Perceptions of impact-based warning information for ice-throw risk: A Norwegian survey

Jelmer Jeuring, Norwegian Meteorological Institute
Anders Sivle, Norwegian Meteorological Institute
Rolv Bredesen, Kjeller Vindteknikk, part of the Norconsult Group

Norwegian
Meteorological
Institute

Recommendations for communicating risk of ice throw/fall in Norwegian wind parks

Jelmer Jeuring and Anders Sivle

Norwegian
Meteorological
Institute

Background

- ## Starting point

- *To develop a platform to communicate the risk of ice to operational staff in the parks and for them to use in communication with other users/visitors.*
- *Everyone should have access to the latest and most relevant information regarding ice to make the area more accessible to various user groups.*
- *The goal is to prevent events were people or animals are hurt, or infrastructure are damaged, because they are hit by ice.*

- ## Qualitative interviews

- *Learned that the park personnel is skilled and reduce risk by observations and procedures.*
  - *the warnings are not primarily meant for them, although consulted sometimes.*
  - *indications that red color means something special, but also that the warnings must be reliable to be used.*
- *Also learned that the parks are not frequently visited (or contacted) wintertime by external visitors.*
  - *difficult to find people to interview (due to COVID, but also lack of interest/will).*
- *Decided to conduct a quantitative survey to get insight into the mindset of a larger group of people.*
  - *potential visitors - "everyone should have access to the latest information..."*

Norwegian
Meteorological
Institute

Survey design

IEA WIND TCP TASK 19 - Qualitative safety measures:

Category	Safety measures	Remark
Awareness of residents	Communication strategy	Independent from the calculated risk, these measures should be taken to inform the residents and – as a long term strategy – change their behaviour.
	Regular education to change behaviour of people.	

"How do people perceive and act upon information around ice-throw/fall risk?"

- Data collection: May-July 2021 (IPSOS panel)
- Data analysis: August-September 2021 (MET Norway)

- Respondents
  - Total 1377 - 48% women, avg 44yo; 52% men, avg 47yo)

Norwegian Meteorological Institute

Survey design

Table X. Respondents per region

	Frequency		Percent
Not nearby wind turbine parks			
Viken (Østfold, Akershus, Buskerud)	209		15.2
Oslo	126		9.2
Nordland	101		7.3
Vestfold og Telemark	72		5.2
Innlandet (Hedmark, Oppland)	63		4.6
Troms og Finnmark	47		3.4
Agder (Aust-Agder, Vest-Agder)	46		3.3
Nearby wind turbine parks			
Rogaland	252		18.3
Trøndelag	235		17.1
Vestland (Hordaland, Sogn og Fjordane)	134		9.7
Møre og Romsdal	92		6.7
Total	1377		100.0

Norwegian
Meteorological
Institute

Survey results

- Theme 1: Familiarity with wind turbine parks
- Theme 2: Information seeking preferences & risk perceptions
- Theme 3: Warning understanding and response

Source: Statkraft

Norwegian
Meteorological
Institute

Survey results

- ## Theme 1: Familiarity with wind turbine parks
  - Theme 2: Information seeking preferences & risk perceptions
  - Theme 3: Warning understanding and response

Source: Statkraft

Norwegian
Meteorological
Institute

Survey results

- Theme 1: Familiarity with wind turbine parks

Table X. Visited wind turbine park			Frequency		Percent
Nearby	Yes		186		**26.1**
	No		506		**71.0**
	I do not know		21		2.9
	Total		713		100.0
Not nearby	Yes		83		**12.5**
	No		550		**82.8**
	I do not know		31		4.7
	Total		664		100.0

Norwegian
Meteorological
Institute

Survey results

- ## Theme 1: Familiarity with wind turbine parks

Consider that you want to visit a wind turbine park in Norway for recreational purposes, how likely would you do that in the following weather conditions?

