



The Norwegian Master Plan on Hydropower *Highlight the hydropower feasibility studies*

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THE NORWEGIAN MASTER PLAN FOR HYDROPOWER DEVELOPMENT

BACKGROUND

- **Based on previous similar work**
 - “Studieselskapet for Norges vannkraft” 1960-65
 - NVE established a resource unit in 1962
 - Watercourse Conservation Plans completed in 1973 (I), 1980 (II) and the conservation plan no III was completed in 1984
 - Small Hydropower Potential studied in 1978-1981

Small hydro power potential 1978 -1981

- All schemes with capacity between 1 and 10 MW
- Pre-feasibility study to identify the power output and cost
 - A two pager was developed to sum up each of the reports
 - NVE used own resources and consultants
 - All consultants had to use a cost manual developed by NVE and map data and hydrology from NVE
 - Site visits of all schemes
 - 7.5 TWh new feasible energy generation capacity identified

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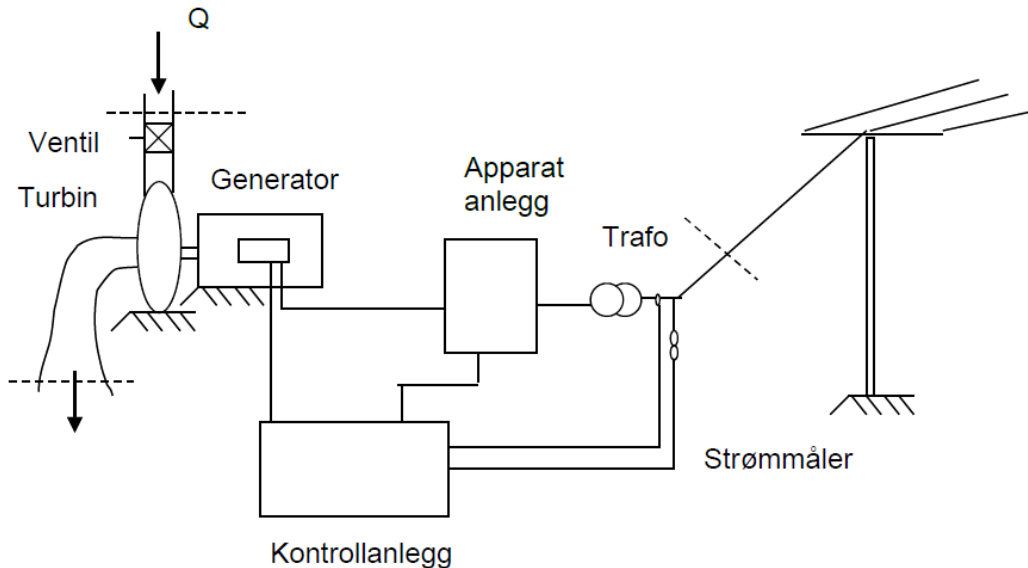
Technical and Economical tasks

- Produce a manual for presentation of the schemes (Chapter 3)
 - Secure correct runoff assessments
 - Develop methodology for output and generation capacity assessments
 - Produce reports by the use of own resources and engage and follow up consulting companies depending on human resource capacity in NVE at any time
 - Close cooperation with local hydropower companies

