Wind Turbines, Solar Farms, and House Prices

Future of Energy Network,
Institute for Advanced Studies
(24 feb. 2020)

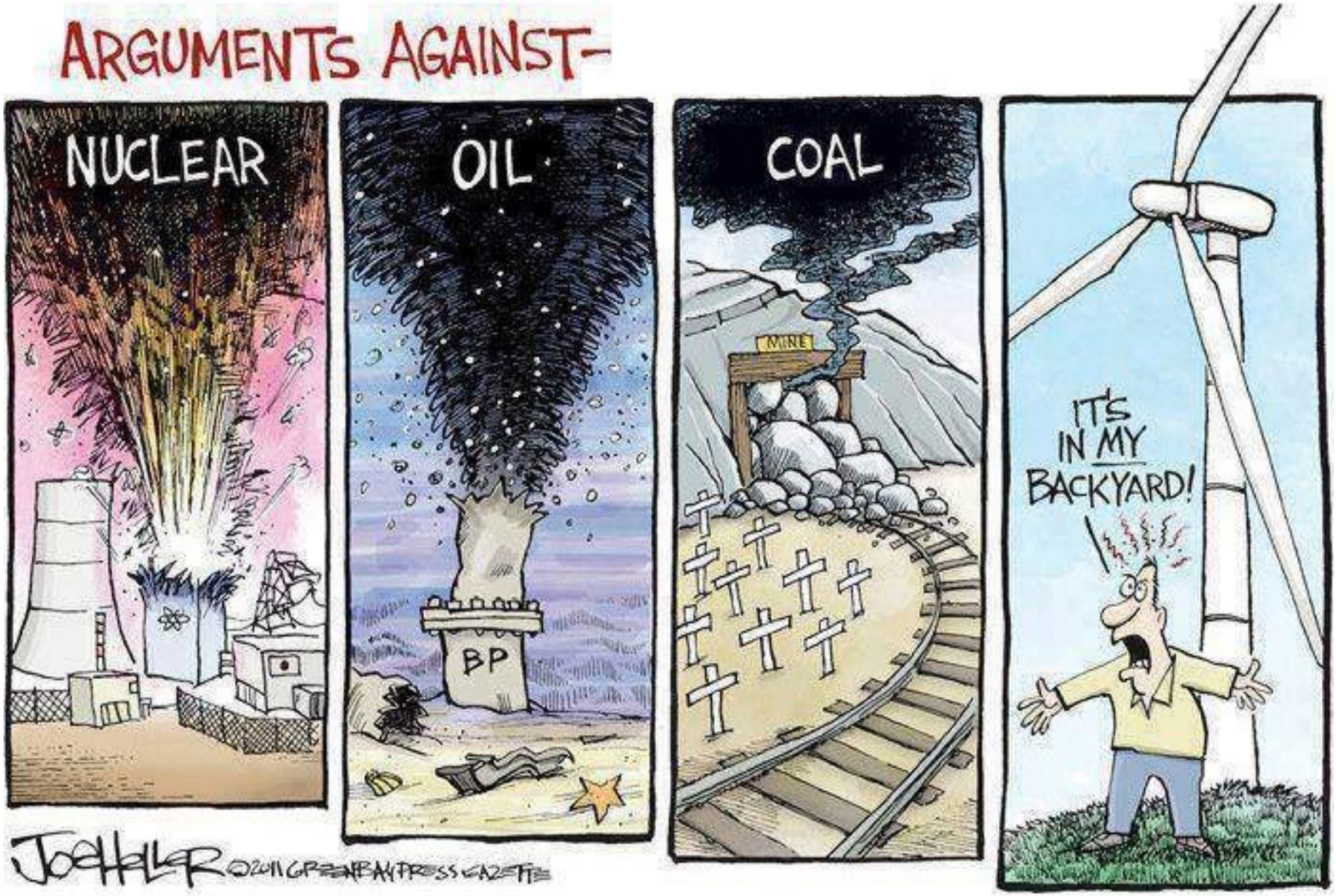
windturbines, zonneparken en woningprijzen, rapport voor ministerie EZK,
https://www.urbaneconomics.nl