		A sunny summer day, temperature 20 degrees Celsius		A foggy autumn day, temperature 5 degrees Celsius		A foggy winter day, temperature just below 0 degrees Celsius		A sunny winter day after several days with snow, temperature just below 0 degree Celsius	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Nearby	Extremely unlikely	174	24.4	232	32.5	320	44.9	231	32.4
	Very unlikely	85	11.9	192	26.9	184	25.8	143	20.1
	Neither (un)likely	142	19.9	133	18.7	84	11.8	138	19.4
	Very likely	178	25.0	83	11.6	54	7.6	114	16.0
	Extremely likely	86	12.1	35	4.9	35	4.9	46	6.5
	Do not know	48	6.7	38	5.3	36	5.0	41	5.8
	Total	713	100.0	713	100.0	713	100.0	713	100.0
Not nearby	Extremely unlikely	168	25.3	239	36.0	302	45.5	237	35.7
	Very unlikely	96	14.5	163	24.5	149	22.4	123	18.5
	Neither (un)likely	140	21.1	116	17.5	88	13.3	130	19.6
	Very likely	116	17.5	56	8.4	43	6.5	80	12.0
	Extremely likely	70	10.5	29	4.4	28	4.2	38	5.7
	Do not know	74	11.1	61	9.2	54	8.1	56	8.4
	Total	664	100.0	664	100.0	664	100.0	664	100.0

Norwegian Meteorological Institute

Survey results

- ## Theme 1: Familiarity with wind turbine parks - Conclusions

- *A small group of people tends to visit wind turbine parks in Norway every now and then.*
- *Wind turbine parks that are relatively nearby people's place of residence are more likely to be visited.*
- *It is likely that wind turbine parks may be visited in **some weather conditions** that are favourable for ice-throw/fall.*
- *These findings indicate that in the Norwegian context, even though the number of visits may be limited, there is a need for providing information/warnings abouts possible ice-throw/fall conditions for those who plan to visit wind turbine parks.*

Norwegian
Meteorological
Institute

Survey results

- Theme 1: Familiarity with wind turbine parks
- ## Theme 2: Information seeking preferences & risk perceptions
- Theme 3: Warning understanding and response

Source: Statkraft

Norwegian
Meteorological
Institute

Survey results

- ## Theme 2: Information seeking preferences & risk perceptions

Table X. Intention to inform oneself about potentially hazardous weather

In order to protect yourself against harm from weather hazards during outdoor activities, how likely would you…	*Search for information that helps you to be prepared*		*Look for information about what you could do to protect yourself*		*Ask local experts about potential weather hazards in an area you plan to be in*		*Check if there are any weather warnings for the area you plan to be in*	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Extremely unlikely	53	3.8	60	4.4	164	11.9	41	3.0
Very unlikely	94	6.8	128	9.3	288	20.9	49	3.6
Neither (un)likely	178	12.9	324	23.5	392	28.5	139	10.1
Very likely	552	40.1	548	39.8	346	25.1	539	39.1
Extremely likely	464	33.7	281	20.4	143	10.4	579	42.0
Do not know	35	2.5	35	2.5	43	3.1	29	2.1
Total	1376	100.0	1376	100.0	1376	100.0	1376	100.0

Norwegian Meteorological Institute

Survey results

- ## Theme 2: Information seeking preferences & risk perceptions

How would you rate your preference for the following information sources to find information about possible ice fall risk from wind turbines?
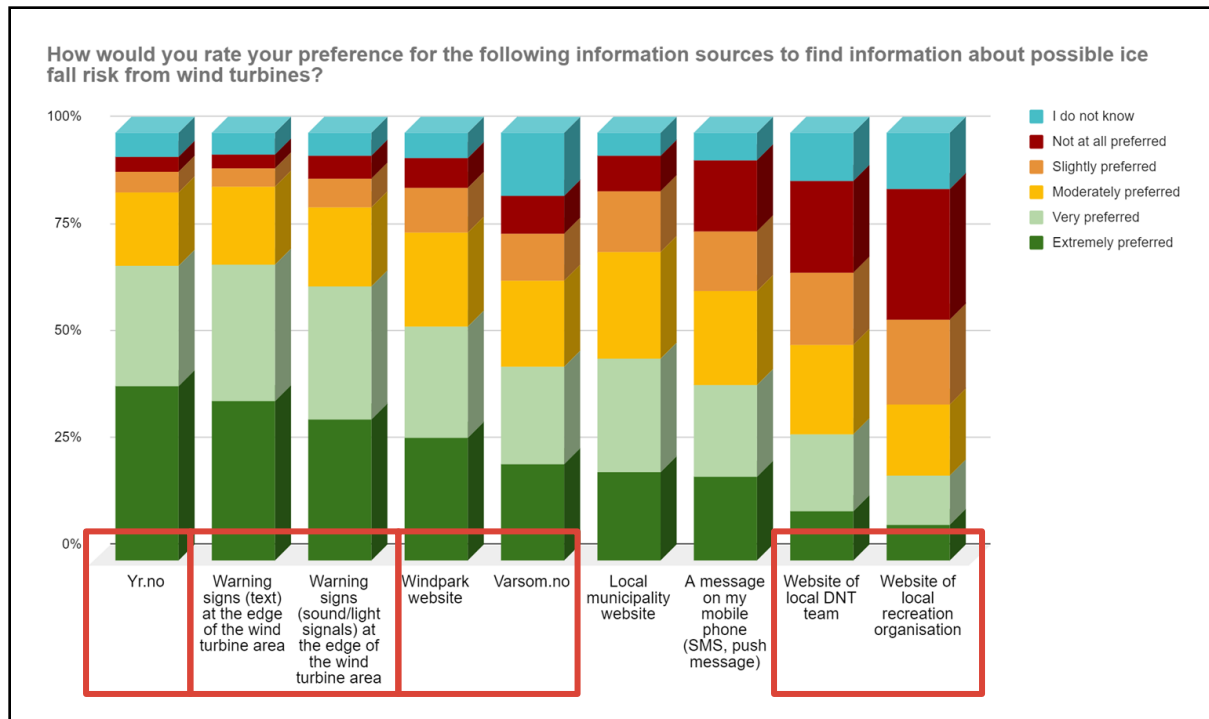
Figure X. Information preferences

