

Country report: Norway

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Research Center for Sustainable Solar Cell Technology

(«FME SUSOLTECH»: 2017 – 2025 ~ 290 MNOK)



NORGES BONDELAG



Agenda

- A brief history of PV in Norway
 - Status for PV in Norway
 - Trends
 - 2023 market breakdown
 - Ground-mounted PV and BAPV/BIPV in Norway
 - Access to area
 - Concession processes
 - PV systems integration
 - PV in Norwegian politics
 - Why collaborate?
- «8TWh by 2030!»

A brief history of PV in Norway

- Early mover in niche markets
 - Remote locations with high alternative costs a historical driver for offgrid PV systems
 - Cabins, antenna stations, lighthouses...
 - Offgrid capacity > ongrid capacity as late as in 2015 in Norway
- Recently fast growth in grid connected PV systems
 - From a low level
- Early movers in process industry
 - Scanwafer ('96) the biggest PV Si wafer factory in the World
 - Still unique role in Europe
- Strong background in supporting material-related (Si) R&D
- Rapidly growing downstream PV industry
 - Domestic installations
 - Internationally oriented companies



A brief history of PV in Norway



Brussels, 08.03.2024

EUROPEAN SOLAR PV INDUSTRY ALLIANCE
Current state of the EU photovoltaic industry

An in-depth look at the ingot-wafer supply chain
Final report summarizing the findings of interviews conducted for the
supply chain gap study

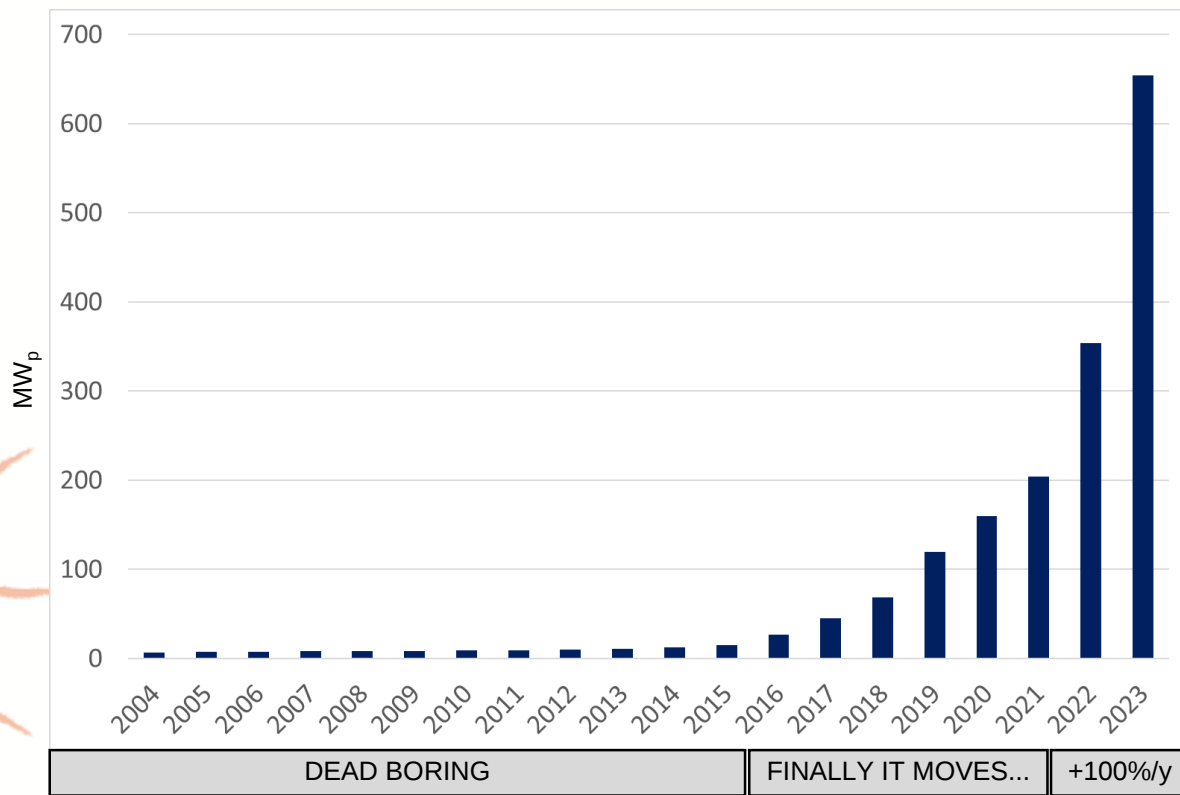
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any use which may be made of the information contained therein