Martijn Dröes
Universiteit van Amsterdam

Hans Koster
Vrije Universiteit Amsterdam






ARGUMENTS AGAINST-
NUCLEAR
OIL
BP
COAL
MINE
IT'S IN MY BACKYARD!
JoeHeller ©2011 GREEN BAY PRESS-GAZETTE

1. Context

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

- Price declines due to wind turbines:
  - → Noise
    - ↳ Local (<0.5km)
  - → Shadow
    - ↳ 12x rotor diameter (<1km)
  - → Horizon pollution
    - ↳ Direct and indirect (?km)

- Price declines due to solar farms:
  - → Noise and flickering
    - ↳ Very local (<100m)
  - → Horizon pollution
    - ↳ Local

- Solar farms (new trend), Wind Turbines: Kyoto (1997), European Energy directive (2009), Energy Agreement (2013)
- Trouw, 29 October 2013, 'Vechten tegen windmolens.' [Fighting agains windmills]

Universiteit van Amsterdam
VU Vrije Universiteit Amsterdam

1. Context

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

- Dröes and Koster (*Journal or Urban Economics*, 2016)
  - → 75% all housing transaction1985-2011 (NVM)
  - → All turbines until 2011
  - → Previous lit., few wind turbines and/or few obs.
- Average effect: –1.4%
  - → ~€ 3,000 per house
  - → ~€ 825,000 per turbine
  - → Only statistically sig. <2km.
  - → Closerby the effect is higher.
- Radio NPO1 (Argos) N33 wind park Groningen
- Questions in Dutch Parlement (SP, PvdA and CDA)
- Eric Wiebes (17 mei 2019): update study + solar farms:
- windturbines, zonneparken en woningprijzen, rapport voor ministerie EZK, https://www.urbaneconomics.nl

Universiteit van Amsterdam
VU Vrije Universiteit Amsterdam

2. Methodology

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

- **House prices**
  - → **Difference between X and Y *because* of wind turbines?**



€ X



€ Y

2. Methodology

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

- **Hedonic, difference-in-differences, price analysis:**
  → **Compare control-treatment group, effects over time, controlling for housing quality, location, etc.**

$$\log P_{it} = \beta_1 w_{it-1} + \beta_2 X_{it} + \lambda_j + \lambda_t + \varepsilon_{it},$$

