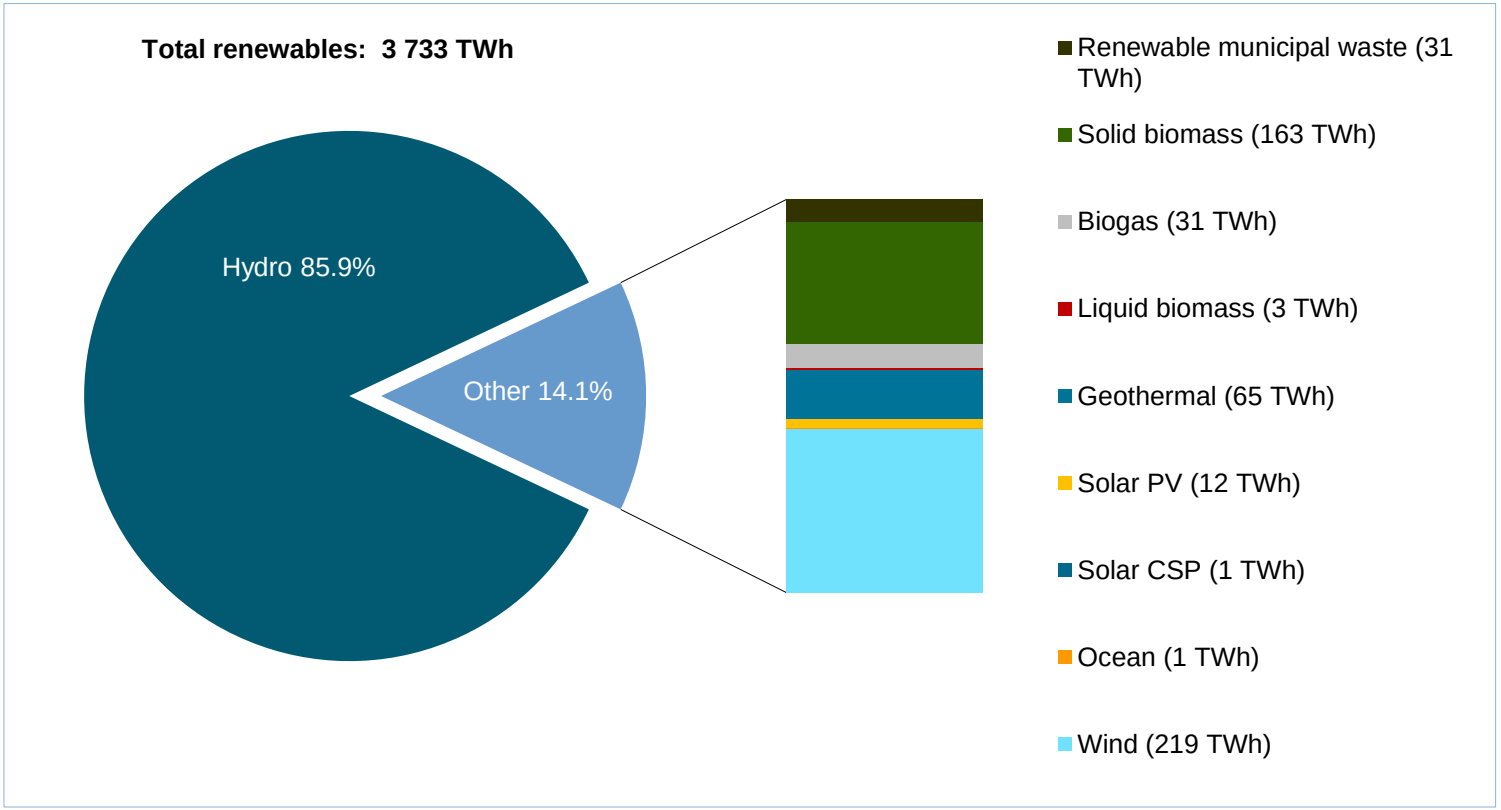
Hydropower Roadmap

International Energy Agency

Role of hydropower in renewable power generation mix



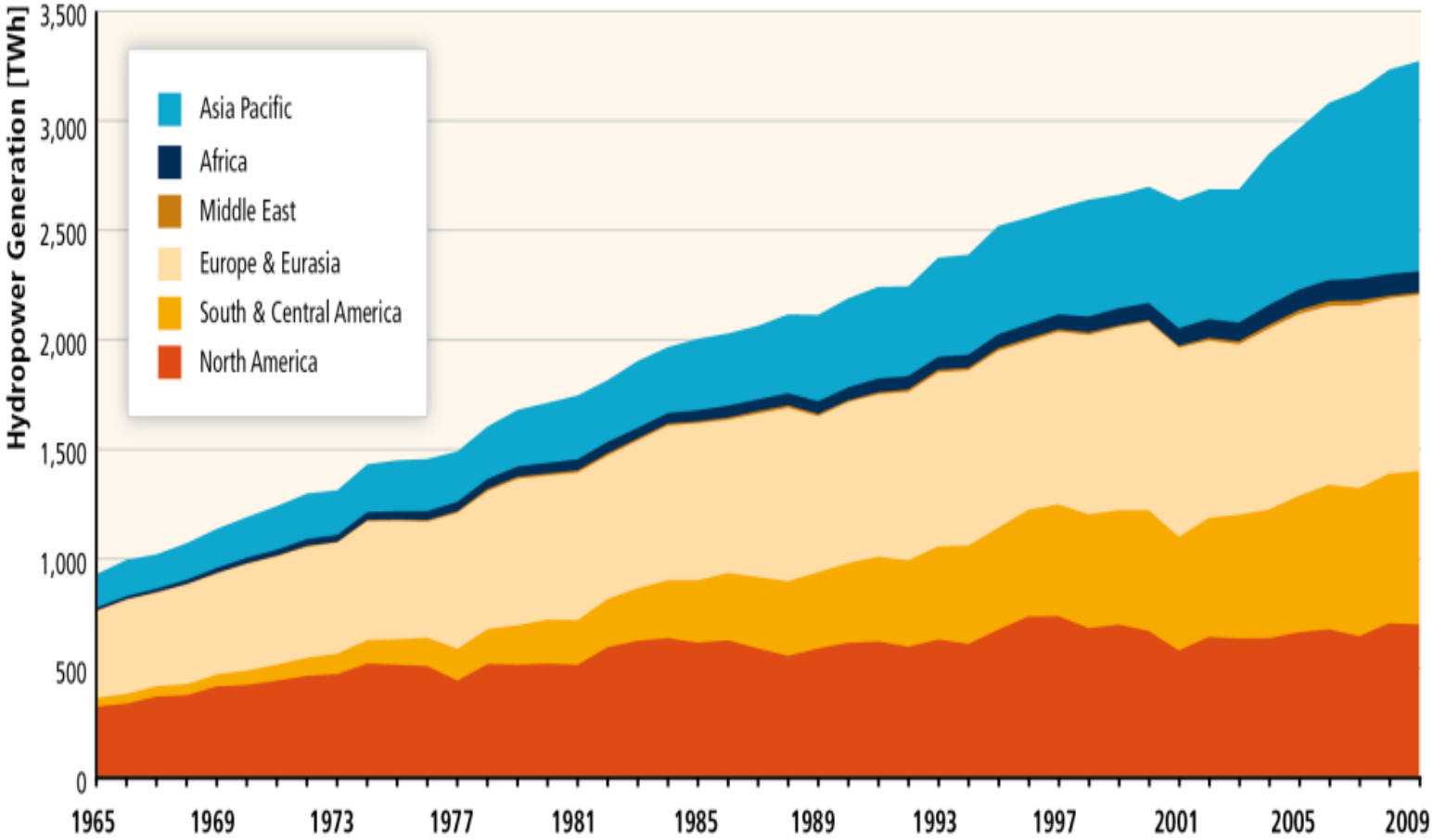
Source: IEA statistics

Hydropower currently supplies 16% of global electricity and is the most important renewable energy source for electricity generation