Role within the PV supply chain	Country HQ	Component	Company name	Annual Production Capacity (Current / Planned)
Polysilicon producer	Germany	Poly-Si	<i>Wacker</i>	Total: 80k Tons ~32 GWp, Undisclosed % for Solar
Polysilicon producer	US		<i>Hemlock (HSC)</i>	Total: 30-35k Tons ~14 GWp, with 60-65% for Solar
Polysilicon producer	Netherlands		<i>Resi BV</i>	Planned Initial Capacity 12.5k Tons ~6 GWp & Full production of 25k Tons ~12 GWp
Polysilicon producer	Sweden		<i>Green14</i>	Planned: 25k Tons ~10 GWp Manufacturing plant using green hydrogen plasma.
Supplier of Crystal growing equipment	USA/China	Cz Pullers	<i>Linton Crystal Technologies</i>	Total: ~6500 Cz pullers ~100 GWp
Supplier of Crystal growing equipment	France		<i>ECM Greentech</i>	-
Supplier of Crystal growing equipment	Germany		<i>PVA TePla CGS</i>	Total: 50 - 70 Cz pullers ~0.7 - 1 GWp (Focused on capacity for Semi-pullers which are not 1:1 to Solar GWp)
Ingot and Wafer producers	Norway	Ingots and Wafers	<i>Norwegian Crystals</i>	(Formerly) Total: 0.25 - 0.5 GWp
Ingot and Wafer producers	Norway		<i>NorSun</i>	Total: 1 GWp Planned: +3 GWp (Norway) +5 GWp (US)
Wafer producers	Germany	Wafers	<i>Nexwafe</i>	Planned: 0.25 GWp
Potential Crucible supplier	France	Crucibles	<i>Saint-Gobain</i>	-
Potential Crucible supplier	Norway		<i>DIGLOO AS</i>	Planned 4 furnaces, able to produce: 25,000 crucibles of 37 inch diameter ~15 GWp
Supplier of high purity Quartz	Norway	High purity Quartz used in Crucibles	<i>The Quartz Corp</i>	Undisclosed current capacity, but enough to maintain market share in the PV market whose total consumption in 2023 was near to 405GWp or ~73K - 81kTons

