

# **DISTRICT HEATING WITH SMALL REACTORS**

**NEW NUCLEAR**  
HELSINKI 12<sup>TH</sup> NOV 2019

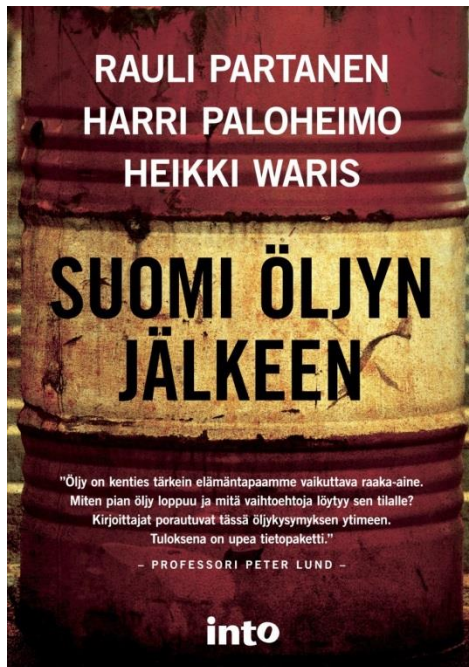
RAULI PARTANEN

THINK ATOM

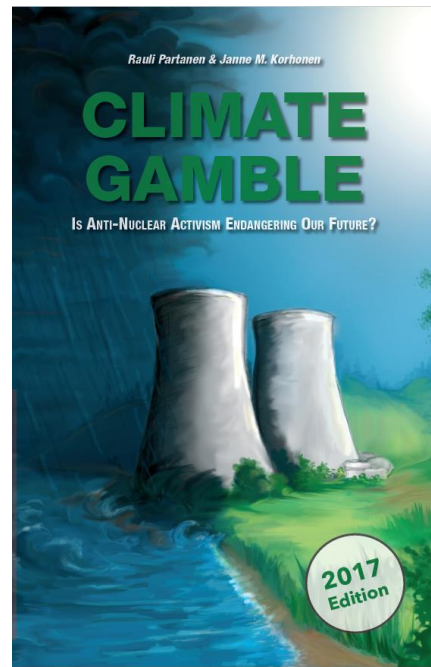
# RAULI WHO?

- ☯ Science writer
- ☯ Activist (Ecomodernist Society of Finland)
- ☯ Co-founder & CEO of Think Atom

