HYDROPOWER FOR A SUSTAINABLE EUROPE

Les atouts de l'hydraulique dans la transition énergétique

Grenoble – 26 novembre 2013

Anne C. Bolle, Head of Climate Policies

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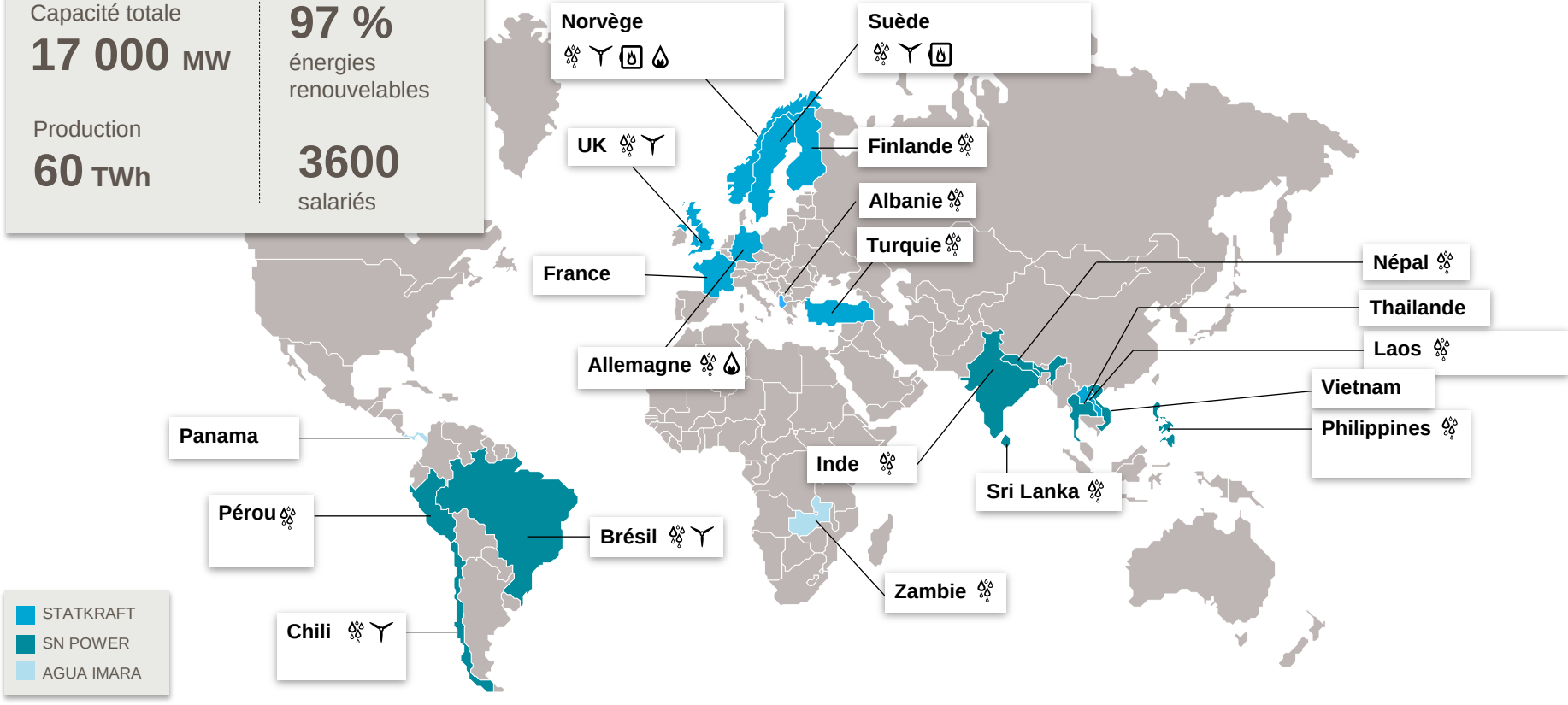
Statkraft d’un coup d’oeil

Capacité totale
17 000 MW

Production
60 TWh

97 %
énergies renouvelables

3600
salariés



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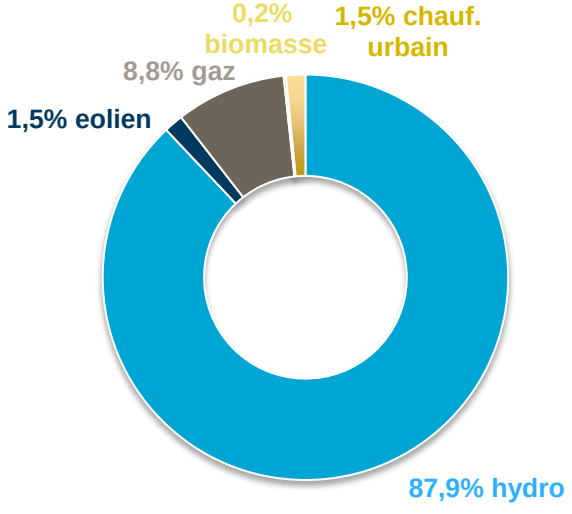
Leader européen des énergies renouvelables

- 1er producteur d'énergies renouvelables en Europe
- Acteur engagé du développement durable

Pionnier de l'énergie osmotique :
1ère centrale osmotique
de production d'électricité au monde

Partenaire de nombreuses institutions environnementales & programmes de recherche internationaux :
- CEDREN
- CONSEIL MONDIAL DU DÉVELOPPEMENT DURABLE
- AIH (association internationale de l'Hydroélectricité)
- WWF
- BELLONA



1er hydroélectricien européen

Une histoire intimement liée au développement de la production d'énergie hydroélectrique en Norvège

100 ans
D'expérience

254
Centrales hydroélectriques

+ 250 barrages

13522 Mw
Capacité installée

57,6 TWh
produits

Soit la consommation annuelle de 12, 5 Millions de foyers français

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Un partenaire intégré dans les territoires

Protection de l'environnement

Partenariats avec les usagers de l'eau

Dialogue social & territorial

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Project group “Strengthening the voice of hydropower”

Hydropower at the heart

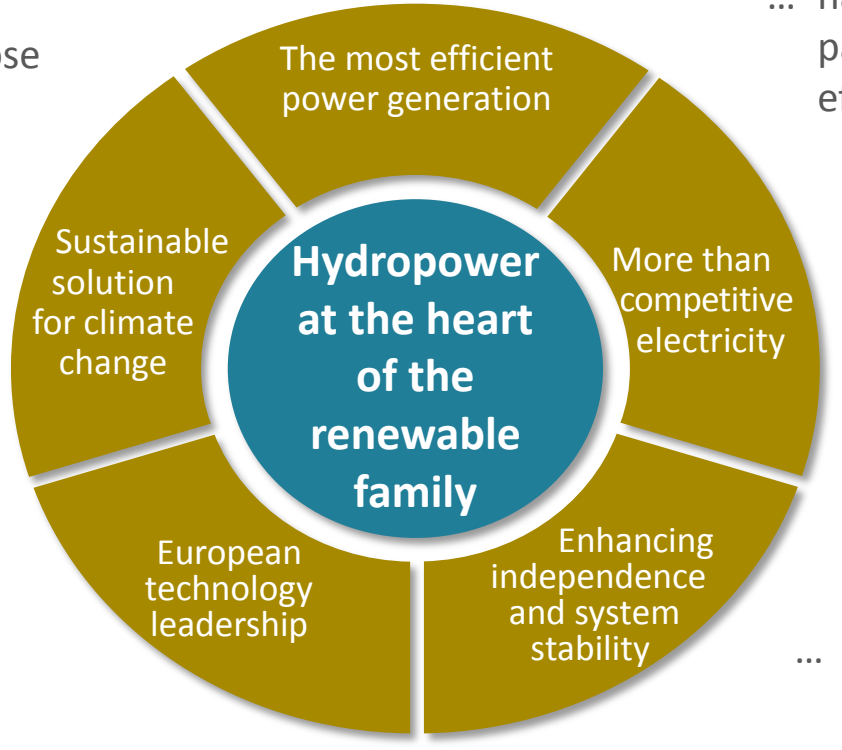
… has long-term profitability and important multi-purpose benefits.