Status for PV in Norway

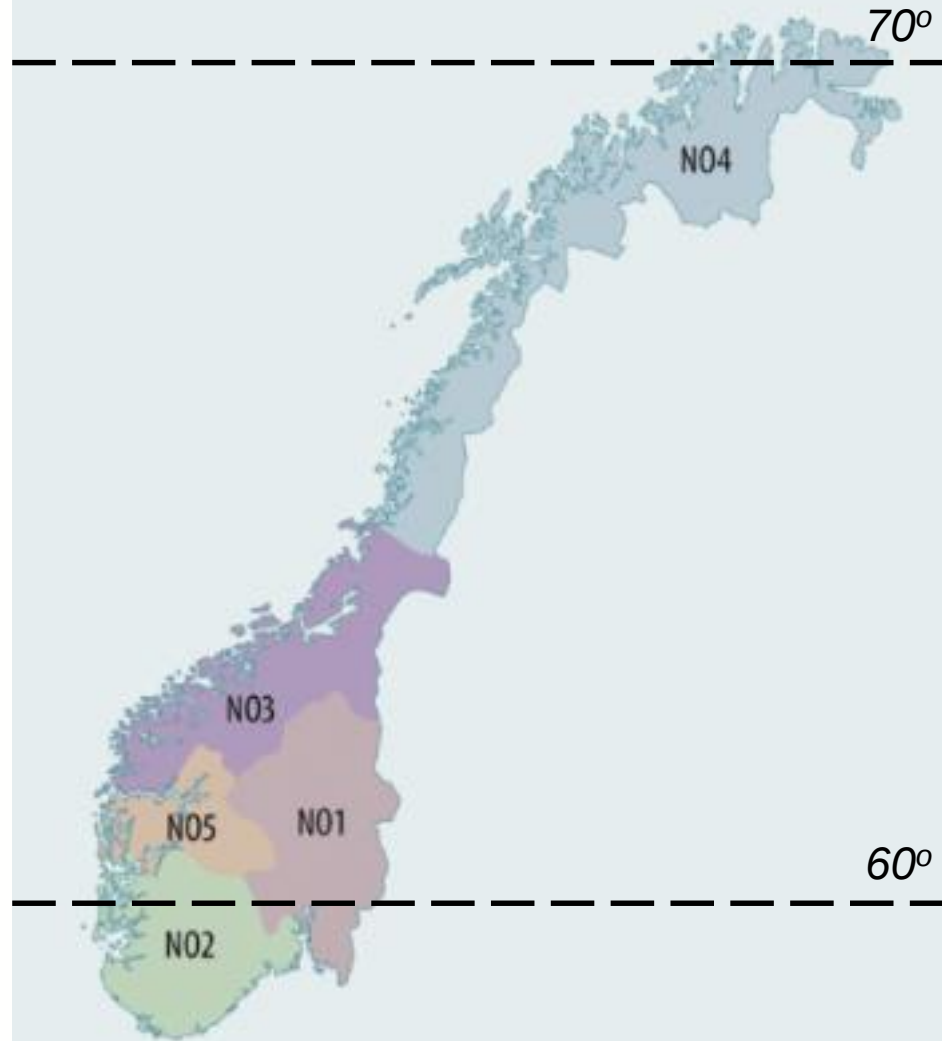


Status for PV in Norway – trends



Source: Elhub / OED /
IFE

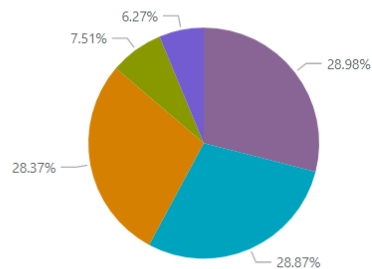
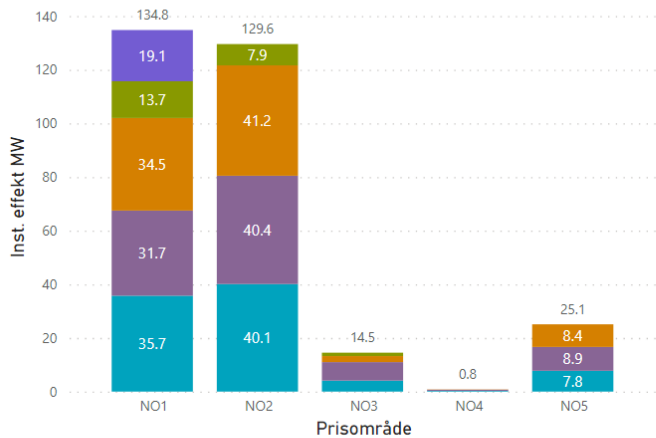
North of 60°?



Status for PV in Norway – 2023 market breakdown

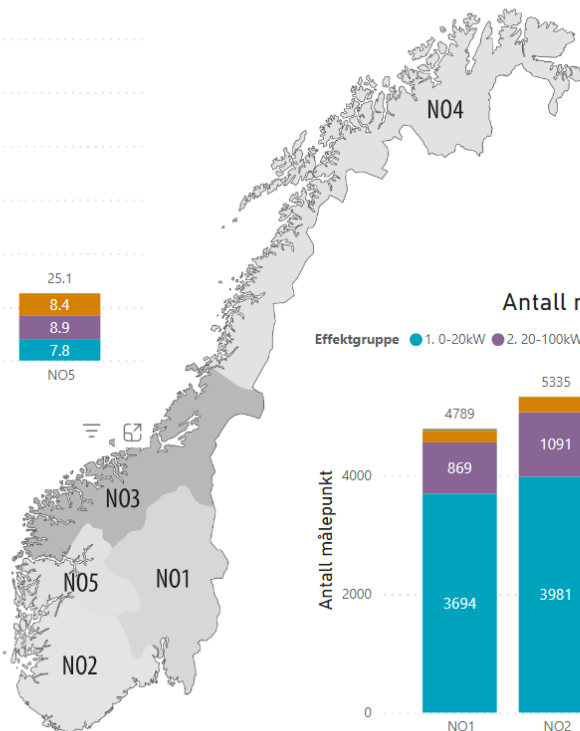
Installert ny effekt (MW)

Effektgruppe 1. 0-20kW 2. 20-100kW 3. 100-500kW 4. 500-1MW 5. 1-10MW



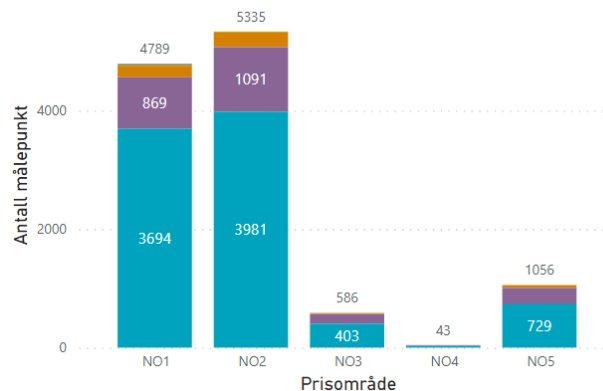
Source: Elhub

Installert effekt og antall målepunkt per prisområde og per effekt-gruppe for en periode