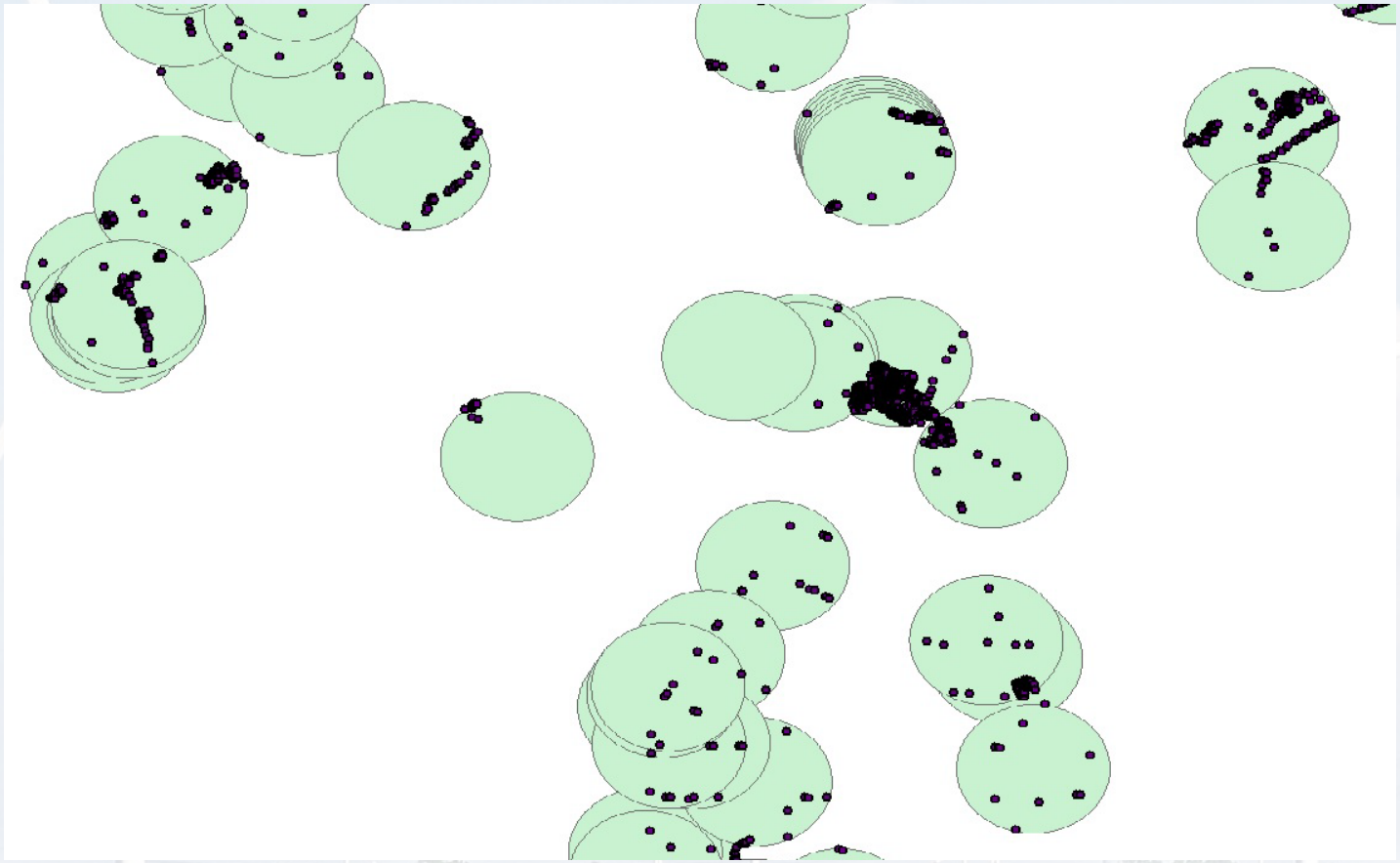


	
€ 100,000	€ 100,000
€ 105,000	€ 110,000

→ Price diff, no turbine is (110,000-100,000)/100,000=10%
→ Price diff with turbine is (105,000-100,000)/100,000=5%
→ *Relative* price decline is 5%.

Universiteit van Amsterdam
VU Vrije Universiteit Amsterdam

2. Methodology



- 3.3 mil. Obs. (1990-2019)
- Treated?: 170,000 transactions. *Nearest* wind turbine. 150,000 houses are treated.
- 2,400 turbines on land.
- 2-3 km as control group.

