Impact of Newspaper Language on Technology Adoption Speed: On the example of the US Wind Energy Sector
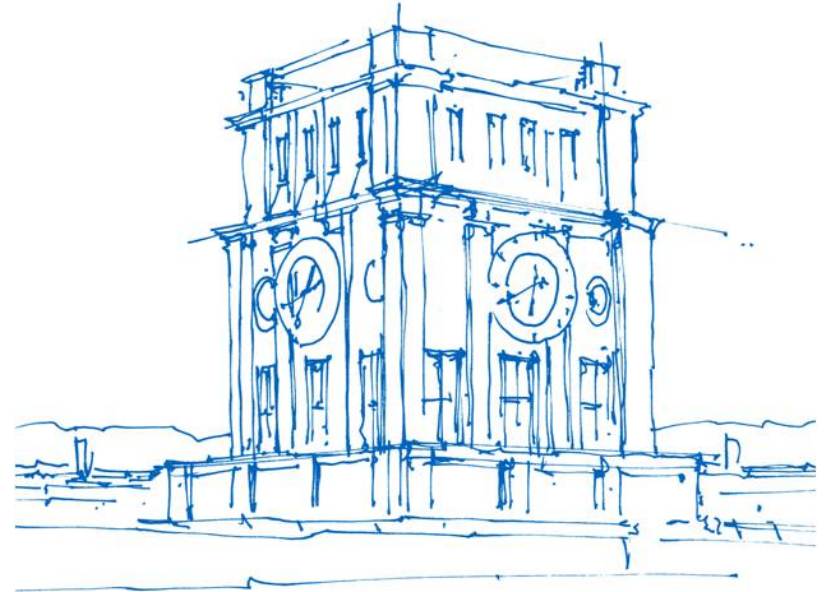
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TUM School of Management

Chair of Management Accounting

IAEE, July 26th, 2023, Milan

Wind energy is faced with plenty of controversial news coverage

CNN
Wind energy has a massive waste problem
By Laura Paddison, CNN
Published 12:01 AM EDT, Sun May 28, 2023

The New York Times
A Climate Conundrum: The Wind Farm Vs. The Eagle's Nest
The state wants to get its electricity from carbon-free sources, but expanding renewable energy faces a range of hurdles.

Give this article

NEW YORK POST
NEWS EXCLUSIVE 228 Comments
Four whales die in 4 days: Wind farms creating 'death zone' at sea says ex-Greenpeace boss
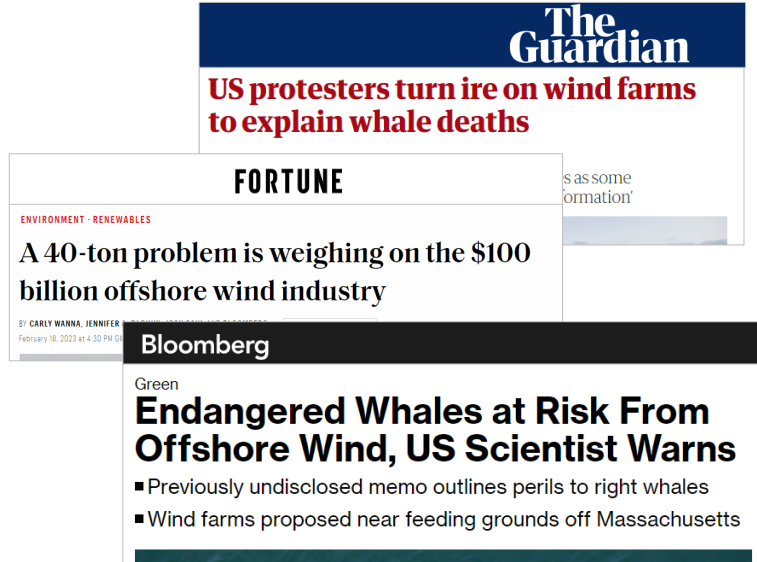By Joshua Rhett Miller and Franklin Raff, Zenger News   May 8, 2023 | 7:27pm

