

A Renewable Energy Future for New Zealand: 75–90% of Total Energy is Possible!

Buildings:

- Solar hot water and space heating
- Biogas and biomass pellets for heating and cooking
- Efficient building design with passive solar architecture
- Advanced thermal storage
- Within 3–5 years: household-scale solar photovoltaic (PV) power

Electric power:

- Wind power combined with pumped hydro and other forms of storage (i.e. Vn Redox)
- Biogas for small-scale power generation?
- Biomass pellets for community-scale combined-heat-and-power plants?

Transportation:

- Urban electric vehicles with advanced batteries charged using intermittent wind/solar
- Vehicles integrated into “smart grids” and time-of-day metering and power rates
- Freight and intercity transport: natural gas, oil, hydrogen → highest value for fossil fuels!
- Ethanol from cellulose, if commercially proven

World Energy Demand, 1990-2030

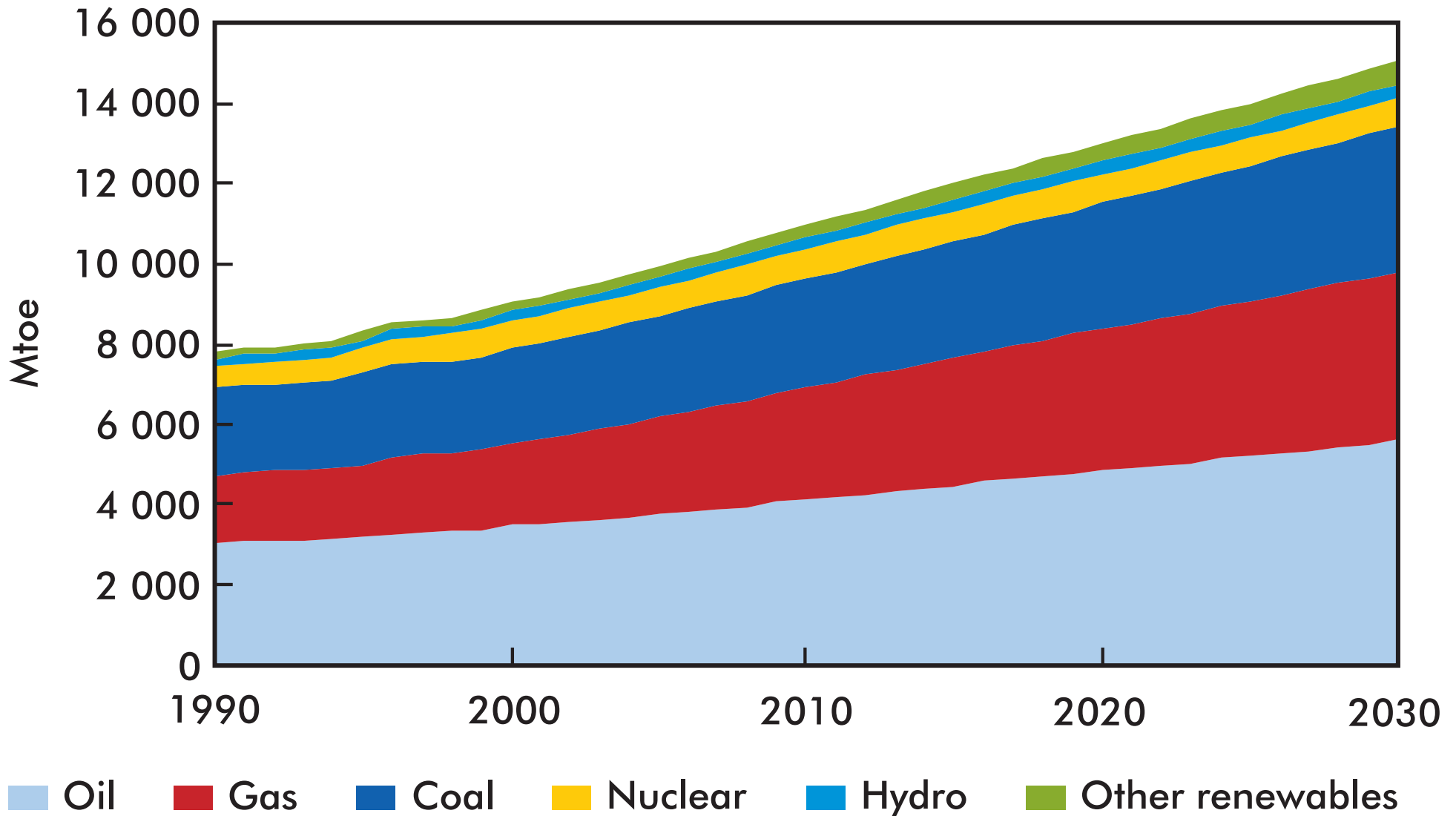


Table 2 Share of primary energy from renewables—policy targets and scenarios^a

Region/ country	2004 actual ^b	2010 policy targets ^c	2020 policy targets or scenarios ^d	Up to 2050 scenarios ^e
World	3.8% or 8.2% or 13.0% or 16.5%	—	5%–15% low/reference	10%–15% low/reference
			15%–20% medium	25%–30% medium
			25% high	40%–50% high
Europe (EU25)	6.5%	12%	10% reference/ carbon constrained	15%–20% reference (by 2030)/carbon constrained
			20% target	30%–40% policies (by 2030)
			23% revolution	50% revolution
United States	4.2%	—	7% reference	8% reference
			20% revolution	50% revolution
Japan	1.2% ^f	3% ^f	—	6% (2030) reference 17%/22% (2030) 25%/50% (2050) high/community

Table 3 Share of electricity from renewables—policy targets and scenarios^a

Region/ country	2005 actual ^b	2010 policy targets	2020 scenarios or policy targets ^c	Up to 2050 scenarios ^d
World	19%	—	15%–20% low/reference	15%–25% low/reference
			20%–25% medium	30%–40% medium
			35%–40% high	50%–80% high
Europe ^e (EU25)	14%	21%	15%–20% reference	20%–25% reference (by 2030)
			25% carbon constrained	30% carbon constrained
			30% policies	45%–60% high (by 2030)
			35% revolution	70% revolution
United States ^f	8%	5%–30% state targets	5%–33% state targets	9%–11% reference 11%–15% alternative (by 2030)
			20% advanced and blueprint	50% high ^g
			30% revolution	80% revolution
Japan ^a	0.4% actual + 10% large hydro	1.35% target + large hydro	11% reference	11% (2030) reference 33%/41% (2030) high/community
				50% high

Scenario Parameters and Types

- Population. Globally, 9 billion by 2050?
 - Gross domestic product. Future growth rates?
 - Energy demand and intensity. How much energy efficiency?
 - Fossil fuel and carbon prices. Wither oil prices? A real carbon market?
 - Renewable energy technology costs. Degree of continued cost reductions?