… has a very low carbon-, water- and land footprint.

… has a unique role in mitigation and adaptation to climate change.

… is reliable for centuries to come.

… industry is leading on a global level.



… has the highest energy payback ratio and the most efficient storage technology.

… represents long experience and innovation at the same time.

… is crucial for system stability and security of supply.

… is the enabler for big scale integration of renewables.

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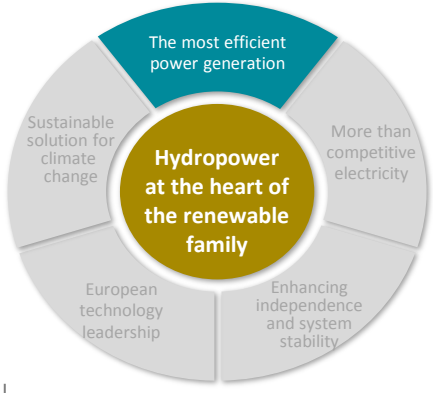
The most efficient power generation

Hydropower – crucial for a sustainable and wealthy Europe



- Highest energy payback ratio in comparison with all other technologies
- Very source efficient
- Most efficient storage technology
- Highest electricity efficiency rate (up to 95 %).

Outlook

- Key role in achieving the EU 20-20-20 goals
- Face the challenge to communicate the actual and potential contribution
- Improve the performance, incl. the sustain-able rehabilitation of existing and new installations

Policy recommendation

- Good framework conditions for the best possible utilization of existing and future hydropower
- Primary goal: public acceptance in Europe in comparison to other technologies in context of storage and flexibility

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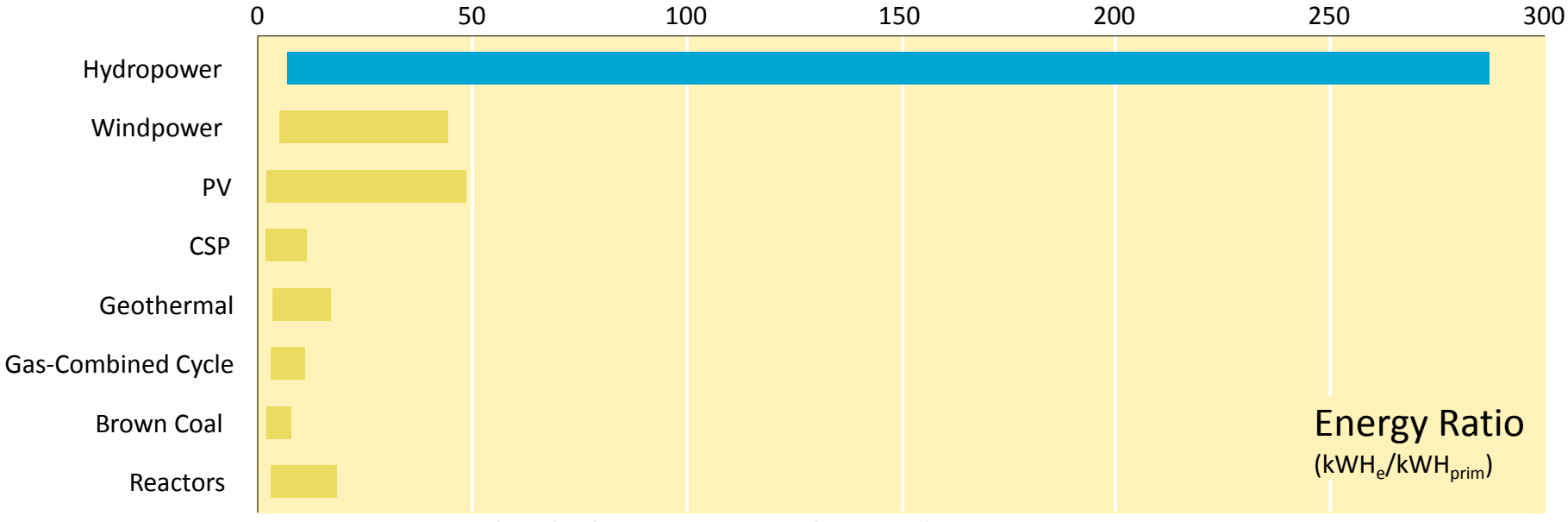
Highest energy payback ratio



Source: EURELECTRIC (2011), Life Cycle Assessment of Electricity)

- **The higher the ratio, the better the environmental performance**
- **One main reason for high energy payback ratio is the very long lifetime**

Energy payback ratio = The ratio of total energy produced during lifetime of a technology divided by the energy needed to build, fuel, maintain and decommission.

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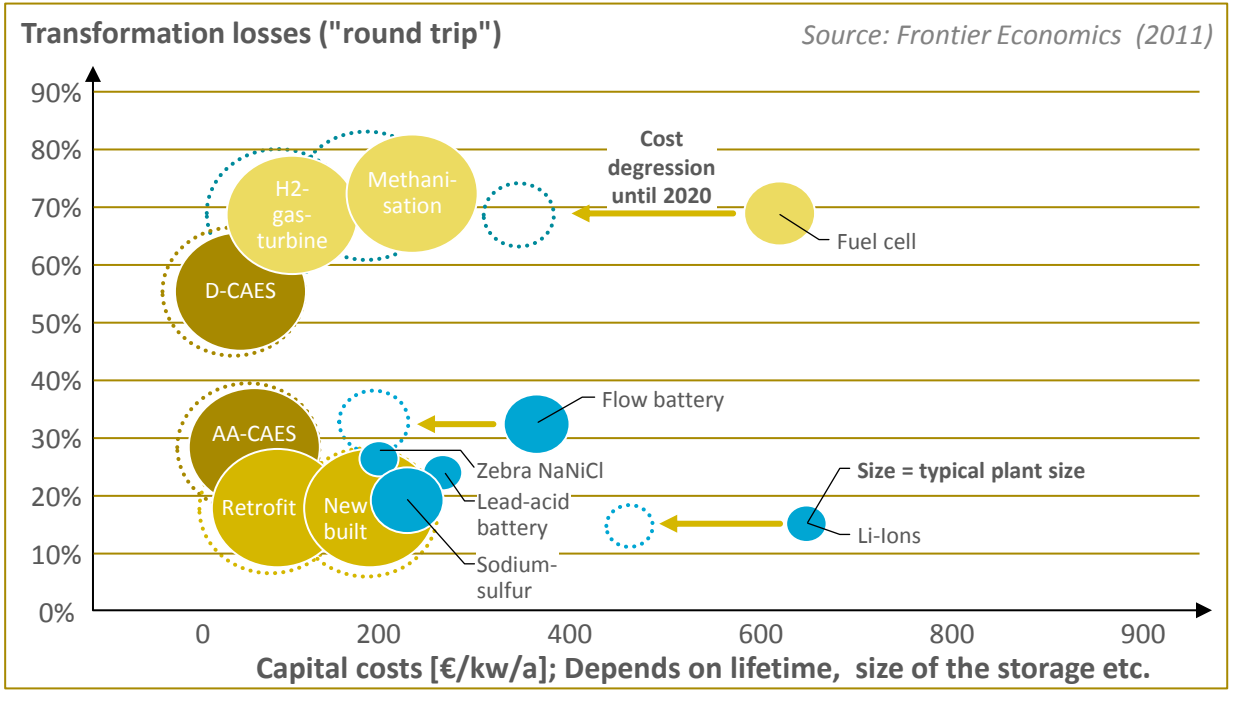
The only efficient large-scale storage technology of today