Christopher Furlong/Getty Images

Source (left to right):
- https://edition.cnn.com/2023/05/28/world/wind-turbine-recycling-climate-intl/index.html
- https://www.nytimes.com/2019/06/25/nyregion/ny-clean-energy-law-wind.html
- https://nypost.com/2023/05/08/not-unreasonable-to-link-whale-deaths-offshore-wind-farm-work-ex-greenpeace-chief-says/

Catchy headlines are quickly picked up by other news outlets

The Guardian
US protesters turn ire on wind farms to explain whale deaths

s as some formation'

FORTUNE
ENVIRONMENT · RENEWABLES
A 40-ton problem is weighing on the $100 billion offshore wind industry
BY CARLY WANNA, JENNIFER
February 18, 2023 at 4:30 PM G

Bloomberg
Green
Endangered Whales at Risk From Offshore Wind, US Scientist Warns
■ Previously undisclosed memo outlines perils to right whales
■ Wind farms proposed near feeding grounds off Massachusetts

NEW YORK POST
NEWS EXCLUSIVE
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Four whales die in 4 days: Wind farms creating 'death zone' at sea says ex-Greenpeace boss
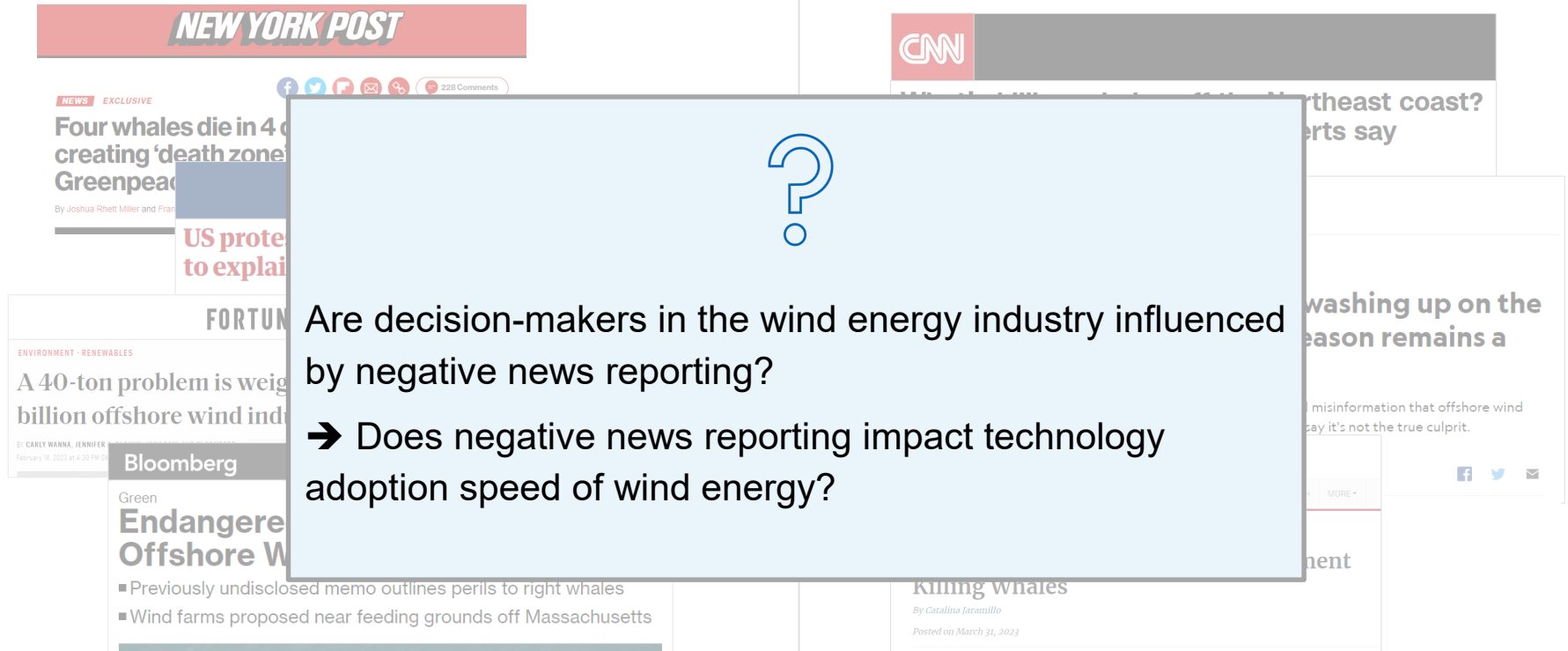By Joshua Rhett Miller and Franklin Raff, Zenger News
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NEW YORK POST