Tieto-Finland -finalist



2013

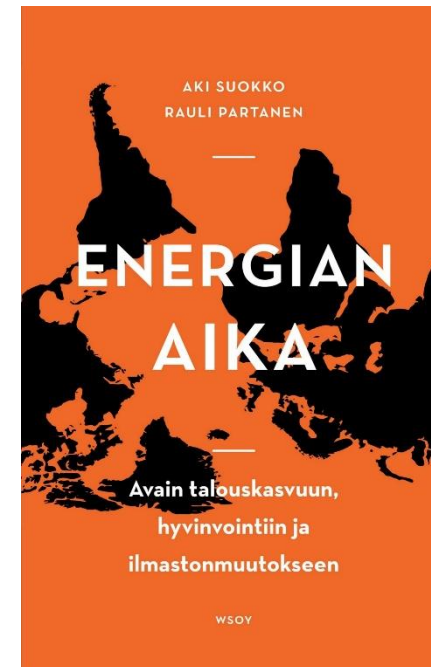


2015



2016

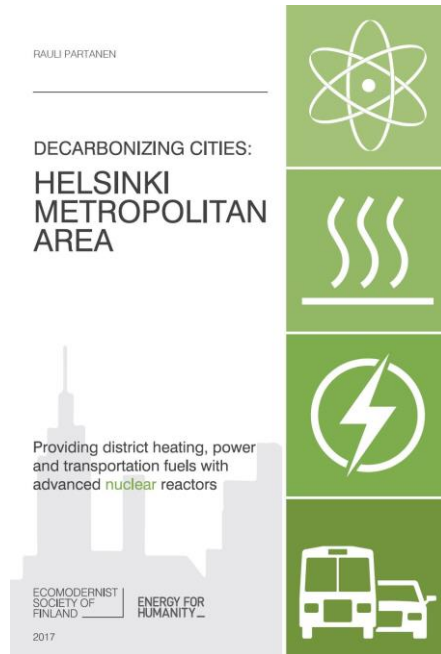
Sciencebook of the year



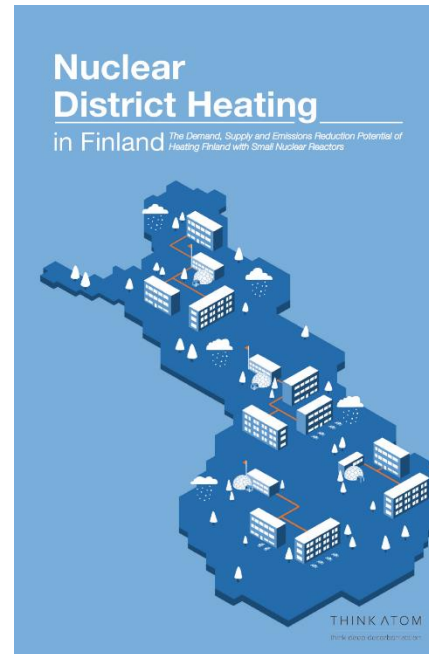
2017

# WHAT IS THINK ATOM

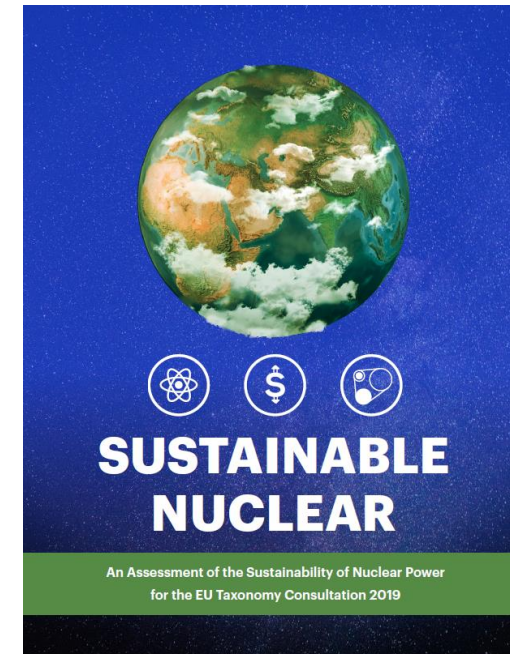
- ☢ Non-profit, independent think tank & consultancy.
- ☢ In a nutshell: How to use nuclear to decarbonize different sectors of our economy (power, heat, transportation).