Pumped hydro storage is the most efficient storage technology

Source: Frontier Economics (2011)

Comparison of storage technologies

- Pumped hydro storage
- Compressed air storage (CAES)
- Hydrogen
- Batteries



- More than 180 TWh 1 installed storage capacity in Europe
- Storage bridges the gap between demand and supply
- Quick response capabilities necessary for peak generation
- Pumped hydro storages best combine investment costs, lifetime and efficiency

[1] *Prof. Dr. Jürgen Schmid, 2007 (UCTE and NRDEL)*

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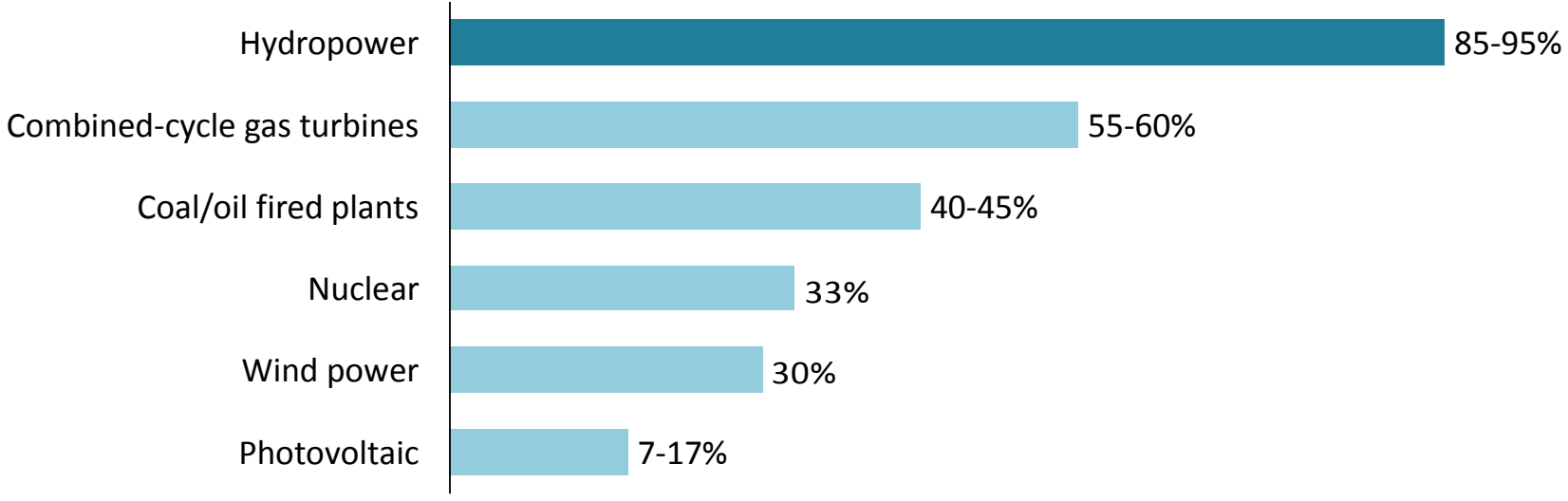
Highest electricity efficiency rate

Electricity conversion ratio

Source: EURELECTRIC (2011), Hydropower in Europe: Powering Renewables



- **Hydropower efficiency rates are the highest of all energy technologies**
- **It directly converts mechanical energy into electricity**

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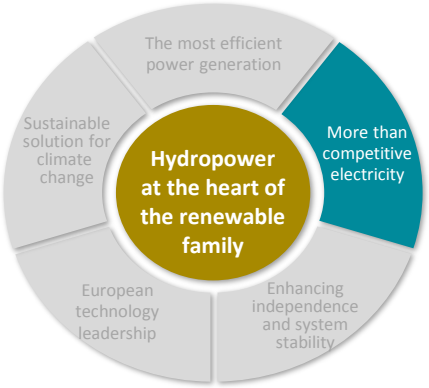
More than competitive electricity

Hydropower – crucial for a sustainable and wealthy Europe



- Competitive and fully integrated in the market.
- Proven long-term profitability.
- Important multipurpose benefits (e.g. flood control, irrigation, navigation, drinking water, tourism).

Outlook

Challenges for competitiveness:

- High capital costs and late payback
- Very long permit granting procedures
- High investment risks due to uncertainty about the future regulatory framework, electricity prices and market issues

Policy recommendation

- Simplify the permit granting procedure
- Commitment to utilize available potential
- Recognition of the multipurpose function of hydro infrastructures
- Level playing field with other generating technologies must be guaranteed

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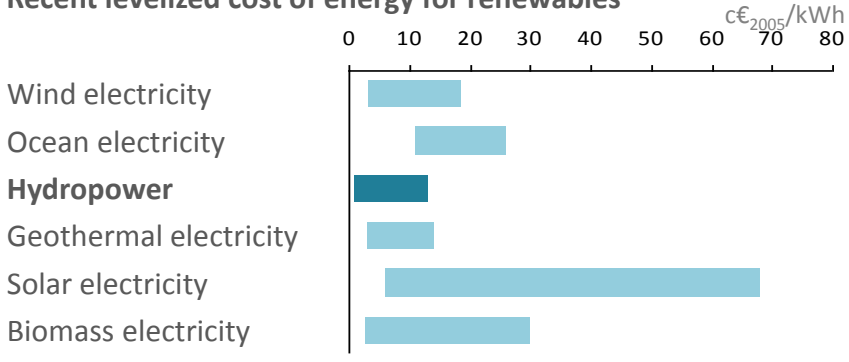
Hydropower plants are competitive

Opportunity

- Lowest generating cost of electricity

Recent levelized cost of energy for renewables



Source: adapted from IPCC, 2011

- Only half of possible potential has been developed (Eurelectric)
- Provides storage and flexibility
- Provides services needed for balancing the grid
- No significant price spread between base and peak load

Challenge

- Environmental and societal goals, regulations and requirements must be weighted against optimizing assets
- Need of balancing different goals/measures like fish passes, appropriate management of water, sediment transportation etc.

