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EXPRESS

Regional Energy Sector Analysis, North Karelia / Finland

Goal: to increase energy self-sufficiency and share of renewables

- **North Karelia: 80%/80% by 2030**

EXPRESS Thematic workshop

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1. **Goals & current energy structure**
2. **Energy shift: Key challenges & opportunities**
   - SWOT analysis & how the process continues in EXPRESS
3. **CASE Traffic**

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1. Current energy structure

Energy statistics 2022 / North Karelia region

Year:	2020 GWh	2022 GWh	Change, % 2022/2020	2022/2008
Wood energy	5 722	5 939	3,8 %	20,8 %
Renewable electricity	1 457	1 165	-20,0 %	-3,7 %
Heat pumps	351	506	**44,2 %**	**532,5 %**
Other renewables	33	42	27,3 %	-30,0 %
Energy peat	344	350	1,7 %	-49,3 %
Heating oil	449	331	**-26,3 %**	**-51,5 %**
Traffic (!) (incl. bio)	1 329	1 366	2,8 %	0,0 %
Motor oil (!)	396	411	3,8 %	3,5 %
Non-renewable electricity	992	840	-15,3 %	30,2 %
TOTAL	**11789**	**10 951**	**-7,1 %**	**9,0 %**
Share of renewables	71 %	72 %		
Domestic energy	66 %	69 %		

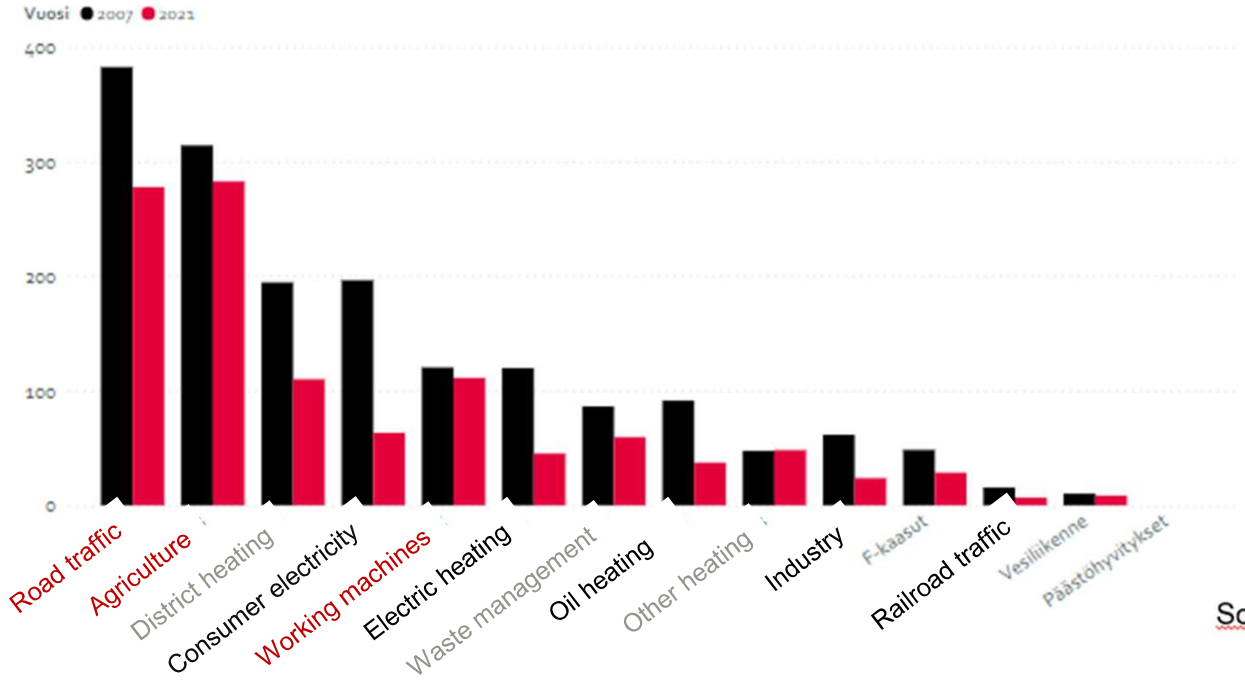
Electricity in North Karelia

Consumption:	**GWh**	**Production:**	**GWh**
Domestic and agriculture	703	Hydro	723
Industry	1 330	Wind & solar	0
Services and construction	441	Thermal	713
TOGETHER:	**2 474**	TOGETHER:	**1 436**

Sectoral CO_2 emissions in North Karelia

Päästöjen määrä Pohjois-Karjalassa 2021 | Kehitys päästölähteittäin

Emissions $ktCO_{2e}$ in Year 2007 and 2021



Top 5 reducers

CO2 source	Change 2007-2021 %
Consumer electr.	-67,8 %
Electric heating	-62,3 %
Industry	-61,6 %
Oil heating	-59,3 %
Railroad traffic	-57,1 %

Source: hiilineutraalisuomi.fi

2. Energy shift

Key challenges?

