

NORWEGIAN WATER RESOURCES AND ENERGY DIRECTORATE
(NVE)

Hydropower development in Norway

Reconciling environmental and energy policy and regulation

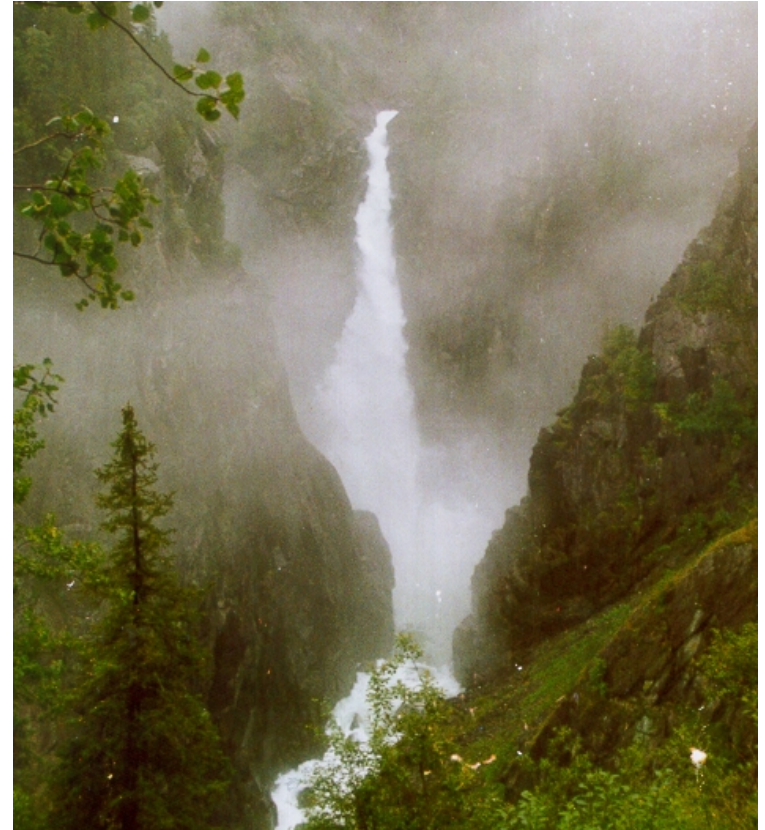
Jens Aabel
Head engineer



Background

1885 -

- first electric hydro power plant in Norway
- supply for the towns and Rural areas, light
- power intensive industry, pulp and paper, chemical, smelting