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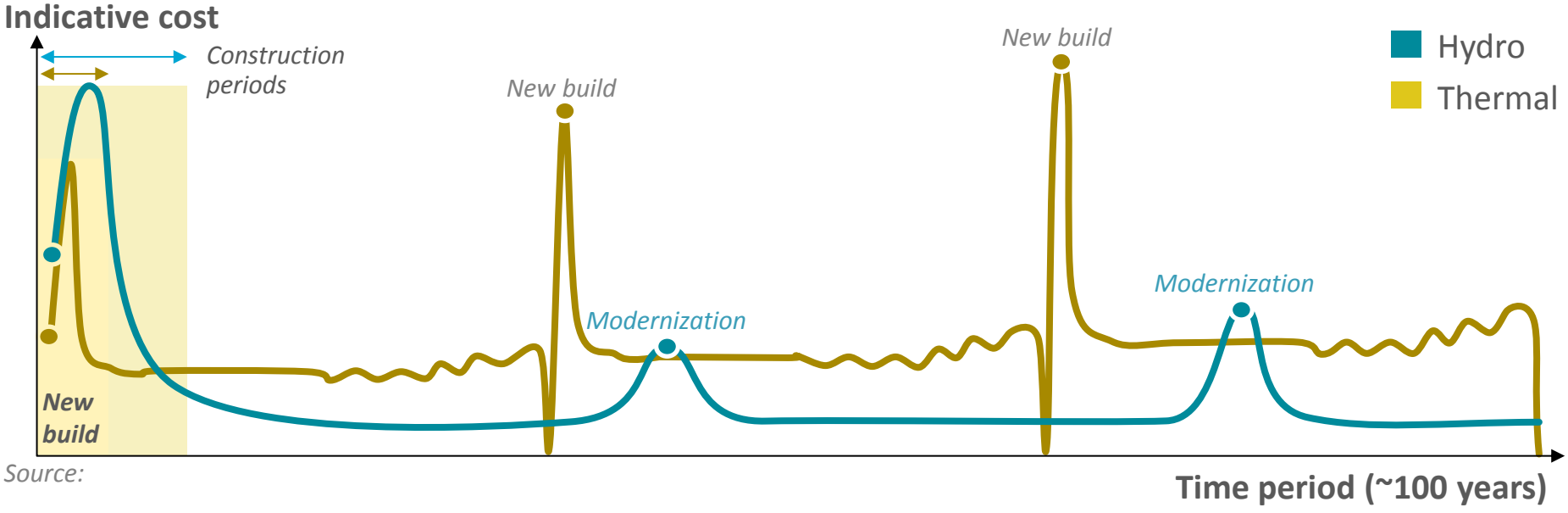
Hydropower has proven long-term profitability

Financing challenge of hydro vs. thermal plants of similar capacity (illustrative)



- Long life of hydropower infrastructure
- Quite high capital costs, but operation & maintenance costs low, even for periodic refurbishments

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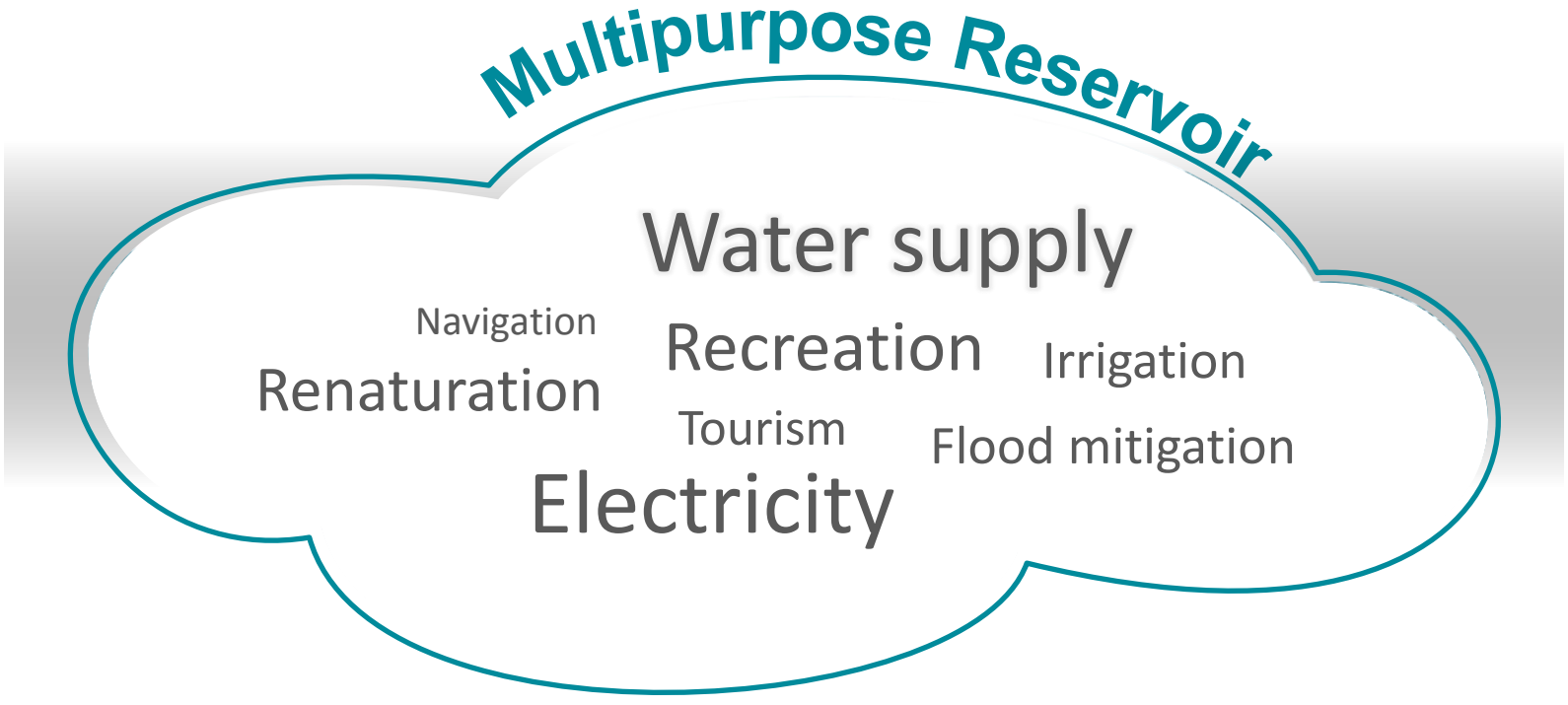
Hydro has important multipurpose benefit



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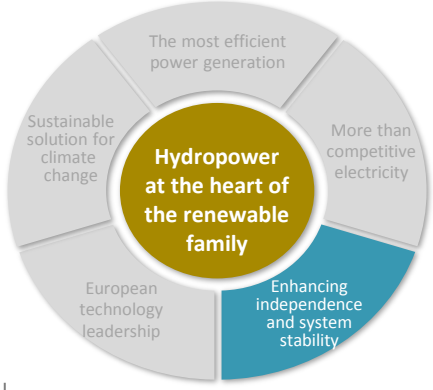
Enhancing EU energy independence and system stability

Hydropower – crucial for a sustainable and wealthy Europe



- Fosters EU energy independence
- Crucial for system stability and security of supply
- Enabler for big scale RES integration

Outlook

- The electricity system of the 21st century is about to lack highly efficient, cost effective large-scale system balancing.
- Hydro storage power plants are high-tech facilities and an important part of grid operation.

Policy recommendation

- Harmonize grid fees for PSP
- Adequate framework conditions have to be defined to meet the ambitious EU goals
- Legal framework should permit more hydro projects and speed up administrative decisions for plant building.

