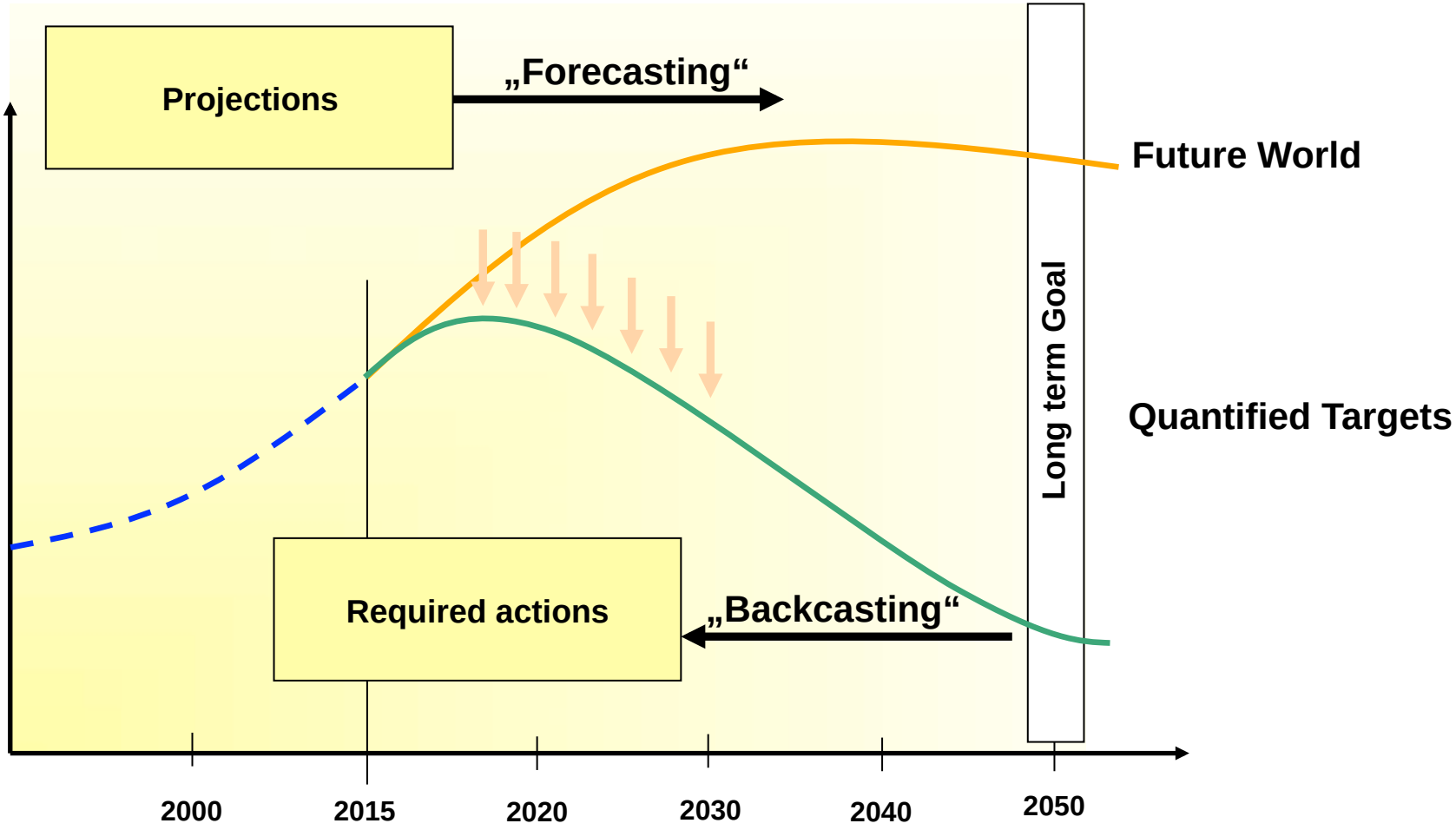
Approccio *backcasting*: identificare un target nel futuro
e definire i passi per raggiungerlo



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Fermare l'apertura di nuovi pozzi di petrolio: phase-out pozzi attualmente in produzione

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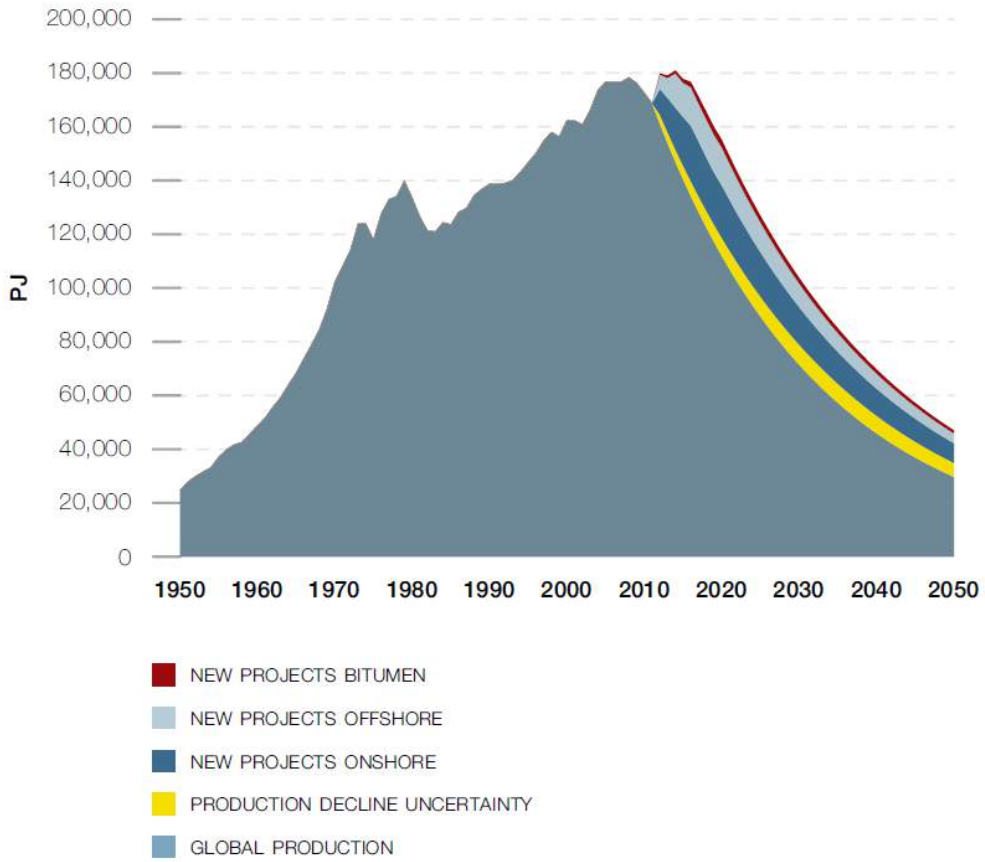
FIGURE 5.3 | GLOBAL OIL PRODUCTION 1950 – 2011 AND PROJECTIONS UNTIL 2050



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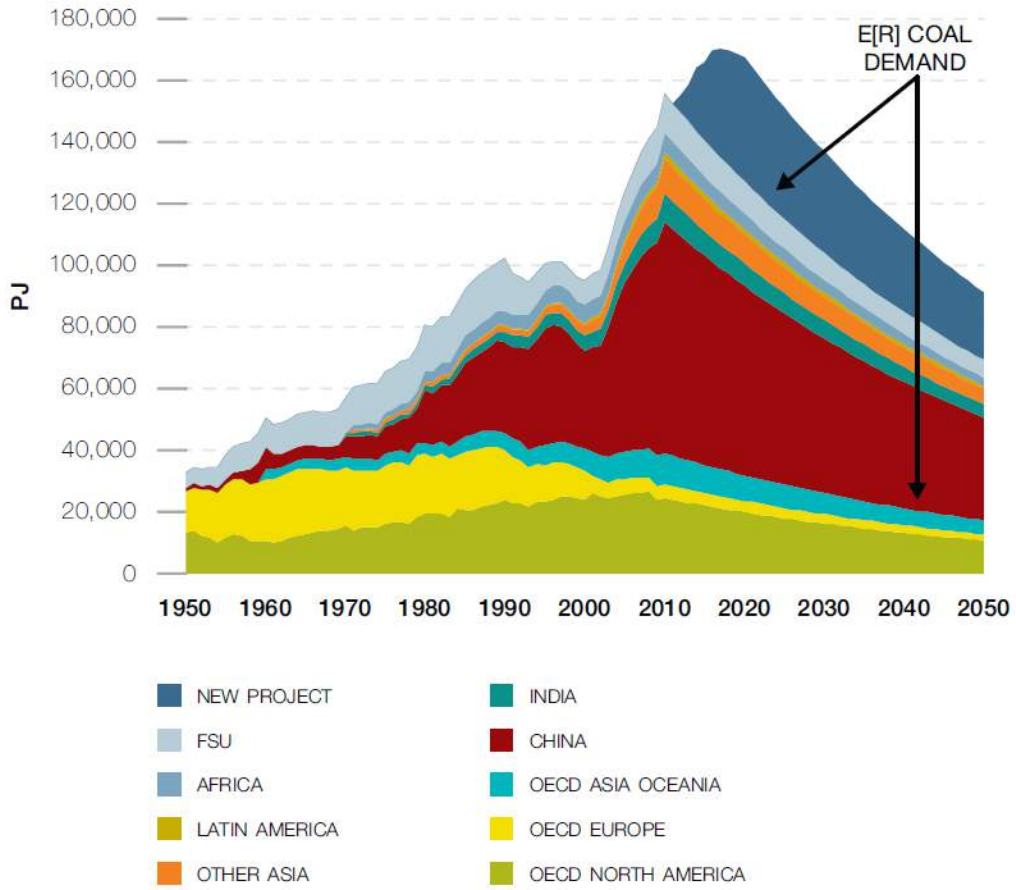
Chiudere le miniere di carbone: non possiamo bruciare il carbone delle miniere esistenti

FIGURE 5.4 | COAL SCENARIO: BASE DECLINE OF 2% PER YEAR AND NEW PROJECTS FSU: FORMER SOVIET UNION



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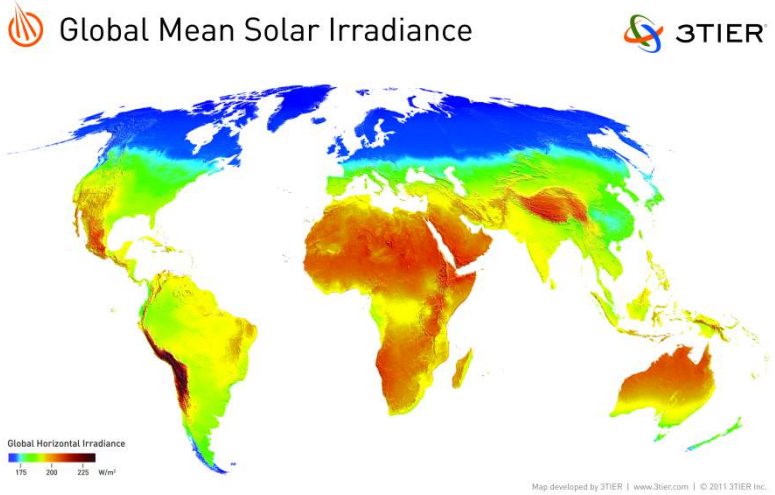
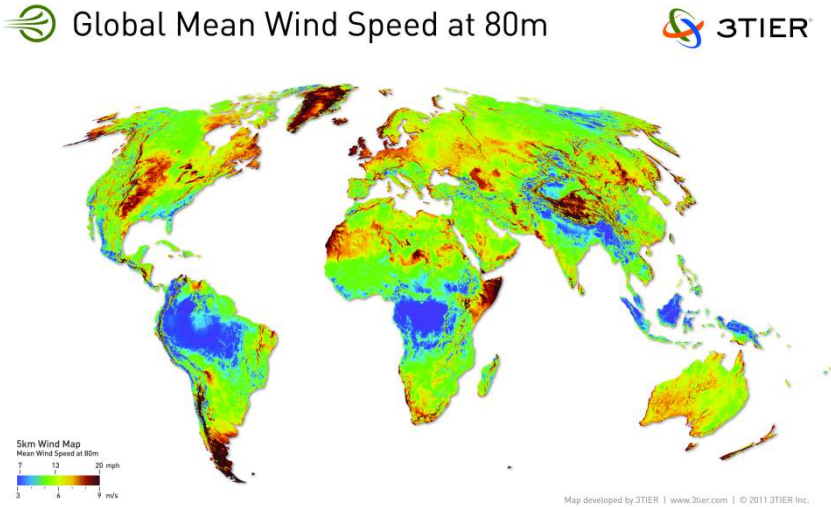
Analisi risorse rinnovabili: differenze regionali riportate negli scenari regionali

Limiti delle risorse naturali sostenibili:

a. Solare
b. Ecolico
c. Idro
d. Bioenergie
e. Geotermico
f. Energia dell'oceano

> Definire il mix regionale ottimale





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Determinanti della domanda di energia: crescita della popolazione

TABLE 5.2 | POPULATION DEVELOPMENT PROJECTIONS

MILLION PEOPLE

	2012	2020	2025	2030	2040	2050
WORLD	7,080	7,717	8,083	8,425	9,039	9,551
OECD EUROPE	564	580	588	594	602	604
OECD NORTH AMERICA	477	512	532	551	582	606
OECD ASIA OCEANIA	204	206	207	206	203	199
EASTERN EUROPE/EURASIA	341	341	339	335	326	316
INDIA	1,237	1,353	1,419	1,476	1,566	1,620
CHINA	1,384	1,440	1,457	1,461	1,444	1,393
OTHER ASIA	1,086	1,193	1,254	1,308	1,395	1,449
LATIN AMERICA	485	526	549	569	601	622
AFRICA	1,084	1,312	1,468	1,634	1,999	2,393
MIDDLE EAST	218	253	272	289	322	349

source UN World Population Prospects - 2012 Revision, medium variant.

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Determinanti per la domanda di energia: crescita economica

TABLE 5.3 | GDP DEVELOPMENT PROJECTIONS - AVERAGE ANNUAL GROWTH RATES

	2012-2025	2025-2040	2040-2050	2012-2050
WORLD	3.4%	3.4%	2.2%	3.1%
OECD EUROPE	1.9%	1.6%	1.0%	1.5%
OECD NORTH AMERICA	2.2%	2.3%	1.2%	2.0%
OECD ASIA OCEANIA	1.8%	1.5%	0.5%	1.3%
EASTERN EUROPE/EURASIA	3.5%	2.6%	1.9%	2.7%
INDIA	6.6%	5.5%	3.1%	5.2%
CHINA	5.3%	4.7%	2.7%	4.4%
OTHER ASIA	4.5%	4.5%	3.0%	4.0%
LATIN AMERICA	3.5%	3.0%	2.2%	2.9%
AFRICA	4.8%	4.7%	4.2%	4.6%
MIDDLE EAST	3.9%	3.4%	3.2%	3.5%

source GEA 2012-2040: IEA (2011a) and 2040-2050: DLR, own calculation (2015).

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Decisioni „turning point“ per uno scenario:

- **Elettricità:** Centralizzata, decentralizzata o un mix?
- **Calore:** Teleriscaldamento/raffreddamento o tecnologie elettriche?
- **Trasporti:** Cambio di modalità, cambio combustibili o mobilità elettrica?