Securing fuel supply for district heating

- Parallel cease of wood chip & electricity import from Russia and shutdown of own energy peat production
- New competitive uses for ”energy quality” wood biomass and cascading use principle (also positive impacts!)

Energy poverty due to increased energy prices

Utilization of hydrogen economy investment boom, wind and solar energy investments as the first wave

- Military radar requirements (same for all Eastern Finland border regions)
- Bottlenecks in National grid transmission capacity (joint problem for border regions)
- Need for Invest in projects for green hydrogen and it’s derivates – development of overall conditions for remarkable investments

Reduction of CO_2 emissions of traffic and moving machines

- Substituting truck transportation by train and waterways in long distance
- Winning technologies for heavy traffic and machines in forestry & mining sector?

Balance between production and supply becoming pivotal challenge

- Demand response, buffers and storages growing business opportunity in all system levels – especially in electricity market

Implementation of new EU energy directives and utilizing their potential

- Energy Communities, The Medium Combustion Plant Directive (MCPD)…

Power transmission – capacity & landscape?

Traffic fuels – roles of biogas and hydrogen?

North Karelia

- Our Big Trends

Energy self-sufficiency and share of renewables in 2030 **80%**

Bioenergy = current basis (about 54%)

Bioenergy 2.0

- Increasing use of waste heat from biomass refining – cascading principle (eg. biocoal production)
- More efficient use of produced & harvested biomasses (freshwood concept, new technology, new biomass sources etc.)
- Security of fuel supply & decreasing CO_2 footprint: biomass terminals, trafficability of lower road network, railroad and waterway infrastructure
- Hybrid energy systems and new business and cooperation models (energy communities, industrial symbiosis', heat entrepreneurship...)
- Bio-based traffic fuels and e-fuels

➔ From bioenergy to hydrogen economy

- Wind and solar power investments
- Heat as side product: heat pumps and district heat networks, energy efficiency – cascading use of biomasses for value-add production
- Bio-based CO_2 → valuable raw material for e-fuels and green chemistry
    - Strong forest industry and district heat infrastructure strengths of Eastern Finland

New survey on wind power potential and locations for wind parks (draft)

Source: Consulting company FCG Oy

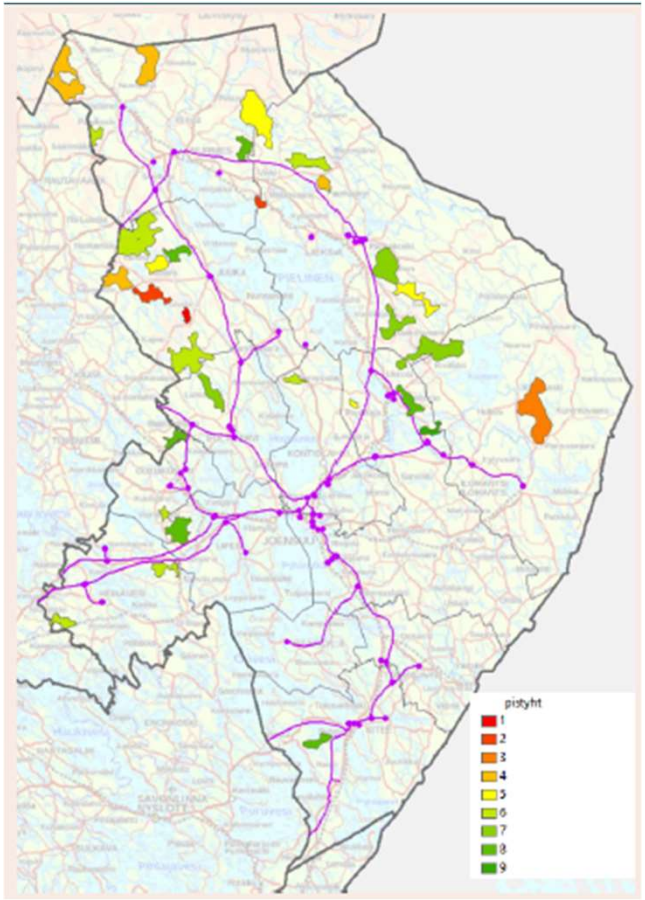
- **31 potential areas for wind parks**
  - Up to 1,526 wind turbines (8 MW)
  - Annual output 43 TWh
- **Draft survey on solar power potential**
  - 31 potential solar park areas (30 – 2,600 ha)
  - Annual output potential up to 7,5 TWh