NEWS EXCLUSIVE

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Endangere... Offshore W...

■ Previously undisclosed memo outlines perils to right whales
■ Wind farms proposed near feeding grounds off Massachusetts

CNN

...Northeast coast?
...erts say

...washing up on the
...eason remains a

...misinformation that offshore wind
...say it's not the true culprit.

...Killing Whales

By Catalina Jaramillo
Posted on March 31, 2023

Are decision-makers in the wind energy industry influenced by negative news reporting?

➜ Does negative news reporting impact technology adoption speed of wind energy?

Sources:
· https://fortune.com/2023/02/18/offshore-wind-turbines-whales-dying-oceans-environment/
· https://www.theguardian.com/environment/2023/feb/20/us-protesters-wind-turbines-whale-deaths-evidence
· https://www.bloomberg.com/news/articles/2022-11-29/endangered-whales-at-risk-from-offshore-wind-us-scientist-warns

Sources:
· https://edition.cnn.com/2023/01/20/us/whale-deaths-offshore-wind-climate/index.html
· https://www.nationalgeographic.com/environment/article/humpback-whales-strandings-offshore-wind-energy
· https://www.factcheck.org/2023/03/no-evidence-offshore-wind-development-killing-whales/

Agenda

1 Introduction

2 Research question & contribution

3 Methodology & data

4 Preliminary results

5 Conclusion

Research questions and hypotheses of applying sentiment analysis to technology adoption speed research

H1: The state-of-the-art natural language processing (NLP) models **can** be used to **effectively capture news sentiment** on a **large scale**.

- Sentiment analysis has already been successfully applied to social media (Loureiro & Alló (2020), Kim et al. (2021))
- Newer models allow extracting sentiments about a particular subject from longer texts (OpenAI (2023), He et al. (2020))

H2: **Negative news sentiment** covering wind energy leads to **slower adoption** of wind energy technologies.

- News sentiment influences and is influenced by public opinion (Shanahan et al. (2011), Christen & Huberty (2007))
- Public opinion plays a major role in wind energy adoption (Devine-Wright (2005), Diogenes et al. (2020))

This research contributes to applied sentiment analysis and wind energy adoption research

Applied sentiment analysis in energy research

Currently, (NLP) sentiment analysis is primarily used in marketing and politics research
(e.g., Drus & Khalid (2019), Hartmann et al. (2019))

Previous energy research factoring in public opinion either apply manual categorization, surveys, or social media analysis
(e.g., Gearhart et al. (2019), Qazi et al. (2023), Kim et al. (2021))

➔ Automated sentiment analysis could provide a valuable panel data set of public opinion data

Technology & wind energy adoption research

News analysis for wind energy has been mostly qualitative
(e.g., Gearhart et al. (2019), Fischlein et al. (2014))

Different technology adoption models in most cases include a factor on public opinion
(Lai (2017), Venkatesh & Davis (2000), Devine-Wright (2005))