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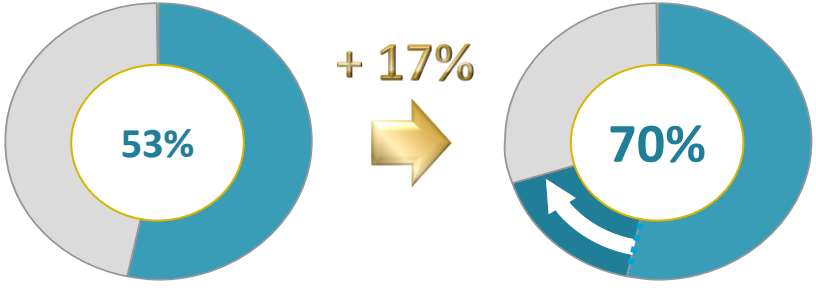
Hydropower fosters EU energy independence [1]

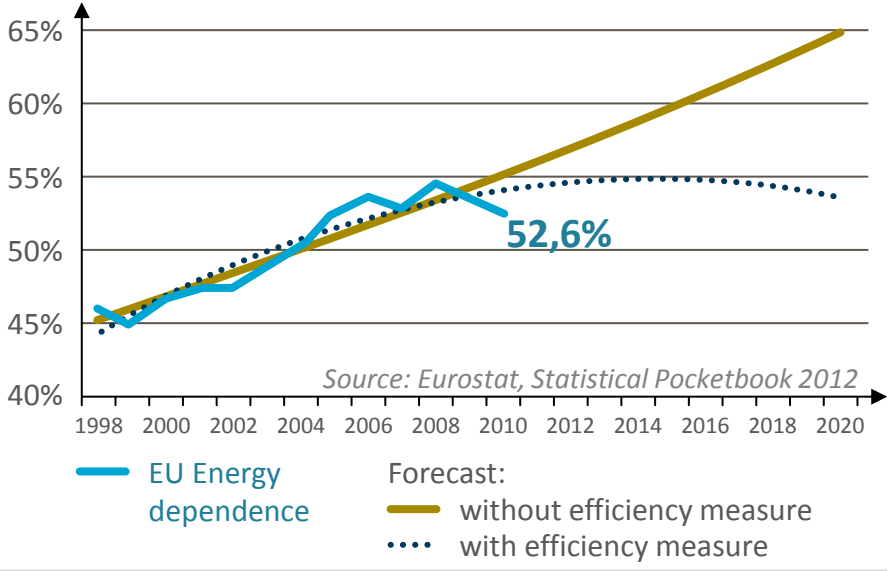
EU27 gross inland energy consumption

Today, the EU27 gross inland energy consumption is approx. 20500 TWh → 53% is imported (reference).

2020 import increase to 70% unless policy measures are taken.



Optimizing existing/ developing new potential



- **The EU 2050 roadmap discusses to reduce gross energy demand by 50% and to meet the rest with 80% RES share of inland production.**
- **Hydropower can help to achieve the EU targets and to limit the growing import dependence.**

[1] Source: EUROSTAT, Statistical Pocketbook 2012

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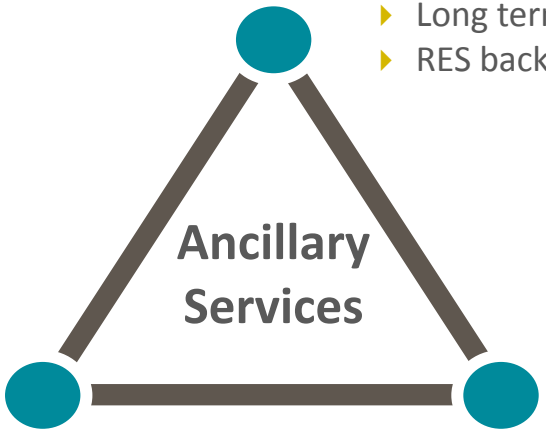
System stability and security of supply

System stability – need of ancillary services



Balancing

- Load frequ. control
- Long term capacity
- RES backup cap.

Reactive Power

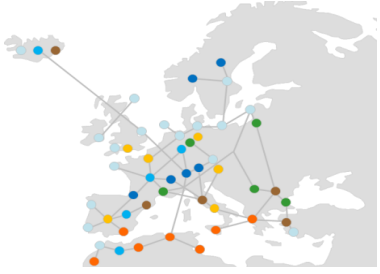
- Voltage stabilisation
- Loop flow control
- Bottleneck control
- Short circuit cap.

Black Start/Quick Start

- Remote operation
- Power system reconstruction

Security of supply

- Hydro (pumped) storage power plants → back bone for system balancing



- Hydropower helps to
  - stabilise transmission voltage
  - manage voltage drop outs
  - reduce loop flows
  - reconstruct the grid after a collapse (black start capacity of hydropower)

- **System stability is an operational precondition for security of supply**
- **Secure availability of hydro storage enables strategic reserves**

[2] Short circuit capacity is needed to operate transmission line protection effectively

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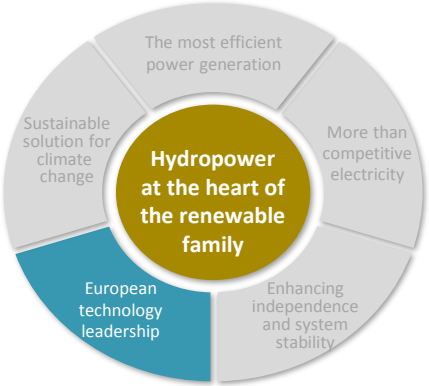
European technology leadership

Hydropower – crucial for a sustainable and wealthy Europe



- A core European industry: 2/3 world market penetration secures thousands of highly skilled jobs in Europe
- Renewable and reliable for centuries to come
- Taylor-made and innovative system solutions for hydropower sites in the world