➔ **Need for remarkable investments in power grid**

➔ **Need for solutions for the military radar barrier**

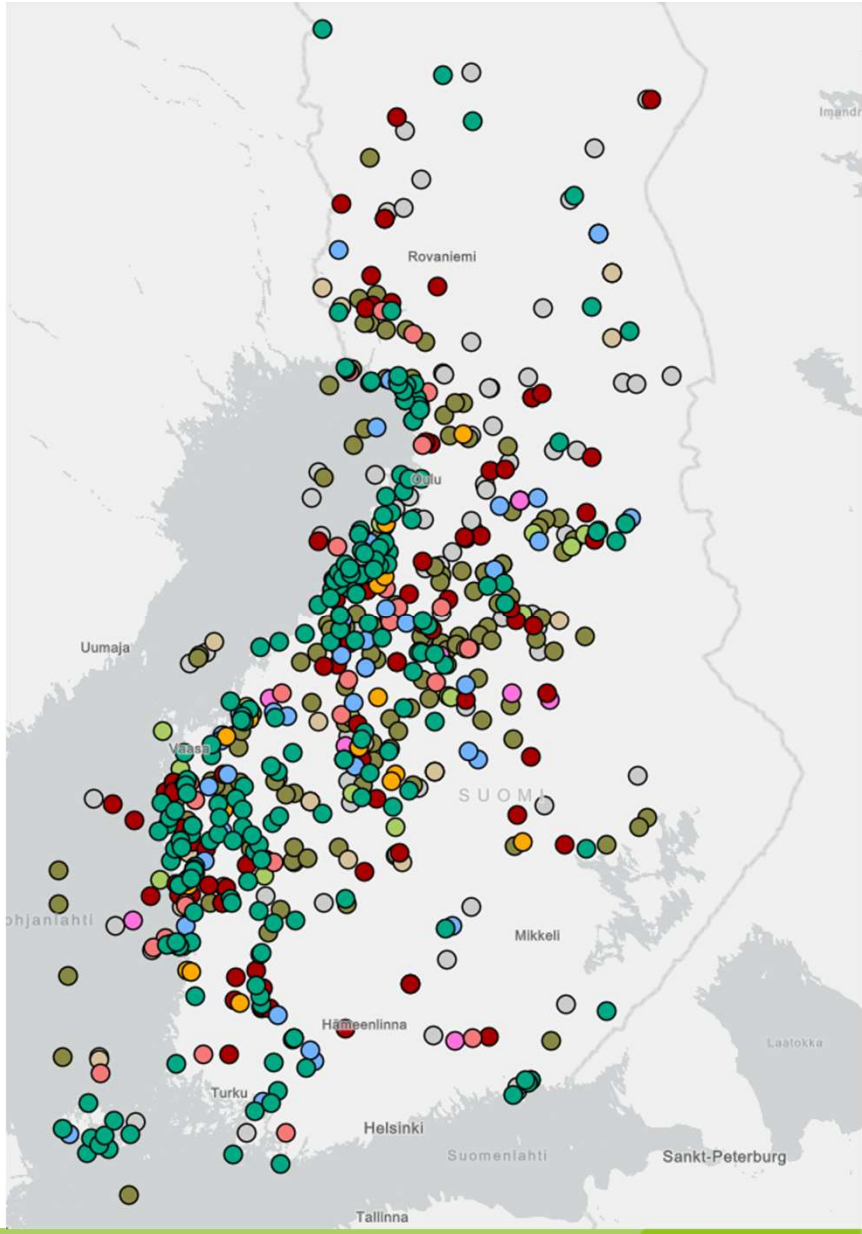
➔ **Need for socially acceptable energy production**

➔ **Opportunities for production of H_2 and e-fuels**



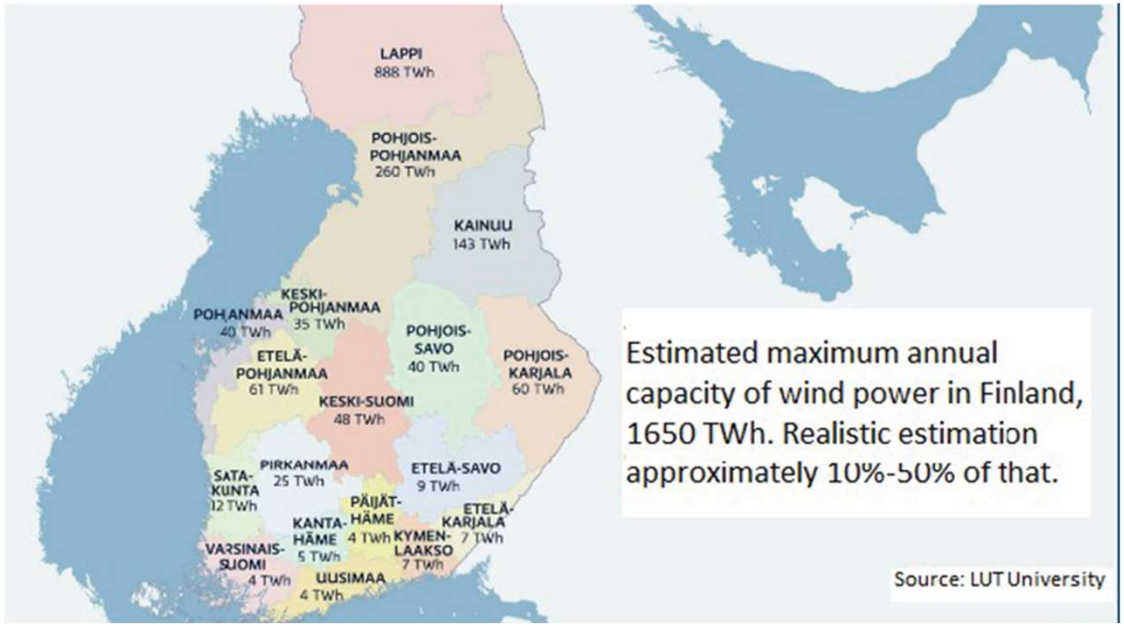
Reality check:

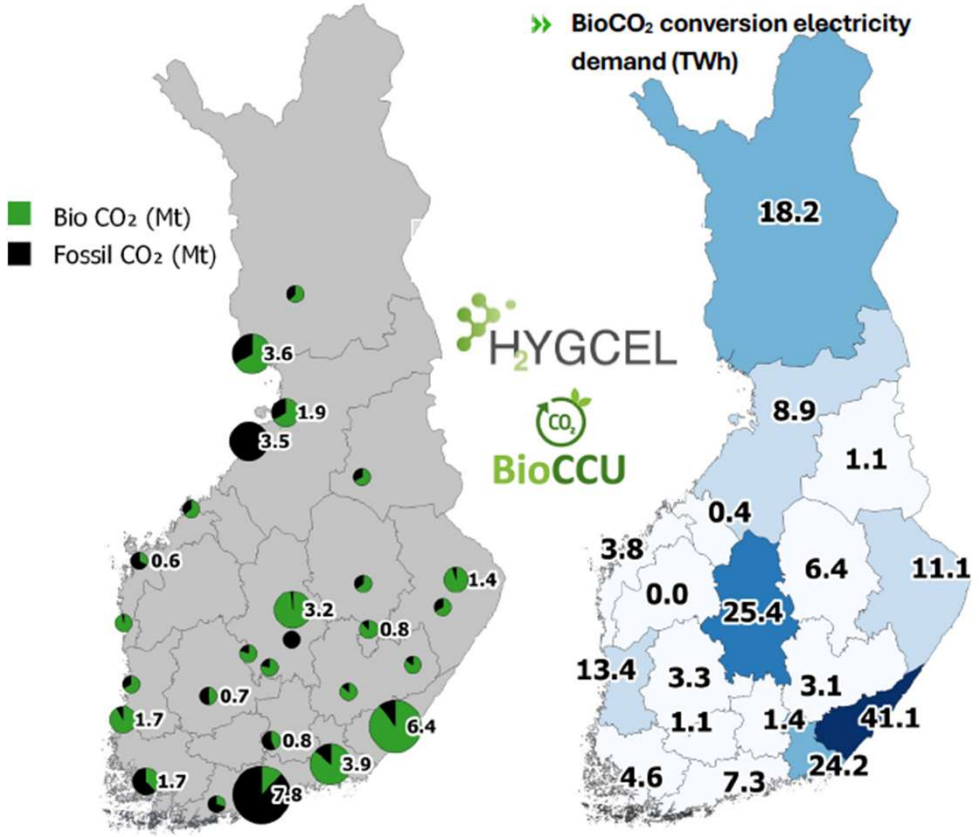
- **In Finland wind power grows very fast:**
  - Current wind power capacity 6,946 MW (12/2023)
    - 1,601 wind turbines
  - Under construction 2,400 MW
    - Starting 2024: 1,000 MW
    - Starting 2025: 1,400 MW
- **Almost no wind park projects progressing in North Karelia / Eastern Finland**
  - Highway 5 as the Iron Curtain for wind power investments
  - BUT: First three wind park projects in early-phase permitting process (60 MW + 2 * 120 MW)
  - Over dozen wind park projects rejected by the military authorities after costly radar effect analysis by VTT (= *"Houston, we have a radar problem…")*



SOURCE: Finnish Wind Power Association (22.2.2024)

New survey on wind power potential for hydrogen & P-2-X production by LUT (Draft!)