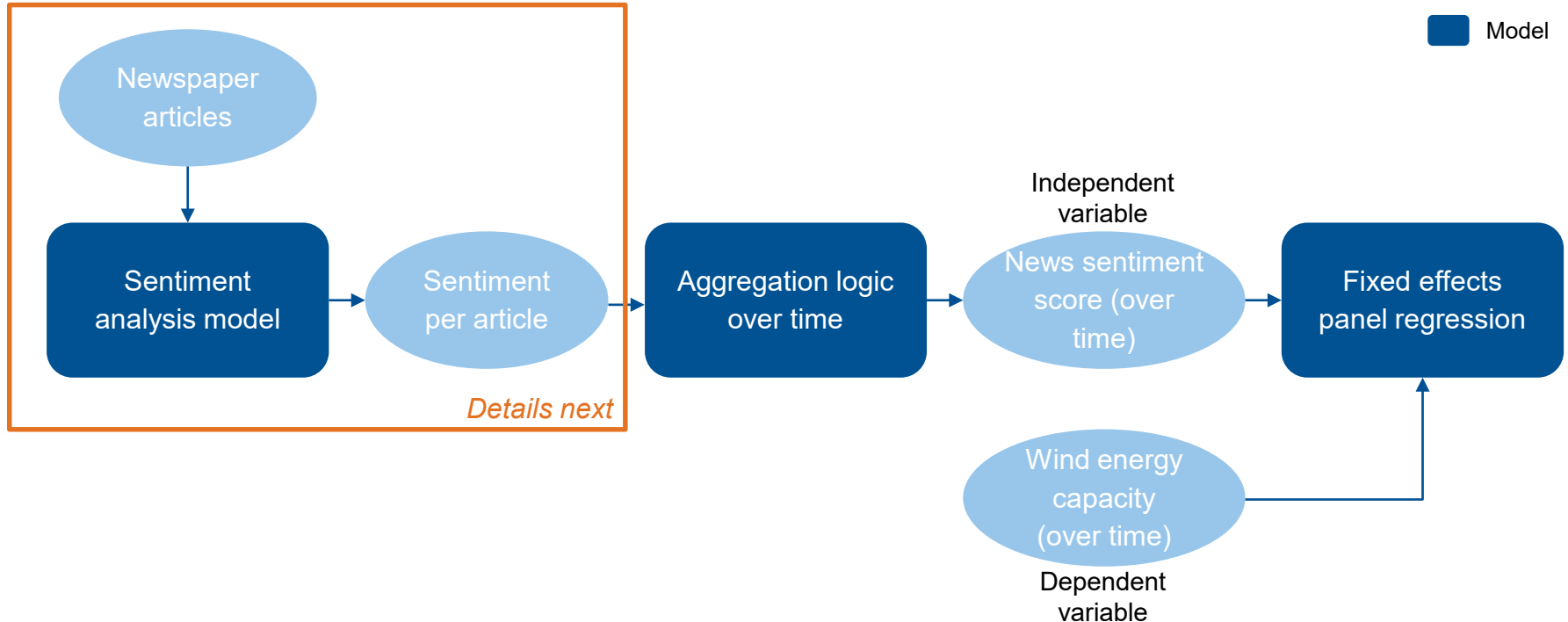➔ Research helps understanding of public opinion as a driver of technology adoption

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This research concept contributes to existing literature by **bridging the gap between automated sentiment analysis and technology adoption research** to examine the sentiment aspect of technology adoption by:
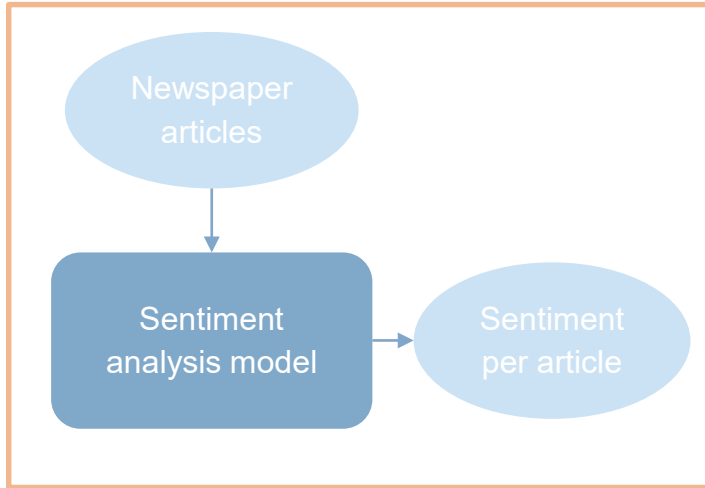- Leveraging modern technology (machine learning) to capture public sentiment (through newspaper sentiment)
- Enables a broader exploration of public sentiment than the surveys that current research employs