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Sviluppo dell'efficienza

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Sviluppo efficienza

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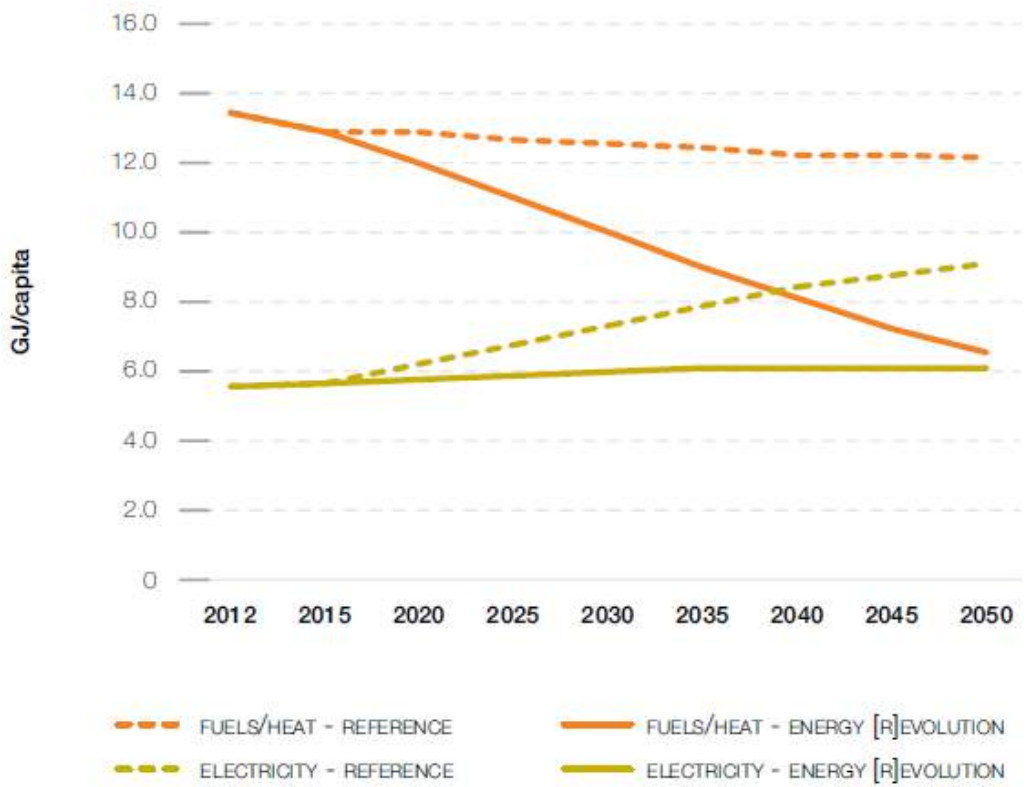
Sviluppo delle intensità energetiche: settore residenziale e edifici (“Altri settori”)

FIGURE 11.22 | AVERAGE GLOBAL ENERGY INTENSITIES IN OTHER SECTORS – ELECTRICITY AND FUELS/HEAT DEMAND PER CAPITA IN THE ENERGY [R]EVOLUTION AND THE REFERENCE SCENARIO



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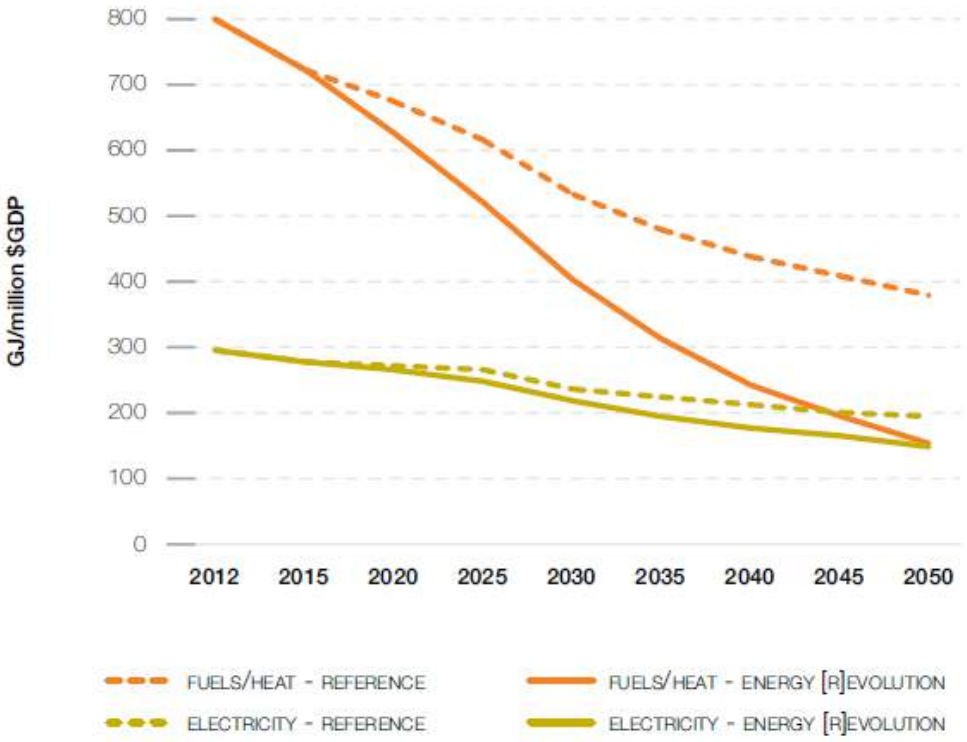
Sviluppo intensità energetiche: industria

FIGURE 11.21 | AVERAGE GLOBAL ENERGY INTENSITIES IN INDUSTRY – ELECTRICITY AND FUELS/HEAT DEMAND PER $ GDP IN THE ENERGY [R]EVOLUTION AND THE REFERENCE SCENARIO



source IEA WEO 2014 / DLR calculations for Reference and E[R] case (2015).

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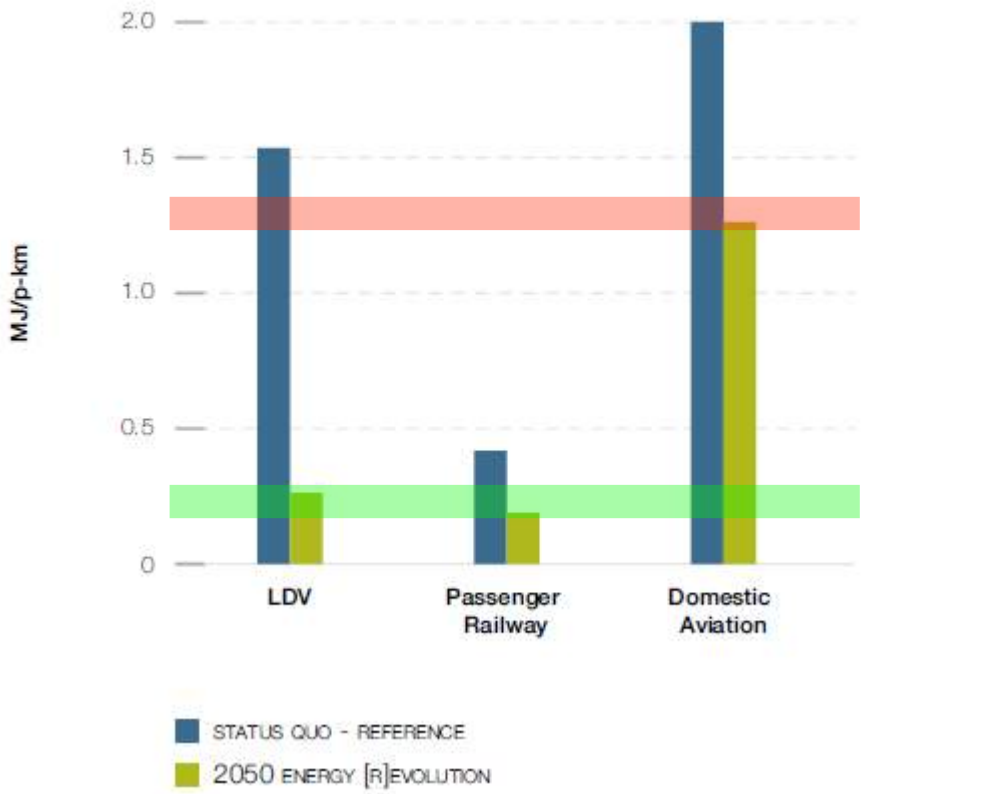
Sviluppo intensità energetiche: trasporto passeggeri

FIGURE 12.5 | WORLD AVERAGE (STOCK-WEIGHTED) PASSENGER TRANSPORT ENERGY INTENSITIES FOR TODAY AND 2050[18]



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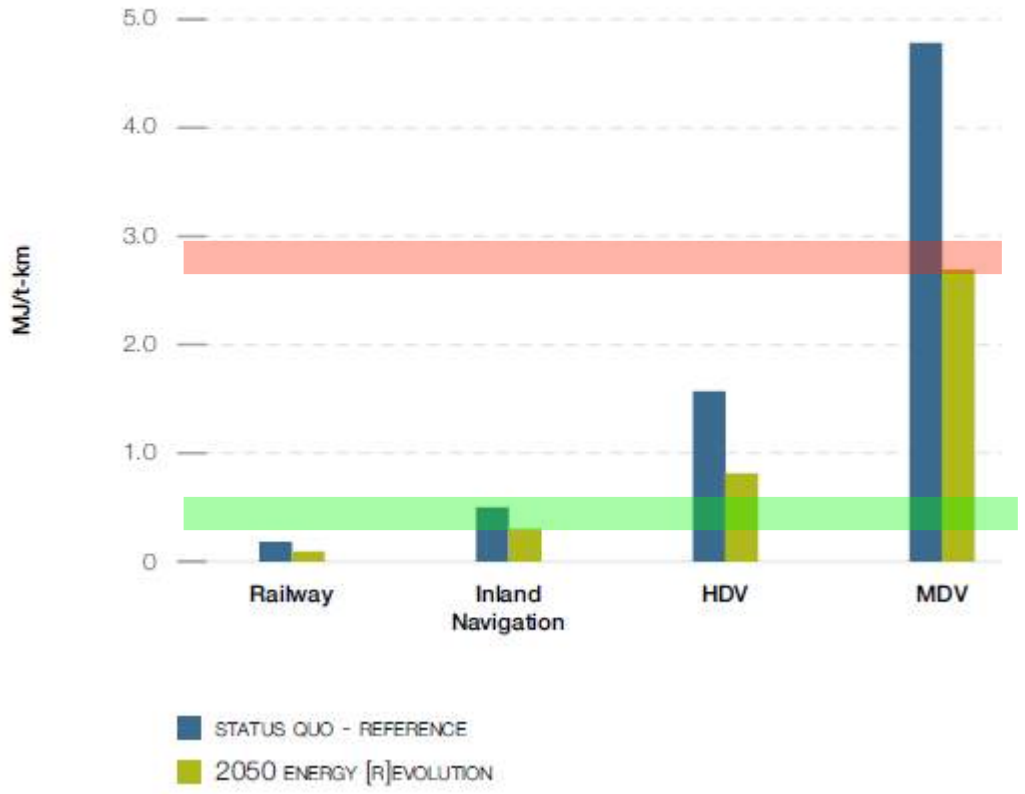
Sviluppo intensità energetiche: trasporto merci

FIGURE 12.6 | WORLD AVERAGE (STOCK-WEIGHTED) FREIGHT TRANSPORT ENERGY INTENSITIES FOR TODAY AND 2050[17]



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Sviluppo potenziale tecnico di efficienza per il trasporto passeggeri e merci

TABLE 12.5 | TECHNICAL EFFICIENCY POTENTIAL FOR WORLD PASSENGER TRANSPORT[17]

MJ/P-KM	STATUS QUO	E[R] 2050
LDV	1.5	0.3
AIR (DOMESTIC)	2.5	1.2
BUSES	0.5	0.3
MINI-BUSES	0.5	0.3
TWO WHEELS	0.5	0.3
THREE WHEELS	0.7	0.5
PASSENGER RAIL	0.4	0.2

TABLE 12.6 | TECHNICAL EFFICIENCY POTENTIAL FOR WORLD FREIGHT TRANSPORT[17]

MJ/T-KM	STATUS QUO	E[R] 2050
MDV	4.8	2.7
HDV	1.6	0.8
FREIGHT RAIL	0.2	0.1
INLAND NAVIGATION	0.5	0.3

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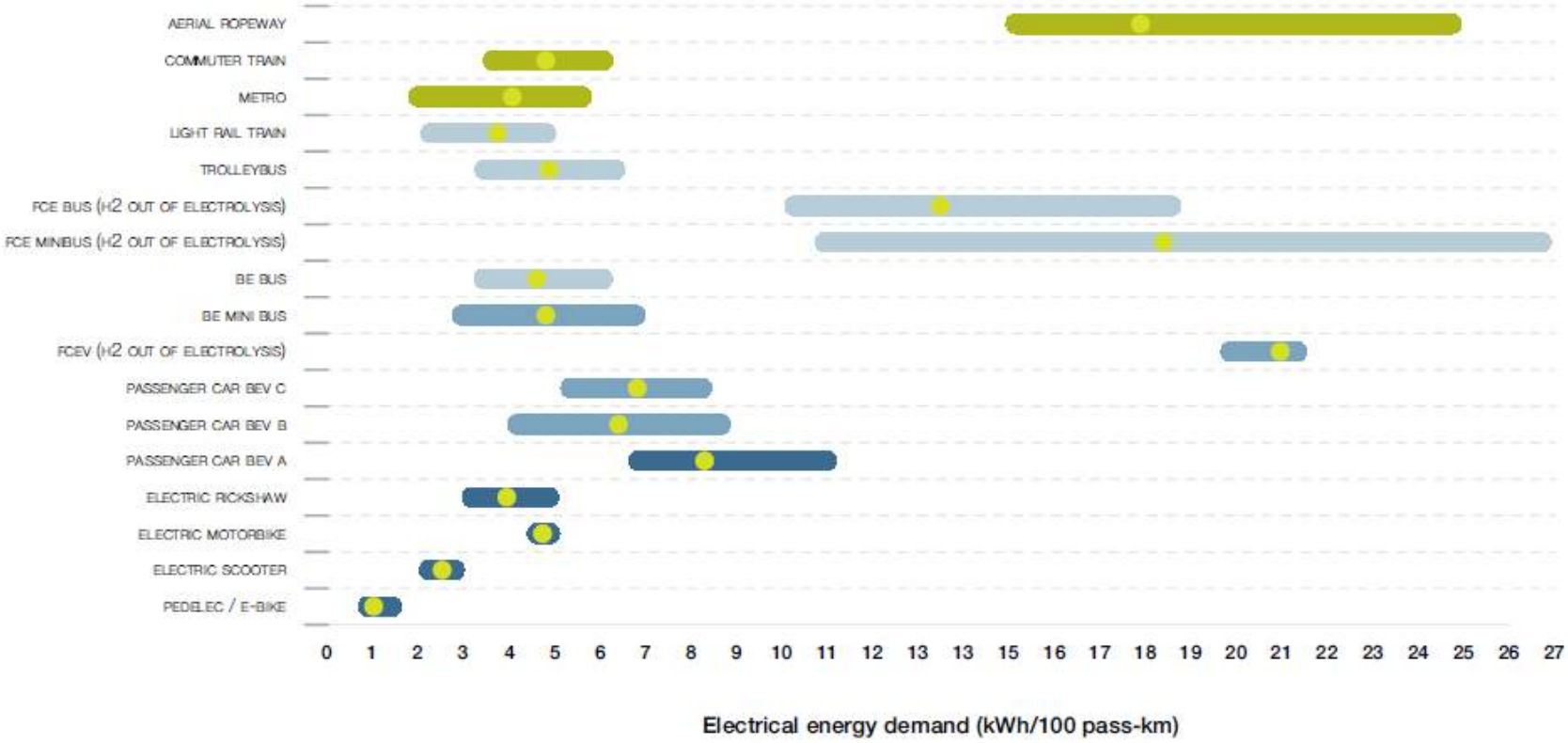
Panoramica: tecnologie per il trasporto passeggeri nelle grandi aree urbane (megacities)

FIGURE 12.14 | OVERVIEW ELECTRICITY DEMAND OF TRANSPORT TECHNOLOGIES PER 100 PASSENGER KILOMETERS



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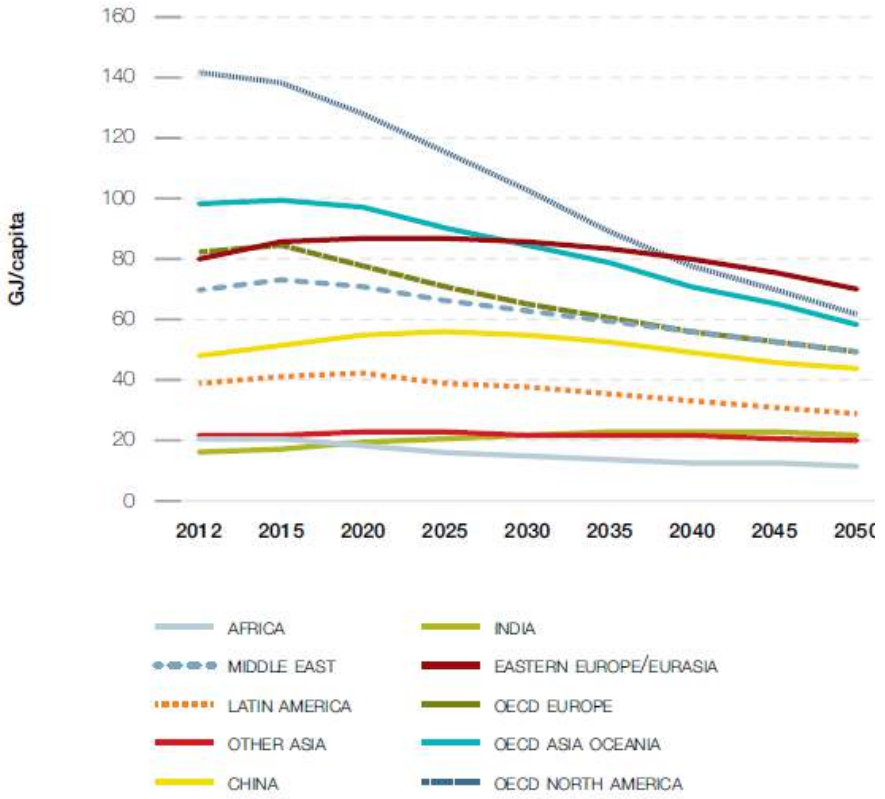
Sviluppo intensità energetiche: consumi finali 2012-2050 – su tutti i settori per Regione

FIGURE 11.23 | AVERAGE GLOBAL ENERGY INTENSITIES PER WORLD REGION – FINAL ENERGY PER CAPITA IN THE ENERGY [R]EVOLUTION SCENARIO



source IEA WEO 2014 / DLR calculations for Reference and E[R] case (2015).