1945 -

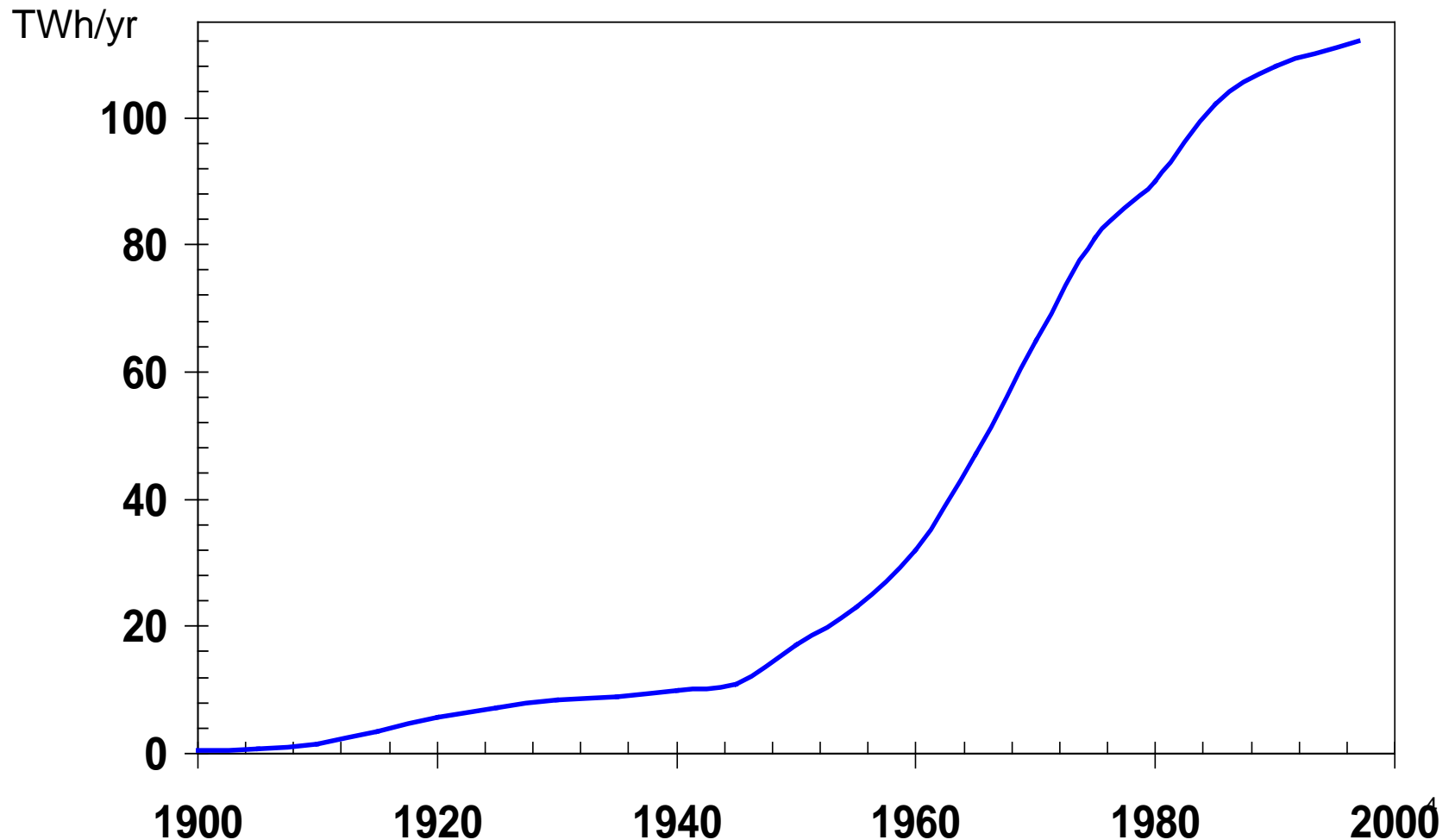
- Rebuilding the country after World War II**
- Growing demand for electricity**
- rapid development of new hydropower plants**



