

Financing hydropower *and geothermal*

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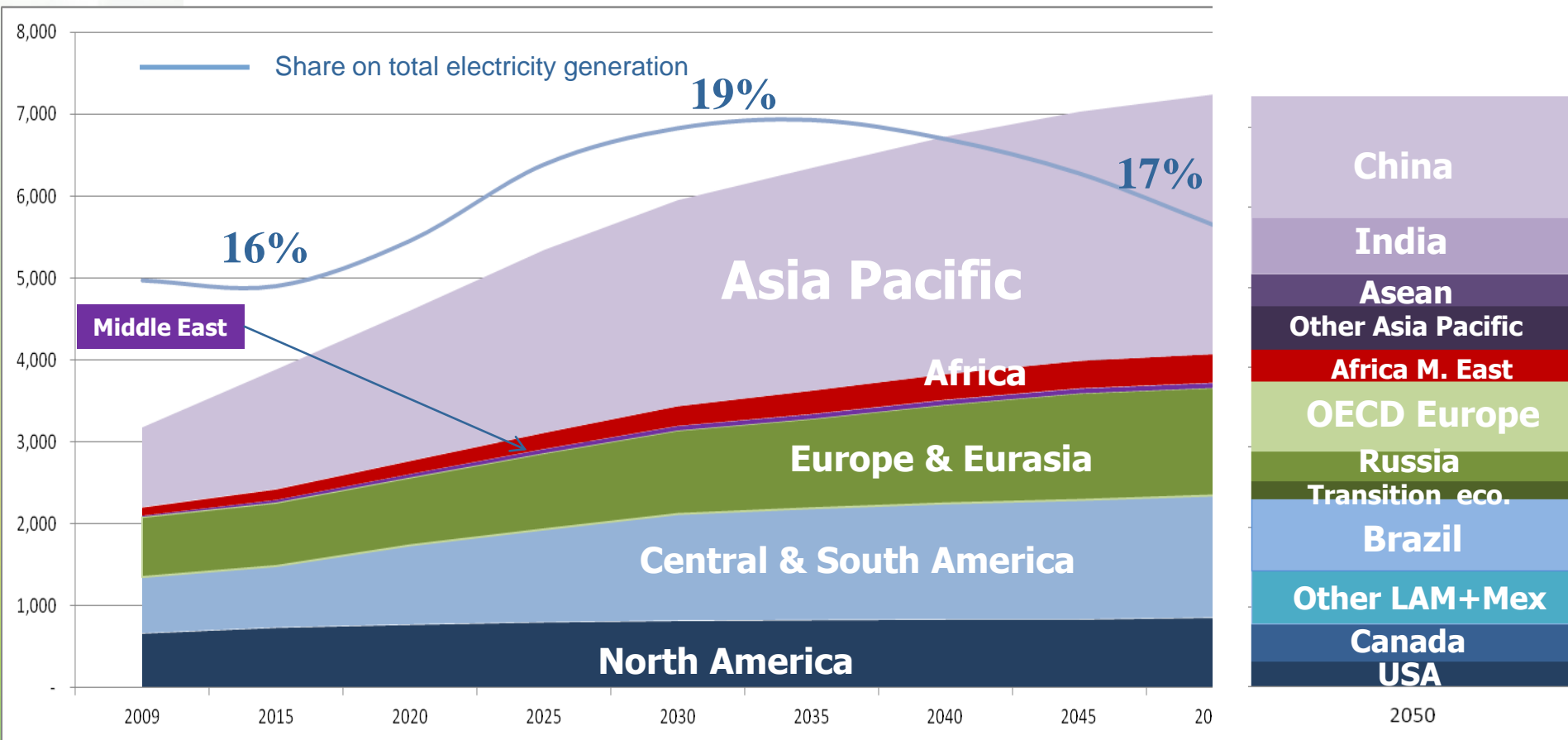
Renewable Energy Division

International Energy Agency

Hydropower drivers

- **Affordable energy, security of supply**
 - Proven, reliable, safe
 - Competitive
 - Fostering social and economic development
 - Improving access to modern energy and alleviating poverty
- **Energy services**
 - Reserves, voltage and frequency support, black-start, etc.
- **Multipurpose water resource management**
 - Irrigation
 - Freshwater supply
 - Flood control
 - Navigation
 - Recreation
- **Support to deploying PV and wind power**
 - Flexibility from:
 - Reservoir hydropower
 - Pumped-hydro power