Antall nye målepunkt

Effektgruppe 1. 0-20kW 2. 20-100kW 3. 100-500kW 4. 500-1MW 5. 1-10MW



Status for PV in Norway

- Buildings: ~650 MW_p
- Ground-mounted PV: ~10 MW_p
- So far mostly direct supply to grid, but
 - PV + battery systems coming
 - PV + wind hybrids being considered



År	Annen kraft	Solkraft	Termisk kraft	Vannkraft	Vindkraft	Total
2019	67	4404	22	1525	43	6061
2020	46	2103	2	60	13	2224
2021	32	2372	8	70	21	2503
2022	78	7697	7	44	5	7831
2023	70	11809	2	41	12	11934
2024	9	487	1	7		504
Total	302	28872	42	1747	94	31057

Source: Elhub, IFE, Solgrid

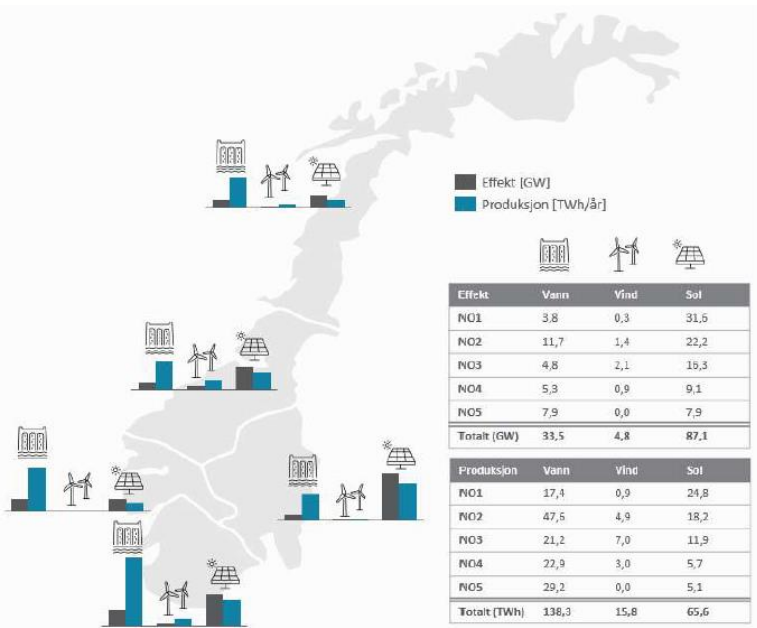
Ground-mounted PV in Norway

- Furuset Solkraftverk only utility-scale PV plant today
 - Capacity: 7 MW_p
 - Operator: Solgrid
- Rapidly increasing list of applications («Søknad»)
- Rapidly increasing list of notifications («Melding»)