2017

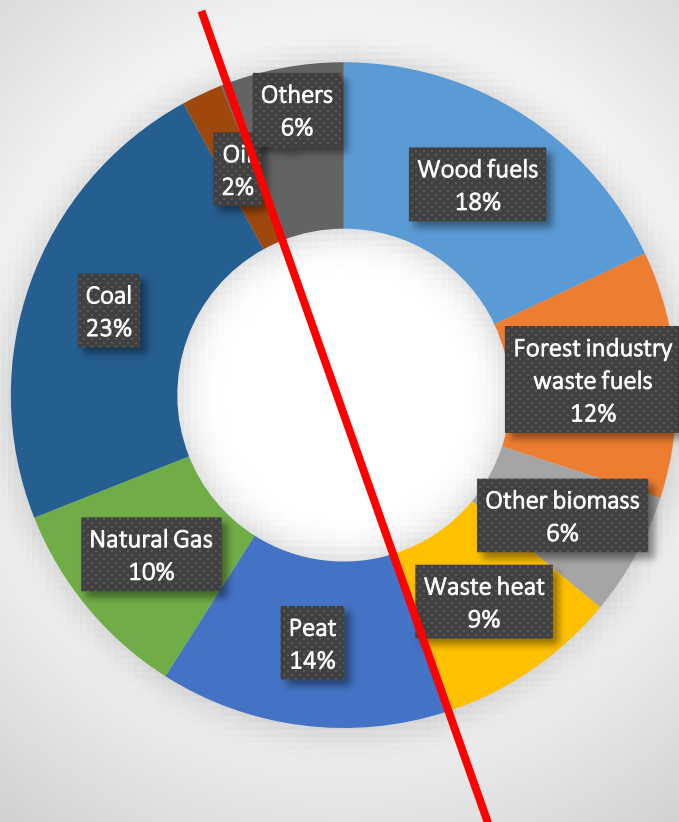


2019



2019

District Heat Energy Sources in Finland -  
2017



# POTENTIAL FOR NUCLEAR DISTRICT HEATING IN FINLAND

---



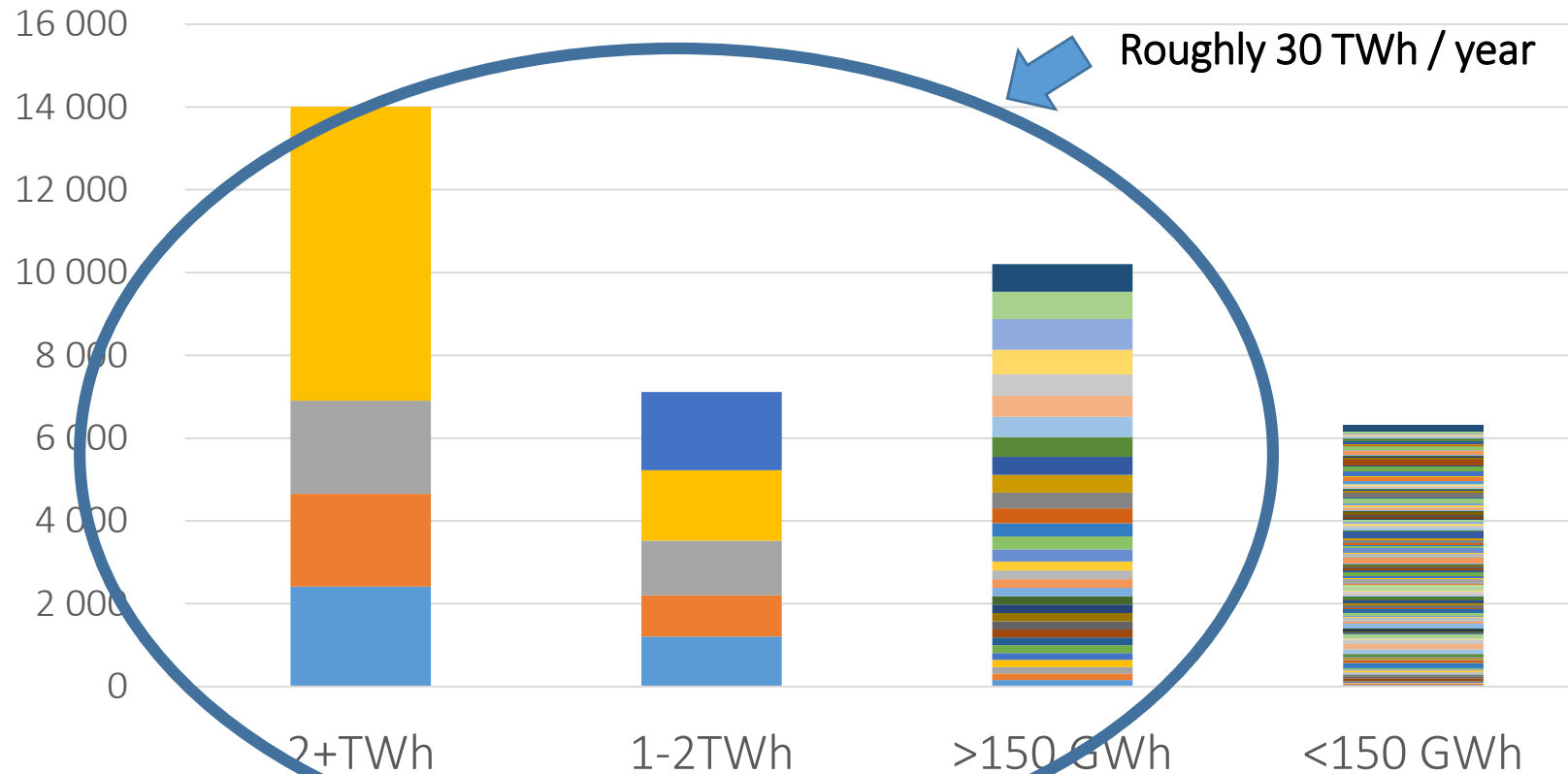
# STRUCTURE

---

- ⚛ District heating networks
- ⚛ Small reactors
- ⚛ Modelling
- ⚛ Emissions reduction potential
- ⚛ Business cases and –models (e.g. “Heat Mankala”)
- ⚛ Lisencing, regulation, public discussion

# DH NETWORKS IN FINLAND

Distribution of Finnish DH networks by annual demand



# REACTORS

---

- ☢ Heat Only (24 – 400 MWt)
  - ☢ DHR-400, HAPPY, NHR200-II (China)
  - ☢ SECURE 200/400 MWt
  - ☢ “Finreactor” microreactor (24 MWt)
- ☢ Light Water / CHP (150 – 900 MWt)
  - ☢ NuScale (US, 200-2400 MWt)
  - ☢ SMART (S-Korea)
  - ☢ KLT-40S / RITM200 (Russia, 150-200 MWt)
  - ☢ BWRX-300 (GE Hitachi)
- ☢ Advanced / non-water
  - ☢ HTR-PM (China – pebblebed/gas)
  - ☢ IMSR (Canada – Molten Salt)
  - ☢ SEALER (Sweden - Lead)
  - ☢ PRISM/ARC100 (GE Hitachi - Metal)