Vision for Hydropower IEA Roadmap



Hydropower generation will double by 2050 and reach 2 000 GW and 7 000 TWh, mostly from large plants in emerging/developing economies

Vision for PSP deployment by 2050

		China	USA	Europe	Japan	RoW	Total
Low	<i>vRE/total energy</i>	21%	24%	43%	18%		
	<i>Hydro/total energy</i>	14%	6%	13%	12%		
	PSP/total capacity	4%	4%	6%	11%	2%	
	GW	119	58	91	35	109	412
High	<i>vRE/total energy</i>	34%	37%	48%	33%		
	<i>Hydro/total energy</i>	15%	6%	11%	13%		
	PSP/total capacity	5%	8%	10%	12%	3%	
	GW	179	139	188	39	164	700

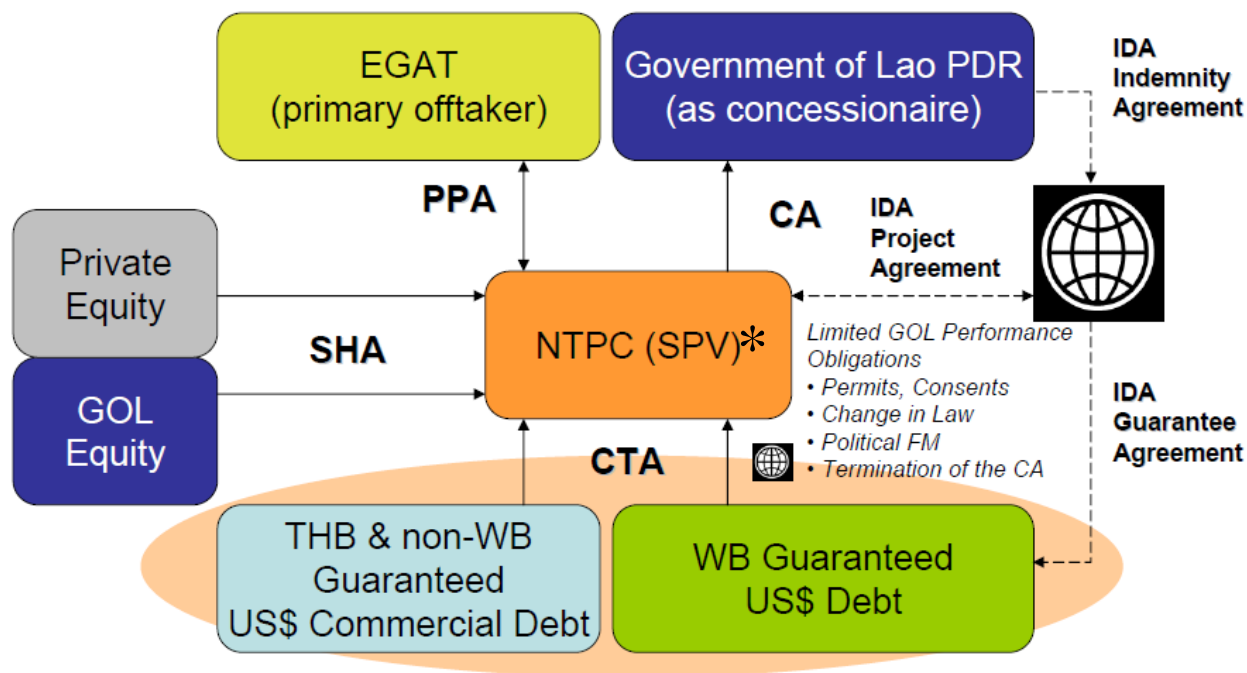
Financing challenges

Technology	Bioenergy	Bioenergy co-firing	Geothermal	Solar PV	CSP	Hydro	Wind onshore	Wind offshore	New coal	New gas CCGT	Micro hydro	Small-scale Solar PV	Small-scale Biogas
min USD/MWh	80	80	35	155	160	20	50	140	40	40	35	185	110
max USD/MWh	250	140	200	350	300	230	140	300	90	120	230	600	155