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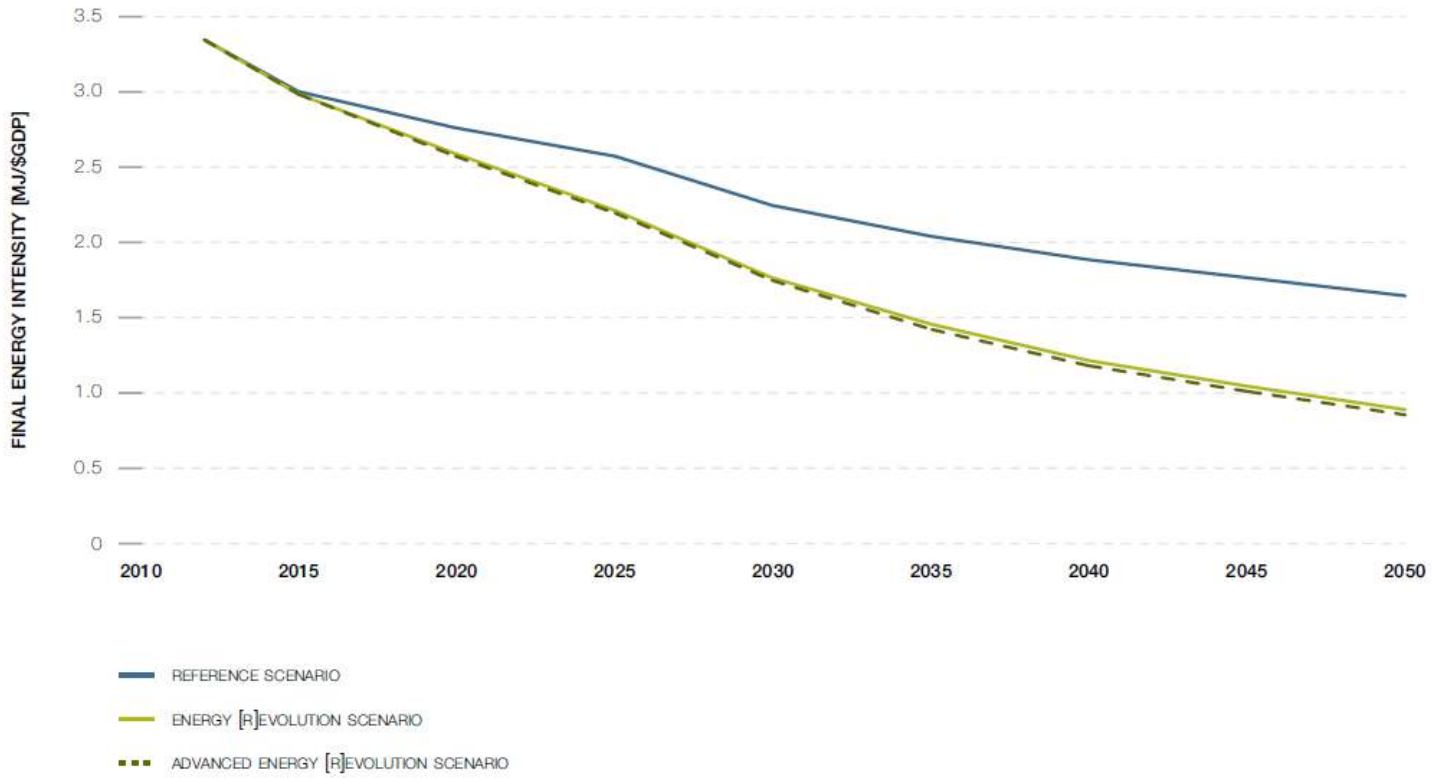
Sviluppo intensità energetiche: consumi finali di energia 2012-2050

FIGURE 6.1.1 | GLOBAL: FINAL ENERGY INTENSITY UNDER THE REFERENCE AND BOTH ENERGY [R]EVOLUTION SCENARIOS



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Analisi del mercato globale impianti produzione elettrica

-

FER: proiezione sviluppo costi

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La logica E[R] per il settore elettrico

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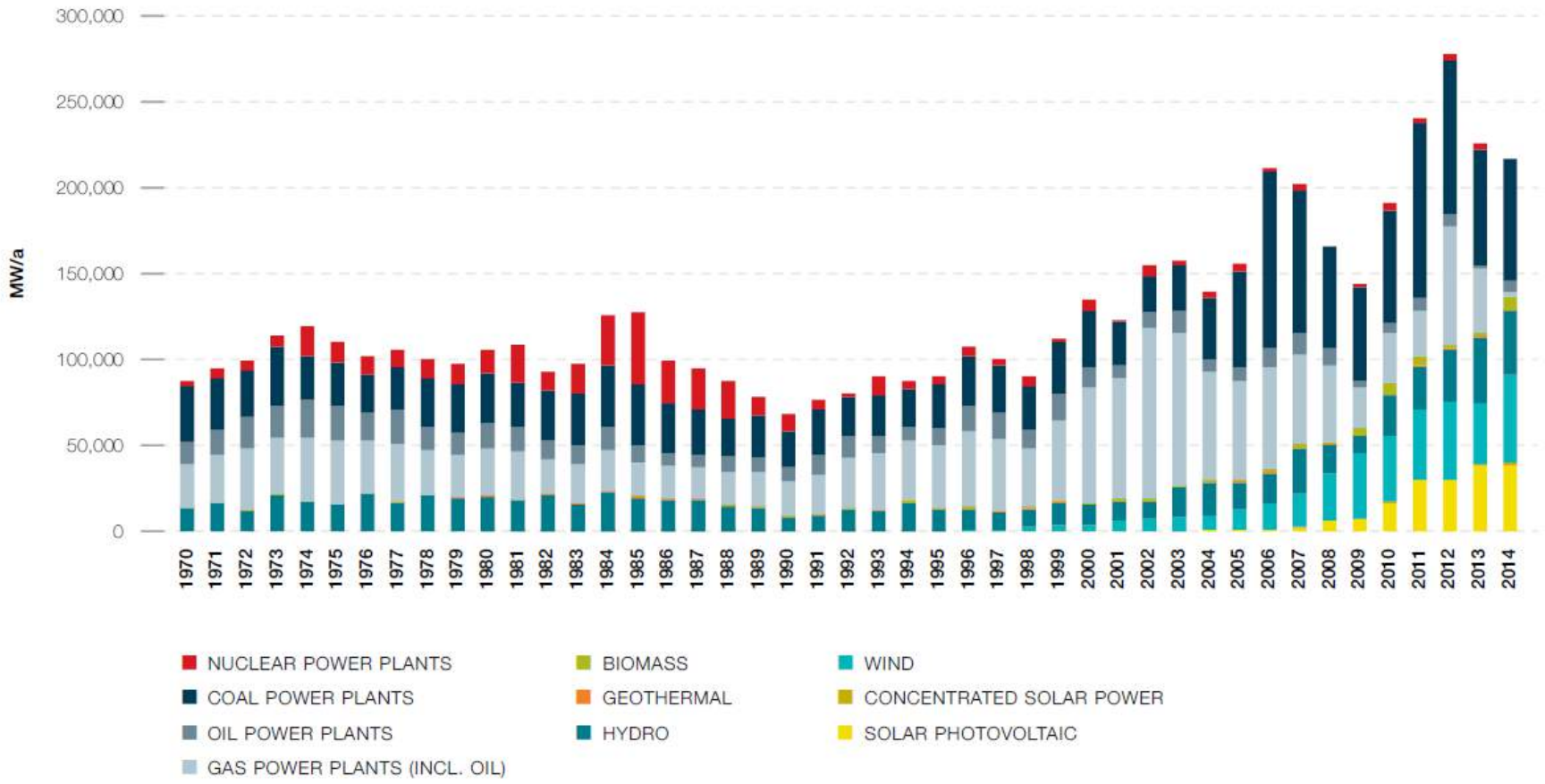
FIGURE 8.1 | GLOBAL ANNUAL POWER PLANT MARKET 1970 - 2014



source Platts, REN21, EWEA, GWEC, EPIA, National Statistics, IEA, Breyer.
data compilation Dr. Sven Teske/Greenpeace.

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La logica E[R] per il settore elettrico

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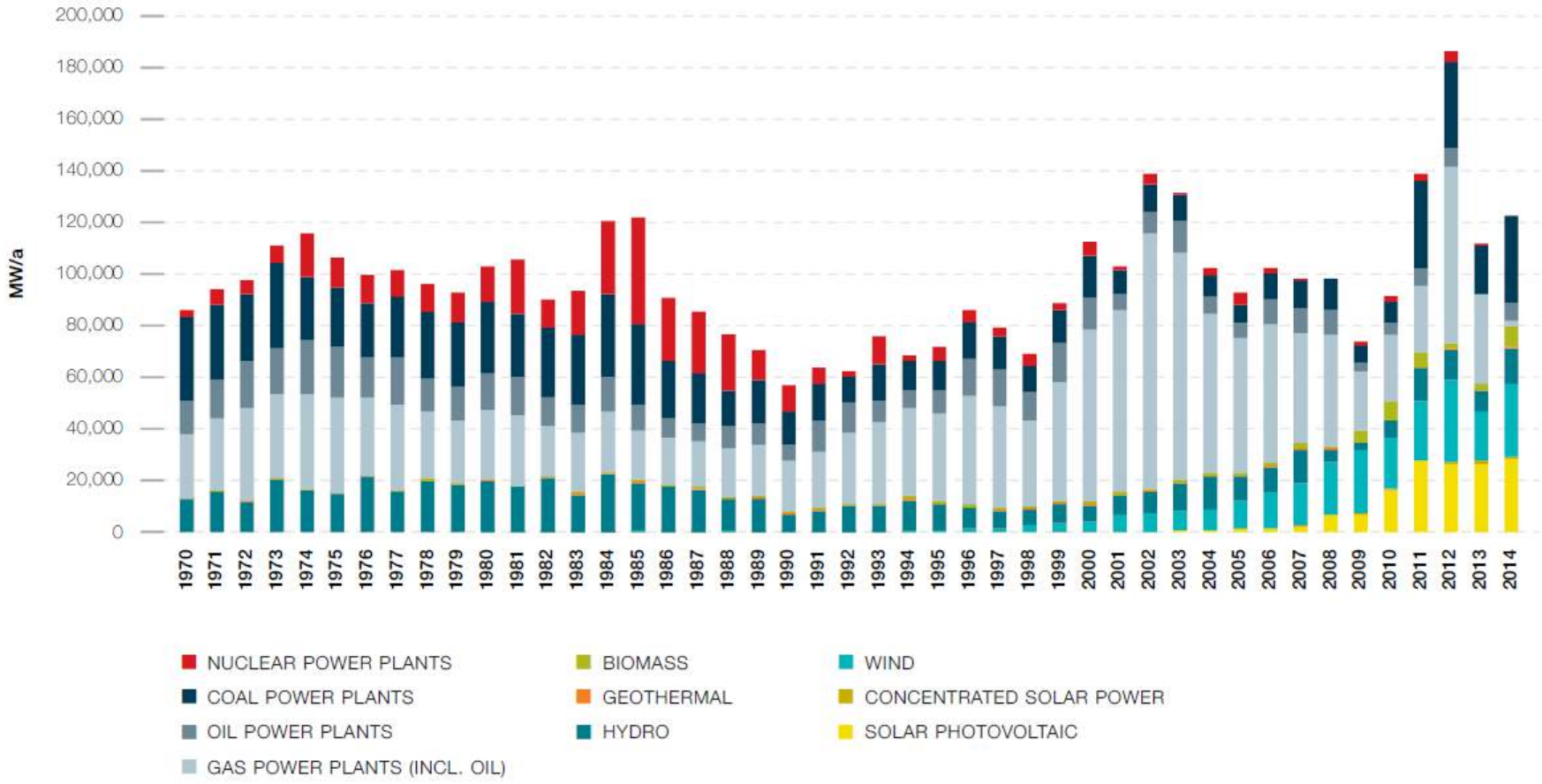
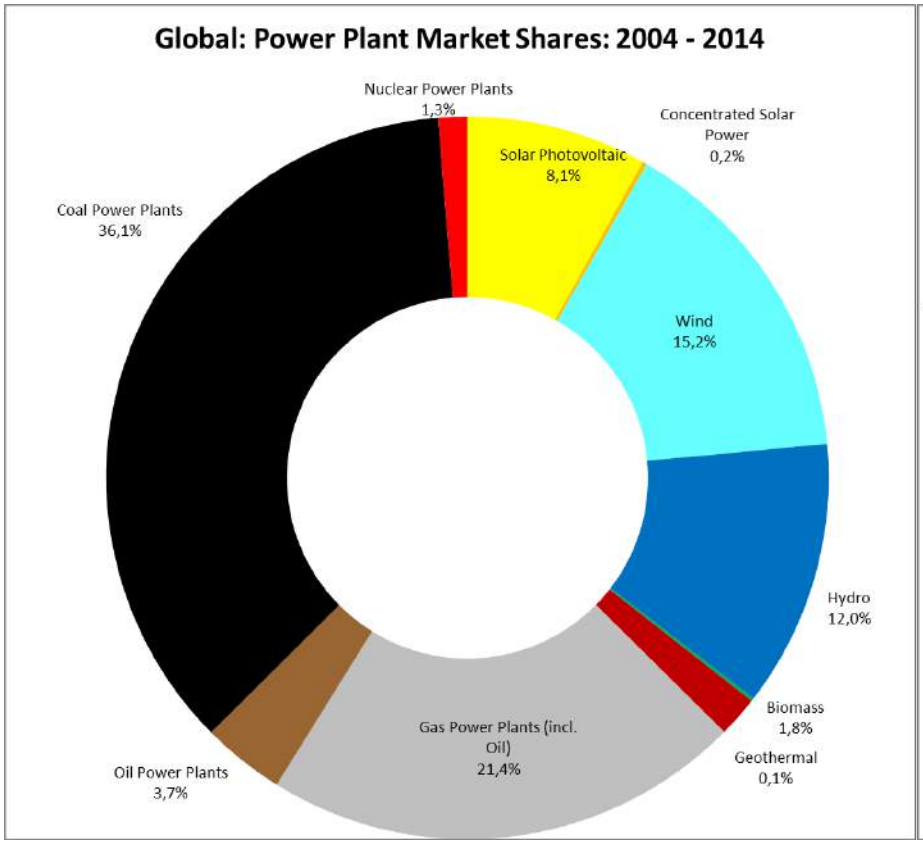
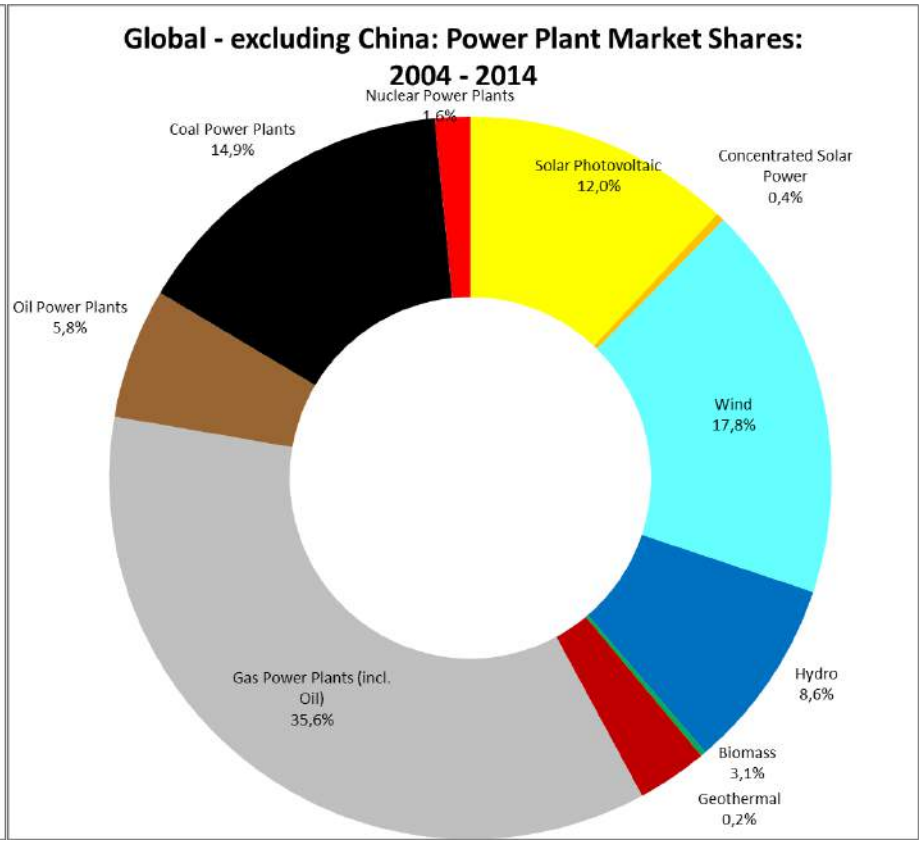
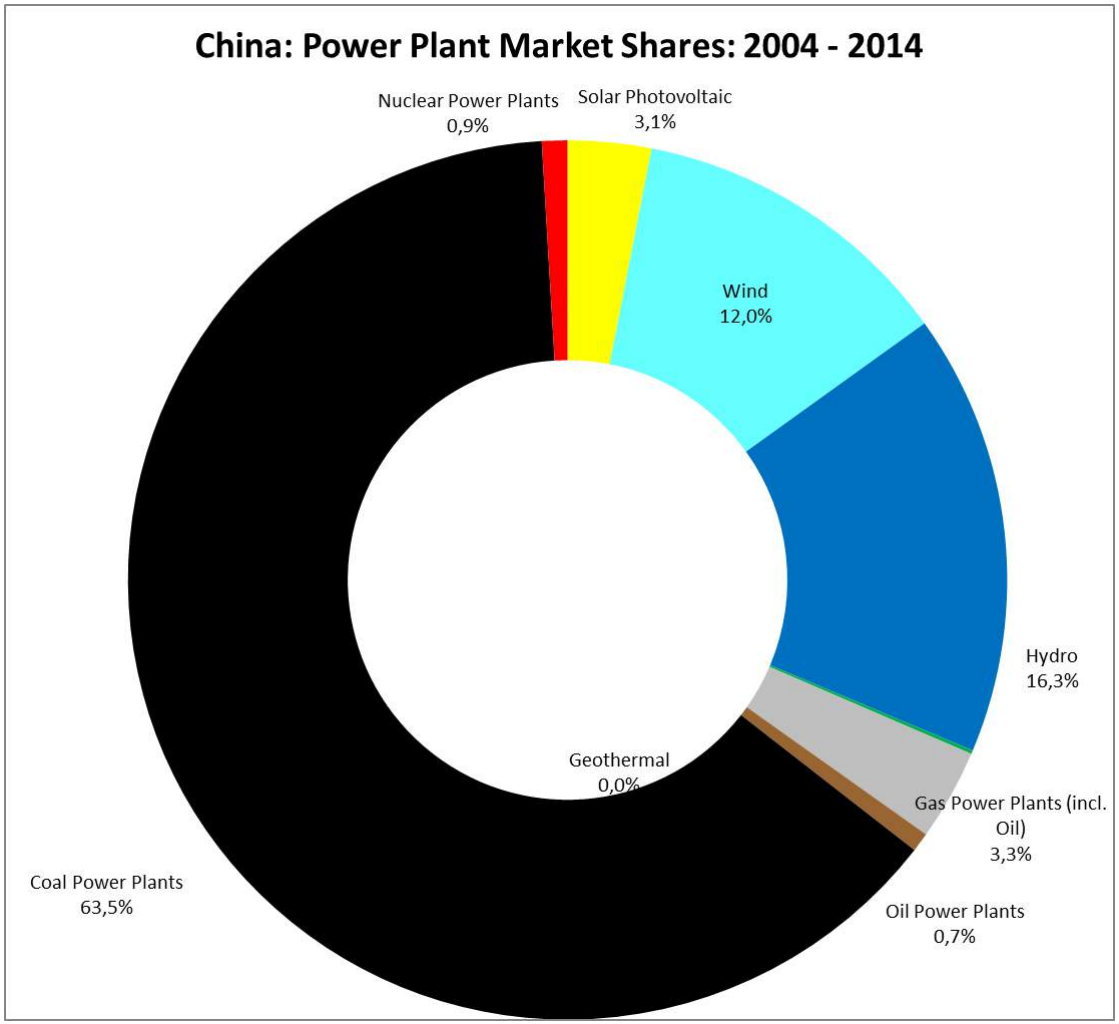
FIGURE 8.2 | GLOBAL ANNUAL POWER PLANT MARKET – EXCLUDING CHINA: 1970 - 2014