3. Data

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

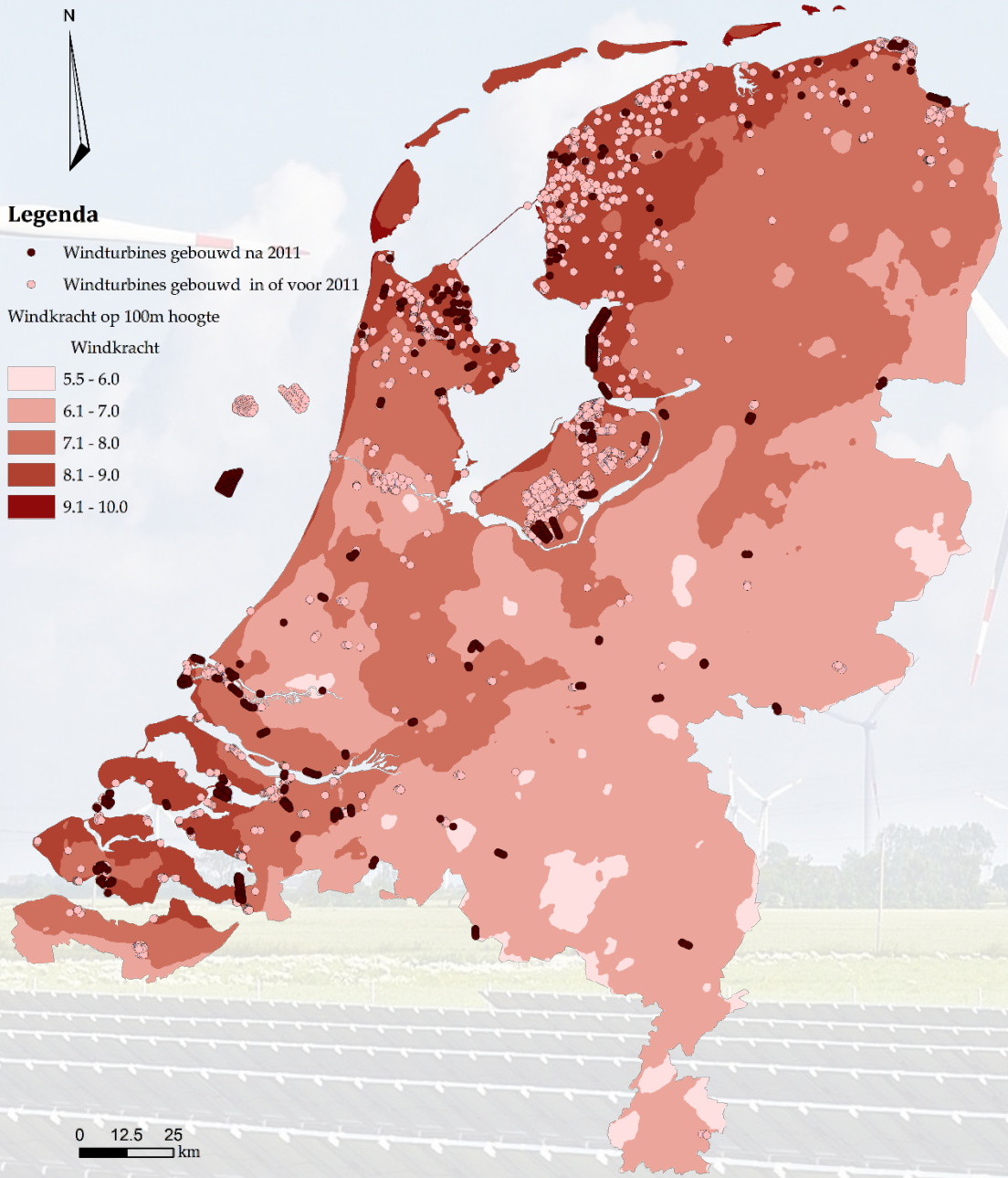
Tabel 3.1: Beschrijvende statistieken: woningprijzen en windturbines (1985-2019)

	(1) gem.	(2) st.dev.	(3) min	(4) max
Verkoopprijs (€)	214.178	121.704	25.000	1.000.000
Windmolen geopend, <2km	0,0283	0,166	0	1
Woonoppervlakte in m^2	117,9	37,71	26	250
Aantal kamers	4,384	1,340	1	25
Rijtjeswoning	0,317	0,465	0	1
Twee-onder-een kap	0,281	0,449	0	1
Vrijstaand	0,128	0,334	0	1
Garage aanwezig	0,331	0,471	0	1
Tuin aanwezig	0,976	0,154	0	1
Goede staat van onderhoud	0,866	0,341	0	1
Centrale verwarming aanwezig	0,891	0,312	0	1
Erfgoed	0,00618	0,0784	0	1
Bouwjaar 1945-1959	0,0717	0,258	0	1
Bouwjaar 1960-1970	0,150	0,357	0	1
Bouwjaar 1971-1981	0,169	0,374	0	1
Bouwjaar 1981-1990	0,138	0,345	0	1
Bouwjaar 1991-2000	0,126	0,332	0	1
Bouwjaar >2000	0,109	0,311	0	1

Notitie: Het aantal observaties is 3.389.903. Appartementen zijn de referentiegroep met betrekking tot het type woning. Woningen voor 1945 die van het bouwjaar.