- **Although cost-effective, hydropower faces financial challenges**
 - Large projects, capital intensive, long building times
 - Returns on investment vary from year to year
 - Long tenures from commercial banks difficult to get
 - Flexibility under-valued on most markets
 - Market design based on marginal running costs may not deliver the right incentives

Financing: the need for innovation

The Nam Theun 2 case: utilising World Bank's partial risk guarantees to mobilise private debt financing

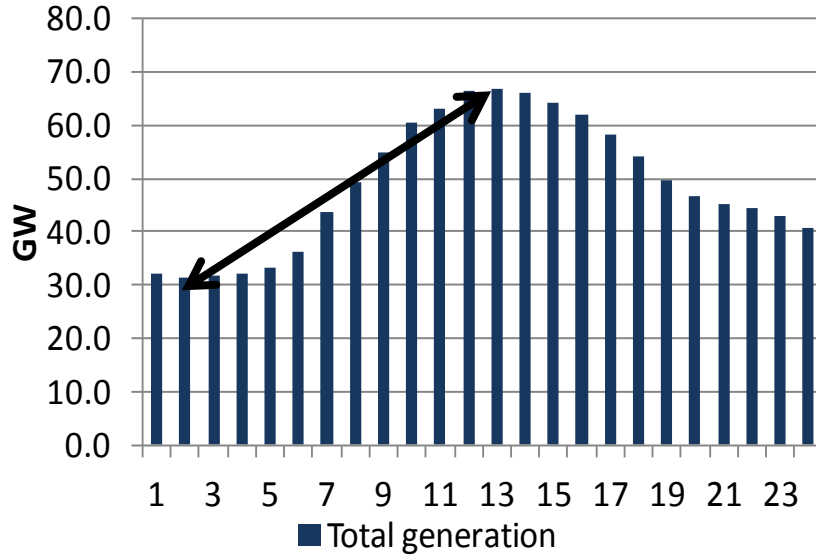


*Nam Theun Power Company (Special Purpose Vehicle)

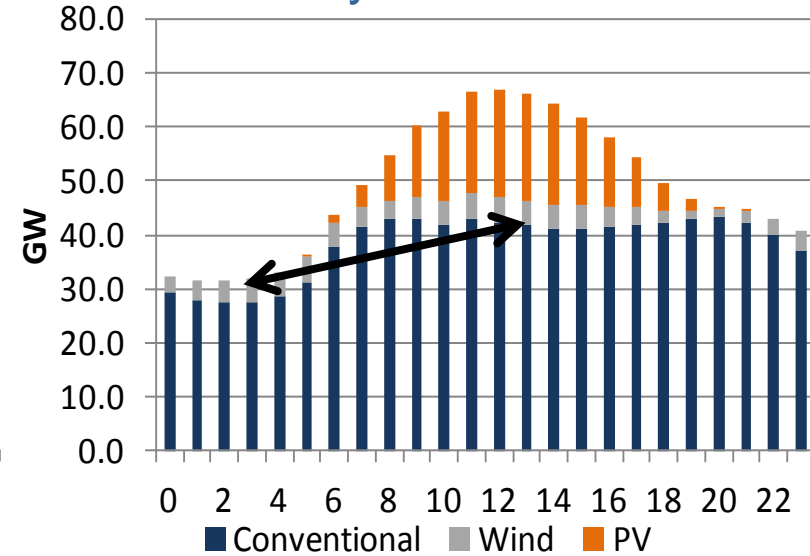
- Addressing all risks requires complex financing structures associating private and public tools