source Platts, REN21, EWEA, GWEC, EPIA, National Statistics, IEA, Breyer.
data compilation Dr. Sven Teske/Greenpeace.


Global: Power Plant Market Shares: 2004 - 2014
Nuclear Power Plants 1,3%
Concentrated Solar Power 0,2%
Solar Photovoltaic 8,1%
Coal Power Plants 36,1%
Wind 15,2%
Hydro 12,0%
Biomass 1,8%
Geothermal 0,1%
Gas Power Plants (incl. Oil) 21,4%
Oil Power Plants 3,7%


Global - excluding China: Power Plant Market Shares: 2004 - 2014
Nuclear Power Plants 1,6%
Coal Power Plants 14,9%
Solar Photovoltaic 12,0%
Concentrated Solar Power 0,4%
Oil Power Plants 5,8%
Wind 17,8%
Hydro 8,6%
Gas Power Plants (incl. Oil) 35,6%
Biomass 3,1%
Geothermal 0,2%


China: Power Plant Market Shares: 2004 - 2014
Nuclear Power Plants
0,9%
Solar Photovoltaic
3,1%
Wind
12,0%
Hydro
16,3%
Geothermal
0,0%
Gas Power Plants (incl.
Oil)
3,3%
Oil Power Plants
0,7%
Coal Power Plants
63,5%

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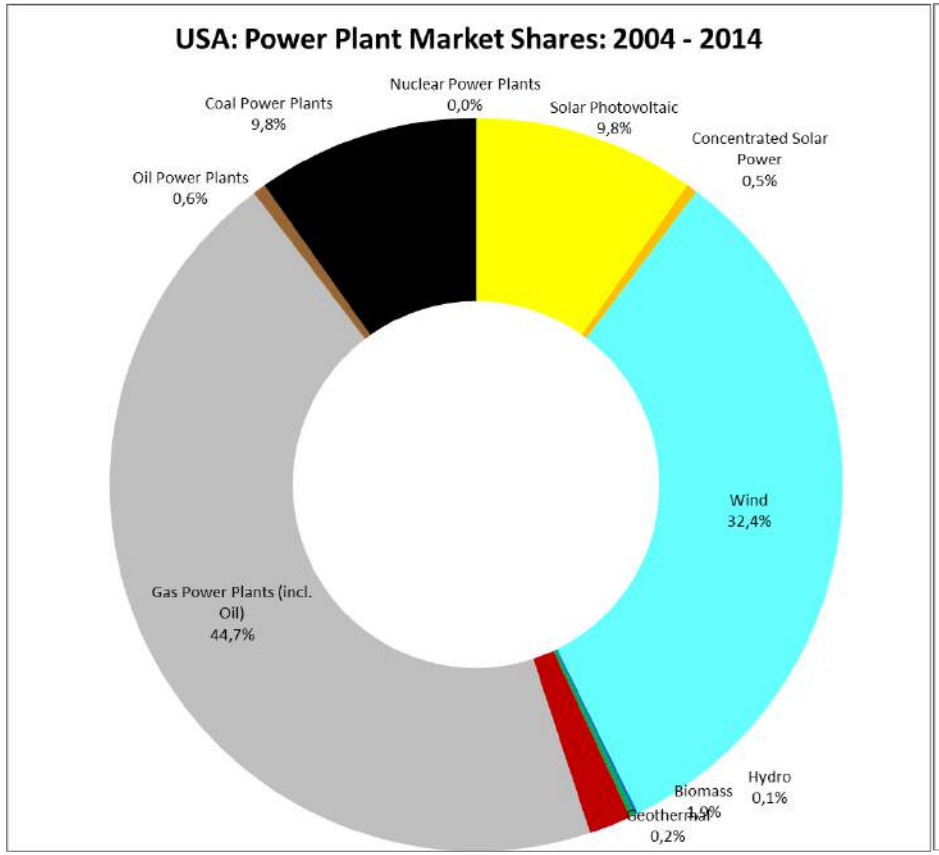

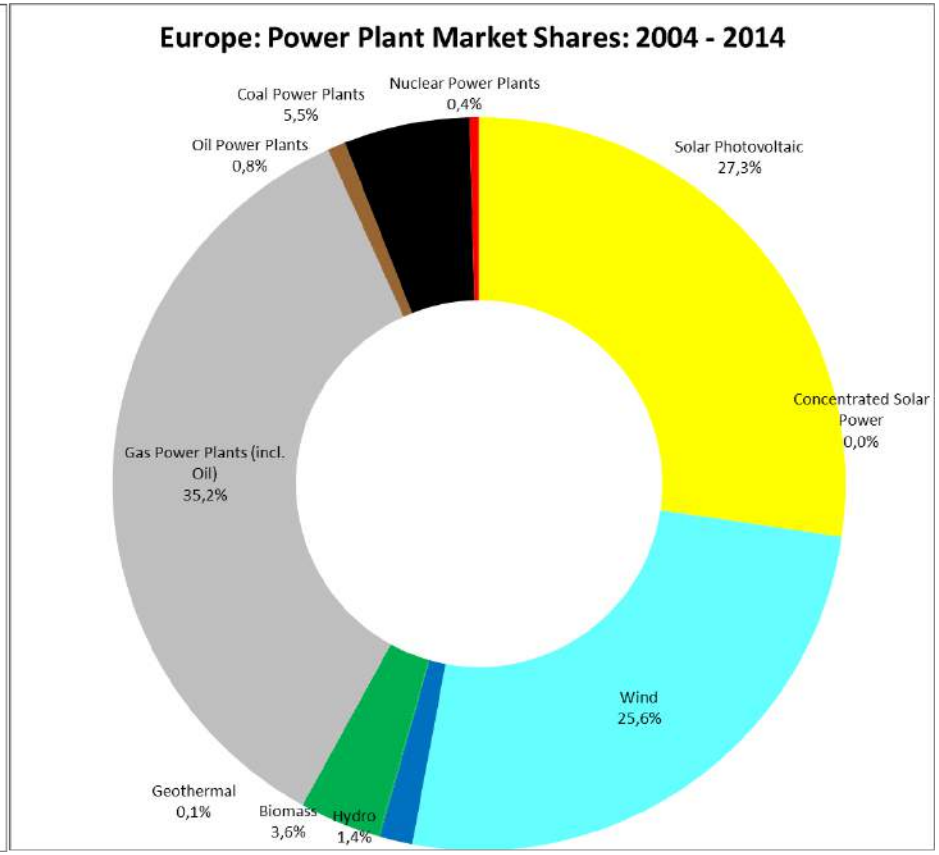

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TABLE 5.15 | ASSUMED AVERAGE GROWTH RATES AND ANNUAL MARKET VOLUMES BY RENEWABLE TECHNOLOGY

	GENERATION [TWh/a]			INSTALLED CAPACITY [GW]			ANNUAL MARKET VOLUME [GW/a]			ANNUAL GROWTH RATE BASED ON GENERATION [%/a]			ELECTRICITY SHARE		
	REF	E[R]	ADV E[R]	REF	E[R]	ADV E[R]	REF	E[R]	ADV E[R]	REF	E[R]	ADV E[R]	REF	E[R]	ADV E[R]
2012	22,604	22,604	22,604	5,680	5,680	5,680									
2020	28,492	27,292	27,586	7,343	7,492	7,645									
2030	36,256	33,631	36,867	9,130	11,521	13,146									
2050	50,110	49,852	67,535	12,033	19,469	25,835									
PV															
2012	97	97	97	97	97	97	39	39	39						
2020	408	942	1,090	332	732	844	29	79	93	23%	38%	41%	1.4%	3.5%	4.0%
2030	630	3,844	5,067	494	2,839	3,725	16	211	288	5%	17%	19%	1.7%	11.4%	13.7%
2050	1,096	9,914	13,613	803	6,745	9,295	15	195	279	3%	5%	5%	2.2%	19.9%	20.2%
CSP															
2012	5	5	5	3	3	3	1	1	1						
2020	34	97	131	11	31	42	1	4	5	33%	54%	61%	0.1%	0.4%	0.5%
2030	85	1,601	2,552	26	405	635	1	37	59	11%	37%	39%	0.2%	4.8%	6.9%
2050	303	8,138	14,035	74	1,473	2,555	2	53	96	7%	9%	9%	0.6%	16.3%	20.8%
WIND ON+OFFSHORE															
2012	521	521	521	277	277	277	52	52	52						
2020	1,254	1,932	2,158	554	820	904	35	68	78	13%	21%	23%	4.4%	7.1%	7.8%
2030	1,962	6,278	7,737	807	2,510	3,064	25	169	216	5%	14%	15%	5.4%	18.7%	21.0%
2050	3,202	14,938	21,673	1,217	5,575	8,040	21	153	249	3%	5%	6%	6.4%	30.0%	32.1%
GEOTHERMAL FOR POWER GENERATION															
2012	70	70	70	11	11	11	1	1	1						
2020	113	190	210	17	28	31	1	2	3	7%	15%	17%	0.4%	0.7%	0.8%
2030	188	916	1,149	28	137	171	1	11	14	6%	19%	21%	0.5%	2.7%	3.1%
2050	425	3,286	4,547	62	485	708	2	17	27	4%	7%	8%	0.8%	6.6%	6.7%
BIOENERGY FOR POWER GENERATION															
2012	379	379	379	87	87	87	8	8	8						
2020	740	937	979	150	194	200	8	13	14	10%	14%	15%	2.6%	3.4%	3.5%
2030	1,039	1,915	1,993	199	392	405	5	20	21	4%	8%	8%	2.9%	5.7%	5.4%
2050	1,577	3,039	3,193	293	746	742	5	18	17	2%	2%	3%	3.1%	6.1%	4.7%
OCEAN															
2012	1	1	1	0	0	0	0	0	0						
2020	3	31	32	1	11	11	0	1	1	29%	80%	81%	0.0%	0.1%	0.1%
2030	13	251	363	4	95	131	0	8	12	15%	26%	31%	0.0%	0.7%	1.0%
2050	76	1,482	2,010	28	552	738	1	23	30	11%	10%	9%	0.2%	3.0%	3.0%
HYDRO															
2012	3,672	3,672	3,672	1,099	1,099	1,099	37	37	37						
2020	4,458	4,349	4,349	1,331	1,316	1,316	29	27	27	3%	2%	2%	15.6%	15.9%	15.8%
2030	5,207	4,613	4,621	1,544	1,397	1,402	21	8	9	2%	1%	1%	14.4%	13.7%	12.5%
2050	6,431	4,937	4,966	1,878	1,503	1,536	17	5	7	1%	0%	0%	12.8%	9.9%	7.4%

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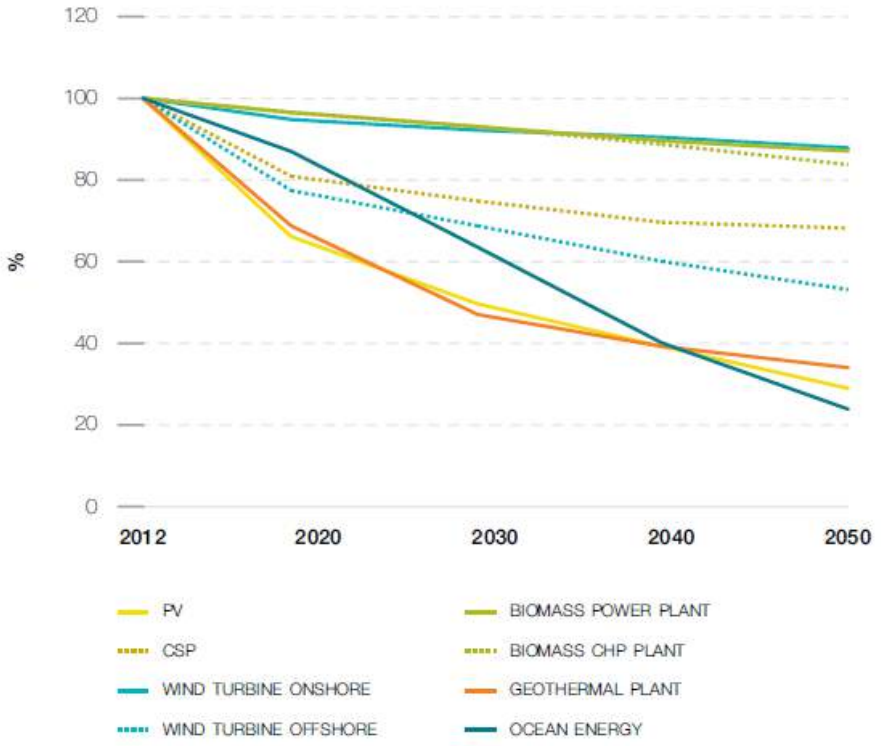
FIGURE 5.1 | FUTURE DEVELOPMENT OF INVESTMENT COSTS FOR RENEWABLE ENERGY TECHNOLOGIES