 - Carbon stabilization and emissions constraints. Stabilization levels typically 450–550 ppm
 - Policy Action. Existing targets achieved? More aggressive/advanced policies?
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- “forecasts” predict likely futures from current trends, using extrapolation and modeling
 - “exploratory scenarios” emphasize the drivers of possible futures
 - “technical scenarios” explore technical possibilities, configurations, feasibility, implications
 - “visions” elaborate desirable and plausible futures, emphasizing benefits
 - “backcasts” start with a predetermined end point—a desirable (or constrained) future
 - “road maps” prescribe specific sequences of policies and measures

Technology Pathways – Issues

1. Long-term potentials and growth rates of wind, biomass, biofuels, solar thermal power, and solar heating. How much, how fast? A Greenpeace scenario shows 29% of global power generation from wind power by 2030. Biomass very diverse scenarios depending on land availability. Biofuels awaiting cellulose technology. Solar thermal power a wildcard.
2. Centralized versus distributed electricity supply and particularly the role of distributed solar PV. One scenario shows distributed solar PV providing 35% of global electricity by 2040, although most scenarios all but ignore solar PV. When do costs come down enough?
3. Hydrogen combined with renewables. Many studies see the ultimate “hydrogen economy” as fuelled entirely by renewables, with electricity and hydrogen as the dominant, and largely interchangeable energy carriers. But transitionally at least, until 2030–2050, studies envision hydrogen from nuclear and fossil fuels (some with carbon sequestration).

Technology Pathways – Issues (continued)

4. Electric vehicle technology. Most scenarios only address biofuels – electric vehicles have been an analytical “blind spot.” Progression from hybrids to plug-in hybrids to electric-only, or more immediate use of electric-only coupled with “smart grids” and two-way power exchanges between vehicles and grid (V2G: “vehicle to grid”).
5. Advanced energy storage technologies. Most scenarios do not address storage possibilities, including grid-support, stationary storage, and vehicle storage. Pumped hydro is main existing medium. Other contenders today are advanced lithium and vanadium-redox flow batteries. Also super capacitors, compressed air, and daily or seasonal thermal storage.
6. Nuclear power and carbon capture and storage. For carbon-constrained scenarios, the degree of nuclear power and carbon capture and storage (CCS) technologies used also determines how much renewables are needed to reduce carbon emissions. Most scenarios envision nuclear remaining at same share as today, about 15%.