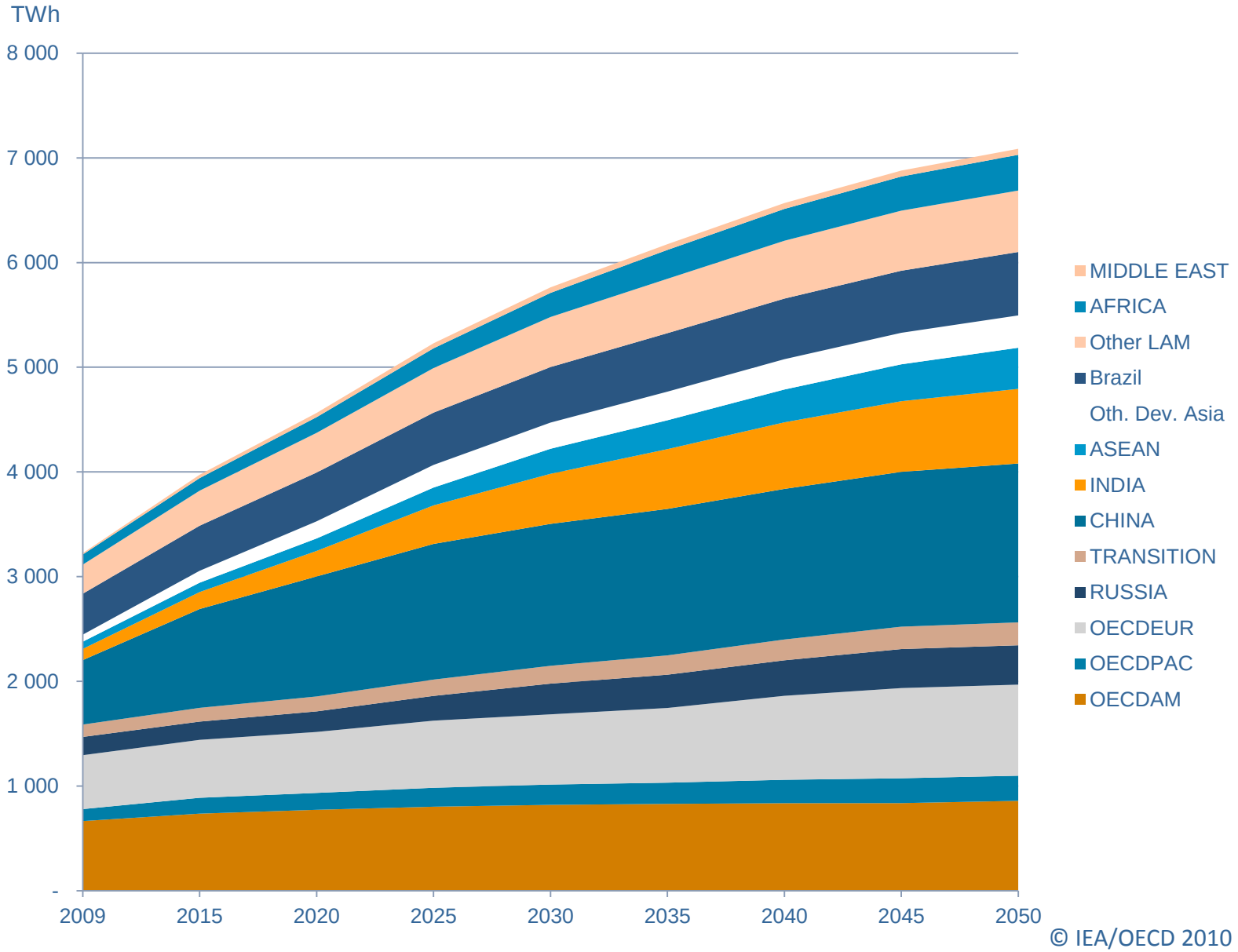
Vision for Technology Deployment and CO_2 Abatement

- The Vision is the desired pathway for hydropower's future growth and positioning to reduce CO2 emissions.
- Hydropower has many drivers, which vary based on region, energy needs, market development and public acceptance
- The selected scenario of the IEA *Energy Technology Perspectives 2012* publication anticipates a global installed hydropower capacity by 2050 of 1947 GW, and generation of near 7 000 TWh, both almost twice the current levels.
- The share of hydropower over total electricity generation would be roughly constant, or even slightly increase.
- 2050 targets would be between 30 to 60% of the estimated technically exploitable potential of hydropower