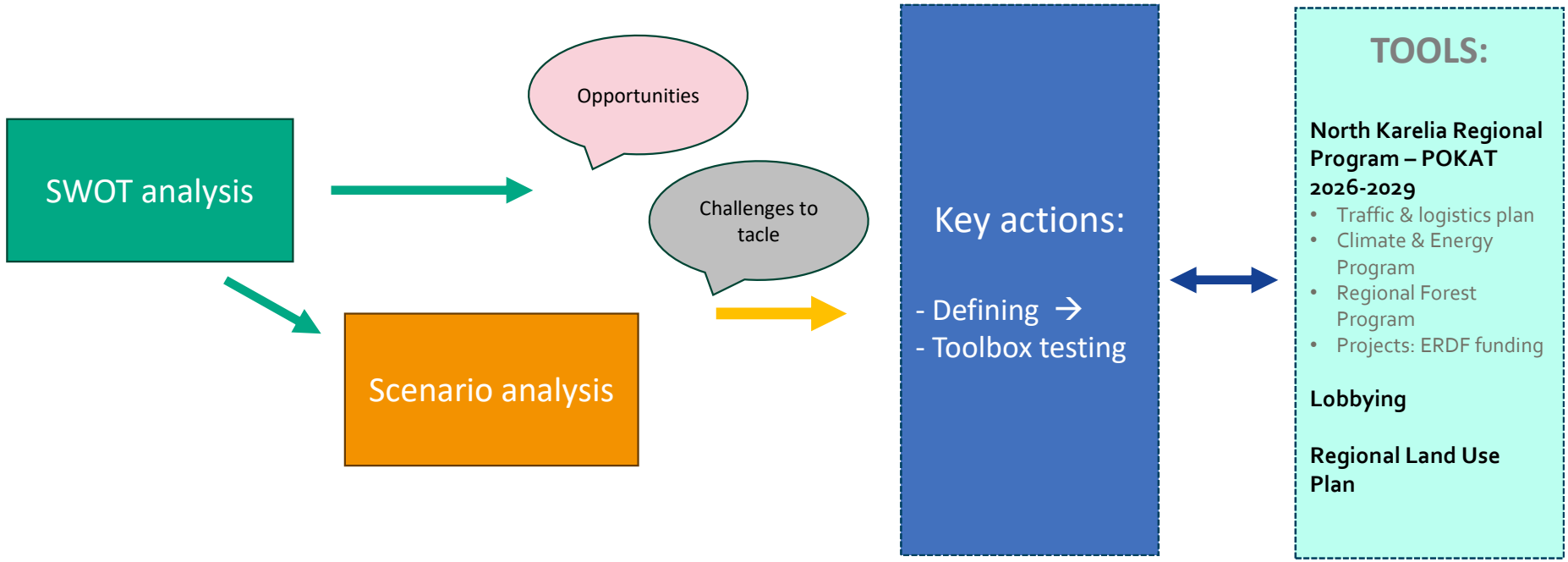
Green energy transition SWOT analysis

- draft(!) 19.2.2024

STRENGHTS	WEAKNESSES
● Large renewable forest and biomass resource ● Biogenic CO2 from forest industry and district heating ● Space for large-scale wind and solar power ● District heat networks for utilizing waste heat ● Abundance of pure sweet water for electrolysis ● Industrial brownfield sites with ready “Chem / Industry” land use status and space for growth ● Strong, evolving forest industry ● Fast and predictable permitting process in international comparison ● World-class biomass supply chain: organizations, data, infra and skills ● The European (Digital) Forestry Capital: R&D&E&I ● Innovative and curious human nature	● Reduced National power grid capacity in the region ● Military radar requirements ● Bottlenecks for switching logistics from trucks to greener electric trains and waterways (especially export industry) ● Weak regional funding resources (for investments) ● Long distance to refined product markets, connections affected by Ukrainian War ● Lack of political power for decision making in National and EU level to promote shift to hydrogen economy

OPPORTUNITIES	THREATHS
• Long global green transition market trend, eg. need for green fuels for aviation and shipping	• Multiple Russian border effects
• Activity of domestic and foreign green energy and hydrogen investors	• EU regulation (eg. biogenic CO2, Green H2...)
• Biogenic CO2 from forest industry and district heating	• Passing green investment boom - being late
• Strong commitment of key companies for green development	• Declining social acceptance of green energy investments (wind power...)
• Strong and reliable National power grid and extending the 400 kV connection into region	• Stagnation of Green transition due to economical or political reasons (EU / Finland)
• New intelligence technology compensating wind power radar effects	• Lack of subsidies for activating building renovations
• Wind power industry's readiness to participate new radar etc. investment funding: Piloting Government Program's compensation model	• Economical recession spiral which moves first the young and educated talents into bigger growth centers
• Land use planning as a tool for setting common rules and combining various interests	• Escalation of international political and military crisis'
• Revitalizing of the use of Saimaa lake system in internal transportation	• Demography problem: retirement wave and lack of labour in companies
• New innovations and technology development	• Mismatch of education in respect to economic transition and needs of business sector: eg. fast electrification and process automation
• Large consensus on the need for allowing Eastern Finland to develop and gain investments: realization as infrastructure investments etc.	• Lack of cooperation: secrecy, driving of own interests…
• Stronger electric railway connections to North and West	
• Recovering of the Saimaa channel connection to East Sea	
• Data: forests / natural resources, energy prioduction & use, buildings…	
• Transfering of good practices: eg. participatory wind power	
• Hydrogen cluster and new business opportunities in hydrogen economy	
• Municipalities' joint vision and will for developing renewable energy & hydrogen projects	
• Stronger cooperation across Eastern Finland: particularly in wind power, power grids, logistic infra and hydrogen cluster development	
• New EU legislation fostering green transition and distributed energy production, eg. Energy communities	
• Technology transfer and export of expertise	
• Strong educational organizations	
• EU policy for developing the Russian border regions for defence reasons	
• Proceeding of democrary and acknowledging of international laws in Russia	