Survey results

- ## Theme 2: Information seeking preferences & risk perceptions
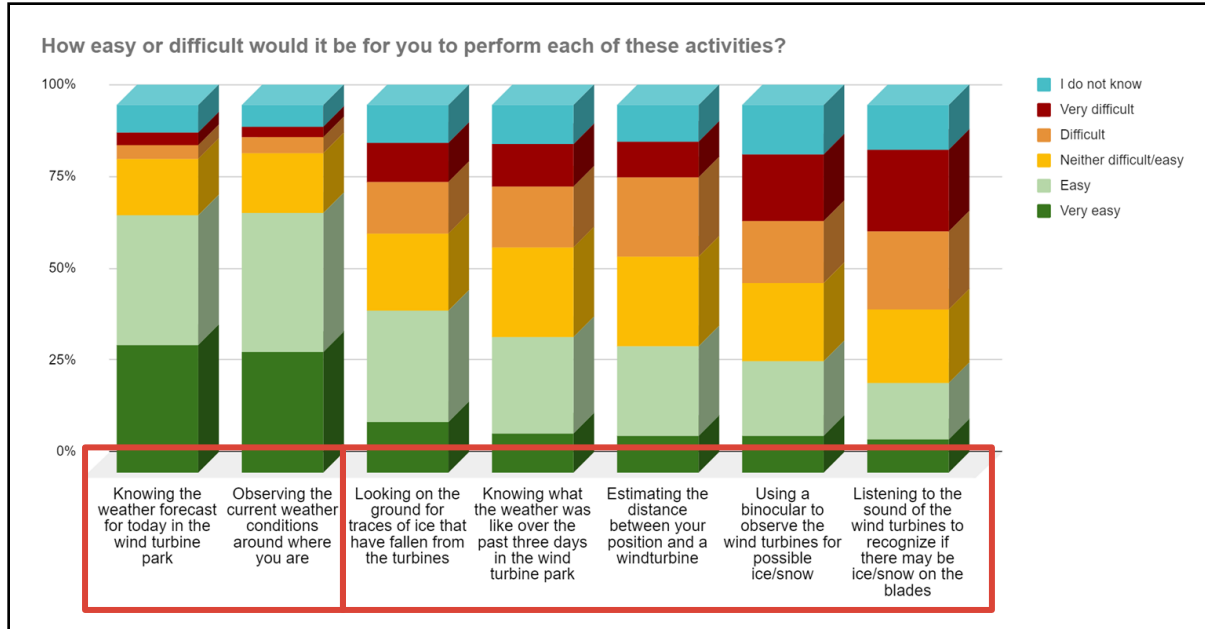
Figure X. Perceived ability to assess ice throw/fall conditions

Norwegian
Meteorological
Institute

Survey results

- Theme 2: Information seeking preferences & risk perceptions - Conclusions

Weather information seeking
- *Very many people are updating themselves on daily weather and warnings*
- *Many think it is important to be familiar with the risks, and look for information to protect themselves…*
- *…but do not primarily consider talking local experts (cf. Maintenance personnel?)*