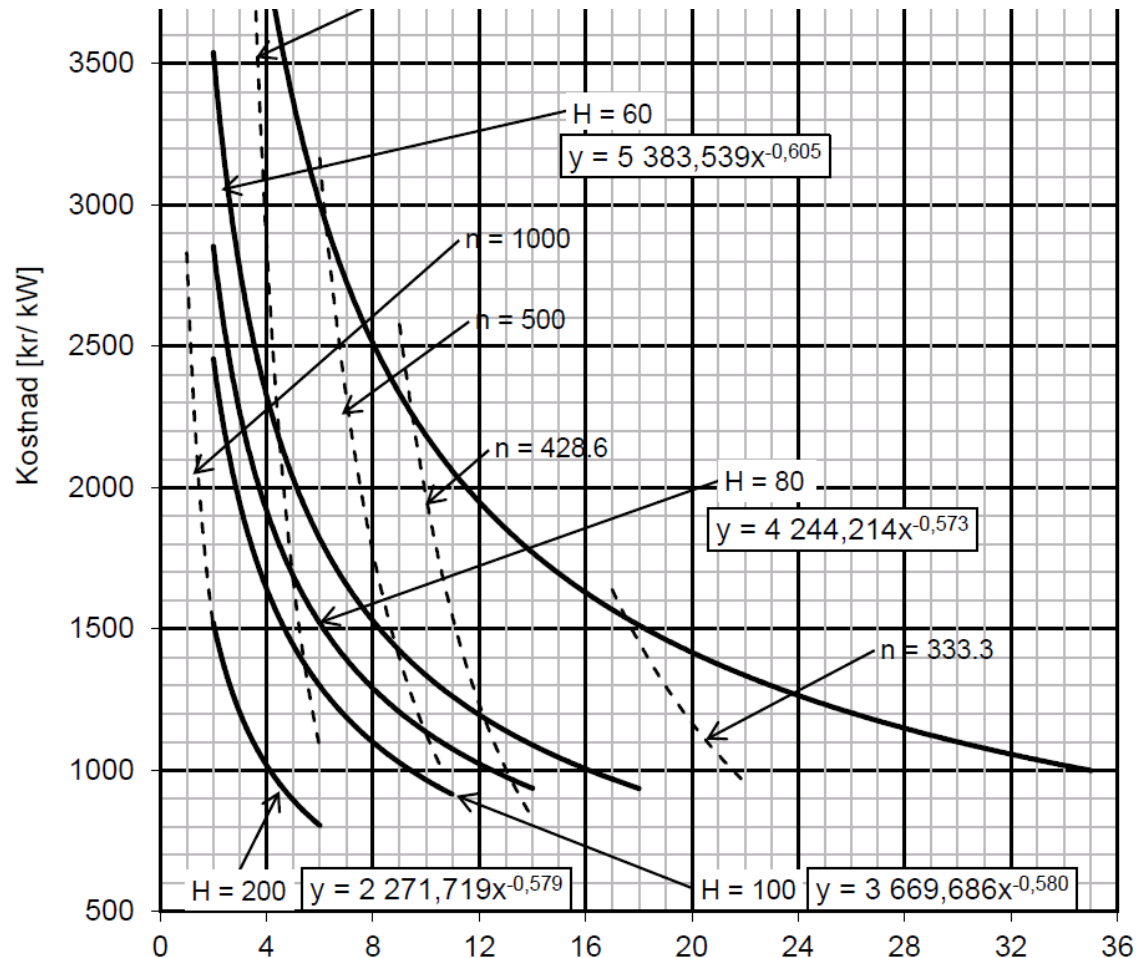
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Technical and Economical tasks

- The cost manual from the small hydro power work were further developed
 - Updating of cost manual for plants between 1 and 10 MW
 - Produce a new cost manual for schemes with capacity over 10 MW



Example Small Francis turbine



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Technical and Economical tasks

- 6 Economy classes
 - The system Economy classes were introduced for the hydropower schemes. The annual generation capacity was compared to the percent of capacity for generation in wintertime. This should secure extra value for schemes with reservoir capacity and winter production.
 - A high winter production would give higher economy class even if the cost pr kWh was higher than a cheaper scheme with low winter production.

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- Phase I included 310 separate projects with 540 alternatives, total 40 TWh/year
- Phase II included 151 projects with 236 alternatives
- Phase III included 82 projects with 165 alternatives

- Total 543 projects with 941 alternatives

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- The most important projects were handled in Phase I, including several large projects. However, a selected group of projects (approximately 10 TWh) was reserved for the increased electricity demand. Several of these projects were already in the licensing system.
- Phase II included mostly small and medium sized projects (1-50 MW)

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- Phase III was a result of a resource study on the potential for upgrading and enlarging of existing hydropower plants, which required a new licensing procedure.

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Why revision every 5 year ?

- New maps available
- Improved hydrology data
- Technological innovations
- New user groups - new conflicts
- Enhanced opportunities for buying/selling electricity to neighbour countries
- Other options for electricity production

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Regional Economy

- This was added later and used as a correction for the grouping of projects. In evaluation of the schemes, regional economy only had a minor impact

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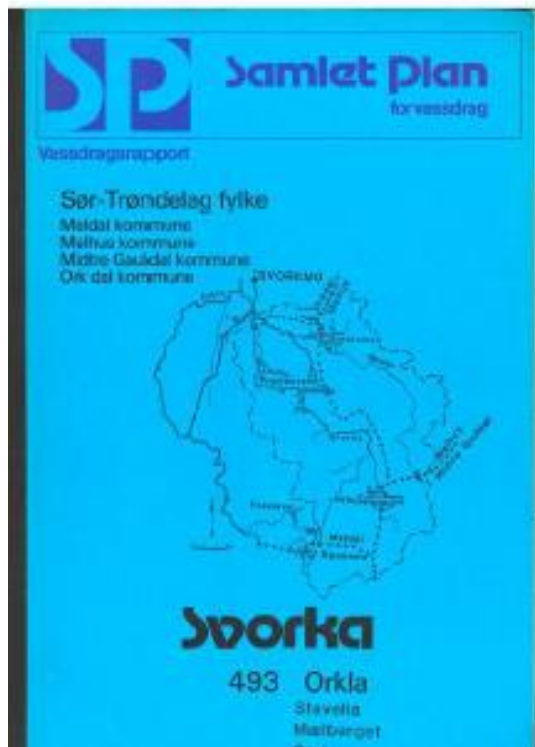
Procedures