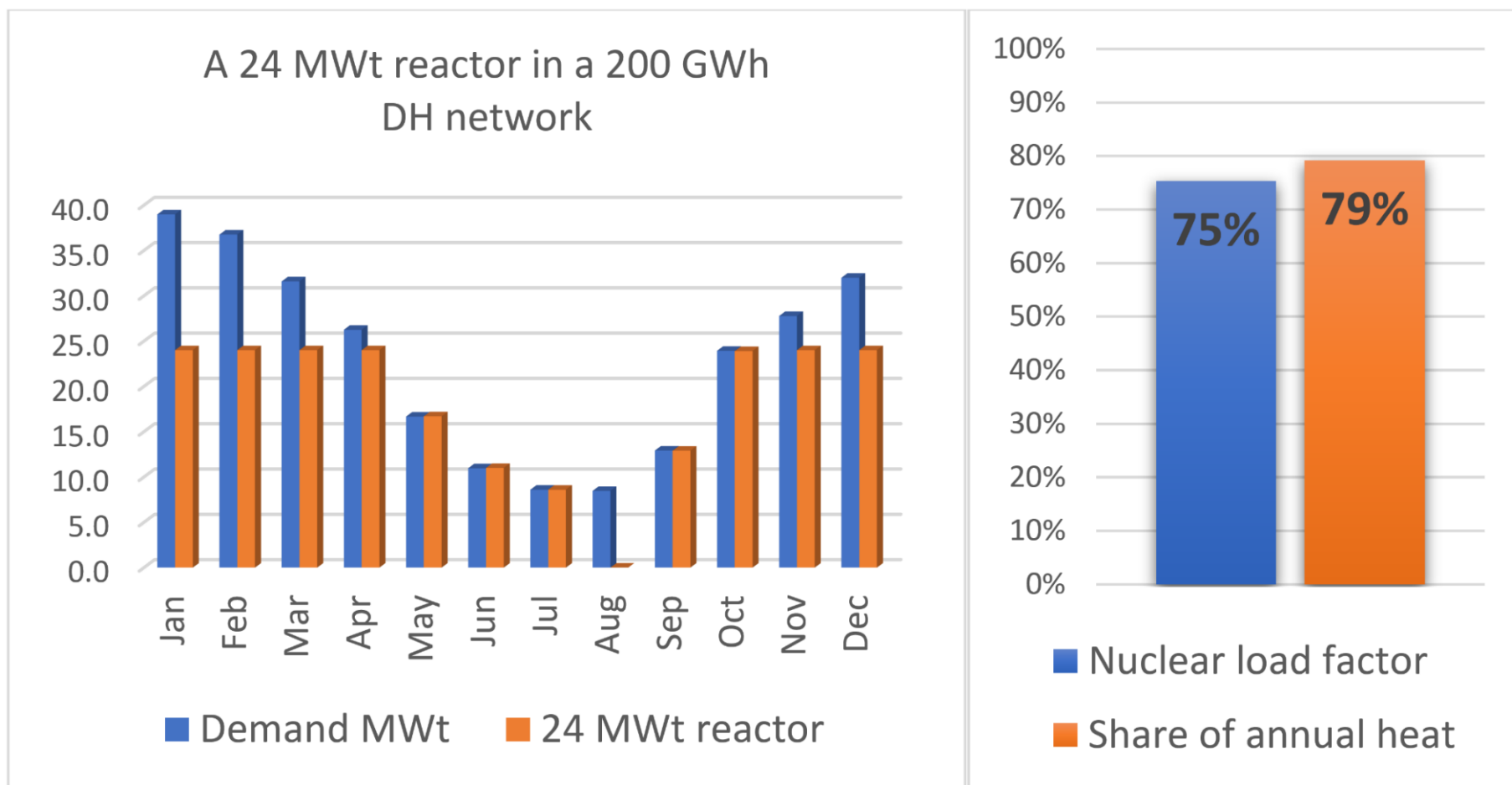
# MODELLING

---

- ✿ DH network sizes:
  - ✿ 200, 500, 1500, 2400 ja 7000 GWh / y
  - ✿ Poland cases: 7 TWh ja 2.5 TWh
- ✿ Reactor sizes used:
  - ✿ 24 MW, 200 MW, 400 MW and ~900 MW
- ✿ Heat only -reactors
- ✿ District Cooling
- ✿ CHP / Combined heat and power