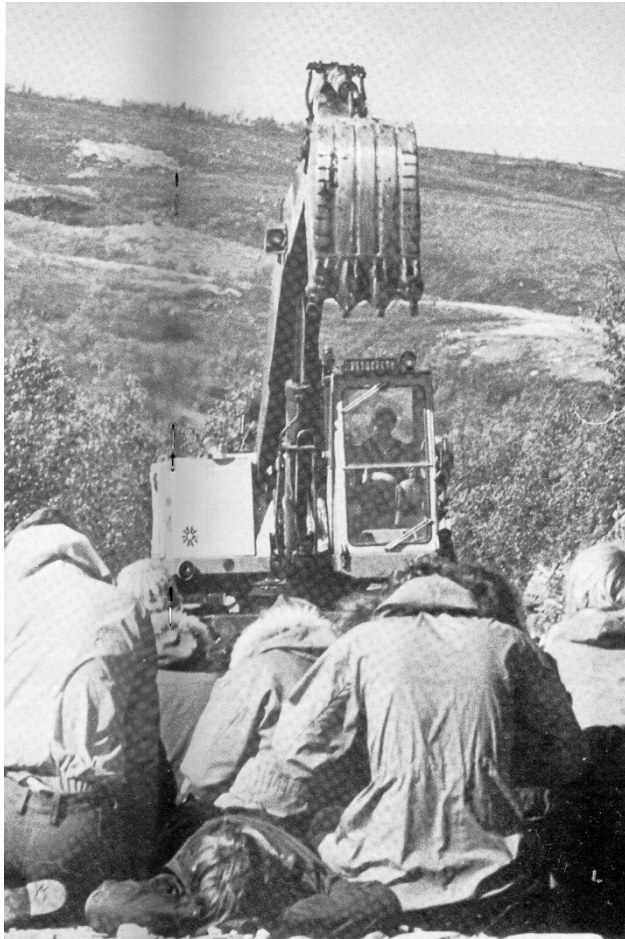
HYDROPOWER IN NORWAY

Mean annual production

1997:
112 TWh/yr



1960s- 1980s



- Growing public concern about the environment
- Conflicts, demonstrations

- Demand for EIAs

- Alternatives
- Mitigating measures

- Protection plan

- Master plan



Protected river systems



1973 - 2009

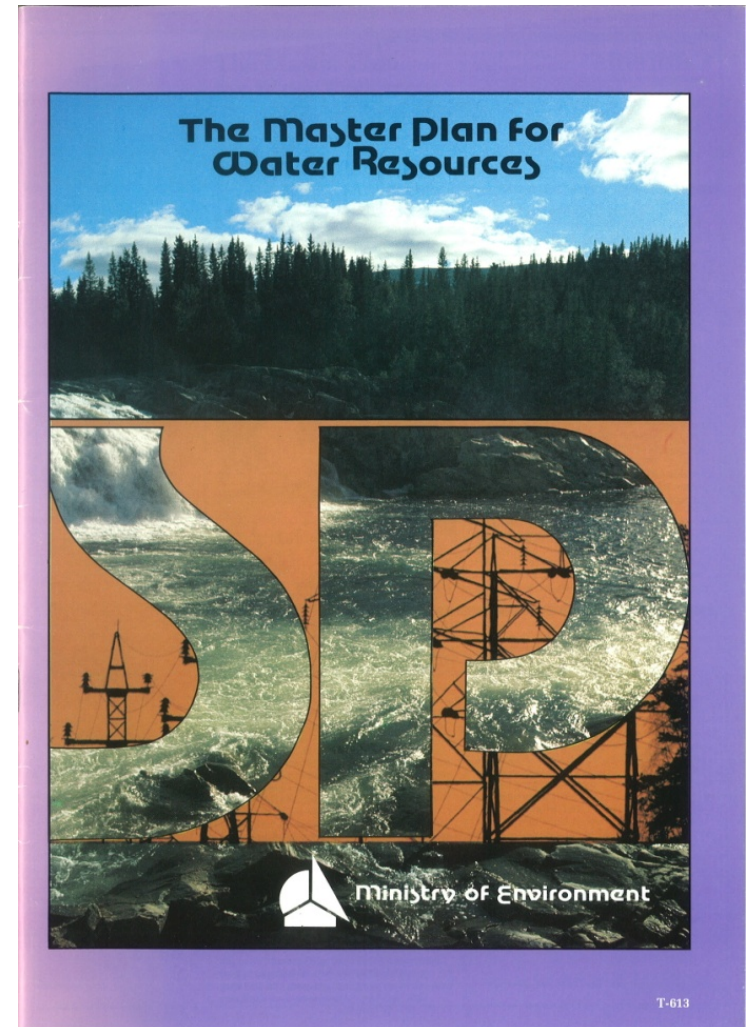
Protection Plan I - VI

**388 river systems are
protected
from hydropower
development**

**Out of a total, theoretical
potential of 214 TWh, 50 TWh
is protected against HP
development**

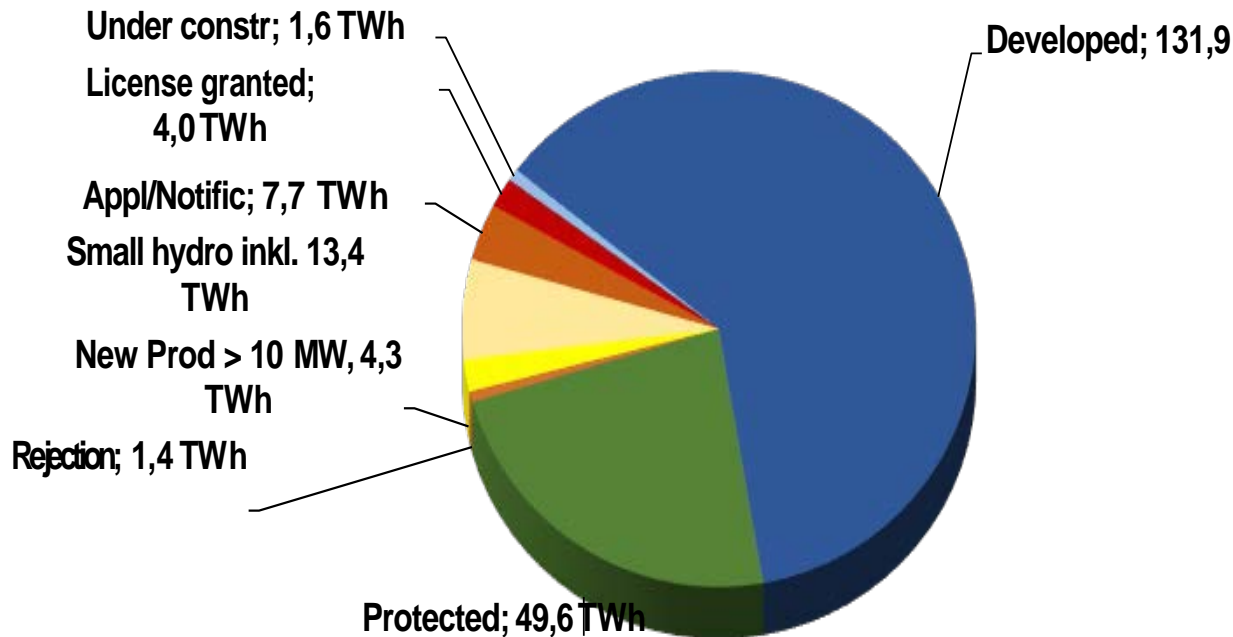
1984 - 92

- **Master Plan for the remaining hydropower resources.**
- **Priority grouping of projects depending on economy and environmental impacts.**



Hydropower potential 1.1.2015