I employ a 3-step approach to address the research questions

SIMPLIFIED

Legend:
- Data
- Model

Newspaper articles → Sentiment analysis model → Sentiment per article → Aggregation logic over time → News sentiment score (over time) → Fixed effects panel regression

Details next

Independent variable — News sentiment score (over time)

Wind energy capacity (over time)

Dependent variable

I compare performance of several sentiment analysis models

Literature does not answer key questions:

- Which sentiment analysis model should I choose for my use case?
- How is the performance of the different sentiment analysis models (especially for longer texts)?

Sentiment analysis model selection

Selected outcomes:

		Selected model
Model	SiEBERT	**DeBERTa v1.1**
Source	Hartmann et al. 2022	Yang et al. 2021

Performance[1]

Accuracy: 71%
Confusion matrix:

		Predicted		
		Pos	Neu	Neg
Actual	**Positive**	55	8	3
	Neutral	8	13	2
	Negative	5	9	17

Accuracy: 85%
Confusion matrix:

		Predicted		
		Pos	Neu	Neg
Actual	**Positive**	59	6	1
	Neutral	3	18	2
	Negative	2	4	25

>> Indicates a **reasonable level of performance** for practical use with **sufficiently large database** of analyzed texts

1. On newspaper articles, sample size n = 120, three-class sentiment classification

Over 3000 news articles were analyzed split between two states for preliminary results

Database for preliminary results:

- Online news articles of local-focused news outlets in two US states (Washington and Minnesota)

- Primarily sourced from LexisNexis

- Filtered for relevant articles based on key words:
  ```
  "wind power" OR "wind
  energy" OR "wind farm!" OR
  "wind turbine!"
  ```
  (filter results for at least two occurrences of any keyword)