Source: NVE

Søknad	Tittel	Titakshav Fylke	Stadium
14049	Bronkemoen Solkraftverk	NØK FORN Innlandet	Høring
19282	Haugerberget solkraftverk	SOLGRID / Innlandet	Melding
19274	Dolven solkraftverk	ANEO AS Vestfold	Melding
19273	Gislevold solkraftverk	SOLGRID / Akershus	Melding
19266	Lamoen Solkraftverk	SOLGRID / Buskerud	Melding
18255	Nordre Gjerpeland Solkraftverk	PYUR ENEI Vestfold	Melding
18254	Magnor 3 solkraftverk	PYUR ENEI Innlandet	Melding
18253	Skjervemoene solkraftverk	PYUR ENEI Vestfold	Melding
18251	Endra AS - Anleggskonsesjon - Ness	ENDRA AS Vestland	Søknad
17234	Pyur Energy AS (Pyur) - Solkraftverk	PYUR ENERGY AS	Melding
17233	Pyur Energy AS - Gaukås solkraftverk	PYUR ENERGY AS	Melding
17232	Pyur Energy AS - Oredalen solkraftverk	PYUR ENERGY AS	Melding
17231	Magnor 1 solkraftverk	PYUR ENEI Innlandet	Melding
17230	Fyresdal solkraftverk	SOLGRID / Telemark	Søknad
17202	Sokna solkraftverk	SOLGRID / Buskerud	Søknad
17201	Solgrid AS - Konsesjon - Nordvi solk	SOLGRID / Innlandet	Søknad
16198	Magnormoen solkraftverk	DIFFER EN Innlandet	Søknad
16172	Farsund Lufthavn solkraftverk	FOTOVOL / Agder	Søknad
16168	Norsk Solkraft AS - Konsesjon - Jåder	NORSK SO Agder	Søknad
16156	Hafslund Magnora Sol AS - Øvre Kill	HAFLSLUNC Akershus	Melding
16129	Greenstat Energy AS - Konsesjon - 9	GREENSTA / Agder	Søknad
16126	Domma solkraftverk	LandInfra Innlandet	Melding
16125	Åkroken solkraftverk	HAFLSLUNC Innlandet	Melding
16119	Slåtta solkraftverk	GREENSTA Agder	Søknad
16117	Løvbergsmoen sør solkraftverk	ANEO AS Innlandet	Utredning
16116	Brandsrud solkraftverk	GREENSTA Vestfold	Søknad
16115	Sokn Solkraftverk	NOVÅ AS Rogaland	Søknad
16114	HIM solkraftverk	ENDRA AS Rogaland	Søknad
16112	Prestegårdskogen solkraftverk	HAFLSLUNC Vestfold	Melding
16111	Solkraftverk på Fossum	FOSSUM S Telemark	Søknad
16107	Lista solkraftverk	FRED. OLS Agder	Melding
15082	Fjeld Solkraftverk	HYBRIDTE Østfold	Melding
14048	Ørje solkraftverk	SOLGRID / Østfold	Søknad
14040	Løvbergsmoen solkraftverk	NØK FORN Innlandet	Utredning
14039	Simonstad solkraftverk	FRED. OLS Agder	Melding
13010	Birkeland solkraftverk	BIRKELANI Agder	Søknad
13006	Sem solkraftverk	FRED. OLS Vestfold	Melding
12994	Måna solkraftverk	NØK FORN Innlandet	Søknad
12966	Kile solkraftverk	GUDBRAN Innlandet	Søknad
12960	Engene solkraftverk	ENGINE SI Vestfold	Søknad
12957	Energeia Store Nøkleberg AS - Store	ENERGEIA Innlandet	Utredning
11918	Mæhlum Solkraftverk	ENERGEIA Innlandet	Utredning
8858	Øystadmarka solkraftverk	ENERGEIA Innlandet	Utredning
7598	Energeia AS - Konsesjon - Seval Sko	ENERGEIA Innlandet	Søknad

Ground-mounted PV and BAPV/BIPV in Norway



Figur 1: Utbygd vannkraft og vindkraft (per juni 2022 [4] [3]) og teknisk potensial for solkraft på bygg (tak og fasade) per prismråde. Østlandet (NO1), Sørlandet (NO2), Midt-Norge (NO3), Nord-Norge (NO4), Vestlandet (NO5).



PV in Norwegian politics

Pre-2022: «Why should we curtail hydropower to make place for PV?»

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Post-2022: «Mer av alt – raskere!»

PV in Norwegian politics

- Rapid growth

- 2021: ~0,1%
- 2022: ~0,2%
- 2023: ~0,4%

new 150 MW_p
new 300 MW_p



- Energy commission ('23) called for 40 TWh of new power production to meet future demand (society, industry, electrification)
- Follow-up in Parliament ('23) with establishment of 8 TWh target in 2030

Performance and reliability

- Active research topic in Norway
 - IFE, NMBU, NTNU, SINTEF, Uni Agder, Uni Oslo, Uni Tromsø, UNIS (Svalbard)...
- Example ongoing projects
 - FME SUSOLTECH (WP4) Performance of PV in Norway
 - KSP SUNPOINT Irradiation
 - KSP PREDICT Performance and reliability of PV in «Nordic conditions»
- Will be covered by colleagues at this workshop:
 - «Validation of solar irradiance products in Norway», Heine Nygard Riise
 - «Snow losses and snow loss prediction», Mari Øgaard
 - «PV module degradation rates in Norway», Christoph Seiffert

Why collaborate?

- Statistically significant populations of PV systems in relevant conditions needed!
 - Performance and Performance Loss Rates
 - Degradation rates
 - Fault rates and fault types
- Many common factors
 - High costs of labour (= expensive O&M actions)
 - Snow
 - Sensitive environments
 - Non-standard deployment areas (= higher and/or more uncertain CAPEX)
 - Low irradiance conditions, non-ideal irradiation conditions and data quality
 - Strong seasonality impacts system role and value of PV
 - Substantial wind power capacity & complementarities to exploit



Thank you for the attention!