Green energy transition: from regional analysis and SWOT to actions



Regional context assesment

Financial & social impacts

Policy analysis

Good practices in financing

Regional policy improvements

3. CASE Traffic

- How to make difference in regional level?

Climate goals challenging for traffic sector – decisions made at National level

TOOLBOX:

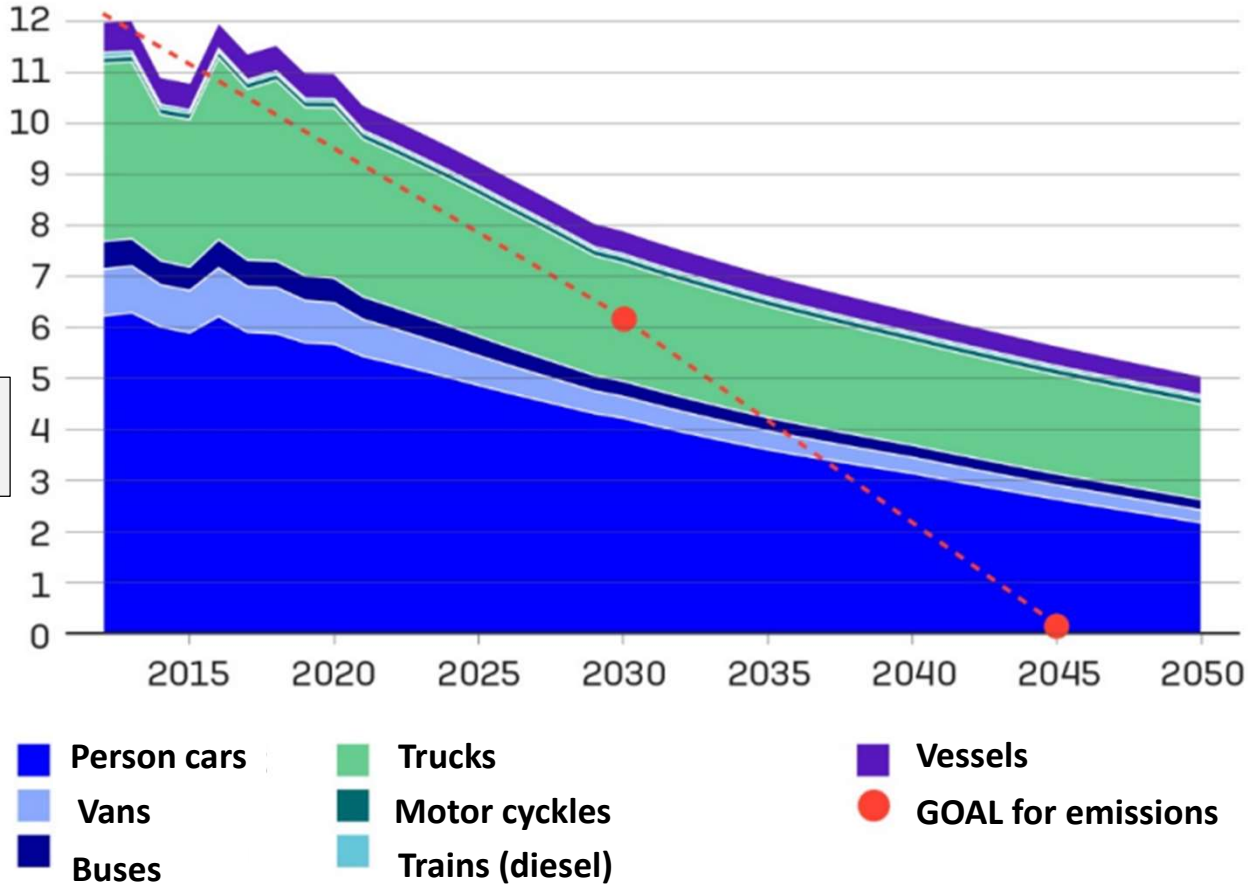
1. Blending traffic fuels with bio-component

Year	Blending obligation, %		
	Old	1.1.2023-	New Gov.
2021	18,0		
2022	12,0		
2023	21,0	13,5	
2024	22,5	28,0	13,5
2025	24,0	29,0	16,5
2026	25,5	29,0	19,5
2027	27,0	30,0	22,5
2028	28,5	31,0	31,0
2029	30,0	32,0	32,0
2030	30,0	34,0	34,0

Message for investors on e-fuel and biofuel projects?!