Number of analyzed news articles over time
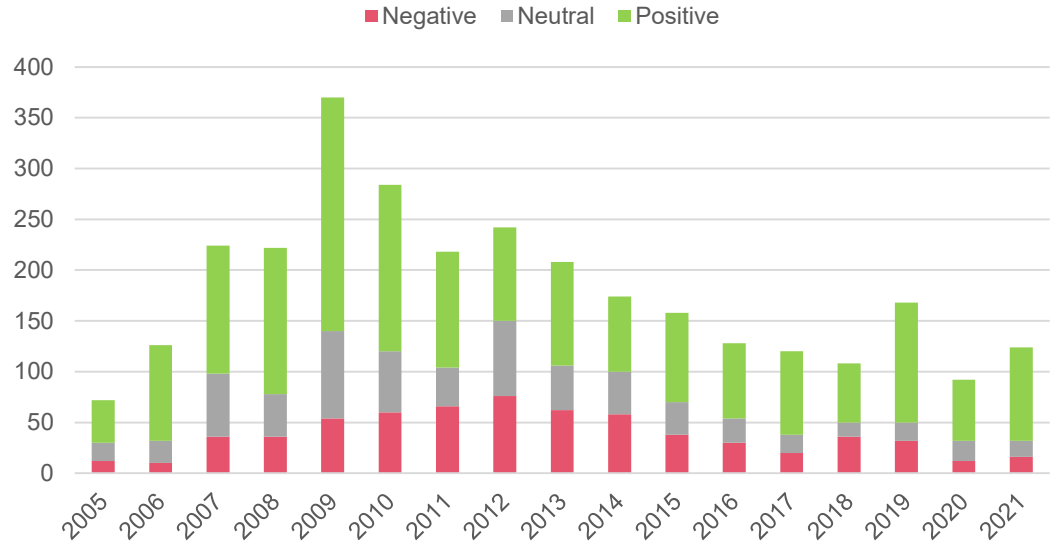
Initial analysis compares wind energy adoption of WA and MN
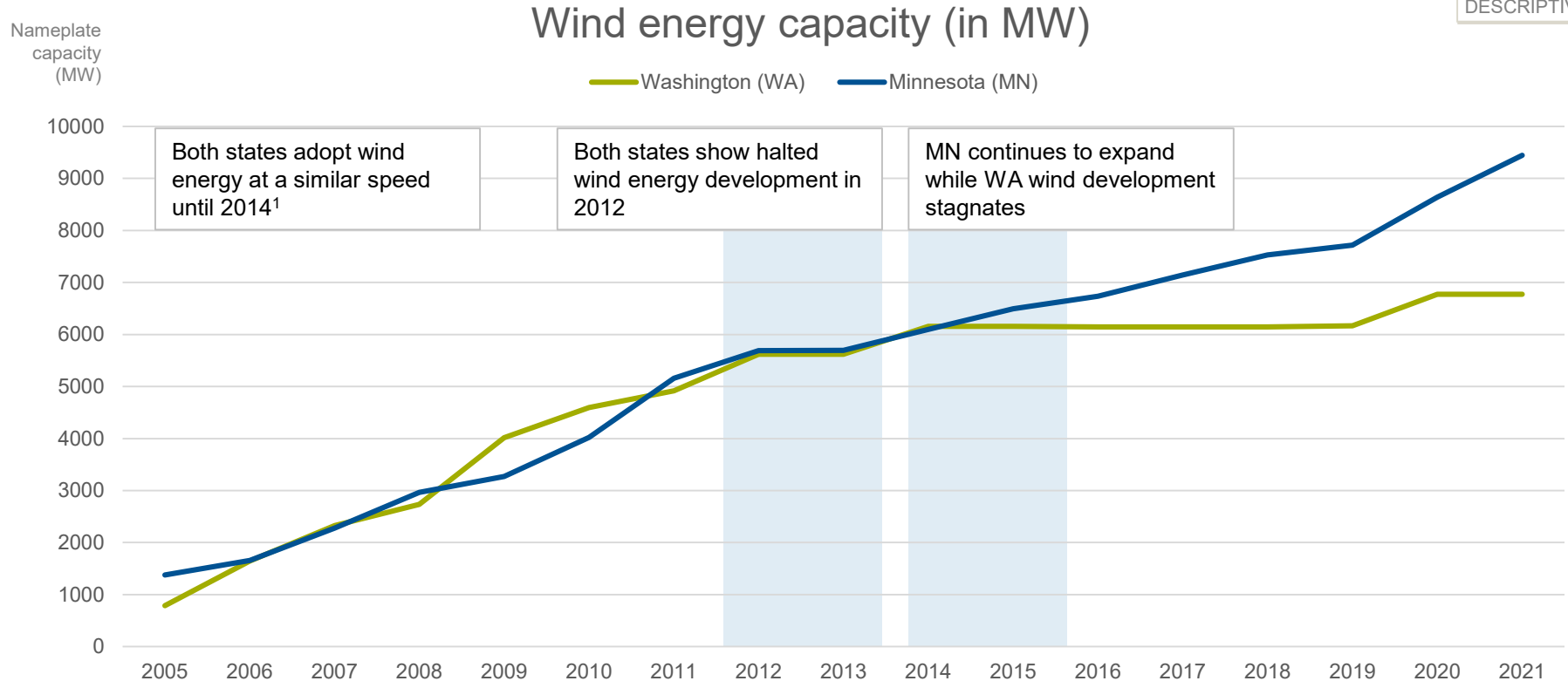
Wind energy capacity (in MW)