- Unified planning and assessment procedures
- Unified cost estimating system
- The same expert groups in different areas analysed all projects
- Classification system taking into account economy and conflicts

Summary sheet

Vassdragsrapporter

Project Reports



Samlet Plan		OMRÅDEKLASSIFISERING, FORELØPIG KONSEKVENSKLASSIFISERING, DATAGRUNNLAG																				
Prosjekt: Svorka/Trilvja	Alternativ: 4	Vassdrag: 493 ORKLA																				
Fylke(r): Sør-Trøndelag	Kommune(r): Orkdal, Meldal, Melhus, Midtre Gauldal																					
Maks. ytelse (MW):	26	Spesifikk kostnad (kr./kWh): 2,40 (pr.1.1.82)																				
Middlere årsproduksjon (GWh/år):	67 (37/30)	Kostnadsklasse: III																				
Brukerinteressertema	1 Områdets verdi før utbygging	2 Foreløpige konsekvenser av evt. utbygging	3 Data-grunnlag	4 Merknader																		
Naturvern	****	Middels neg.	B																			
Friuftsliv	***	Middels neg.	C																			
Vilt	***	små neg.	C																			
Fisk	***	små neg.	B																			
Vannforsyning		Ingen	B																			
Vern mot forurensning		små neg.	C																			
Kulturminnevern	****	Store neg.	B																			
Jord- og skogbruk		Ingen	B																			
Reindrift	***	Middels neg.	B																			
Flom- og erosjonssikring		ingen	C																			
Transport		Middels neg.	C																			
Is og vintemperatur		Ingen	C																			
Klima		Små neg.	C																			
Regionalekonomi	Kraftutbyggingen vil få beskjeden virkning på den regionale økonomien. I anleggsperioden vil ca 50 personer kunne bli sysselsett. Det kan bli 1-2 varige arbeidsplasser ved anlegget.																					
1 Områdets verdi før utbygging: Angir en klassifisering av prosjektområdet generelle verdibruk sett uavhengig av prosjektet. En slik prosjektuavhengig områdevurdering er et nødvendig utgangspunkt for konsekvensvurderingen for flere interesser, f.eks. naturvern og friluftsliv.		Klassifiseringsvektar: **** Meget høy verdi *** Høy verdi ** Middels verdi * Uten/ingen verdi																				
2 Foreløpige konsekvenser av evt. utbygging: Disse konsekvensvurderingene er foreløpige og basert på en vurdering av prosjektet isolert. Konsekvensvurderingene vil kan for flere interesser/temaer endres når prosjektet vurderes sammen med andre prosjekter i Samlet Plan. Følgende klassifiseringsvektar blir brukt:		<table border="1"> <tr> <td>MEGET GODT</td> <td>STORE</td> <td>MIDDELE</td> <td>SMÅ</td> <td>INGEN POSITIVE ELLER NEGATIVE KONSEKVENSER</td> <td>SMÅ</td> <td>MIDDELE</td> <td>STORE</td> <td>MEGET STORE</td> </tr> <tr> <td colspan="4">NEGATIVE KONSEKVENSER</td> <td></td> <td colspan="4">POSITIVE KONSEKVENSER</td> </tr> </table>			MEGET GODT	STORE	MIDDELE	SMÅ	INGEN POSITIVE ELLER NEGATIVE KONSEKVENSER	SMÅ	MIDDELE	STORE	MEGET STORE	NEGATIVE KONSEKVENSER					POSITIVE KONSEKVENSER			
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NEGATIVE KONSEKVENSER					POSITIVE KONSEKVENSER																	
3 Klassifisering av datagrunnlag: Følgende klassifiseringsvektar blir brukt: A. Meget godt. B. Godt. C. Middels. D. Mindre tilfredsstillende.																						



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Consequence classes

Economy classes

	C1	C2	C3	C4	C5	C6	C7	C8
E1	1	1	2	3	5	7	9	12
E2	1	1	2	3	5	7	9	12
E3	2	2	3	4	6	8	10	13
E4	3	3	4	5	7	9	11	14
E5	4	4	5	6	8	10	12	15
E6	5	5	6	7	9	11	13	16

Category 1



Category 2



Category 3



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Other Experiences

- Strong political backing required - a prerequisite for successful implementation of the plan
- Social and local economic impacts must be included, and regional economy must be more important
- Too many projects listed for development outside the economic interest for developers due to low firm power capacity
- Problem comparing small and large scale projects
- Revisions and adjustments necessary

Thank You



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