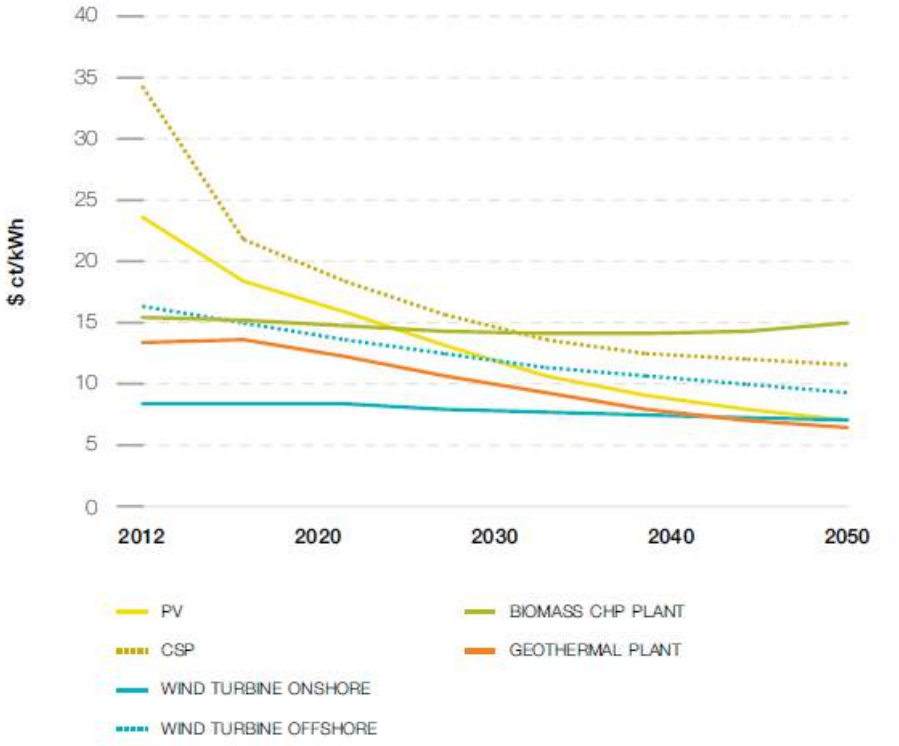
NORMALIZED TO 2012 COST LEVELS



note $ ct/kWh, converted using an exchange rate €2012 to $2012 of 1,236; biomass CHP costs without heat credits.

FIGURE 5.2 | EXPECTED DEVELOPMENT OF ELECTRICITY GENERATION COSTS FROM RENEWABLE POWER GENERATION IN THE ENERGY [R]EVOLUTION SCENARIOS

DEPENDING ON THE ASSUMED DEVELOPMENT OF FULL LOAD HOURS PER YEAR, EXAMPLE FOR OECD EUROPE



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A sustainable World Energy Outlook 2015 – 100% Renewable Energy For All

Risultati principali

DLR / Greenpeace International

Settembre 2015

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Globale : settore elettrico

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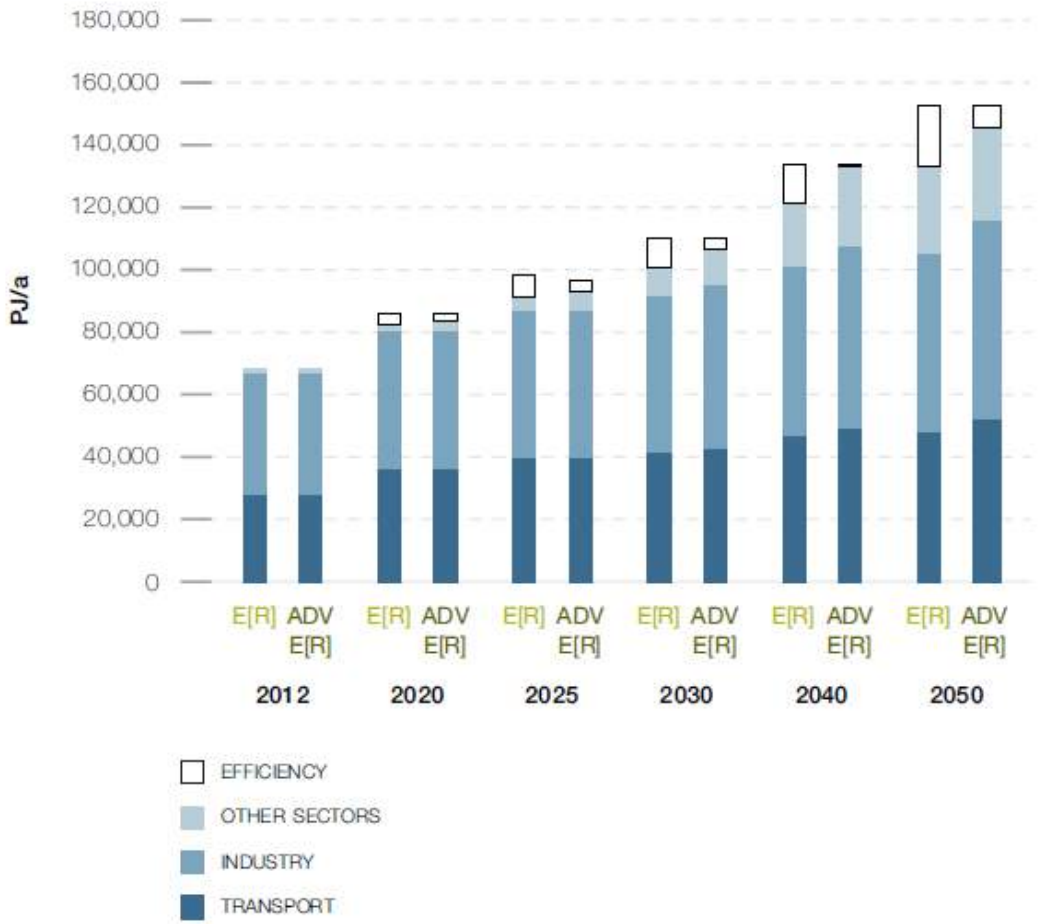
FIGURE 6.1.3 | GLOBAL: DEVELOPMENT OF ELECTRICITY DEMAND BY SECTOR IN THE ENERGY [R]EVOLUTION SCENARIOS



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Globale : settore elettrico

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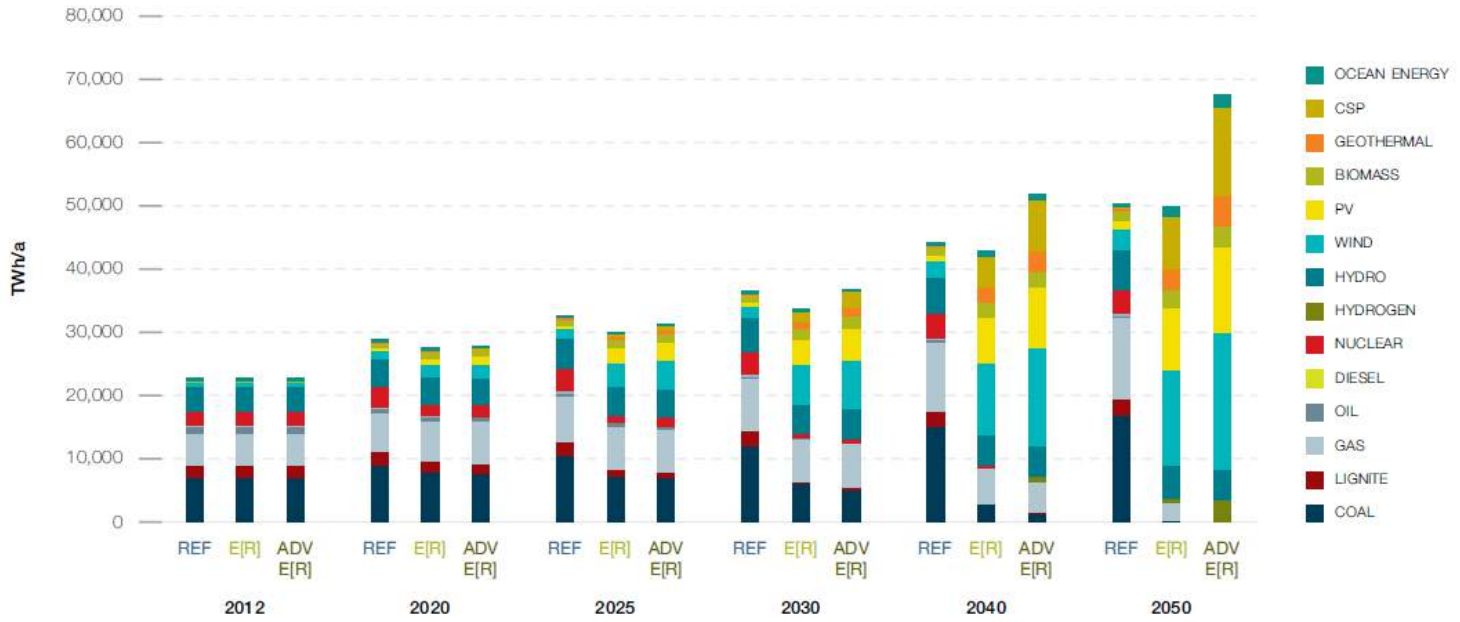
Quota FER elettricità: 2012: 21% // 2020: 32% // 2030: 64% // 2050: 100%

FIGURE 6.1.6 | GLOBAL: DEVELOPMENT OF ELECTRICITY GENERATION STRUCTURE – REFERENCE, ENERGY [R]EVOLUTION, ADVANCED ENERGY [R]EVOLUTION SCENARIOS



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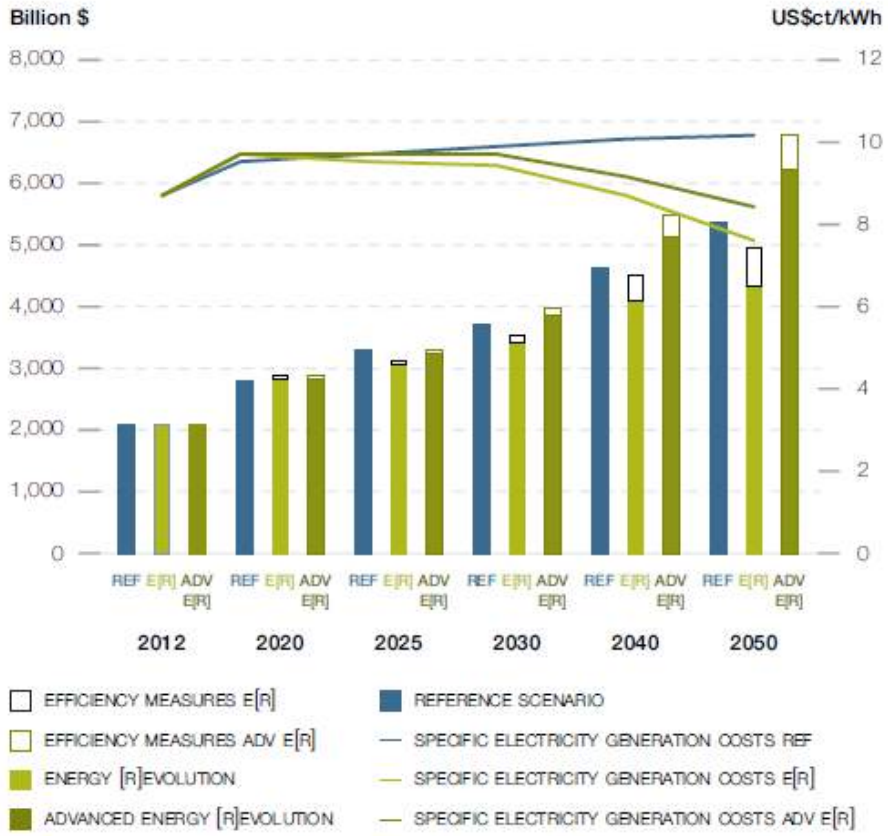
Costi produzione elettrica: nella media sin dall'inizio

FIGURE 6.1.7 | GLOBAL: DEVELOPMENT OF TOTAL ELECTRICITY SUPPLY COSTS & OF SPECIFIC ELECTRICITY GENERATION COSTS IN THE SCENARIOS



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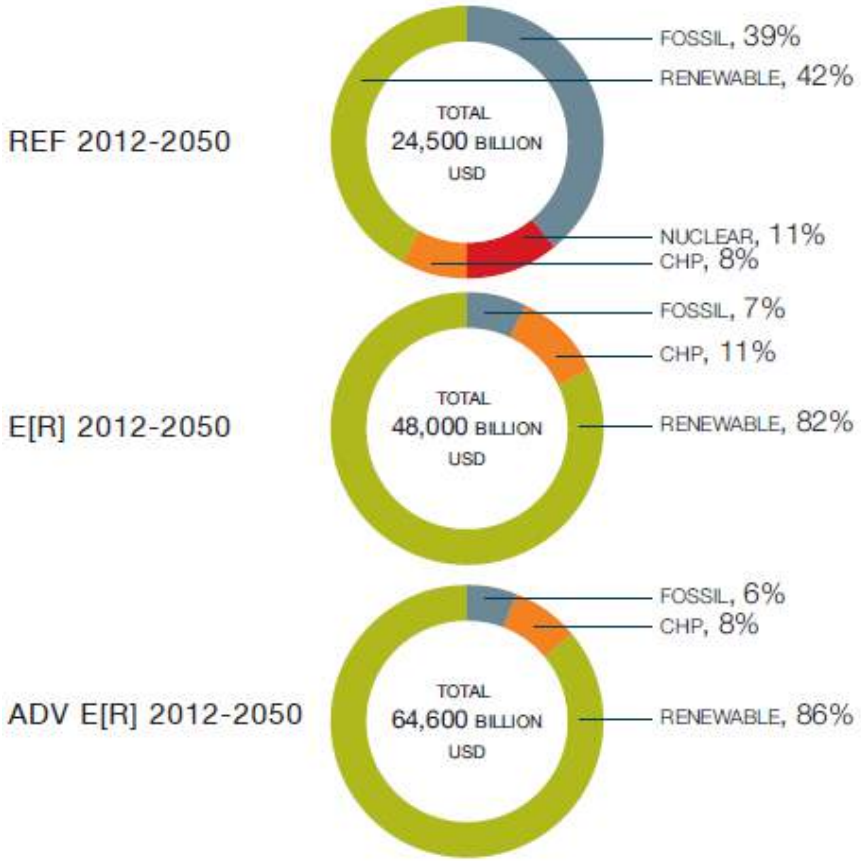
Volume mercato FER nello scenario E[R] “advanced” al 2050: 55.000 mld $

FIGURE 6.1.8 | GLOBAL: INVESTMENT SHARES - REFERENCE VERSUS ENERGY [R]EVOLUTION SCENARIOS



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Global : Power Sector

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Costi investimenti aggiuntivi – totalmente rifinanziati dai risparmi di combustibile

TABLE 6.1.8 | GLOBAL: 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 $	987.3	2,448.9	2,441.1	2,528.7	8,406.0	215.5
RENEWABLES (INCL. CHP)	BILLION $	-2,014.1	-11,835.8	-16,264.6	-18,555.9	-48,670.4	-1,248.0
TOTAL	BILLION $	-1,026.9	-9,386.9	-13,823.5	-16,027.1	-40,264.5	-1,032.4
ACCUMULATED FUEL COST SAVINGS SAVINGS CUMULATIVE ADVANCED E[R] VERSUS REF							
FUEL OIL	BILLION $	51.5	483.3	769.7	633.4	1,937.9	49.7
GAS	BILLION $	-113.0	1,502.4	6,057.6	12,315.0	19,761.9	506.7
HARD COAL	BILLION $	232.0	2,449.7	5,960.2	8,299.8	16,941.7	434.4
LIGNITE	BILLION $	32.5	253.7	442.3	562.2	1,290.8	33.1
NUCLEAR ENERGY	BILLION $	63.4	384.2	698.5	945.4	2,091.4	53.6
TOTAL	BILLION $	266.4	5,073.2	13,928.3	22,755.8	42,023.8	1,077.5