3. Data (windstats.nl)

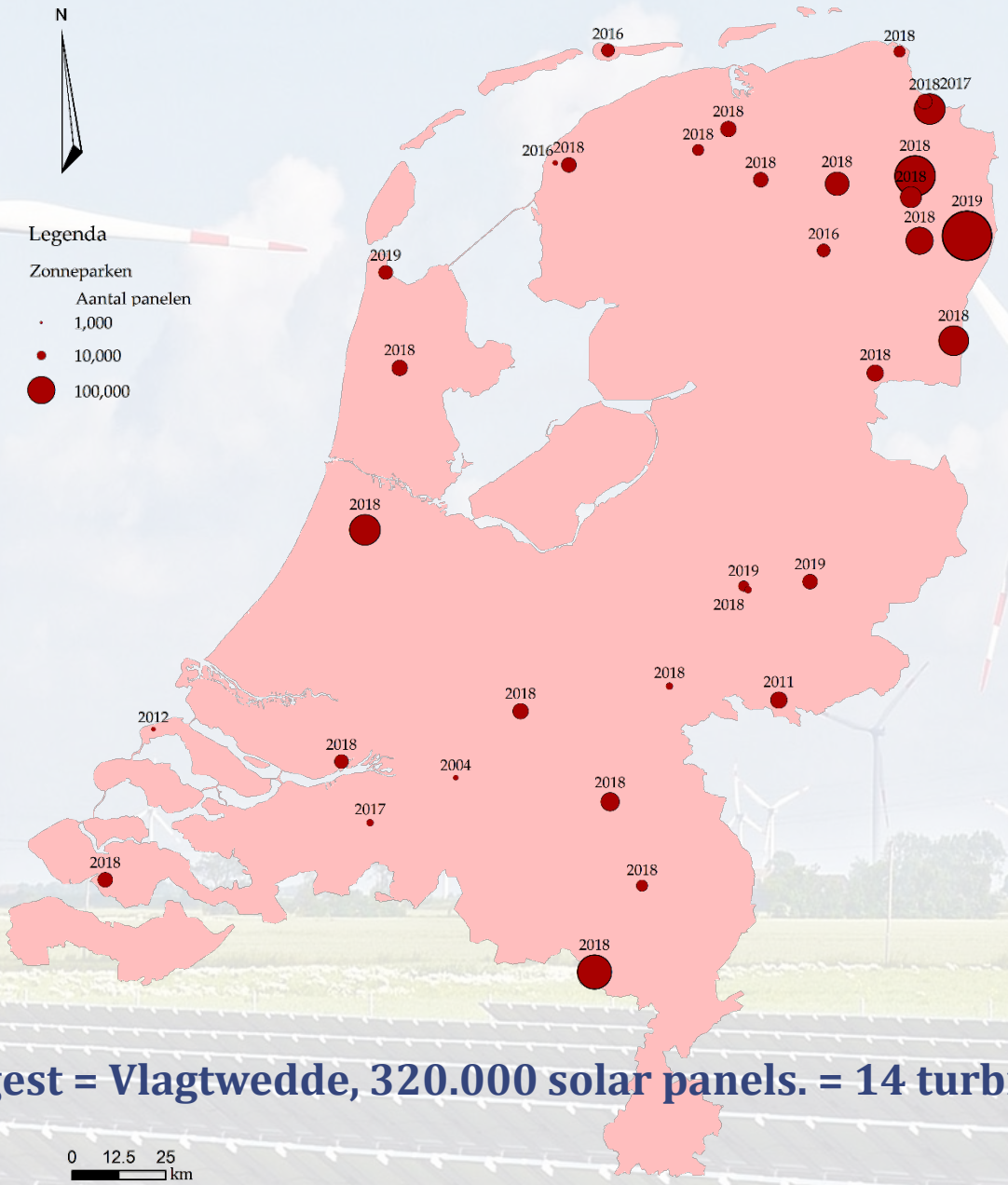
1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion



Universiteit van Amsterdam
VU VRIJE UNIVERSITEIT AMSTERDAM

2. Data (Wikipedia, internet sources)

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion



Largest = Vlagtwedde, 320.000 solar panels. = 14 turbines.