vRE and the value of storage

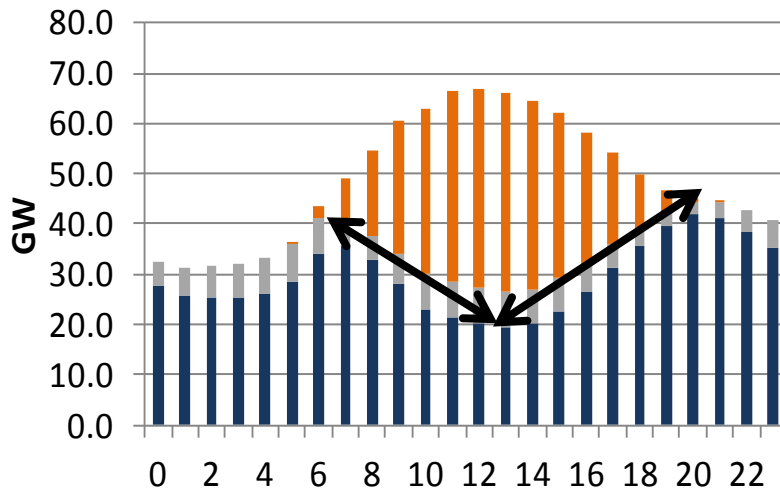
Past



Today-Medium term



Future

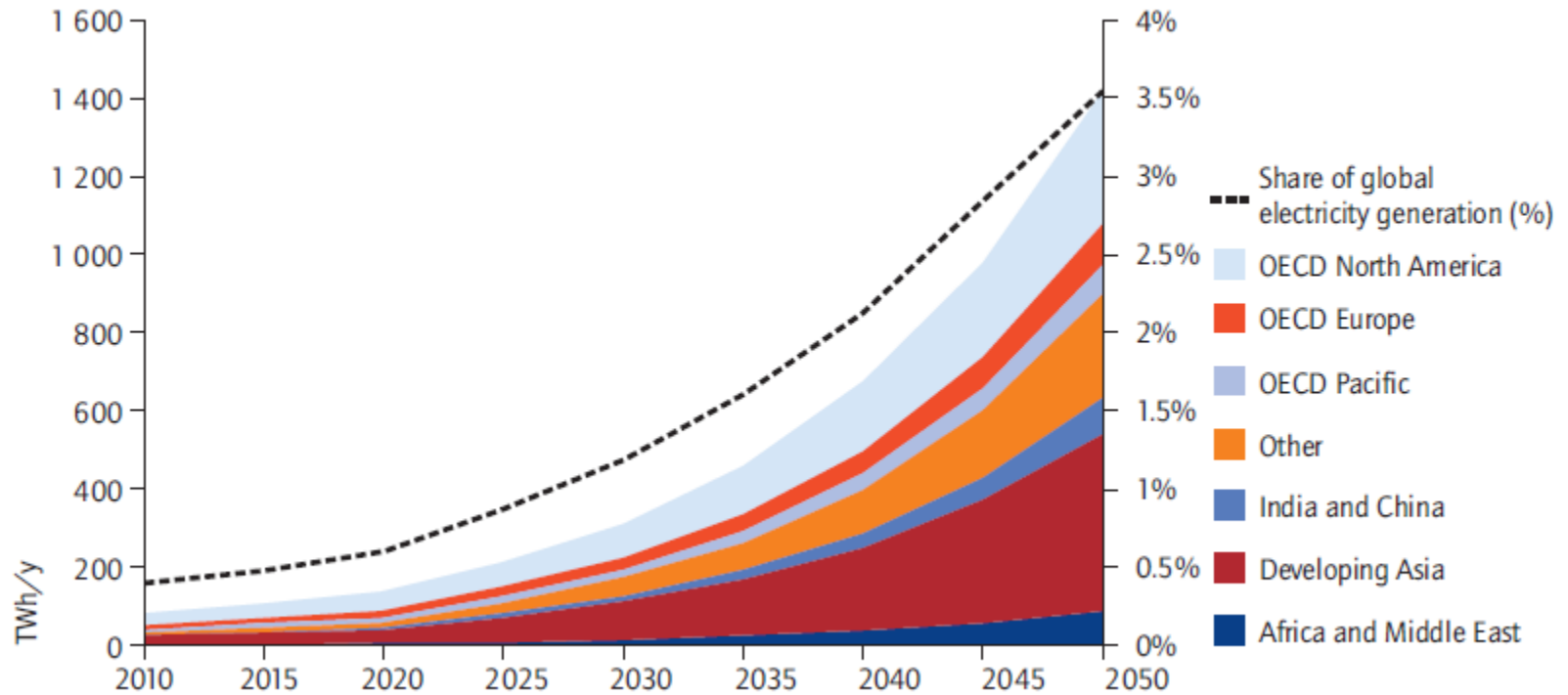


■ **Medium-term: PV *reduces* value of flexible resources**

€/MWh	2007	2008	2009	2010	2011
Phelix Base	37.99	66.76	38.85	44.49	51.12
Phelix Peak	56.16	88.07	51.15	55.02	58.95
Spread [%]	149	134	132	124	115