2. Electric cars
3. Public transport, walking & cyckling
4. Biogas
5. Remote work
6. Approaching new technologies

Finnish traffic sector CO2 emissions (Mt) – basic scenario



SOURCE: Roadmap to fossil-free transport. Finnish Ministry of Transport and Communications. 2021. http://urn.fi/URN:ISBN:978-952-243-588-0

Greening traffic: moving heavy transport from trucks to rails and waterways?

Due to The Ukraine War Eastern Finland lost the connection to East Sea (the Saimaa channel goes via Russia)

- Important for trade: export and import from Joensuu deep sea harbor
- Old, silenced Kymi channel plan inside Finnish borders…

- Railway connection South from Joensuu is 1-rail and has bottlenecks

  ➔ most of the heavy traffic from vessels moved to trucks
- Big potential for shifting industry's logistics from truck transportation to electric trains
  - Fluent 2-rail connection from Joensuu to South
  - Electrifying railways from Joensuu to North and West
  - Connecting the main industrial sites straight into railway net …
- Shifting forest trucks to green fuels is a big challenge
  - E-fuels, H_2…

EU Climate target 2010 → 2030: remove 30% of long distance transportation (300+ km) away from roads

Railroad net in Eastern Finland

SOURCE: Väylävirasto

Thank you!

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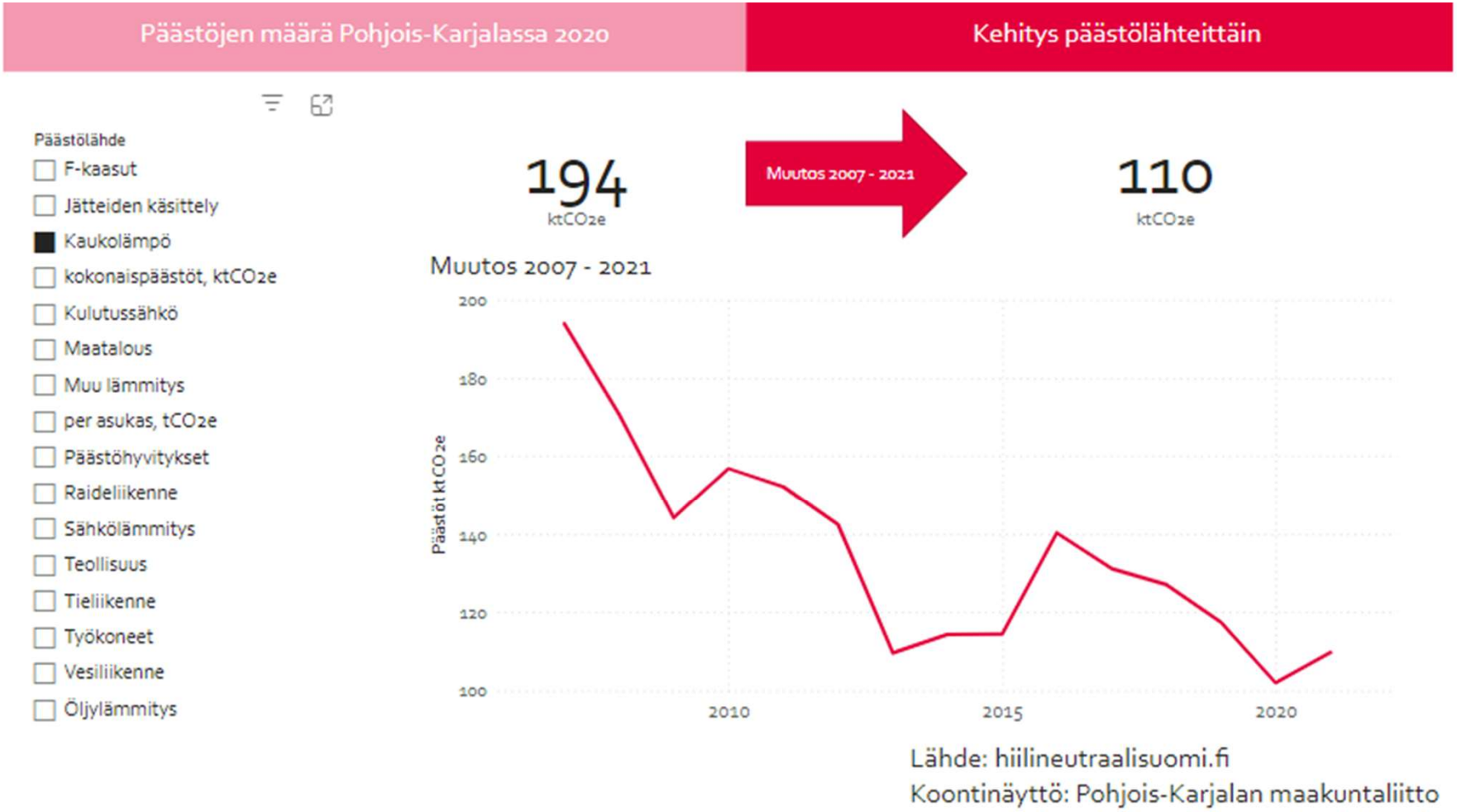
APPENDIX