Ice-throw/fall information preferences
- *People are not perceiving the risk of ice-throw as worse than other similar risks*
- *Preferences for risk communication channels are guided by familiarity*
  - *Existing channels (physical signs, park website)*
  - *Yr.no*
- *Observation skills can be an important addition to warnings…*
- *…but are seen as difficult to perform*

Norwegian
Meteorological
Institute

Survey results

- Theme 1: Familiarity with wind turbine parks
- Theme 2: Information seeking preferences & risk perceptions
- ## Theme 3: Warning understanding and response

Source: Statkraft

Norwegian
Meteorological
Institute

Survey results

- ## Theme 3: Warning understanding and response

Please carefully read the following information, before continuing with the survey.
Consider the following scenario:

Activity
It is a Saturday morning in February. You plan to go for a hike or ski tour, starting at 09.30h until 14.30h. The distance of the trip is within your physical ability.

Weather information
After a week of variable weather, with snow showers and temperatures just below freezing, the forecast for both Saturday and Sunday is sunny with some clouds, wind northwest 5m/s and a maximum temperature of -1 degrees Celsius. There is snow on the ground, but it is easily possible to both walk and ski.

Route information
The route of your trip will go through an area where various wind turbines are located. The following information about the windpark is available to you:

Iskast varsel Vindpark (sist oppdatert: kl.08:00)

Iskast							
	Nå	Lør 14:00	Lør 20:00	Søn 02:00	Søn 08:00	Søn 14:00	Søn 20:00

Is på turbin							
	Nå	Lør 14:00	Lør 20:00	Søn 02:00	Søn 08:00	Søn 14:00	Søn 20:00

- Minimal sannsynlighet (green)
- Lav sannsynlighet (yellow)
- Medium sannsynlighet (orange)
- Høy sannsynlighet (red)

Iskast varsel nivå: Rød (sist oppdatert: kl.08:00)
Forklaring
- Ekstrem situasjon
Konsekvenser:
- Høy sannsynlighet for at snø eller is løsner fra bladene på turbinen og kastes opp til 200 meter vekk fra turbinen
- Ferdsel i vindparken er frarådet
Tidsperiode
- Pågår. Oppdateres kl.14:00

VINDPARK VETT
1. Sjekk alltid isingsvarselet før ferdsel i vindparken. Unngå ferdsel ved fare for iskast.
2. Vær særlig oppmerksom ved temperaturer rundt 0 grader.
3. Ikke gå nærmere vindmøllen enn 300 meter.
4. Lytt! Lyd fra vindmøllene endrer karakter når det er is på vingene.
5. Bruk synet! Isbiter på bakken eller spor etter isklumper i snøen indikerer økt risiko.
6. Hvis mulig: Se alltid vindmøllen forfra – faren er størst på baksiden av vindmøllen. Ha alltid vinden i ryggen dersom du må gå nær en vindmølle med is.
7. Parker bilen mer enn 300 meter fra nærmeste vindmølle.

Norwegian Meteorological Institute

Survey results

- ● Theme 3: Warning understanding and response

Figure X. Average agreement with statements about warning information understanding, per warning scenario (Statements were assessed on a 1-5 scale (1 totally disagree, 5 totally agree)).

Survey results

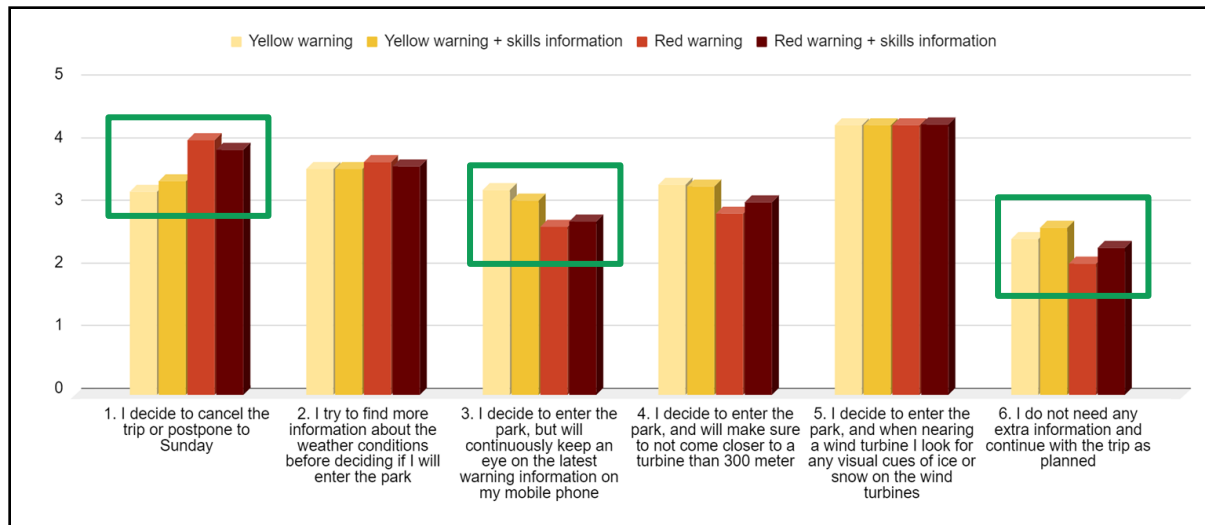- ● Theme 3: Warning understanding and response