Mean annual production 213,9 TWh, ref 1981-2010



Impact assessment (IA)

- Environment
 - Hydrology
 - Geology
 - Landscape
 - Local climate
 - Water quality
 - Freshwater biology
 - Terrestrial biology
 - Cultural monuments
- Natural resources
 - Agriculture
 - Forestry
 - Freshwater resources
 - Marine resources
 - Minerals & gravel
- Community
 - Industries
 - Population
 - Service
 - Local financials
 - Infrastructure
 - Social conditions
 - Health
 - Outdoor life



Focal Issues in Licensing

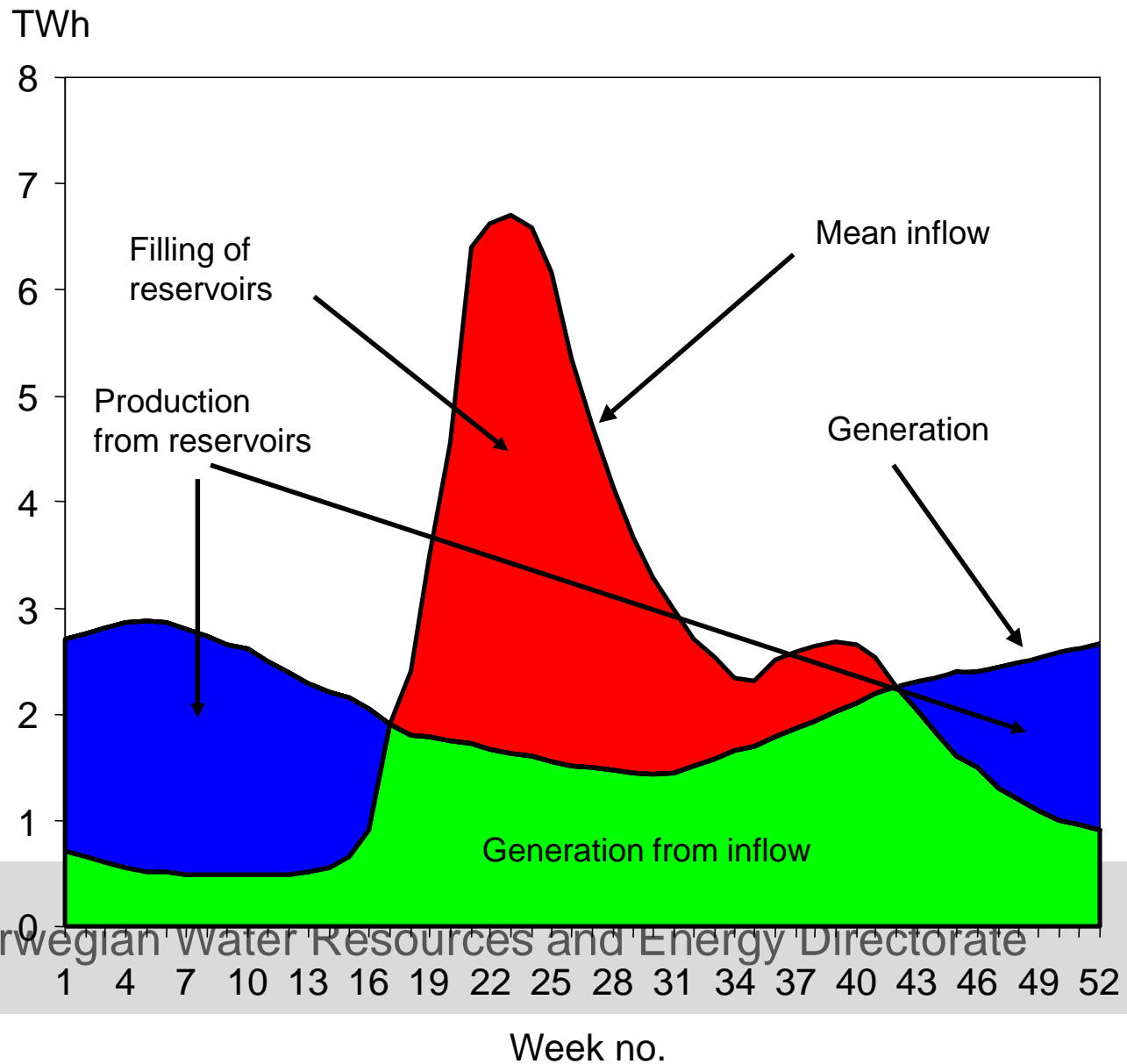
- Environmental, Cultural and Social Impacts
 - (National Framework)
 - (EU Water Frame Directive)
- Secure delivery of Energy
- New Renewable Production
 - Norw/Swe 26,4 TWh by 2020
 - EU directive 67,5 % renewable