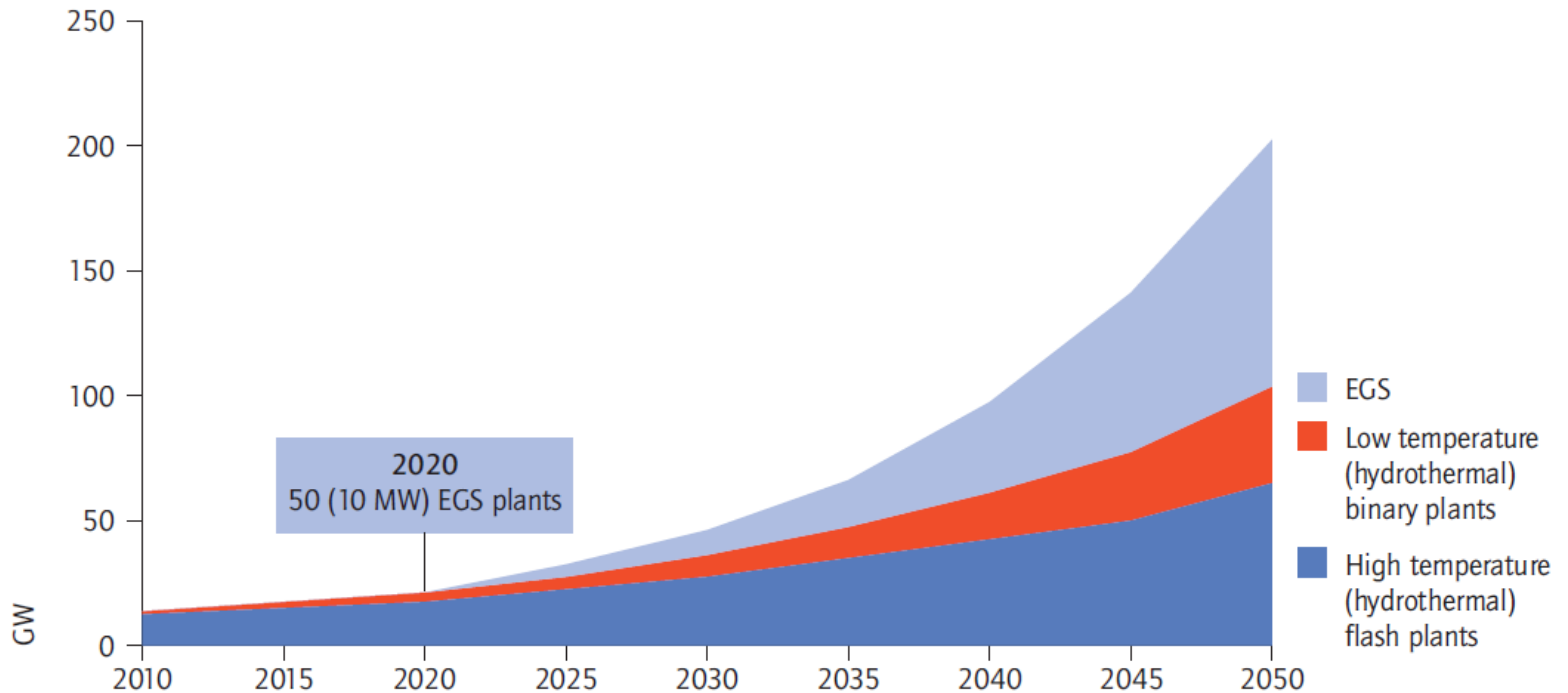
■ **Long-term: Mutual *increase* of market value**

Roadmap vision of geothermal power production by region (TWh/y)