Hydropower: from past growth…



… to future growth in the 2DS



World's fastest growing economies… leading countries for hydro and dam development

	Installed hydro capacity (present) (MW)	Hydro capacity under construction (MW)	Major dams in operation (+ u/c))
China 	147,000	80,000	26,000 (+68)
India 	37,000	15,371	2600 (+10)
Brazil 	83,752	5500	387 (+2)
Russia 	47,000	7000	>100 (+5)

Enablers for Development

- Socio-economic and environmental issues
- Public Acceptance
- Multipurpose development
- Financial issues
- Technological improvements
- Improving existing facilities
- Network Integration

Policy framework: Near-term Actions for Stakeholders

Vision

1. **Each sovereign nation prepare a development plan for hydropower and track progress , taking into account concerns and cross boundary issues.**

Sustainability

2. **Develop regulatory frameworks for the development of sustainable and appropriate hydropower, that avoid, minimize, mitigate and compensate legitimate and important environmental and social concerns**
3. **Prepare guidance to enable a balanced assessment of all potential impacts and concerns against the benefits of a hydropower project.**
4. **Evaluate existing sustainability protocols and select requirements**
5. **Manage net GHG emissions from reservoirs through measurement and predictive modelling.**
6. **Understand impacts of climate change on water resource/hydropower output**

Policy framework: Near-term Actions for Stakeholders

Public acceptance

7. Increase and improve dissemination of information to governments and other stakeholders on the role that hydropower in the provision of sustainable energy and contribution to climate change reduction targets.

Financial challenges

8. Streamline processes to reduce the lead times for hydro project assessment and design phases,

9. Establish protocols and economic tools to value the non-energy contributions of multi-purpose hydropower developments

10. Identify and develop effective financial models to support large numbers of medium scale hydro projects in Africa and other developing regions

11. Reduce interconnection costs for small-scale hydropower projects, through regulation, technology, efficient practices and subsidy

Technology Development

Technology Development	Example
Advances in Technology	Higher turbine efficiency and performance
New materials	Materials and coatings for cost reduction and corrosion/abrasion protection
Adaptions from existing hydropower technologies	Low-head and kinetic flow turbines for use in canals, pipes and rivers without dams
Reductions in costs	Roller-compacted concrete (RCC) dams
Environmental benefits	• Oil-free Kaplan turbines • Fish friendly turbines
Enhanced network integration and stability	Application of variable speed machines for pumped storage developments
Improved controls for network integration	Increasing need for integration of large amounts of variable renewable generation
Improved Development Approaches	• Off-shore platform, • Comprehensive Vision Based Planning (CVBP) • IHA's 2010 Hydropower Sustainability Assessment Protocol

Policy framework: Near-term Actions for Stakeholders

Improving existing capacity

12. **Each sovereign nation inventory existing hydropower generation and "encourage" improvements in output, efficiency and reliability**
13. **Develop guidance for rehabilitation, upgrading or uprating existing hydroplants to increase efficiency, output, capacity and value.**
14. **Identify opportunities to redevelop very old hydropower plants, having obsolete equipment and less than optimum use of the water resource.**
15. **Identify dams originally developed for flood control, irrigation, navigation or drinking water and assess their feasibility for adding hydropower.**

Electric system services: empowering variable renewables

16. **Develop / improve technologies at hydropower plants, to better support the integration of large amounts of variable renewable energy sources.**
17. **Develop guidance to determine the real value of hydropower providing integration services, and mechanisms for remuneration**

Hydropower has a critical role in the goal of halving global energy-related CO_2 emissions by 2050

Future perspectives for large, small and pumped storage hydropower :

- **Large hydropower will be a major contributor of renewable energy to the world's energy growth, by managing environmental and social impacts and gaining public acceptance**
- **Small hydro will continue to supply a growing niche hydropower market and will also adapt technology and applications to meet new opportunities**
- **Pumped storage will grow in importance as a low-cost and reliable integrator of non-firm renewables, with improved technology and minimum**

Thank you

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