Universiteit van Amsterdam

VU Vrije Universiteit Amsterdam

4. Wind turbines

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

Tabel 3.2: Gemiddelde daling woningprijzen binnen 2km (1985-2019)

(Afhankelijke variabele: logaritme van woningprijzen)

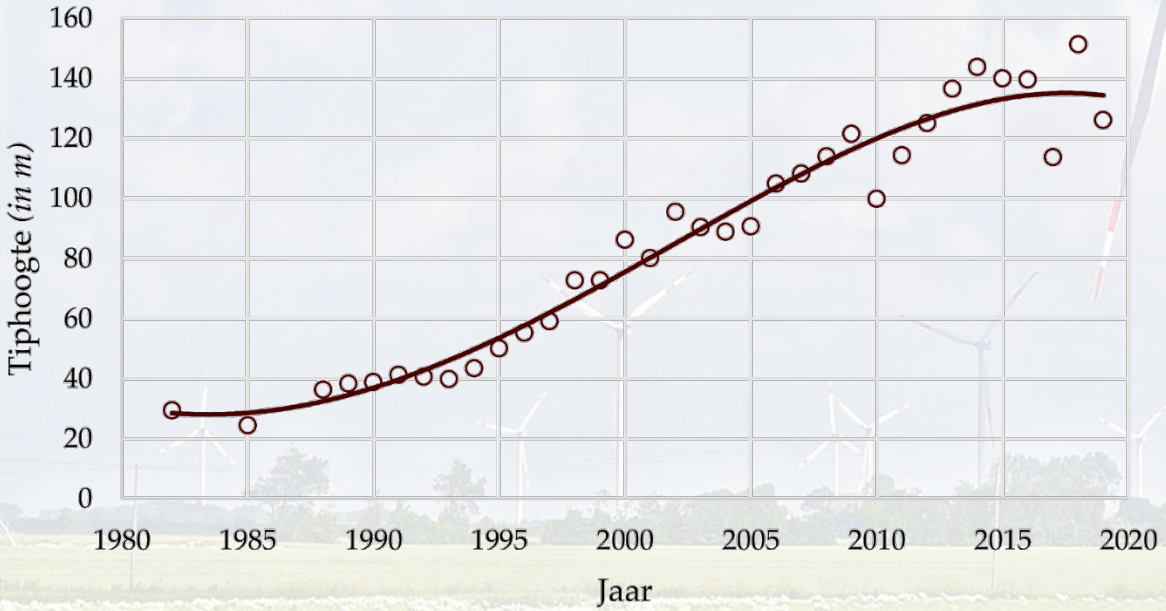
	(1)	(2)	(3)
	Replicatie D+K	*Volledige periode tot 2019*	*Voor, na 2011*
Windmolen geplaatst <2km	-0,0135**	-0,0214***	-0,0125**
	(0,0063)	(0,0048)	(0,0055)
Windmolen geplaatst <2km, na 2011 (interactieterm)			-0,0179**
			(0,0078)
Woningkenmerken	✓	✓	✓
Postcode fixed effects	✓	✓	✓
Jaar en maand fixed effects	✓	✓	✓
Observaties	358.085	710.703	710.703
R^2	0,93	0,92	0,92

Notitie: Deze tabel is gebaseerd op woningprijzen vanuit de NVM (Brainbay) tussen 1985 en 2019. Standaardfouten zijn geclusterd op buurtniveau en staan tussen haakjes. *** p<0,01, ** p<0,05, * p<0,10.