TABLE 6.1.9 | GLOBAL: 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 $	458.8	2,570.7	4,929.7	4,631.6	12,590.9	322.8

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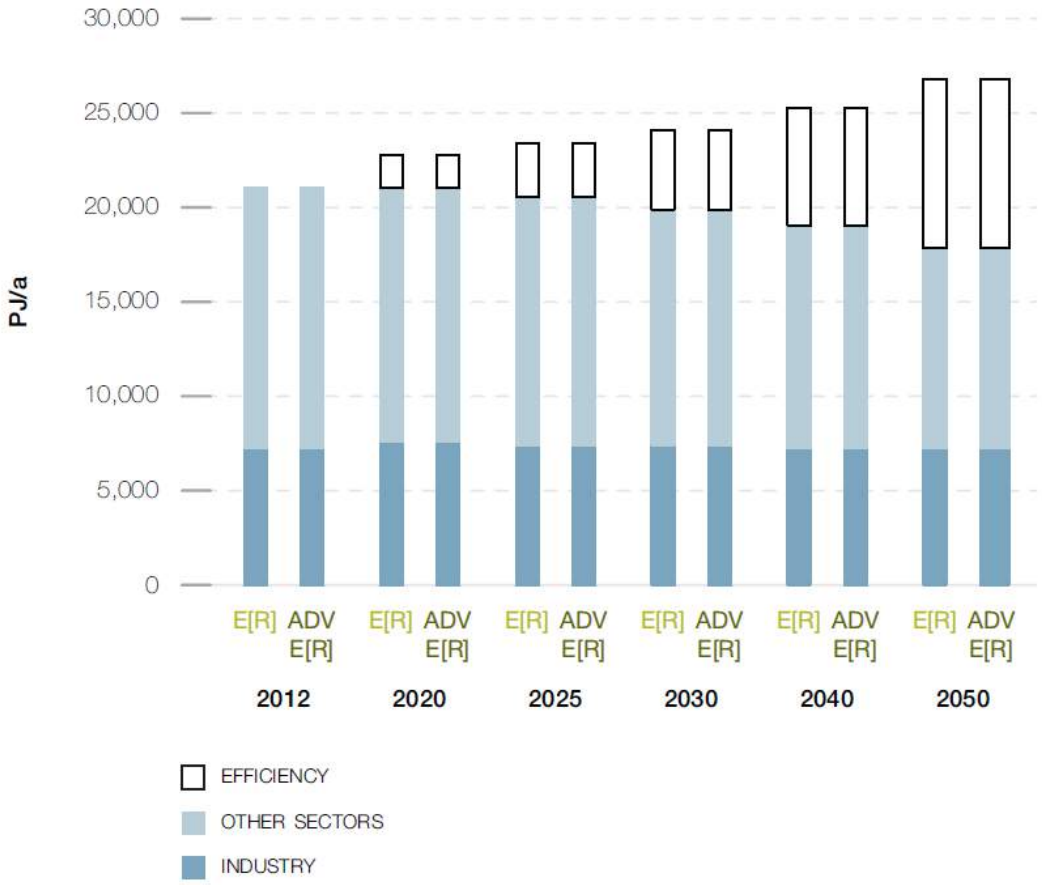
FIGURE 6.1.5 | GLOBAL: DEVELOPMENT OF FINAL ENERGY DEMAND FOR HEAT BY SECTOR IN THE ENERGY [R]EVOLUTION SCENARIOS



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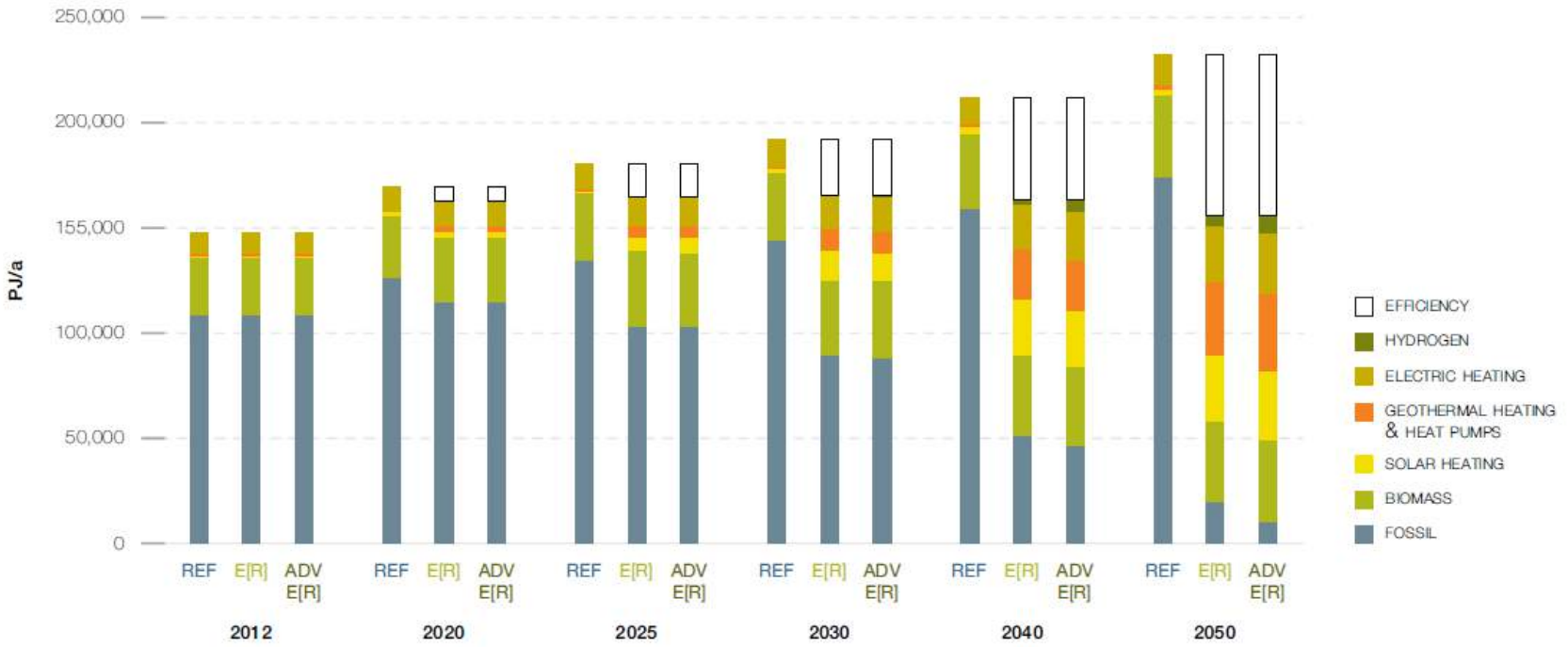
Globale: settore usi termici GREENPEACE

Quota FER termiche: 2012: 21% // 2020: 25% // 2030: 43% // 2050: 94%

FIGURE 6.1.9 | GLOBAL: PROJECTION OF HEAT SUPPLY BY ENERGY CARRIER – REFERENCE, ENERGY [R]EVOLUTION, ADVANCED ENERGY [R]EVOLUTION SCENARIOS



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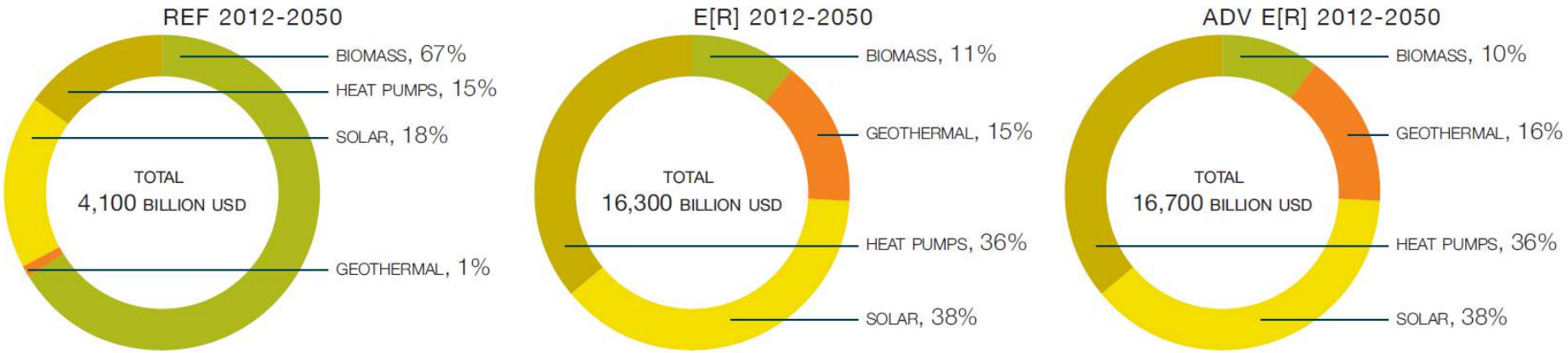
Volume mercato FER termiche nello scenario E[R] avanzato al 2050: 16.700 mld$

FIGURE 6.1.10 | GLOBAL: DEVELOPMENT OF INVESTMENTS FOR RENEWABLE HEAT GENERATION TECHNOLOGIES – REFERENCE, ENERGY [R]EVOLUTION, ADVANCED ENERGY [R]EVOLUTION SCENARIOS



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Globale: settore trasporti

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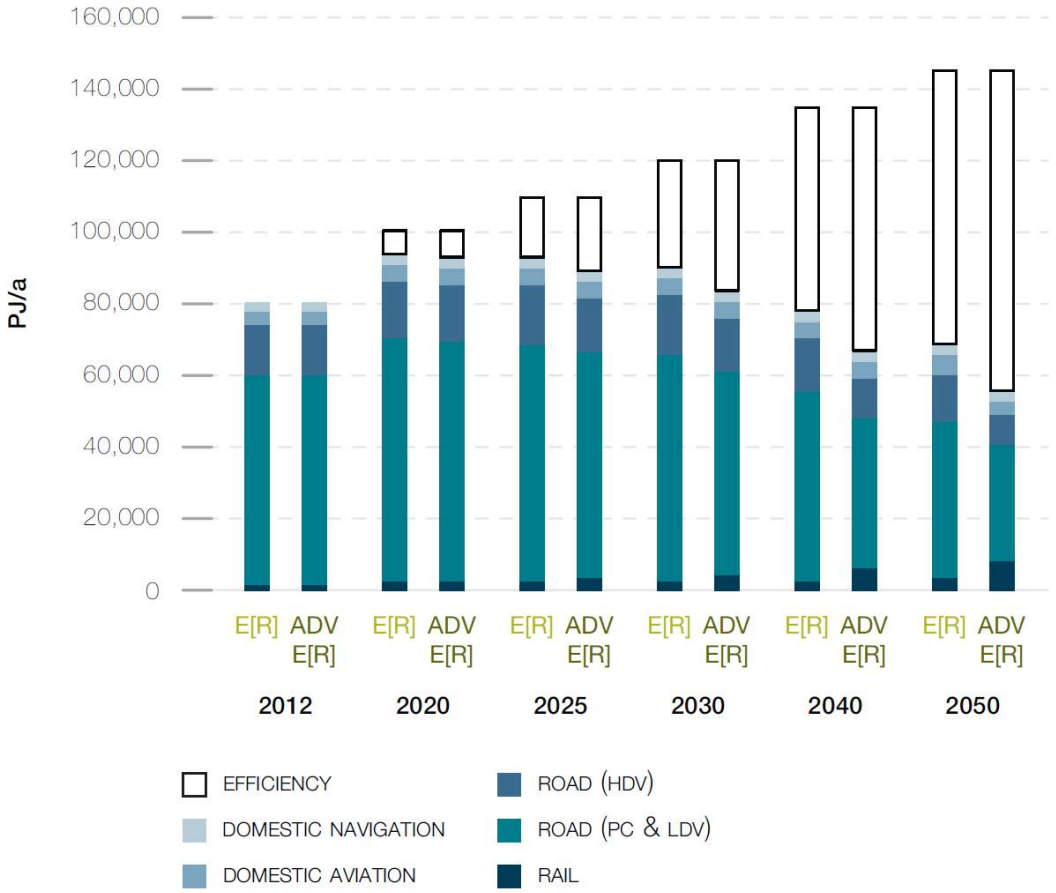
FIGURE 6.1.4 | GLOBAL: DEVELOPMENT OF THE FINAL ENERGY DEMAND FOR TRANSPORT BY SECTOR IN THE ENERGY [R]EVOLUTION SCENARIOS



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Globale: settore trasporti

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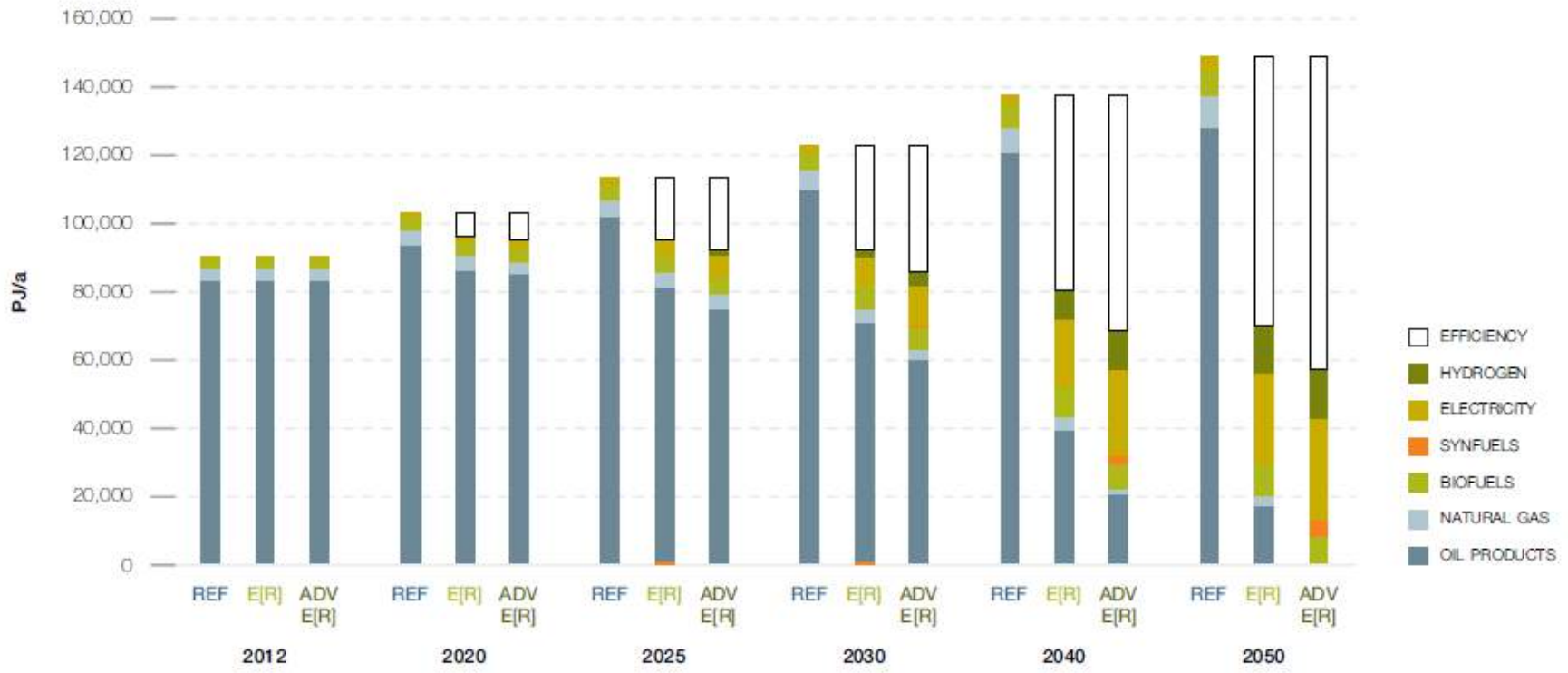
Quota FER trasporti: 2012: 3% // 2020: 5% // 2030: 19% // 2050: 100%