Outlook

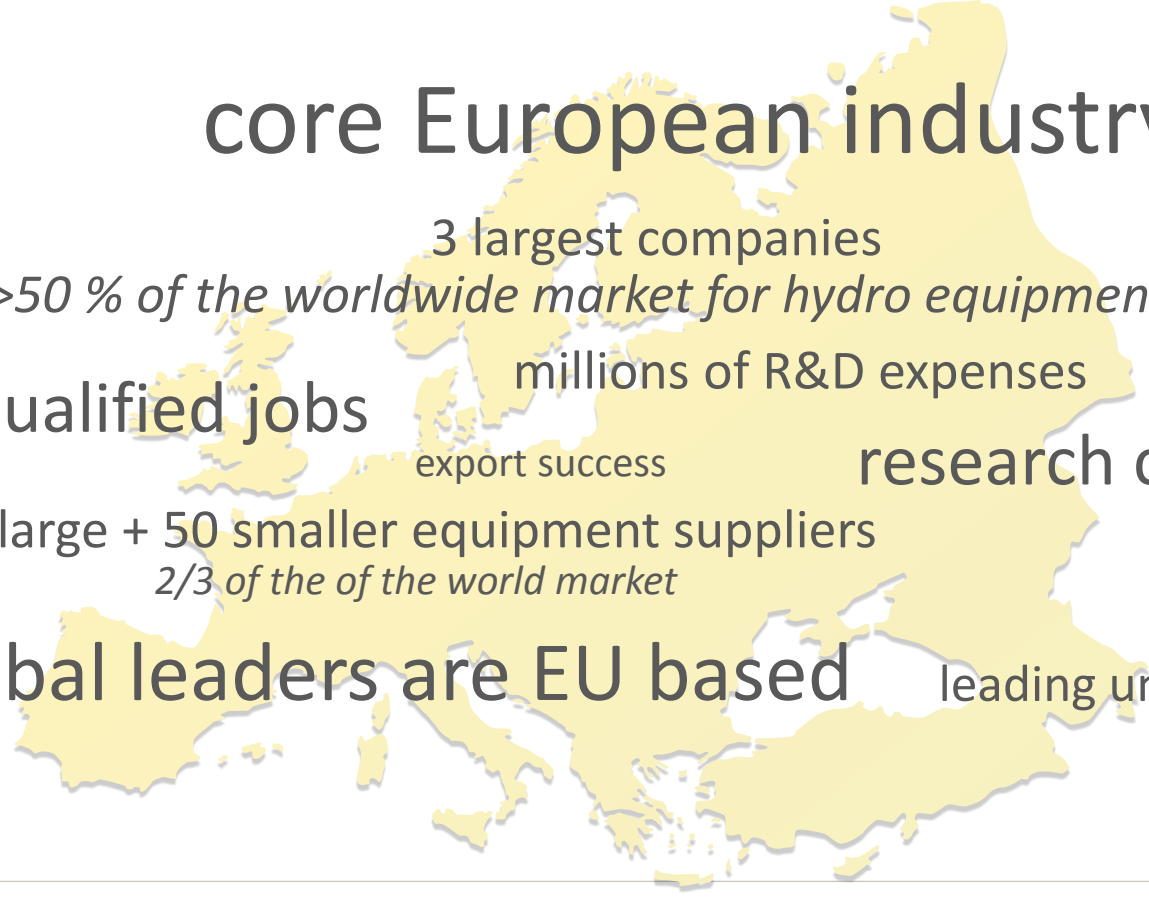
The market will require developments in:

- Dynamical operation
- Adaptation of existing technologies and management / upgrade of existing facilities
- New materials and coatings
- Environmental benefits
- Reduction in costs

Policy recommendation

- A strong market in Europe will keep leadership in the world
- Highest education standards for highly qualified jobs
- EU-R&D and technology programs should support hydropower for technology leadership in EU/Europe

A core European industry



core European industry

3 largest companies

>50 % of the worldwide market for hydro equipment supply

millions of R&D expenses

highly qualified jobs

export success

research centers

3 large + 50 smaller equipment suppliers

2/3 of the of the world market

global leaders are EU based

leading universities

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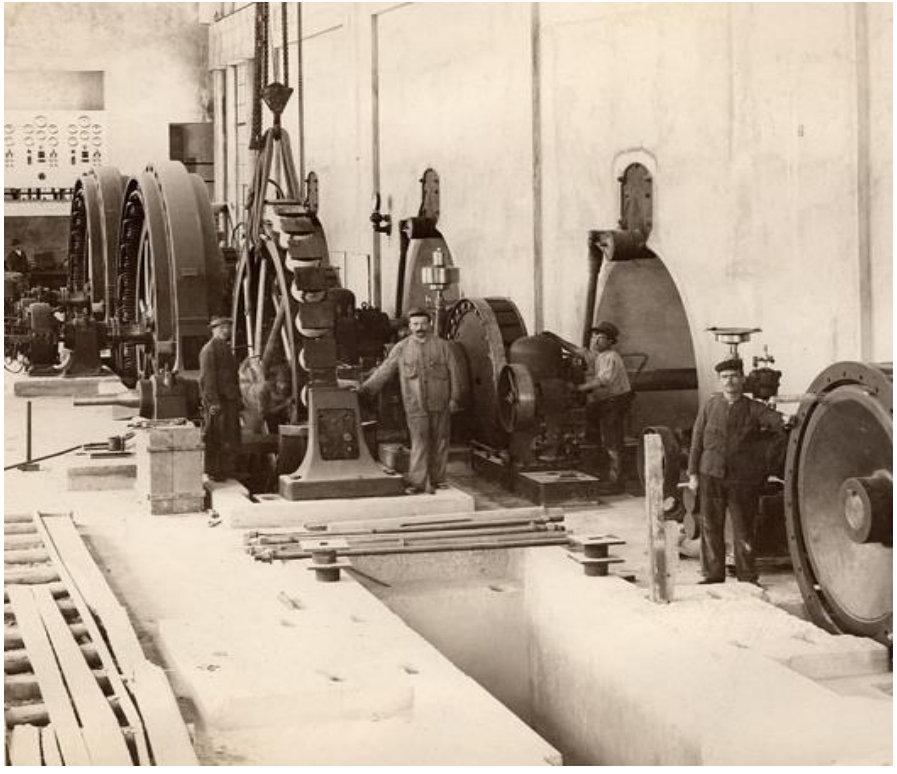
Reliable for centuries to come



Source: VERBUND

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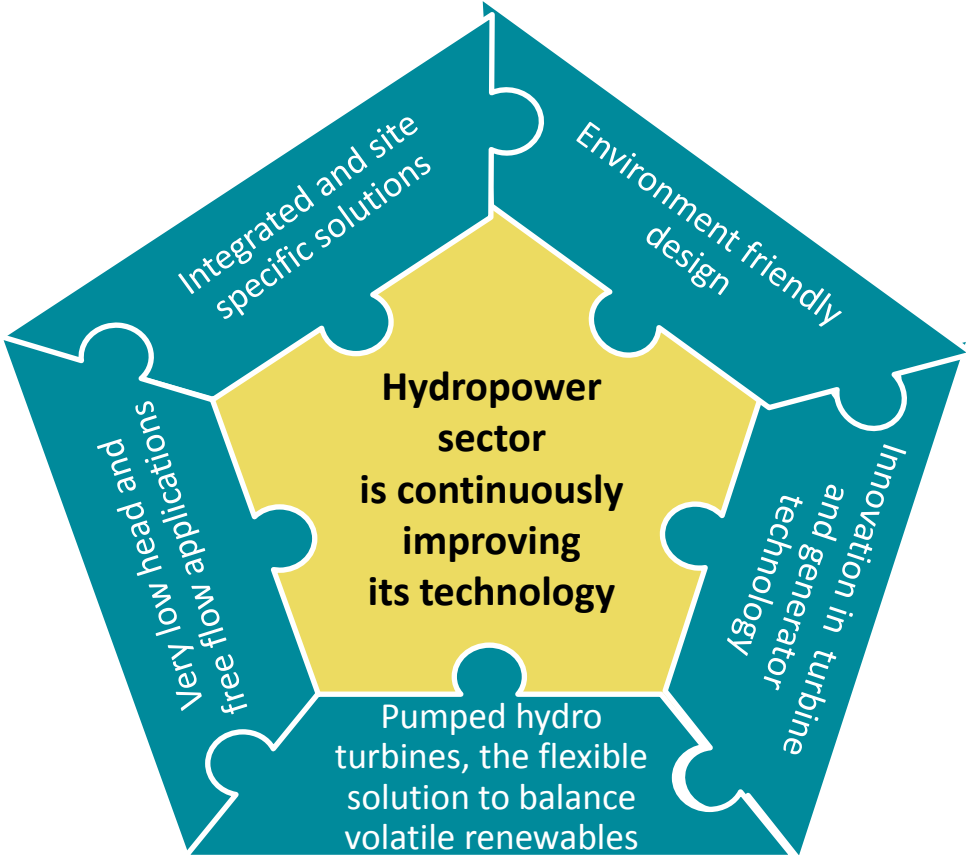
Taylor-made and innovative system solutions for the energy future