The Norwegian Hydro Power System

- Reservoir capacity:
85 TWh (62 bill. m³)
- Reservoir capacity is
about 70% of mean
production capacity
- Approximately 50%
of total reservoir
capacity in Europe



Water Inflow and Electricity Generation during a year



Revision of conditions



- Licence is normally issued for unlimited time
- After 30 years it is possible to request a revision of the licence conditions.
- The purpose of revision is to update and “modernise” the conditions in order to meet new environmental requirements
- Revision is thus limited to environmental issues, e.g. minimum/environmental flow, environmental funds (new) restriction on manoeuvring reservoirs
- **Limiting reservoir levels (HRWL / LRWL), are normally not subjected to revision.**



Revision of Conditions (2)

- All Hydropower Licenses (400) are subject to revision of conditions within 2022.
- Revision will be done within the framework of EU water directive (as much as possible within national priorities)
- Revision might reduce electricity Production by 3-4 TWh Annual Production

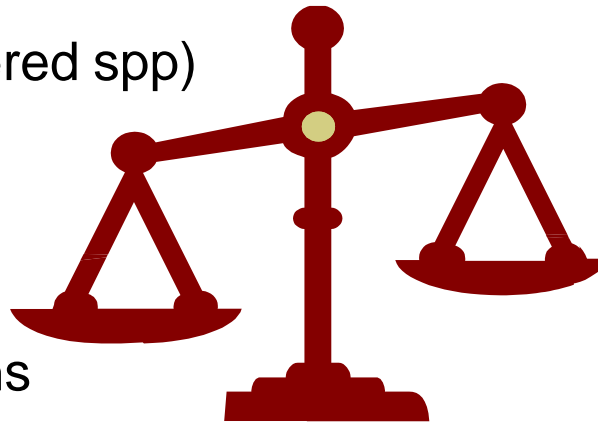
Cost/benefit issues

Restoration potential:

- Fish and fishing
- Biological diversity (endangered spp)
- Landscape and recreation

Production loss:

- Environmental flow
- Dam maneuvering restrictions




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Main challenge

Global environment vs nature protection ?



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An aerial photograph showing a large, long dam made of dark, textured material (possibly gravel or stone) stretching across a deep valley. The dam is filled with water, creating a large reservoir. The surrounding landscape is rugged and mountainous, with steep slopes and some patches of green vegetation. The sky is clear and blue.

Thank you for your attention