FIGURE 6.1.13 | GLOBAL: FINAL ENERGY CONSUMPTION IN TRANSPORT UNDER THE SCENARIOS



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Globale: usi finali energia

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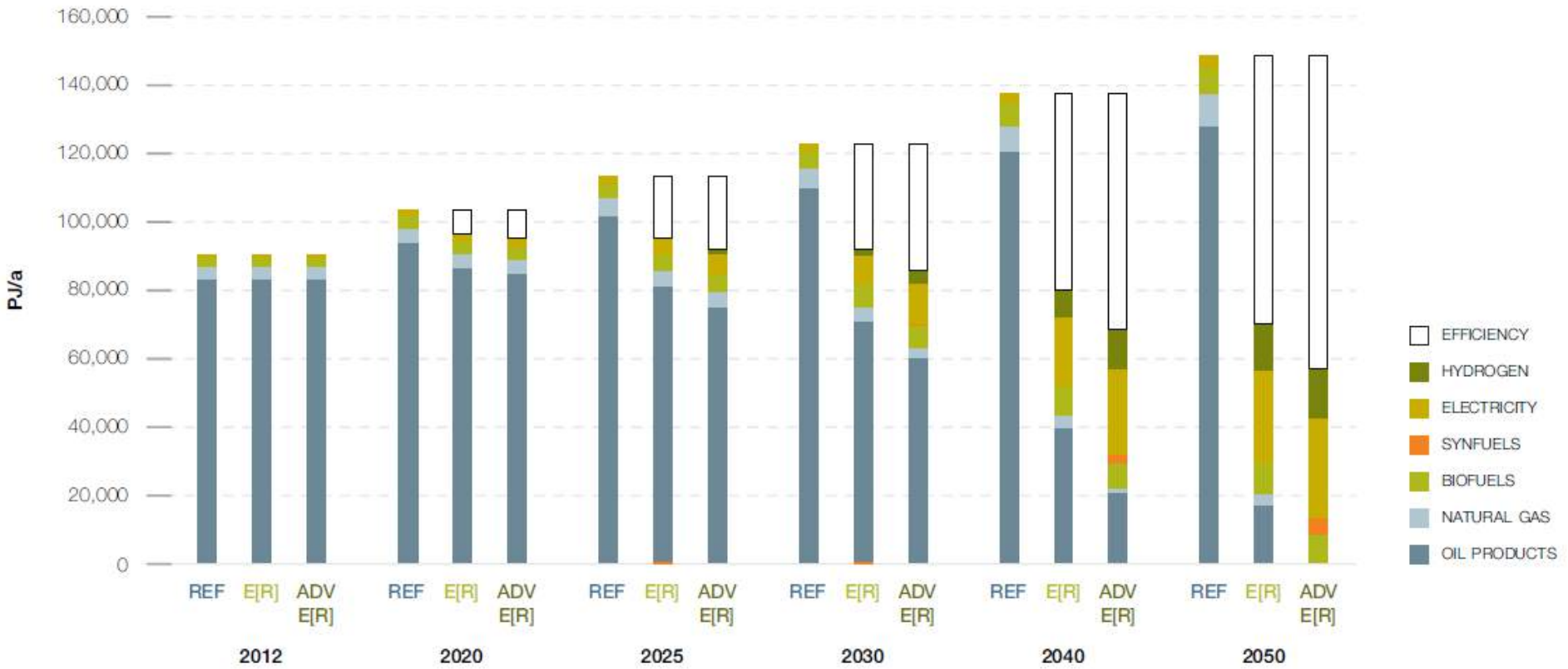
Quota FER usi finali energia: 2012: 19% // 2020: 23% // 2030: 42% // 2050: 100%

FIGURE 6.1.13 | GLOBAL: FINAL ENERGY CONSUMPTION IN TRANSPORT UNDER THE SCENARIOS



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Globale: emissioni CO_2

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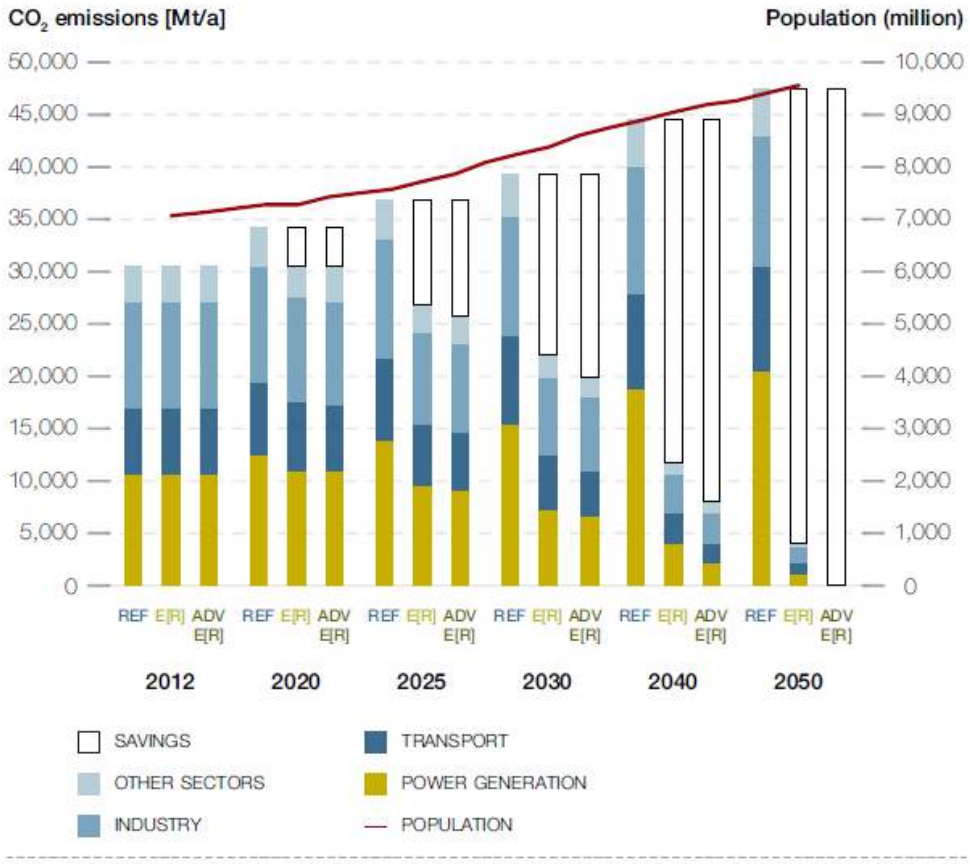
% emissioni su 1990: 2012: 146% // 2020: 145% // 2030: 96% // 2040: 39% // 2050: 0%

FIGURE 6.1.15 | GLOBAL: DEVELOPMENT OF CO_2 EMISSIONS BY SECTOR UNDER THE ENERGY [R]EVOLUTION SCENARIOS

'SAVINGS' = REDUCTION COMPARED TO THE REFERENCE SCENARIO



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Implicazioni occupazionali dell'Energy [R]evolution

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Globale: posti di lavoro

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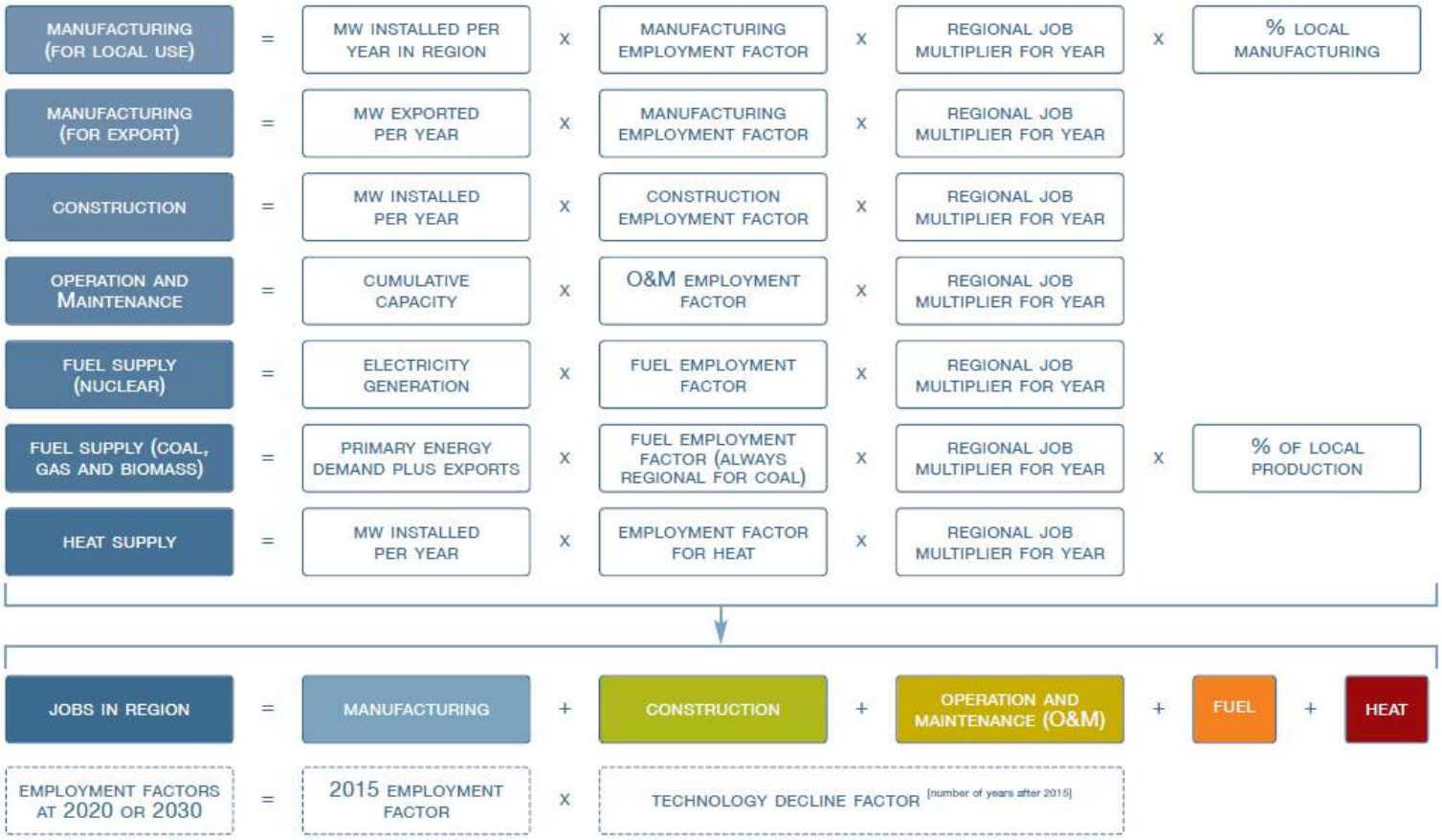
FIGURE 7.1 | METHODOLOGY OVERVIEW



REFERENCES

1 RUTOVITZ, J., DOMINISH, E. AND DOWNES, J. 2015. CALCULATING GLOBAL ENERGY SECTOR JOBS: 2015 METHODOLOGY UPDATE. PREPARED FOR GREENPEACE INTERNATIONAL BY THE INSTITUTE FOR SUSTAINABLE FUTURES, UNIVERSITY OF TECHNOLOGY SYDNEY.

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TABLE 6.1.4 | GLOBAL: TOTAL EMPLOYMENT IN THE ENERGY SECTOR IN MILLION JOBS

		REFERENCE SCENARIO			ADVANCED E[R] SCENARIO		
	2015	2020	2025	2030	2020	2025	2030
BY FUEL							
COAL	9.76	9.67	8.63	7.70	4.80	3.28	1.97
GAS, OIL & DIESEL	3.58	4.16	4.56	4.67	4.00	4.18	3.98
NUCLEAR	0.73	0.86	0.83	0.74	0.52	0.52	0.51
RENEWABLES	14.62	15.41	15.59	14.84	26.91	38.68	41.56
TOTAL JOBS	28.69	30.11	29.62	27.95	36.24	46.65	48.01
BY SECTOR							
CONSTRUCTION AND INSTALLATION	4.86	5.09	4.60	3.95	8.32	14.59	15.56
MANUFACTURING	2.38	2.44	2.23	1.91	5.49	8.87	9.58
OPERATIONS AND MAINTENANCE	3.23	3.94	4.30	4.27	4.82	6.96	9.00
FUEL SUPPLY (DOMESTIC)	17.76	18.12	17.93	17.27	17.27	15.97	13.67
COAL AND GAS EXPORT	0.47	0.52	0.54	0.57	0.34	0.26	0.20
TOTAL JOBS (MILLION)	28.69	30.11	29.62	27.95	36.24	46.65	48.01
BY TECHNOLOGY							
COAL	9.76	9.67	8.63	7.70	4.80	3.28	1.97
GAS, OIL & DIESEL	3.58	4.16	4.56	4.67	4.00	4.18	3.98
NUCLEAR	0.73	0.86	0.83	0.74	0.52	0.52	0.51
BIOMASS	10.97	11.85	12.05	11.76	12.07	12.55	11.54
HYDRO	1.45	1.46	1.47	1.29	1.01	0.83	0.71
WIND	0.70	0.72	0.76	0.65	4.22	6.91	8.18
PV	1.01	0.87	0.84	0.66	6.69	11.04	10.32
GEOTHERMAL POWER	0.03	0.03	0.03	0.03	0.18	0.30	0.39
SOLAR THERMAL POWER	0.03	0.04	0.05	0.08	0.45	1.66	2.66
OCEAN	0.00	0.00	0.00	0.01	0.23	0.45	0.65
SOLAR - HEAT	0.36	0.37	0.34	0.31	1.59	3.94	5.64
GEOTHERMAL & HEAT PUMP	0.07	0.05	0.04	0.04	0.48	0.99	1.46
TOTAL JOBS (MILLION)	28.7	30.1	29.6	28.0	36.2	46.7	48.0

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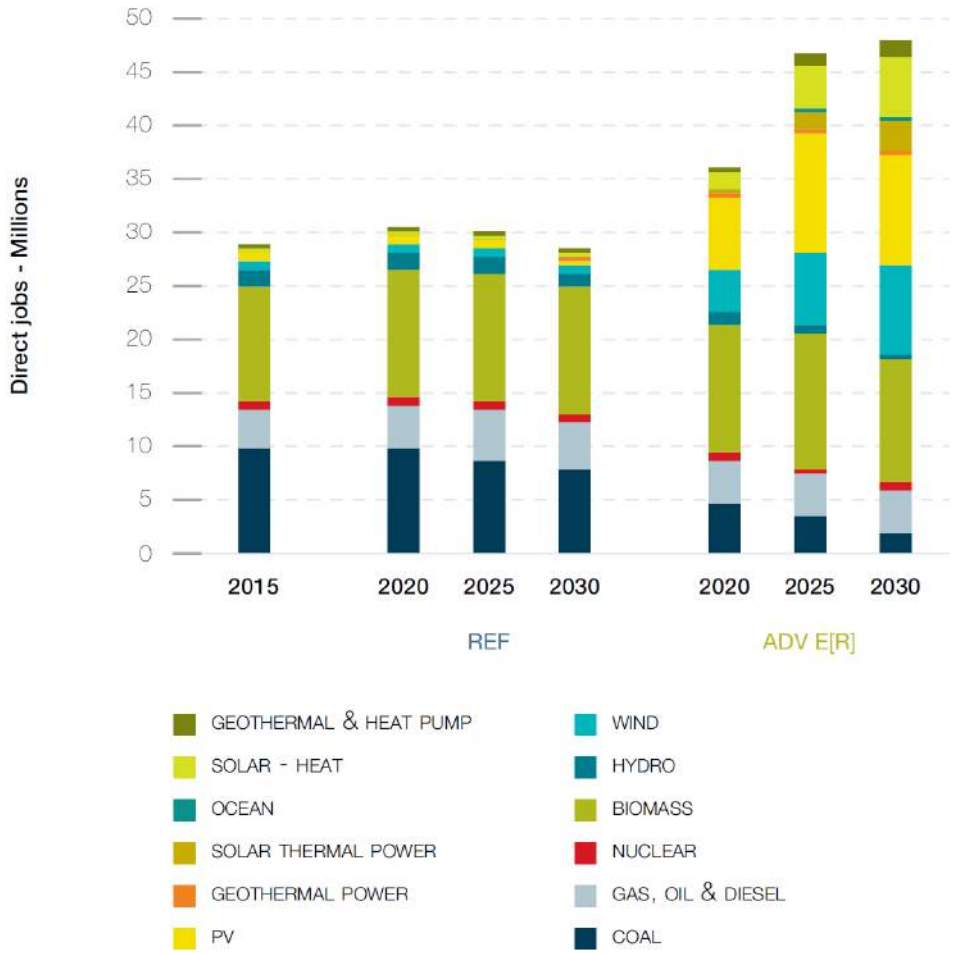
FIGURE 6.1.11 | GLOBAL: EMPLOYMENT IN THE ENERGY SECTOR UNDER THE REFERENCE AND ADVANCED ENERGY [R]EVOLUTION SCENARIO



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- INFRASTRUTTURE -

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FIGURE 3.3 | THE EVOLVING APPROACH TO GRIDS.