Figure X. Average perceived likelihood of protective actions, per warning scenario (Statements were assessed on a 1-5 scale (1 very unlikely, 5 very likely)).

Survey results

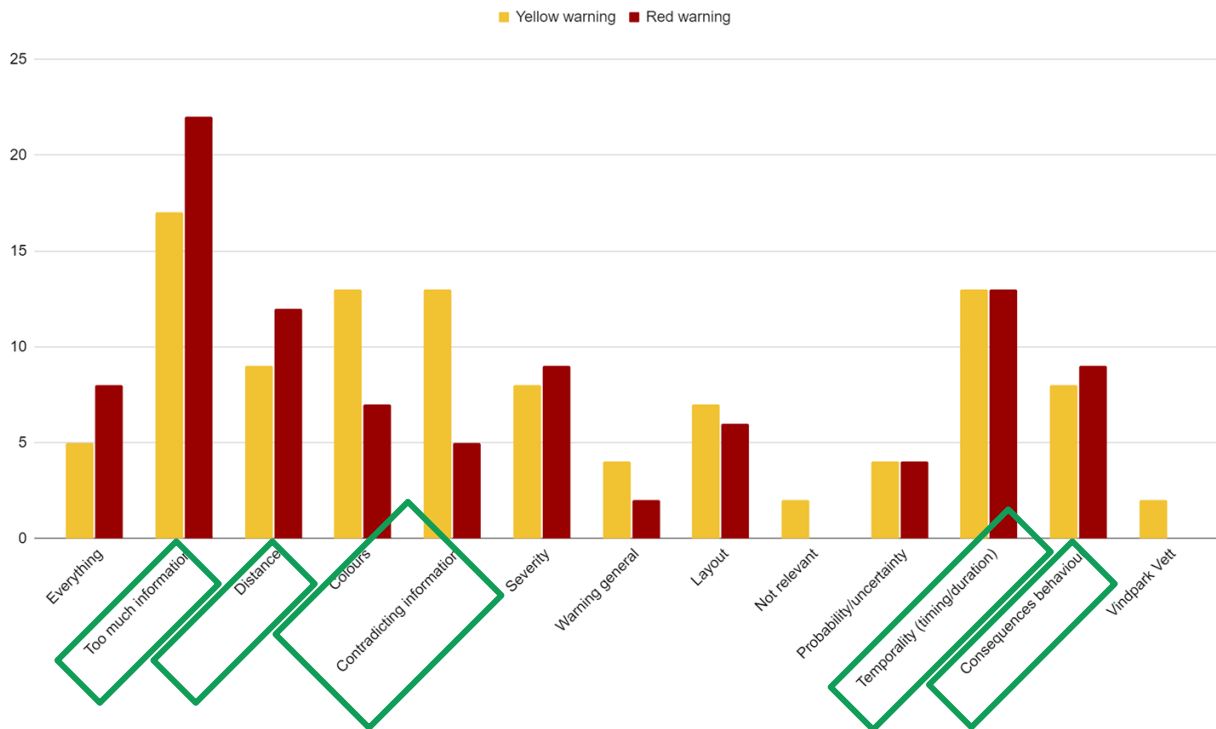- ## Theme 3: Warning understanding and response

Figure X. Perceived minimum safety distance for different warning scenarios (percentages).