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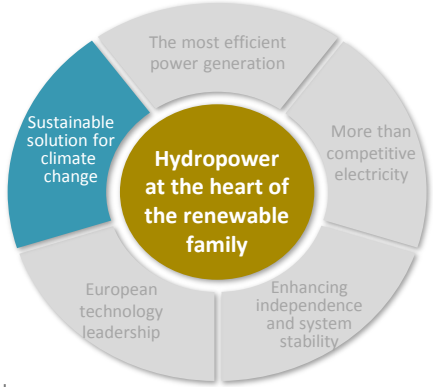
Sustainable solution for climate change

Hydropower – crucial for a sustainable and wealthy Europe



- Unique role in both mitigation of and adaptation to climate change
- Very low carbon footprint
- Contribution to EU climate targets
- Development follows strict sustainability criteria
- Offers water management opportunities

Outlook

- Crucial contribution to the climate change challenge
- Hydropower industry is willing to improve standards for balancing the different social, economic and environmental goals
- Storage hydropower can provide flexibility for the increasing renewables

Policy recommendation

- 2030/2040 policy targets for energy and climate should be established as soon as possible
- Various policy targets must not be undermined by each other

Climate Change

- The **20th Century** was the **warmest** so far,

Warming continues to rise – an increase of more than 2 C° will have **drastic consequences**

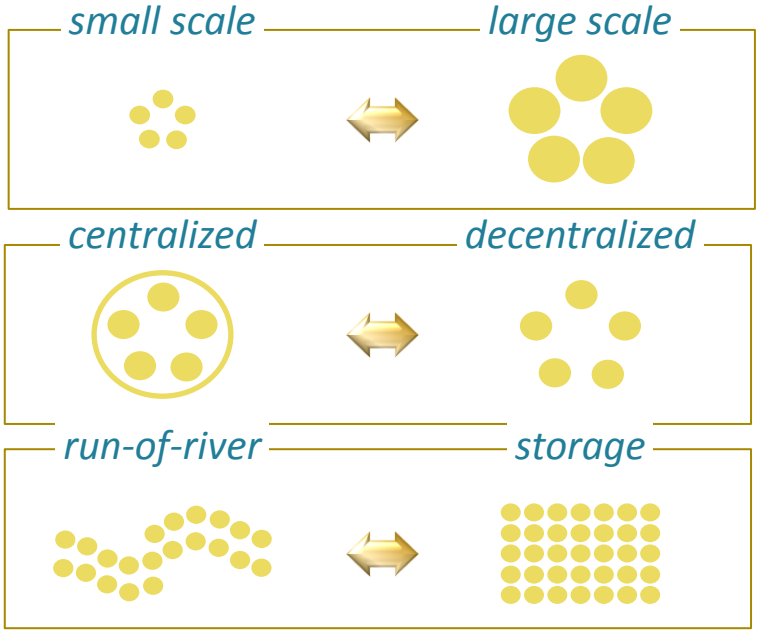
Main cause of ongoing **climate change: burning of fossil fuels** and the **associated emission of greenhouse gases**

The **energy sector is responsible for more than 50% of global emissions**.

Replacing fossil energy with renewable energy sources and carriers (such as electricity) is crucial for the reduction of GHG-emissions.

Unique role in mitigation and adaptation

Spectrum of hydropower



- Hydropower´s low carbon foot print is crucial in mitigating climate change.
- Storage hydropower provides quick and cost efficient flexibility.
- Hydropower contributes with flexibility and increases security of supply at any time.
- Hydropower plants have a crucial role in avoiding inundations during floods, providing water in dry seasons and irrigation and supply of drinking water.
- Creating reservoirs is often the only way to adjust the uneven distribution of water in space and time.

Integrated water management will become an important tool in adapting to climate change.

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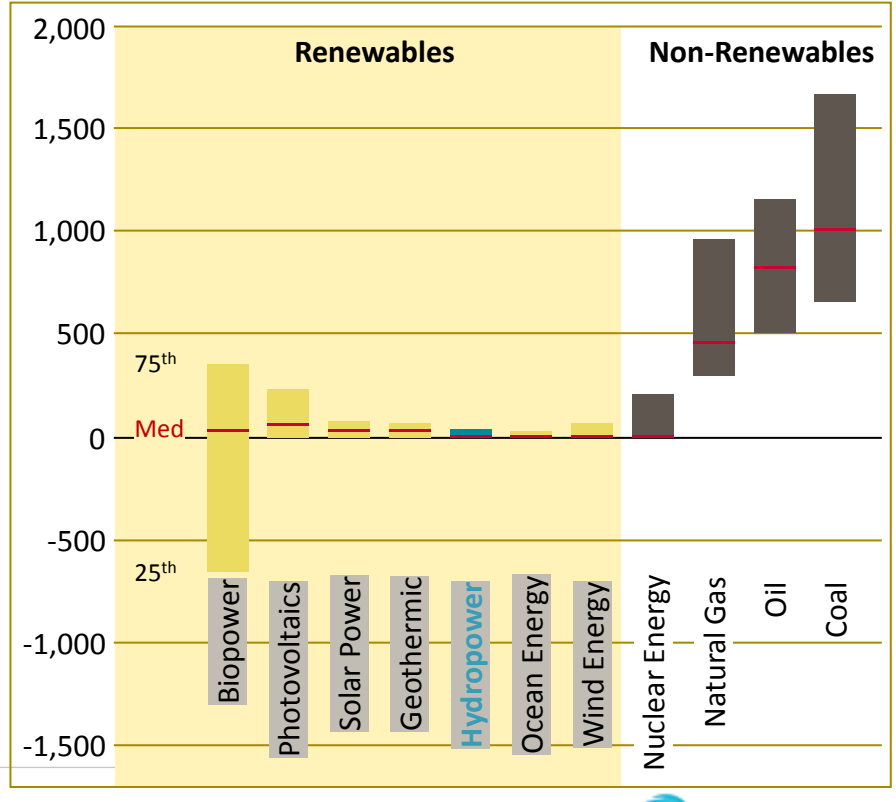
Low carbon footprint

- Definition: total quantity of GHG emitted over the life cycle of a product/process.
- Low carbon footprint: essential for environmental compatibility of a product and for the transition to a low-carbon future.
- Hydropower plants have lowest carbon footprint (shown by the examination of different electricity generation technologies).
- Emissions from hydropower: mainly caused indirectly during the construction phase.

Lifecycle GHG Emissions, g CO_2 eq / kWh



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Strict sustainability criteria are applied

Utilization of the energy in water has an impact on water systems and the environment

- Modifying a water body affects those who are in close vicinity.
- Cost-benefit consideration for all construction projects necessary.
- Integration of all stakeholders and the implementation of accompanying measures can improve a region´s value.
- Guidelines to minimize impacts and criteria for sustainable development have been developed and improved.