CURRENT SUPPLY SYSTEM:

- LOW SHARES OF FLUCTUATING RENEWABLE ENERGY
- THE 'BASE LOAD' POWER IS A SOLID BAR AT THE BOTTOM OF THE GRAPH.
- RENEWABLE ENERGY FORMS A 'VARIABLE' LAYER BECAUSE SUN AND WIND LEVELS CHANGES THROUGHOUT THE DAY.
- GAS AND HYDRO POWER CAN BE SWITCHED ON AND OFF IN RESPONSE TO DEMAND. THIS COMBINATION IS SUSTAINABLE USING WEATHER FORECASTING AND CLEVER GRID MANAGEMENT.
- WITH THIS ARRANGEMENT THERE IS ROOM FOR ABOUT 25 PERCENT VARIABLE RENEWABLE ENERGY.

TO COMBAT CLIMATE CHANGE MUCH MORE THAN 25 PERCENT RENEWABLE ELECTRICITY IS NEEDED.

source GREENPEACE ENERGY [R]EVOLUTION 2012.

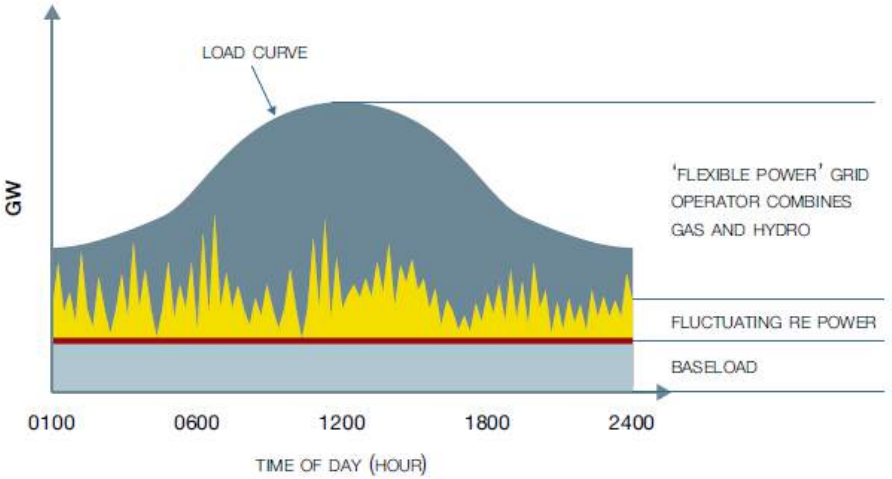

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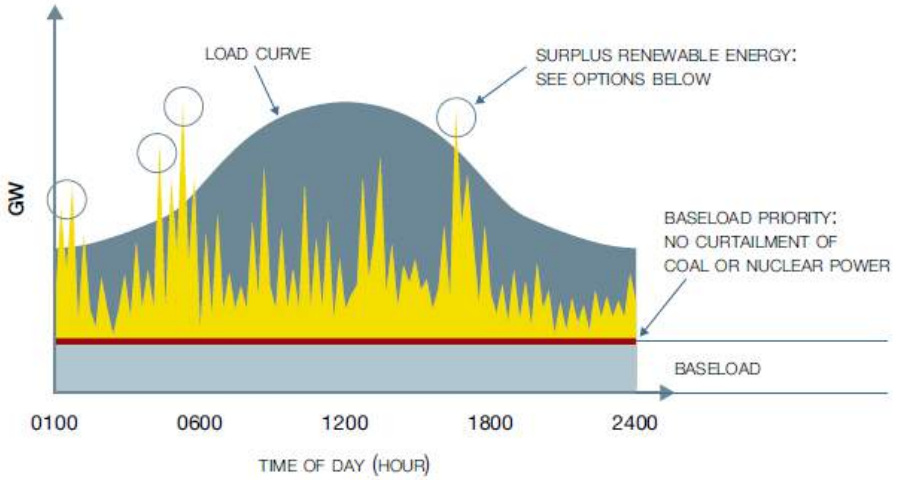
FIGURE 3.5 | **THE EVOLVING APPROACH TO GRIDS.** continued.

SUPPLY SYSTEM WITH MORE THAN 25 PERCENT FLUCTUATING RENEWABLE ENERGY > BASE LOAD PRIORITY:

- THIS APPROACH ADDS RENEWABLE ENERGY BUT GIVES PRIORITY TO BASE LOAD
- AS RENEWABLE ENERGY SUPPLIES GROW THEY WILL EXCEED THE DEMAND AT SOME TIMES OF THE DAY, CREATING SURPLUS POWER.
- TO A POINT, THIS CAN BE OVERCOME BY STORING POWER, MOVING POWER BETWEEN AREAS, SHIFTING DEMAND DURING THE DAY OR SHUTTING DOWN THE RENEWABLE GENERATORS AT PEAK TIMES.

THIS APPROACH DOES NOT WORK WHEN RENEWABLES EXCEED 50 PERCENT OF THE MIX, AND CANNOT PROVIDE RENEWABLE ENERGY AS 90- 100% OF THE MIX.



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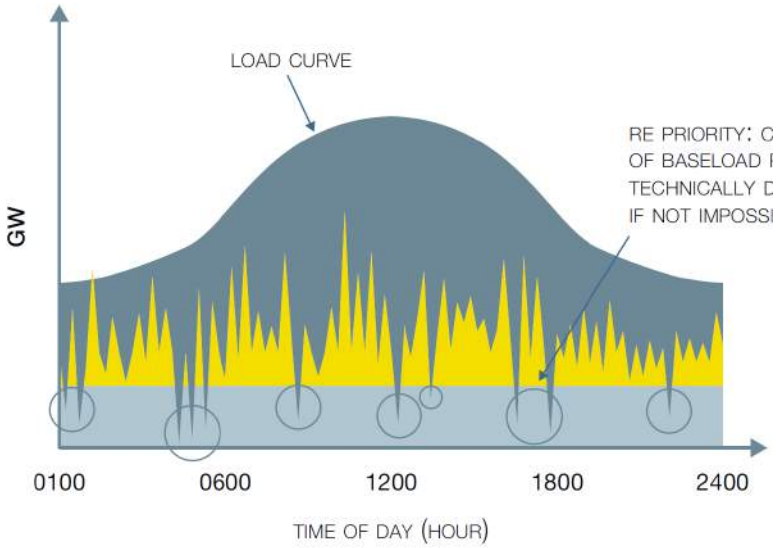
SUPPLY SYSTEM WITH MORE THAN 25 PERCENT FLUCTUATING RENEWABLE ENERGY – RENEWABLE ENERGY PRIORITY

- THIS APPROACH ADDS RENEWABLES BUT GIVES PRIORITY TO CLEAN ENERGY.
- IF RENEWABLE ENERGY IS GIVEN PRIORITY TO THE GRID, IT "CUTS INTO" THE BASE LOAD POWER.
- THEORETICALLY, NUCLEAR AND COAL NEED TO RUN AT REDUCED CAPACITY OR BE ENTIRELY TURNED OFF IN PEAK SUPPLY TIMES (VERY SUNNY OR WINDY).
- THERE ARE TECHNICAL AND SAFETY LIMITATIONS TO THE SPEED, SCALE AND FREQUENCY OF CHANGES IN POWER OUTPUT FOR NUCLEAR AND CCS COAL PLANTS.

TECHNICALLY DIFFICULT, NOT A SOLUTION.



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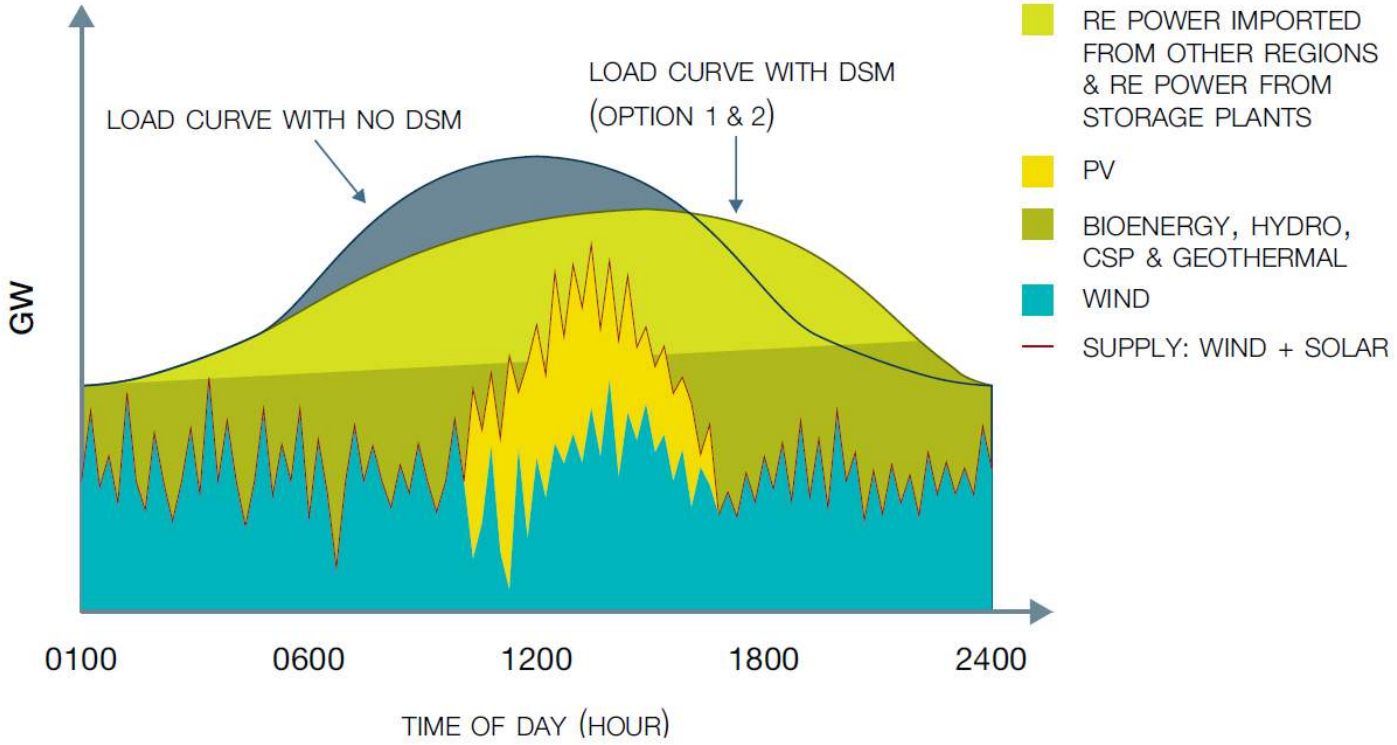

THE SOLUTION: AN OPTIMISED SYSTEM WITH OVER 90% RENEWABLE ENERGY SUPPLY

- A FULLY OPTIMISED GRID, WHERE 100 PERCENT RENEWABLES OPERATE WITH STORAGE, TRANSMISSION OF ELECTRICITY TO OTHER REGIONS, DEMAND MANAGEMENT AND CURTAILMENT ONLY WHEN REQUIRED.
- DEMAND MANAGEMENT EFFECTIVELY MOVES THE HIGHEST PEAK AND 'FLATTENS OUT' THE CURVE OF ELECTRICITY USE OVER A DAY.

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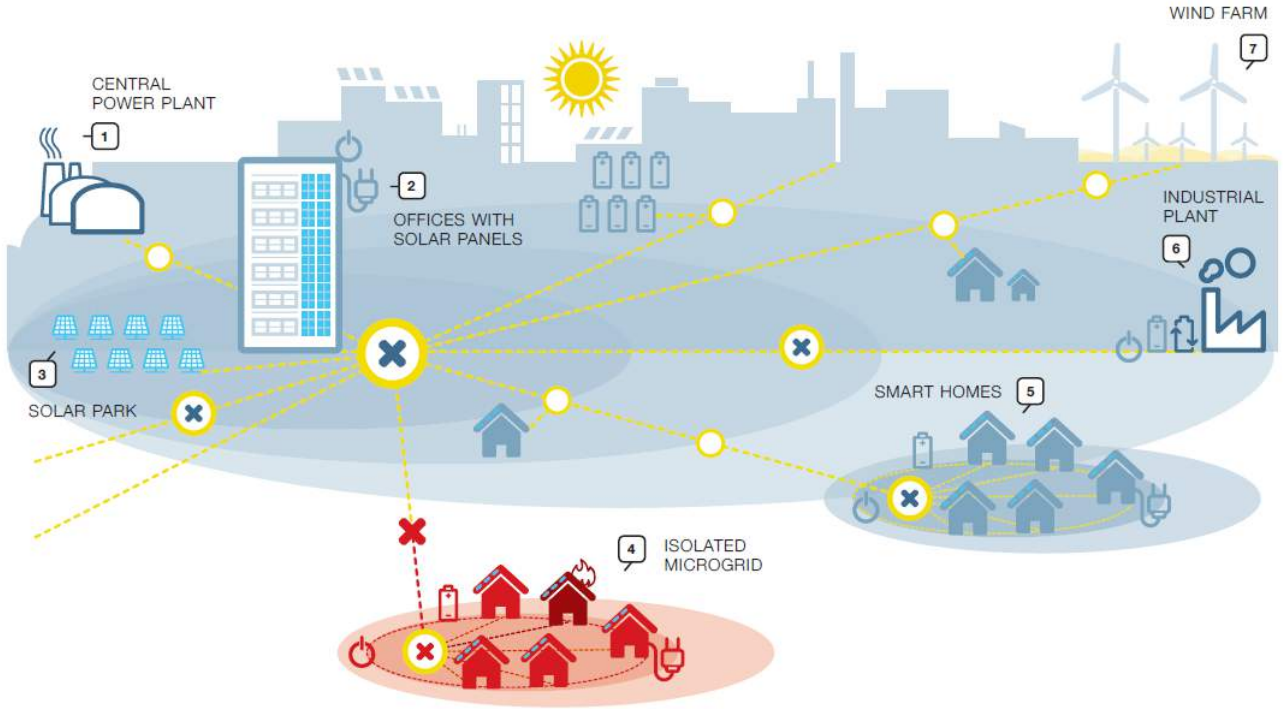
FIGURE 3.4 | **THE SMART-GRID VISION FOR THE ENERGY [R]EVOLUTION**

A VISION FOR THE FUTURE – A NETWORK OF INTEGRATED MICROGRIDS THAT CAN MONITOR AND HEAL ITSELF



PROCESSORS

EXECUTE SPECIAL PROTECTION SCHEMES IN MICROSECONDS

SENSORS (ON 'STANDBY')

DETECT FLUCTUATIONS AND DISTURBANCES, AND CAN SIGNAL FOR AREAS TO BE ISOLATED

SENSORS ('ACTIVATED')

DETECT FLUCTUATIONS AND DISTURBANCES, AND CAN SIGNAL FOR AREAS TO BE ISOLATED

DISTURBANCE

IN THE GRID

SMART APPLIANCES

CAN SHUT OFF IN RESPONSE TO FREQUENCY FLUCTUATIONS

DEMAND MANAGEMENT

USE CAN BE SHIFTED TO OFF PEAK TIMES TO SAVE MONEY

GENERATORS

ENERGY FROM SMALL GENERATORS AND SOLAR PANELS CAN REDUCE OVERALL DEMAND ON THE GRID

STORAGE ENERGY

GENERATED AT OFF-PEAK TIMES COULD BE STORED IN BATTERIES FOR LATER USE

source GREENPEACE ENERGY [R]EVOLUTION 2012.

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Politiche richieste per uno scenario 100% FER:

A. settore trasporti

1. shift modale da strada a ferrovia
2. accelerare su mobilità elettrica (non solo auto elettriche!)
3. armonizzare espansione mobilità elettrica con sviluppo FER

B. settore usi termici

1. target FER usi termici
2. interconnessione sistemi di riscaldamento/raffrescamento e infrastrutture rete elettrica
3. elettricità (= pompe geotermiche) rimpiazzano combustibili (ad es. gas)

C. Settore elettrico – si tratta solo di reti!

1. accesso prioritario FER a reti
2. priorità dispacciamento FER
3. integrare stoccaggi con politiche specifiche nei mercati elettrici
4. organizzare chiusura centrali a carbone e nucleari con specifiche leggi
5. No al „capacity market“ – solo mercato dell‘energia

Un nuovo mercato elettrico

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Grazie per la pazienza!

Il rapporto integrale:

http://www.greenpeace.org/international/en/publications/Campaign-reports/Climate-Reports/Energy-Revolution-2015/