Norwegian
Meteorological
Institute

Survey results

- ## Theme 3: Warning understanding and response

Which parts of the information did you find particularly difficult to understand and/or of little use, and why?
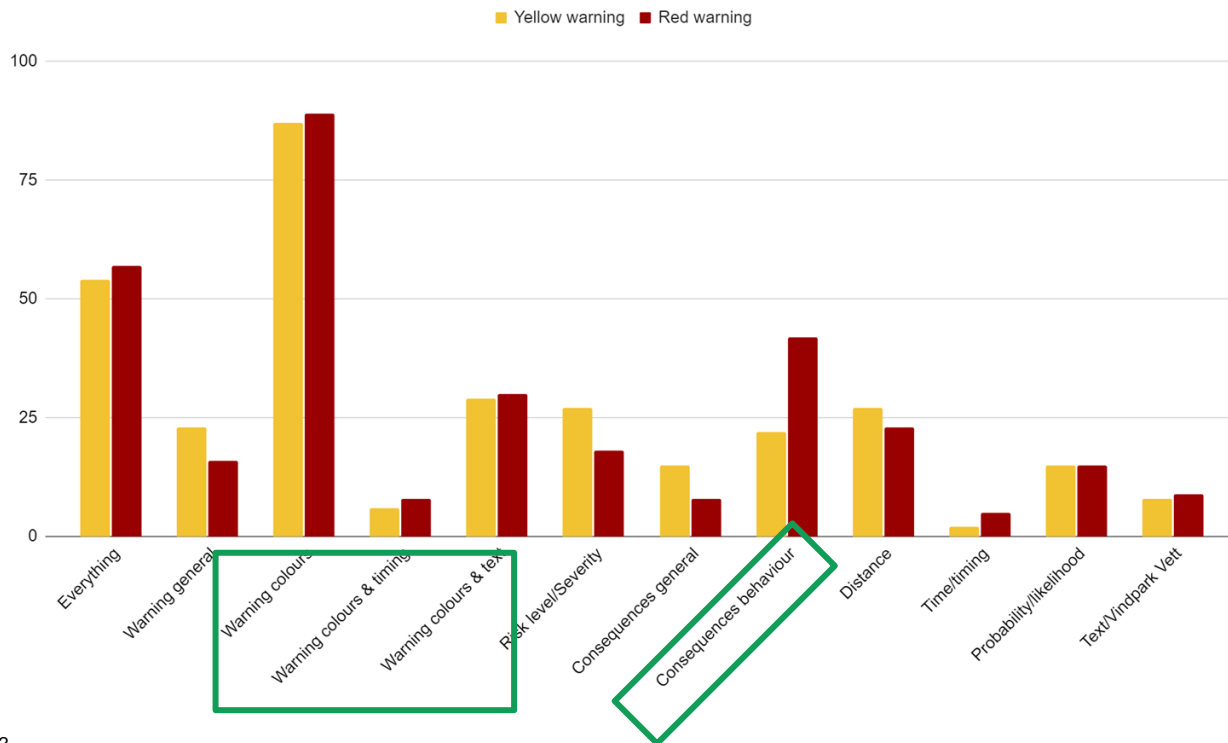
Figure X. Evaluation - negative *'Nothing difficult': n yellow=155; n red=152

Survey results

- Theme 3: Warning understanding and response

Which parts of the information did you find particularly understandable and/or useful, and why?

Figure X. Evaluation - positive

Survey results

- ## Theme 3: Warning understanding and response - Conclusions

  - *Overall, CAP warning information appears understandable and actionable*
  - *Colours are appreciated (esp. red colour/warning stands out)*
    - *People are likely to follow clear advice: cancel or postpone visit*
    - *Yellow colour/warning is ambivalent (safe vs not safe)*
  - *Risk for information overload with too much text*
  - *Distance to turbines*
    - *Challenging to assess*
    - *Distance advice is noticed by those who consider visit*
    - *Turbines avoided by those who do not want to visit*
  - *Skills*
    - *Unclear effect of skills information (Vindpark Vett) on response*
    - *Many would use own observations to mitigate on-site risk (but difficult to know how to)*
    - *Need to develop/communicate on-site observing skills (distance perception, icing cues)?*

Norwegian
Meteorological
Institute

Takeaways from Rolv

- *Norwegian wind farms are not that much visited at this time*
- *It is important to monitor and understand the risk-reducing effects from the warning system*
- *The most important recipient is the one that is most exposed and not yet reached*
- *Education of the frequent users*
- ***More research** in needed on design of warning systems*

Norwegian
Meteorological
Institute

Report available at https://www.met.no/publikasjoner/