Nameplate capacity (MW)

— Washington (WA) — Minnesota (MN)

Both states adopt wind energy at a similar speed until 2014[1]

Both states show halted wind energy development in 2012

MN continues to expand while WA wind development stagnates

1. WA and MN have roughly comparable inhabitant numbers (7m and 6m), median household income ($82k and $78k) and land area (67 sq miles vs 79 sq miles, but WA can offshore)

Preliminary results imply a correlation between news sentiment score and net capacity addition of wind energy

DESCRIPTIVE
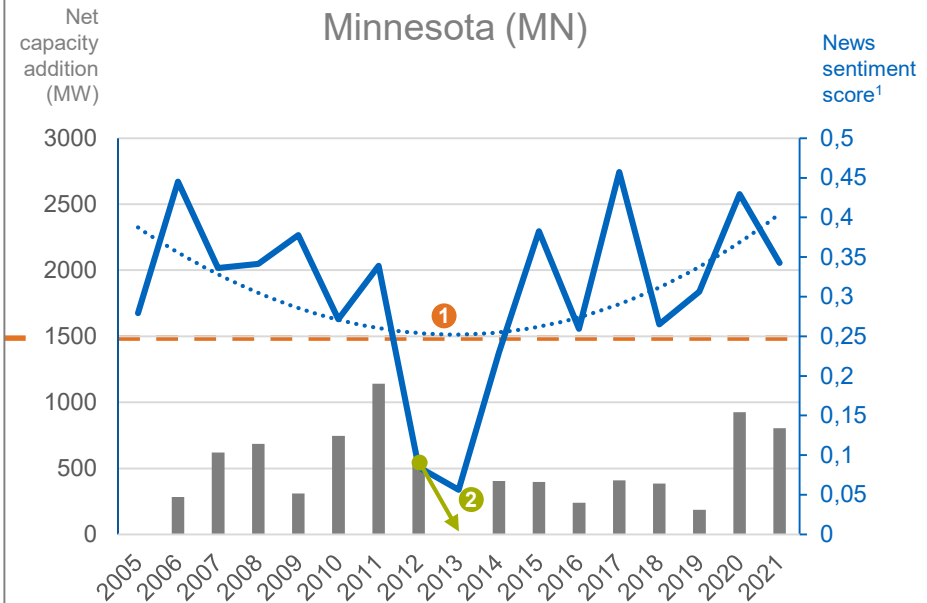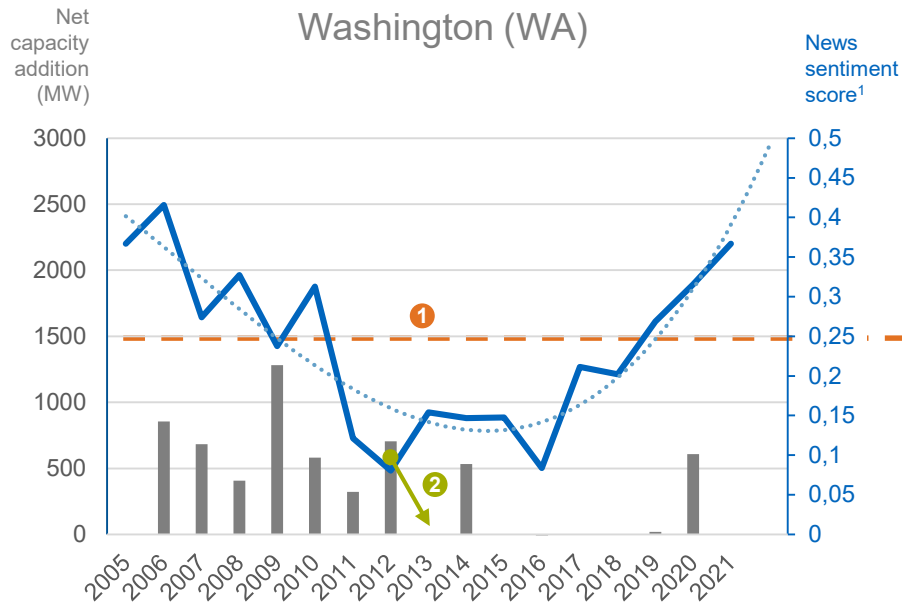
① Longer lasting, more negative news reporting correlated with less wind energy built out in WA compared to MN