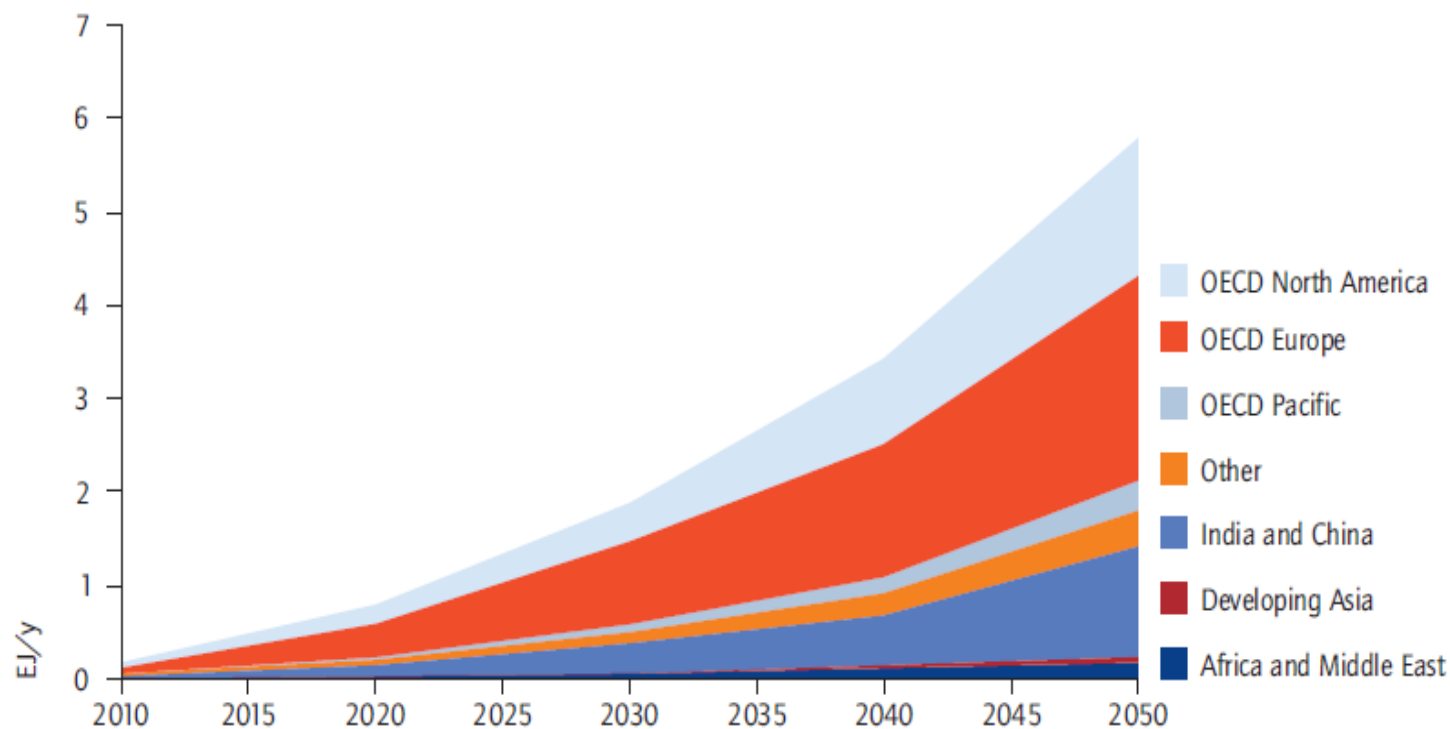
Geothermal electricity capacity could reach 200 gigawatts by 2050, providing 1400 TWh per year (3.5% of electricity production)

Growth of geothermal power capacities by technology (GW)



Enhanced Geothermal Systems (EGS) plays an important role in the roadmap vision for geothermal energy

Roadmap vision of direct use of geothermal heat by region (EJ/y)



Geothermal heat could contribute to 5.8 EJ per year by 2050, (3.9% of final energy for heat), excluding ground source heat pumps

Risks compared



- **Geothermal**
 - **Drilling risks**

- **Hydropower**
 - **Acceptance risk**
 - **Construction risks**
 - **Hydrologic risk**
 - **Off-taker risk**
 - **Regulatory risk**