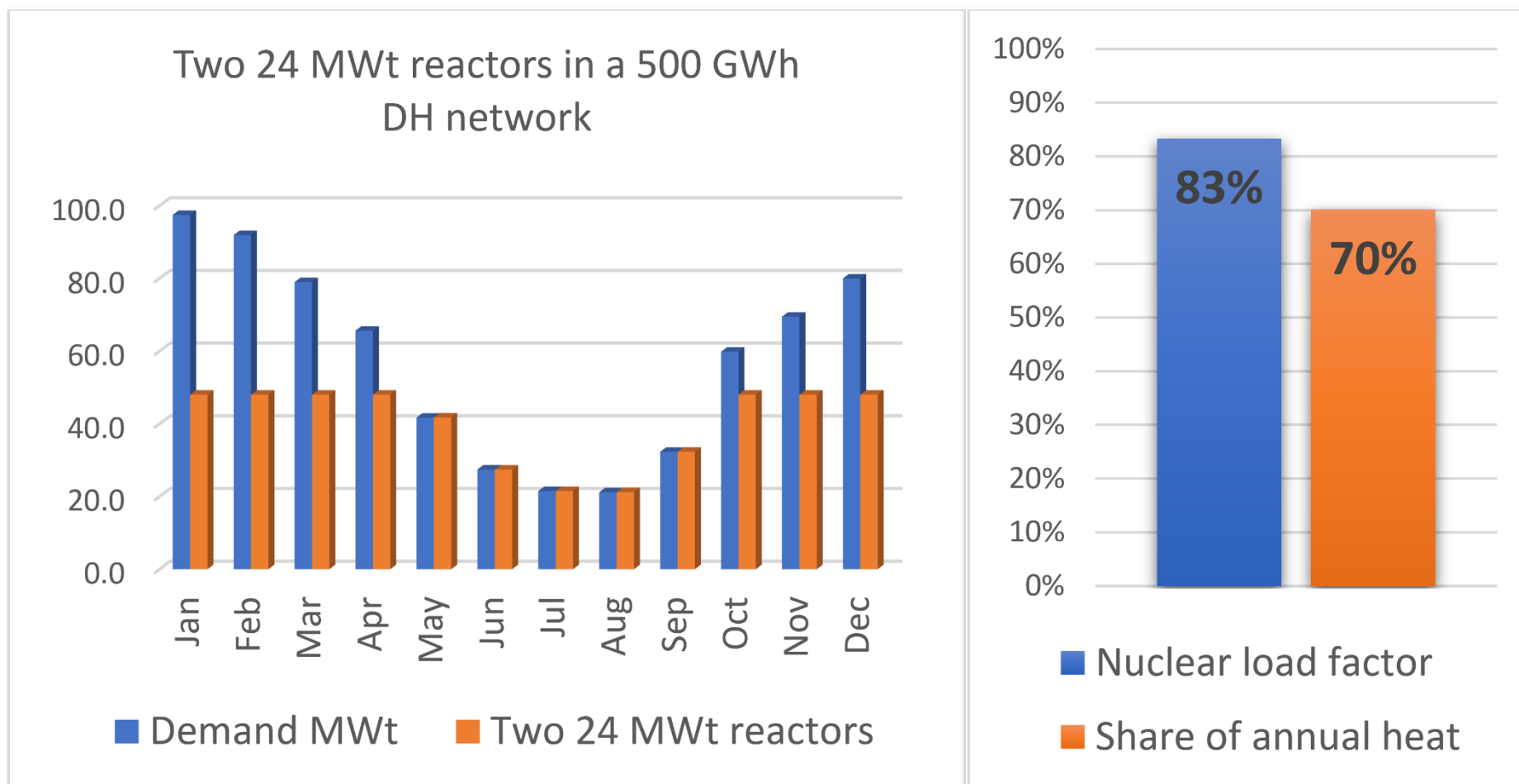
# MODELLING RESULTS



☢ Finland has ~20 DH systems of 150-350 GWh

THINK ATOM

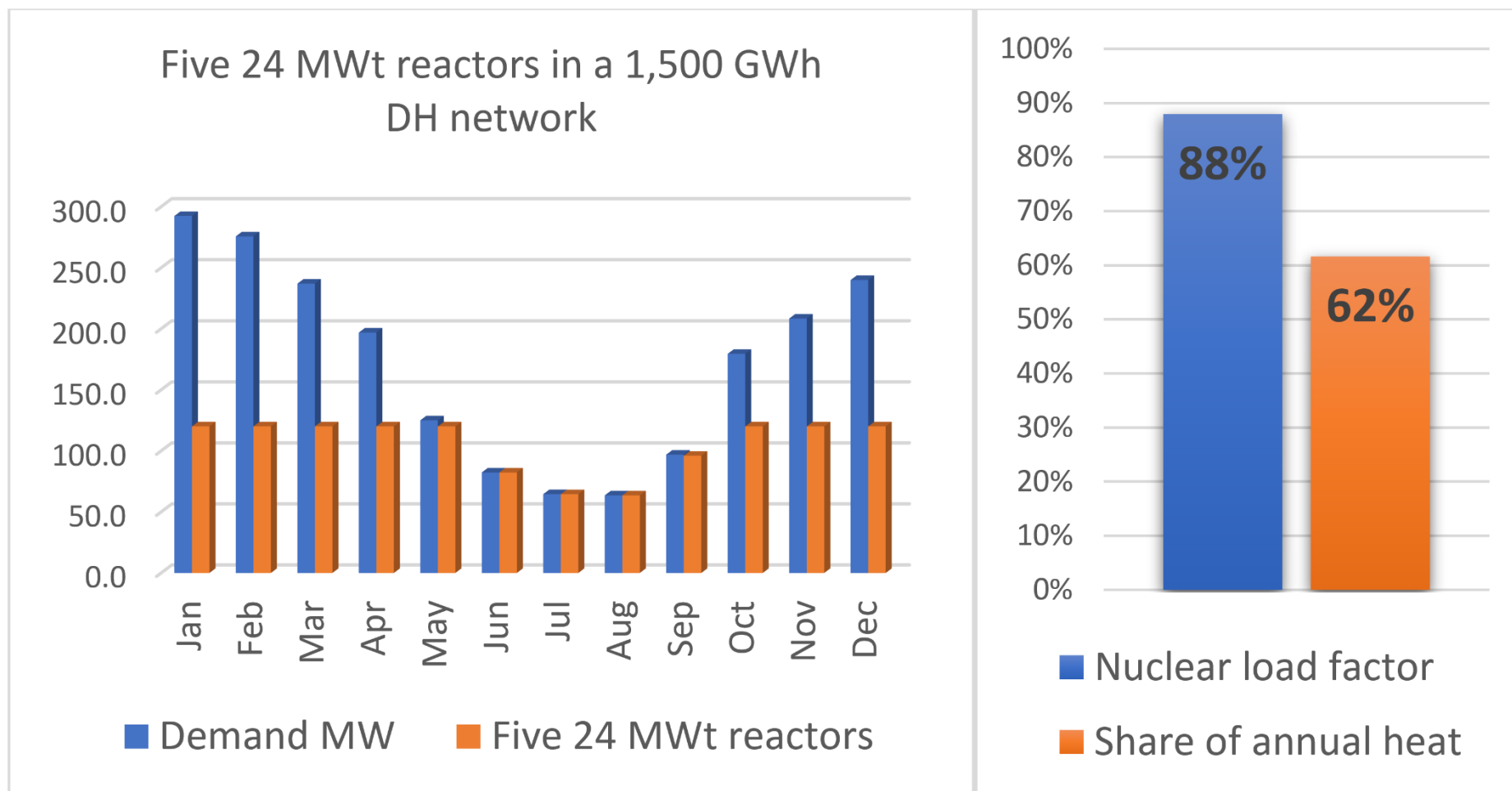
# MODELLING RESULTS



☢ Finland has ~12 DH systems of 350-750 GWh

THINK ATOM

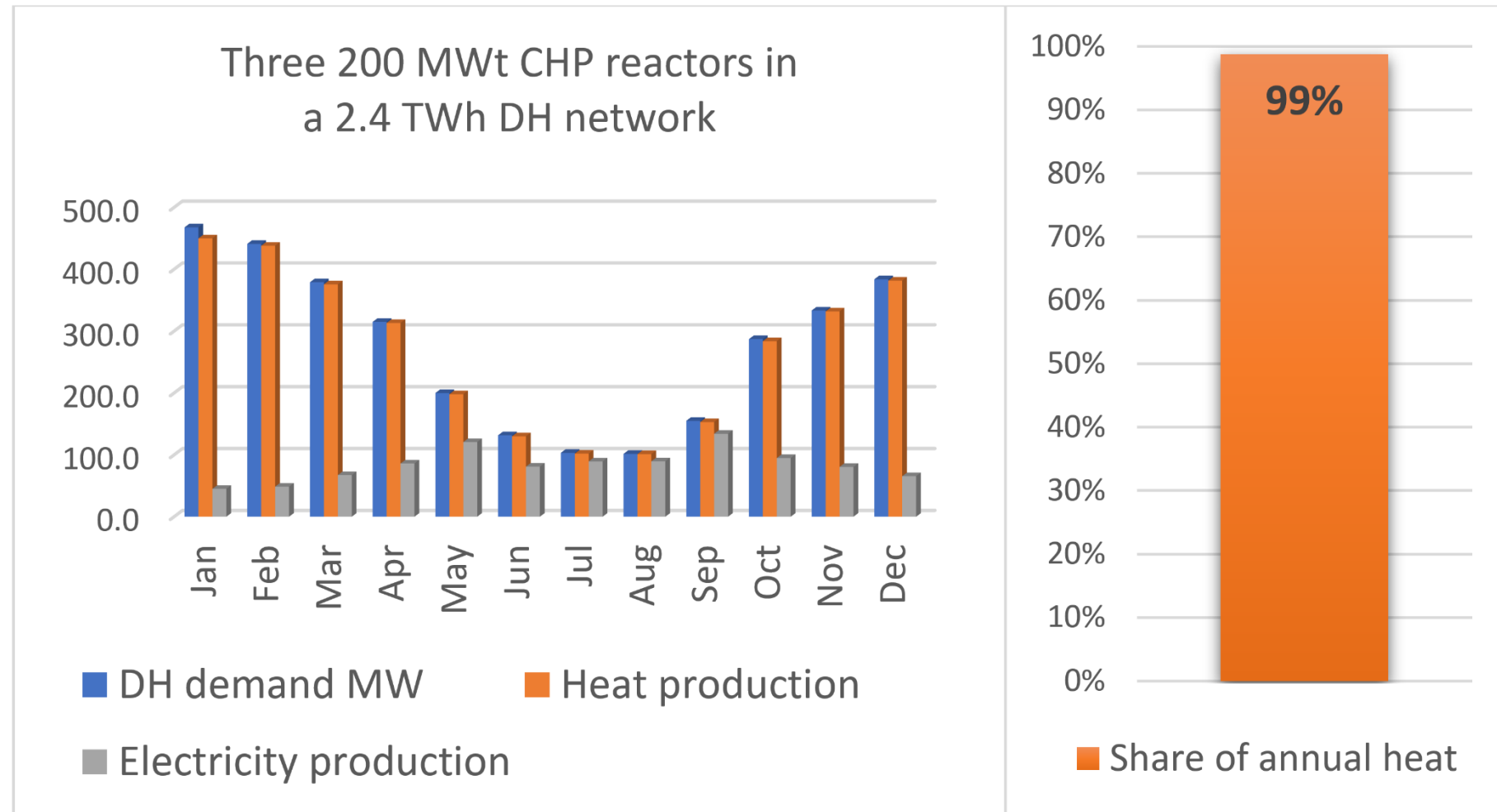
# MODELLING RESULTS



☢ Finland has 5 DH systems of ~1500 GWh

THINK ATOM

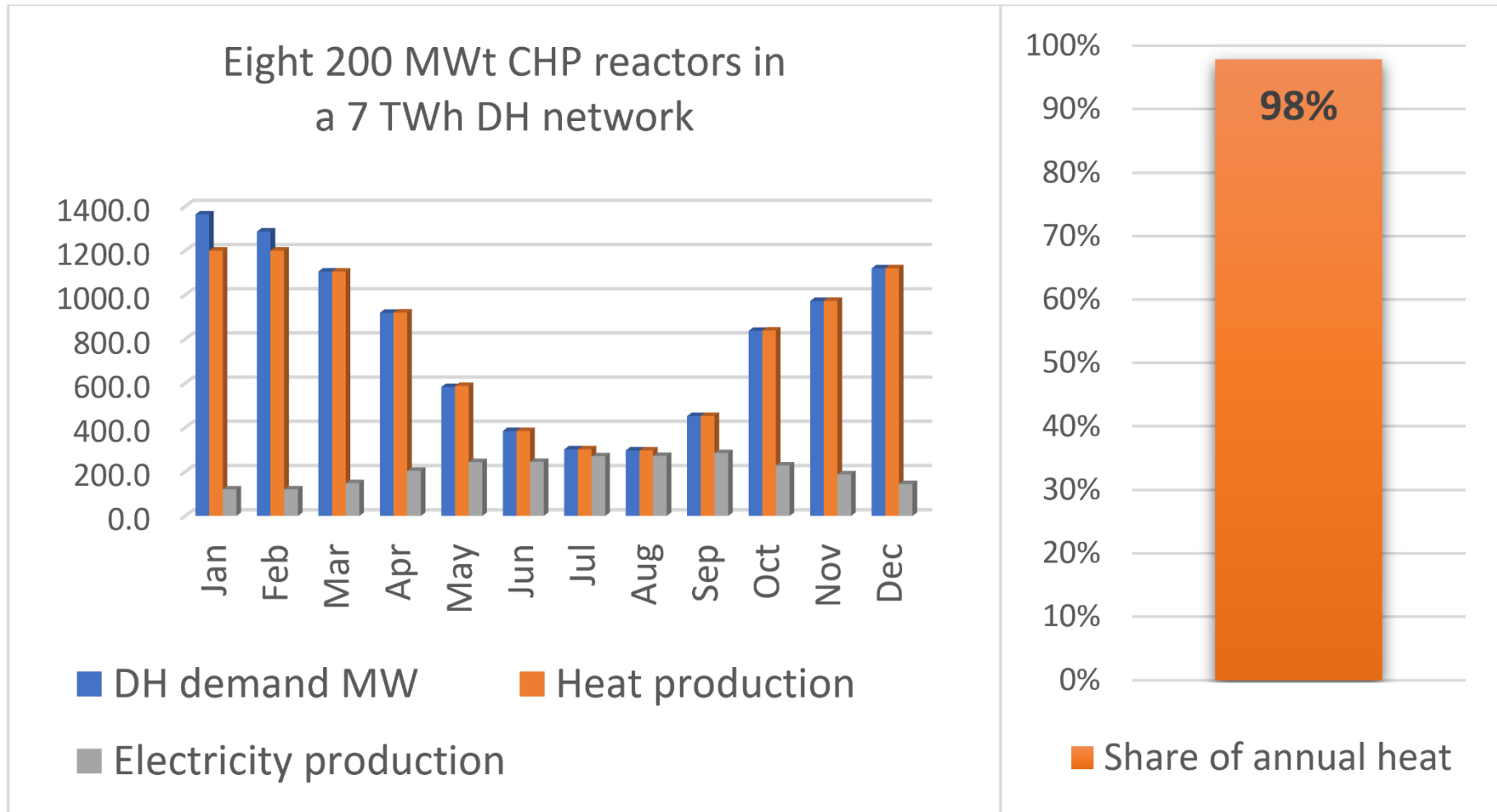
# MODELLING RESULTS



☢ Finland has 3 DH systems of ~2400 GWh

THINK ATOM

# MODELLING RESULTS



☢ Finland has one DH system of ~7000 GWh

THINK ATOM

# KEY FINDINGS

---

- ✿ Roughly half of DH could be supplied with heat-only reactors, high capacity factor
  - ✿ 5-8 ~200MWt SMR's (5 biggest cities)
  - ✿ 20-40 24 MWt microreactors (20-30 biggest towns)
- ✿ Fossil fuels and peat could be replaced (5+ Mton CO<sub>2</sub>), no pressure to increase bioenergy use.
- ✿ With CHP or lower capacity factor, roughly 70 % of DH could be nuclear.
  - ✿ Forestry residue left for more valuable uses
- ✿ LCOH ~15-30 € / MWh. Going nuclear would mean both **lower cost** and **lower carbon** from today.
- ✿ Bottleneck today is lack of suitable regulation/legislation, not technology.