4. Wind turbines

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

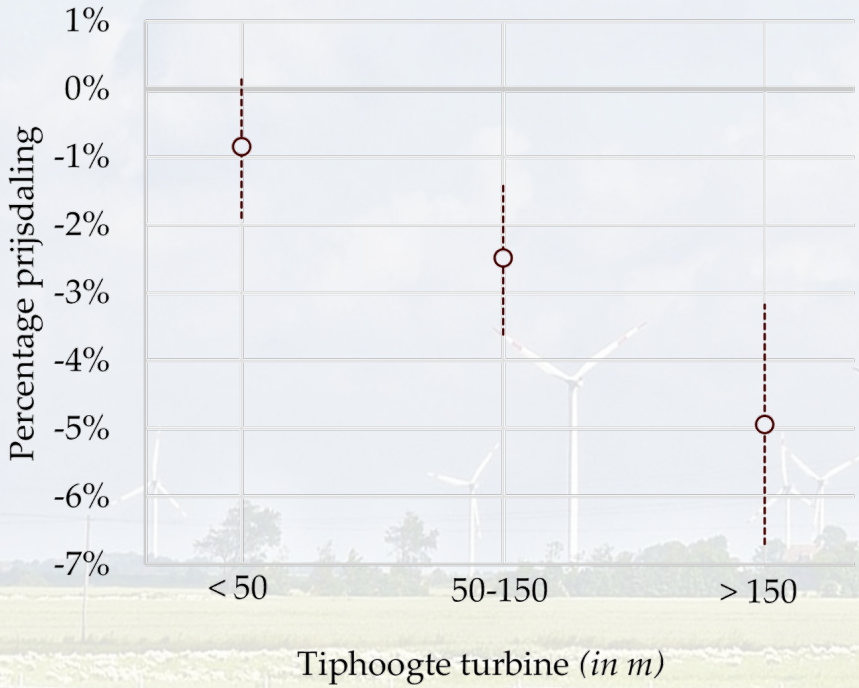
- **Why effect higher after 2011?**
  - **Turbines are getting higher**



4. Wind turbines

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

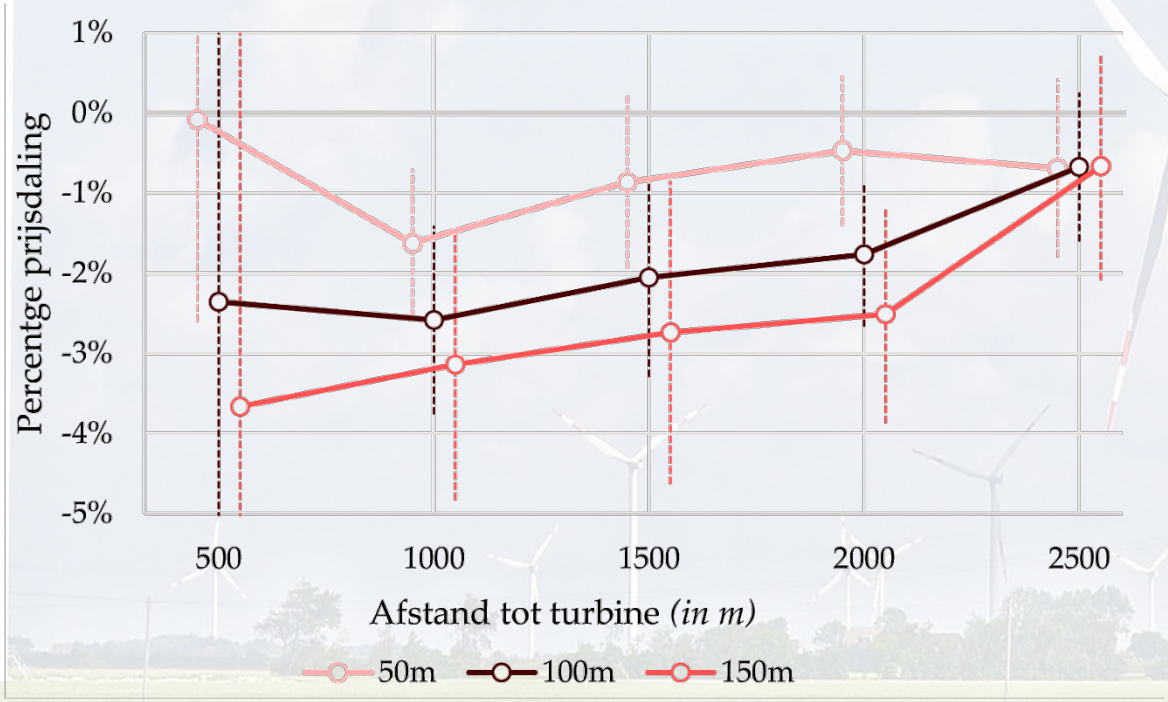
- **The effect at different (tip)heights**
  - → **–0.9% for turbines <50m**
  - → **–2.5% for turbines 50-150m**
  - → **–5% for turbines >150m**