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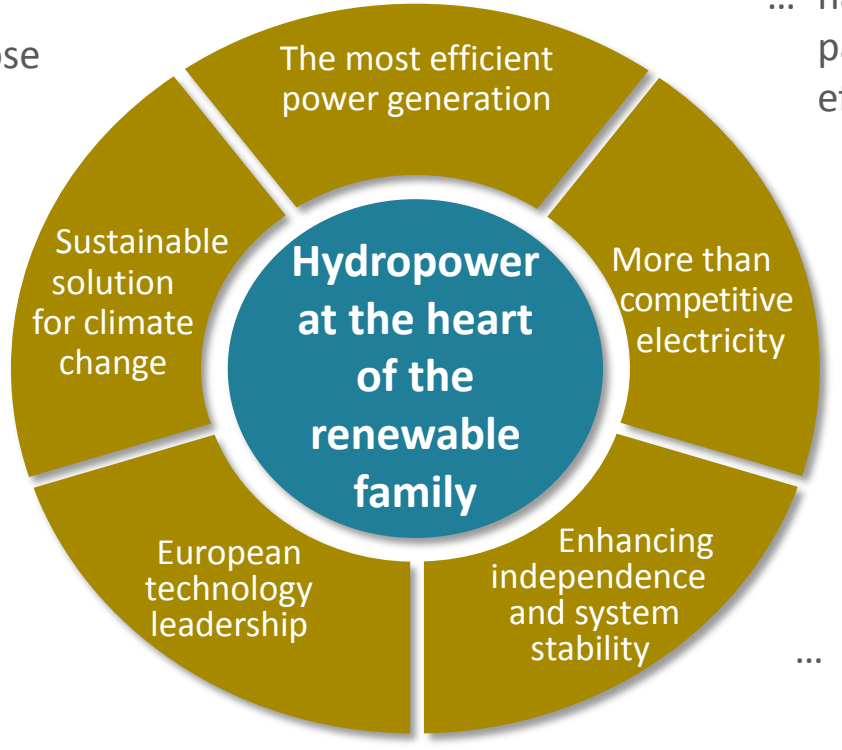
Hydropower at the heart

- … has long-term profitability and important multi-purpose benefits.
- … has a very low carbon-, water- and land footprint.
- … has a unique role in mitigation and adaptation to climate change.
- … is reliable for centuries to come.
- … industry is leading on a global level.



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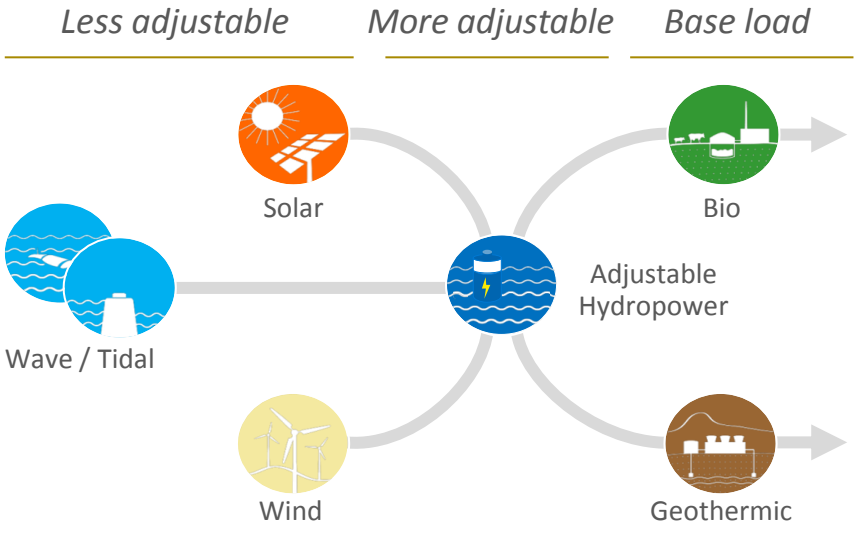
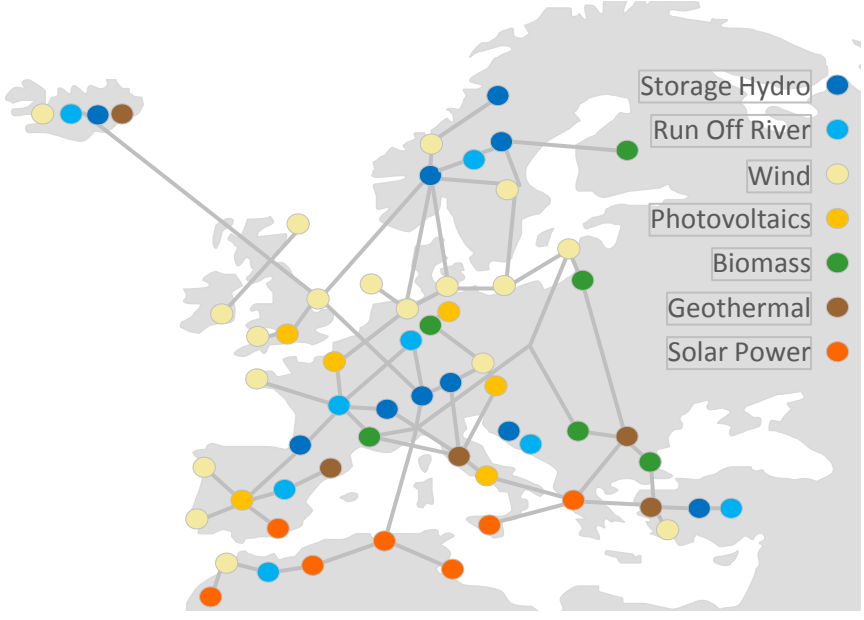
A renewable energy future is possible

The renewable family



Vision of the renewable energy system



- Renewable technologies interplay as a family
- Different sizes, capacities and characteristics create synergies and make each other stronger
- Hydropower is at the heart with its storage and flexibility abilities

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The heart of the renewable family

Outlook and Challenges

- Challenges for the future: expansion of wind and solar power.
- A system with energy storage and balancing services through hydropower would allow more wind power in the system without compromising the security of supply.

Policy Recommendations

- European policy makers need to recognize the important role of hydropower in the European power systems.
- Sufficient transmission capacities need to be facilitated in order to exploit the full potential of the renewable family.

The work continues…..

Macro-economic study on hydropower

The hydropower sector's contribution to a sustainable and prosperous Europe.

What is the macro-economic value of hydropower for Europe today and tomorrow?

Project group "Strengthening the voice of hydropower"

Content of the study

Overall objective:

To contribute to draw the attention of policy makers and other stakeholders to the significant benefits which hydropower brings to the European society.

- Contributions to economic and social welfare
- To reaching the European energy, climate and environmental goals

- Based on sound technical analysis
- Tailored to use in communication and advocacy work with European and national policy makers
- Illustrating and explaining issues and economic and d benefits in a clear, understandable and convincing way
- Case examples
- Including multipurpose effects

18 Financial contributors so far

Confirmed financial contributions:
150.000 €

Nationalities	Companies	Associations
Austria	VERBUND, TIWAG, ÖBB	Oesterreichs Energie
Norway	Statkraft	Energy Norway
Sweden	Vattenfall	Svensk Energi
Germany	E.ON, EnBW, Schluchseewerk	
Italy	Enel	
Switzerland		Swiss Electric, VSE, SWV
Portugal	EDP	
European		HEA
International		IHA

THANK YOU

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