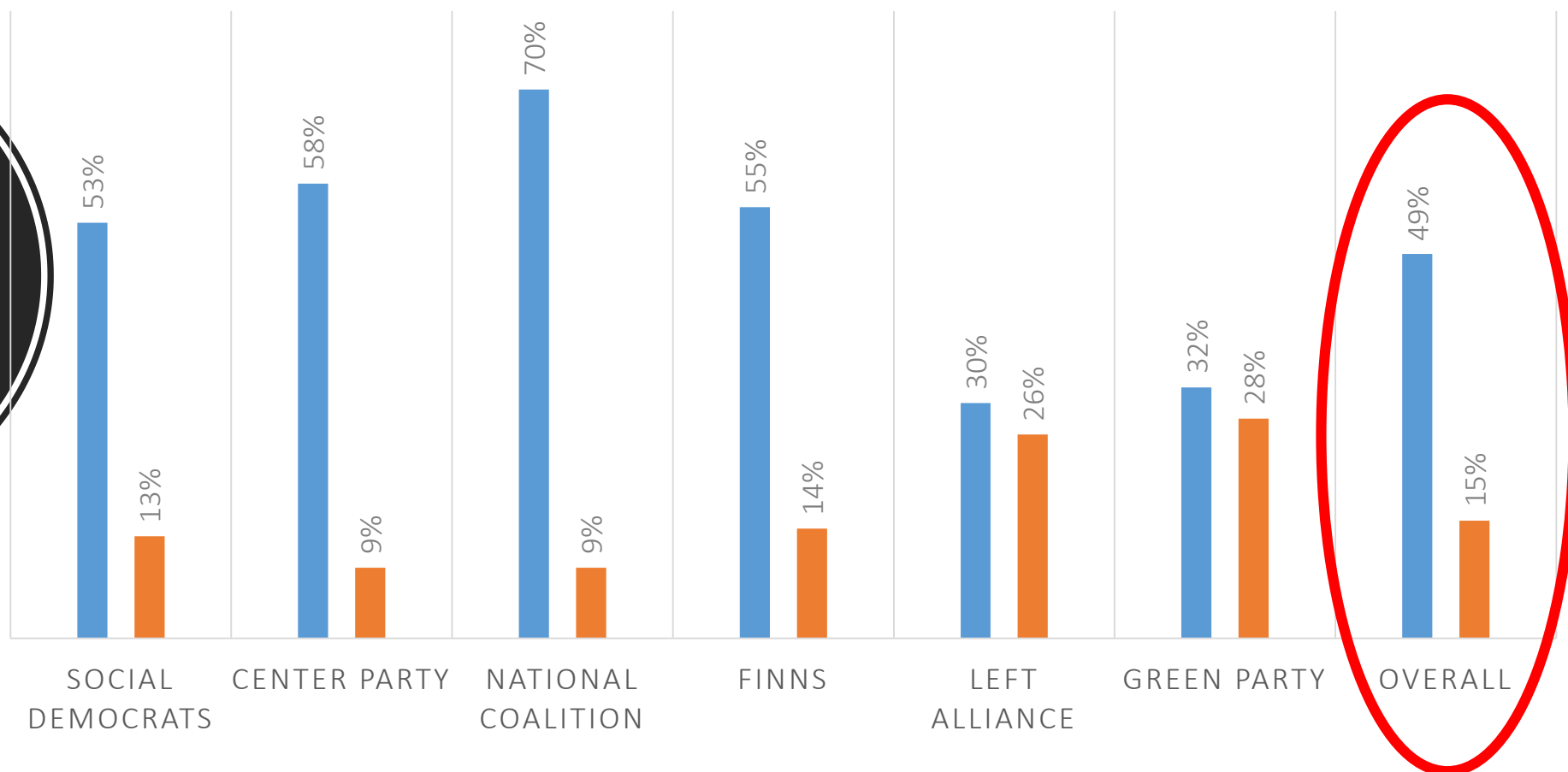
SITUATION IN FINLAND

---

PUBLIC  
ACCEPTANCE  
IS  
IMPROVING

## POSITION ON NUCLEAR ENERGY FOR VOTERS OF DIFFERENT PARTIES - SPRING 2019 (DATA: FINNISH ENERGY)

■ For nuclear ■ Against Nuclear



# NEW NUCLEAR IS PROGRESSING

- ✿ In May 2018, Helsinki city council passed a vote to investigate “non-bioenergy options” for district heating.
- ✿ In 2019, new Government target: Finland will be carbon neutral by 2035.
- ✿ In Oct 2019, parliament initiative to renew our regulations and legislation to better allow SMRs and new uses of nuclear.
- ✿ In Oct 2019, a working group started to plan reform of nuclear legislation.

				Kousa Tuuli (Vihr.)					
Månsson Björn (SFP)	Koskinen Kauko (Kok.)	Bogomoloff Harry (Kok.)	Rautava Risto (Kok.)	Kivekäs Otso (Vihr.)	Soininvaara Osmo (Vihr.)	Sinmemäki Anni (Vihr.)	Heinäluoma Eveliina (SDP)	Taipale Ilkka (SDP)	Vuorjoki Anna (Vas.)
Donner Jörn (SFP)	Urho Ulla-Marja (Kok.)	Hakola Juha (Kok.)	Vapaavuori Jan (Kok.)	Kari Emma (Vihr.)	Holopainen Mari (Vihr.)	Saares Pauliina (Vihr.)	Haatainen Tuula (SDP)	Heinäluoma Eero (SDP)	Arhinmäki Paavo (Vas.)
Biaudet Eva (SFP)	Pelkonen Jaana (Kok.)	Asko-Seljavaara Sirpa (Kok.)	Karhuvaara Arja (Kok.)	Raatikainen Mika (PerusS)	Chydenius Jussi (Vihr.)	Stranius Leo (Vihr.)	Wallgren Thomas (SDP)	Taipale Kaarin (SDP)	Puhakka Sirpa (Vas.)
Rantala Marcus (SFP)	Klemetti Tapio (Kok.)	Muurinen Seija (Kok.)	Koulumies Terhi (Kok.)	Halla-aho Jussi (PerusS)	Hamid Jasmin (Vihr.)	Vesikansa Sanna (Vihr.)	Lovén Jape (SDP)	Jalovaara Ville (SDP)	Honkasalo Veronika (Vas.)
Borgarsdóttir Sandelin Silja (SFP)	Vartiainen Juhana (Kok.)	Rydman Wille (Kok.)	Peltokorpi Terhi (Kesk.)	Rantanen Mari (PerusS)	Juva Kati (Vihr.)	Oskala Hannu (Vihr.)	Vainikka Mirka (SDP)	Järvinen Jukka (SDP)	Koivulaakso Dan (Vas.)
Laaksonen Heimo (Kok.)	Kaleva Atte (Kok.)	Harkimo Joel (Kok.)	Puska Pekka (Kesk.)	Kopra Pia (PerusS)	Yanar Ozan (Vihr.)	Ohisalo Maria (Vihr.)	Vepsä Sinikka (SDP)	Mohamed Abdirahim (SDP)	Mutttilainen Sami (Vas.)
Nygård Mia (Kok.)	Pajunen Jenni (Kok.)	Sazonov Daniel (Kok.)	Ebeling Mika (KD)	Hyttinen Nuutti (PerusS)	Alametsä Alviina (Vihr.)	Hernberg Kaisa (Vihr.)	Vanhanen Reetta (Vihr.)	Abdulla Zahra (Vas.)	Said Ahmed Suldaan (Vas.)
Parpala Matti (Kok.)	Meri Otto (Kok.)	Saxberg Mirita (Kok.)	Venemies Mauri (KD)	Strandén Juhani (PerusS)	Tamminen Lilja (Vihr.)	Harjanne Atte (Vihr.)	Silvo Satu (Vihr.)	Korkkula Vesa (Vas.)	Malin Petra (Vas.)
Niskanen Dani (Kok.)	Apter Ted (Kok.)	Pennanen Petrus (PIR)	Aro Katju (FP)						

**THANK YOU**

RAULI PARTANEN

THINK ATOM

# SOURCES AND CONTACT

---

- ✿ The reports/studies: <https://thinkatom.net/publications/>
- ✿ My book Climate Gamble:  
<https://www.amazon.com/Climate-Gamble-Anti-Nuclear-Activism-Endangering/dp/9527139112/>
- ✿ French edition:  
<https://www.amazon.com/Pari-sur-climat-anti-nucl%C3%A9aire-met-ebook/dp/B01HOLSGY4/>
- ✿ Legislation working group press release: [https://valtioneuvosto.fi/artikkeli/-/asset\\_publisher/1410877/tyoryhma-selvittamaan-ydinenergiain-kokonaisuudistusta?\\_101\\_INSTANCE\\_YZfcyWxQB2Me\\_languageId=en\\_US](https://valtioneuvosto.fi/artikkeli/-/asset_publisher/1410877/tyoryhma-selvittamaan-ydinenergiain-kokonaisuudistusta?_101_INSTANCE_YZfcyWxQB2Me_languageId=en_US)
- ✿ [raulipartanen@gmail.com](mailto:raulipartanen@gmail.com) / [info@thinkatom.net](mailto:info@thinkatom.net)

THINK ATOM