② Negative reporting had relatively quick effect on new capacity build out (time lag ~1 year), which is plausible as common reasons for halting wind park development are protests and lawsuits

1. Scale of [-1;+1] with -1 representing purely negative news reporting and +1 purely positive news reporting on wind energy

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Additional steps are planned to enhance the analysis

Curate more data (in particular to cover additional US states and newspaper outlets; as well as analyze for extreme language)

Implement control variables, e.g.:

- Electricity price
- Political leadership of a state
- Geographical limitations

Quantify relationship in a fixed effects panel regression (to determine significance)

Preliminary results support hypotheses but further research will be needed

Initial hypotheses	Insights	Limitations
H1: The state-of-the-art natural language processing (NLP) models **can effectively capture news sentiment** on a large scale.	With 85% accuracy and only 3% categorized the opposite sentiment, current sentiment analysis models produce **meaningful results** that can be leveraged for further analysis given a sufficient sample size.	• Quick development in sentiment analysis space could produce even better models quickly (e.g., ChatGPT)
H2: **Negative news sentiment** covering wind energy leads to **slower adoption** of wind energy technologies.	From initial data analysis, the correlation **seems plausible**. Further research will be needed for significant results.	• Sample size • Endogeneity of public opinion and technology adoption speed

The results may hold implications for other researchers & business decisions

Practical implications if hypotheses are accepted

- Possibility to produce panel data of public sentiment

- Anticipate adoption barriers through automated newspaper scanning and adapted communications strategies

- Help investors/energy companies make more informed decisions and address concerns early

Questions:

- Do you have advice for relevant literature?

- Do you know news article databases?

- Would you be interested in a more in-depth view on sentiment analysis model selection and comparison?

Thank you for your attention!

Presented paper concept:

Impact of Newspaper Language on Technology Adoption Speed:

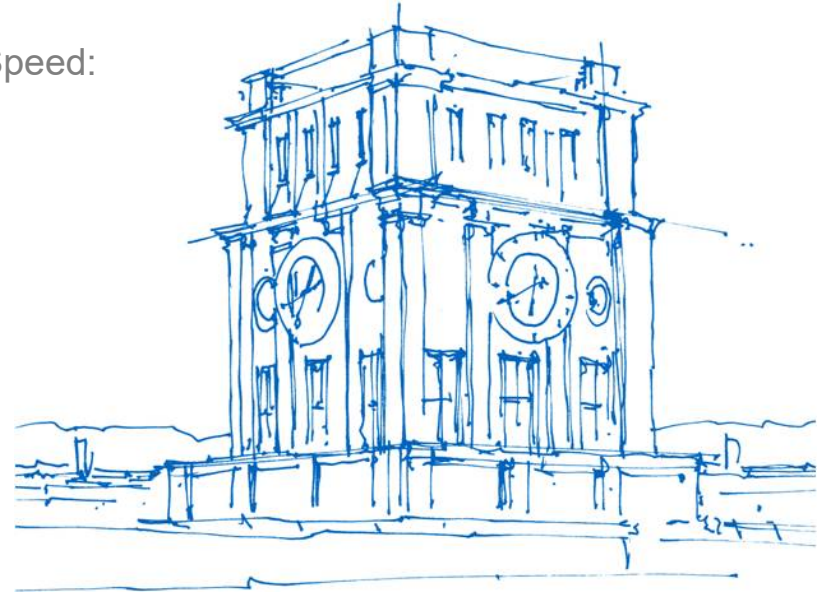On the example of the US Wind Energy Sector

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