4. Wind turbines

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

- **Also for high turbines the effect is relevant <2km**



4. Wind turbines

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

- Overall los in house values (2019 prices): 1,36 billion euros.
- 0.57 million euros per turbine.
- 1% of the turbines create more than 50% of the loss in value.
- (JUE, 2016, construction cost and CO2 gains, total balance is negative).

5. Solar Farms

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

- Same methodology
  - → Effect probably more local ⇒ <1km.
  - → Problem: few solar farms (48)
  - → Price data from 2009-2019.
  - → Only 256 transaction within 1km after placing a solar farm
  - → … ⇒ large standard errors/confidence intervals.

5. Solar Farms

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

- **Regression results…**
  → **Effect ⇒ –3%, limited evidence.**
- **Average total price effect per solar farm**
  → **–€ 640 thousand.**

Tabel 4.2: Gemiddelde daling woningprijzen (2009-2019)
(Afhankelijke variabele: logaritme van woningprijzen)

	(1)	(2)	(3)	(4)
	Heel Nederland	*Controle groep 1-2km*	*Controle groep 2-5km*	*Afstandsprofiel*
Zonnepark geplaatst <1km	-0,0609***	-0,0318*	-0,0278*	-0,0282*
	(0,0163)	(0,0170)	(0,0163)	(0,0167)
Zonnepark geplaatst 1-2km				0,0173
				(0,0153)
Woningkenmerken	✓	✓	✓	✓
Postcode fixed effects	✓	✓	✓	✓
Jaar en maand fixed effects	✓	✓	✓	✓
Observaties	1.470.808	15.203	85.326	98.010
R^2	0,90	0,87	0,89	0,89

Notitie: Deze tabel is gebaseerd op woningprijzen vanuit de NVM (Brainbay) tussen 2009 en 2019. Standaardfouten zijn geclusterd op buurtniveau en staan tussen haakjes. *** p<0,01, ** p<0,05, * p<0,10

6. Conclusion

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

2. **Windturbines and house prices:**
   - → **Average –2.2% <2km**
   - → **≈ –€ 6 thousand euros**
   - → **Effect higher after 2011 ⇒ –3.1%**
   - → **...Due to higher turbines**
     - ↳ **–2.5% <2km, turbines 50-150m**
     - ↳ **–5% <2km, turbines >150m**

⇛ **Include these extra costs in cost-benefit analysis and policy, are larger turbines desirable? Reimburse homeowners?**

6. Conclusion

1. Context
2. Methodology
3. Data
4. Wind turbines
5. Solar Farms
6. Conclusion

3. Solar farms and house prices:
   - → Average –3% <1km
   - → Inaccurate due to low nr. of obs. (also lower total impact).

   - ⇛ Repeat this research in a year of five.
   - ⇛ Take these possible extra costs in consideration when placing solar farms.

   - ⇛ (*horizontal versus vertical production of renewable energy*: How do solar farms and wind turbines compare in terms of CO2, construction costs, etc.?)

Thank you for listening



Martijn Dröes
Universiteit van Amsterdam

Hans Koster
Vrije Universiteit Amsterdam

Universiteit van Amsterdam

VU VRIJE UNIVERSITEIT AMSTERDAM