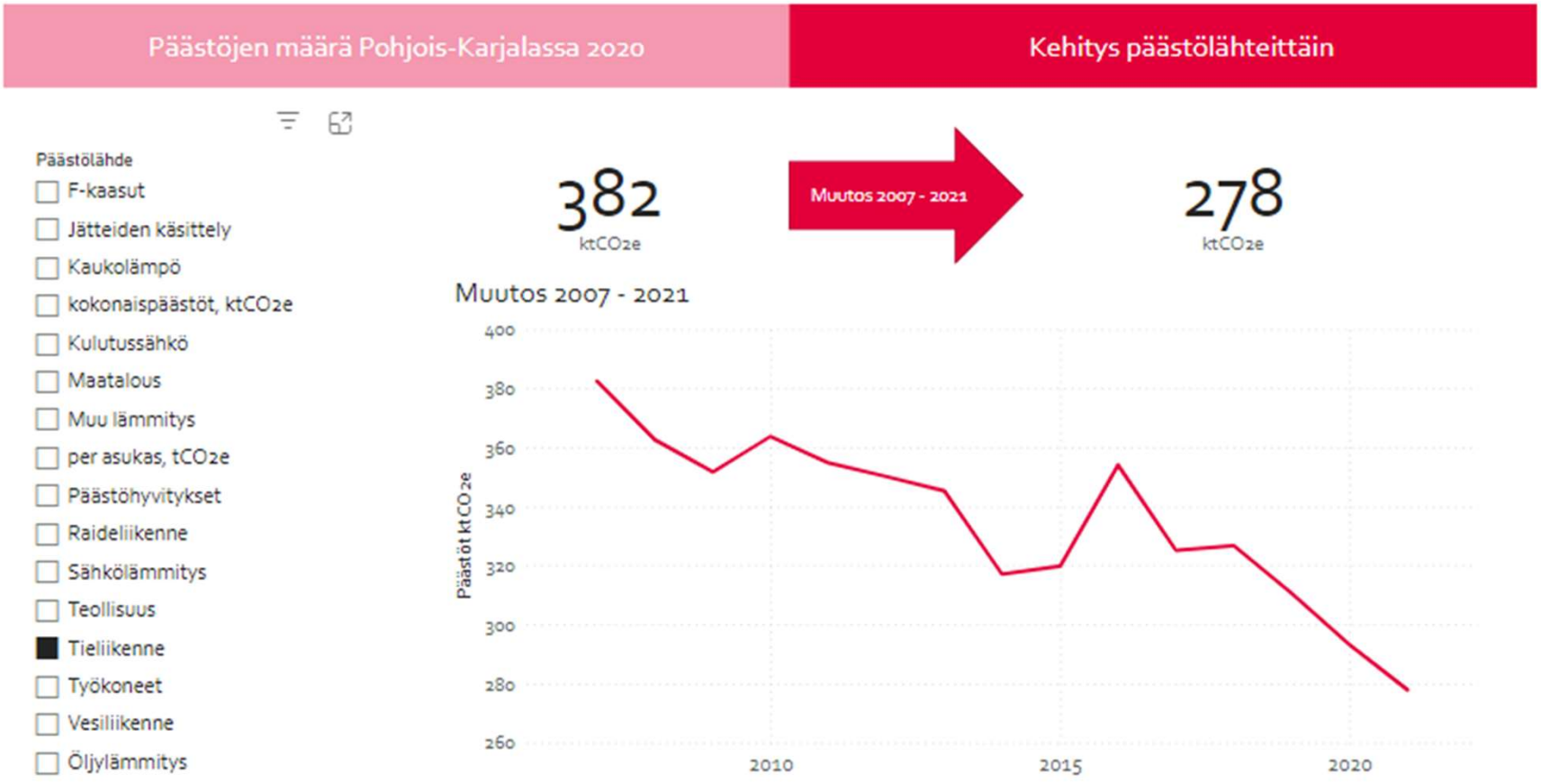
Climate statistics from North Karelia

Development of greenhouse emissions in North Karelia

Good progress in district heating



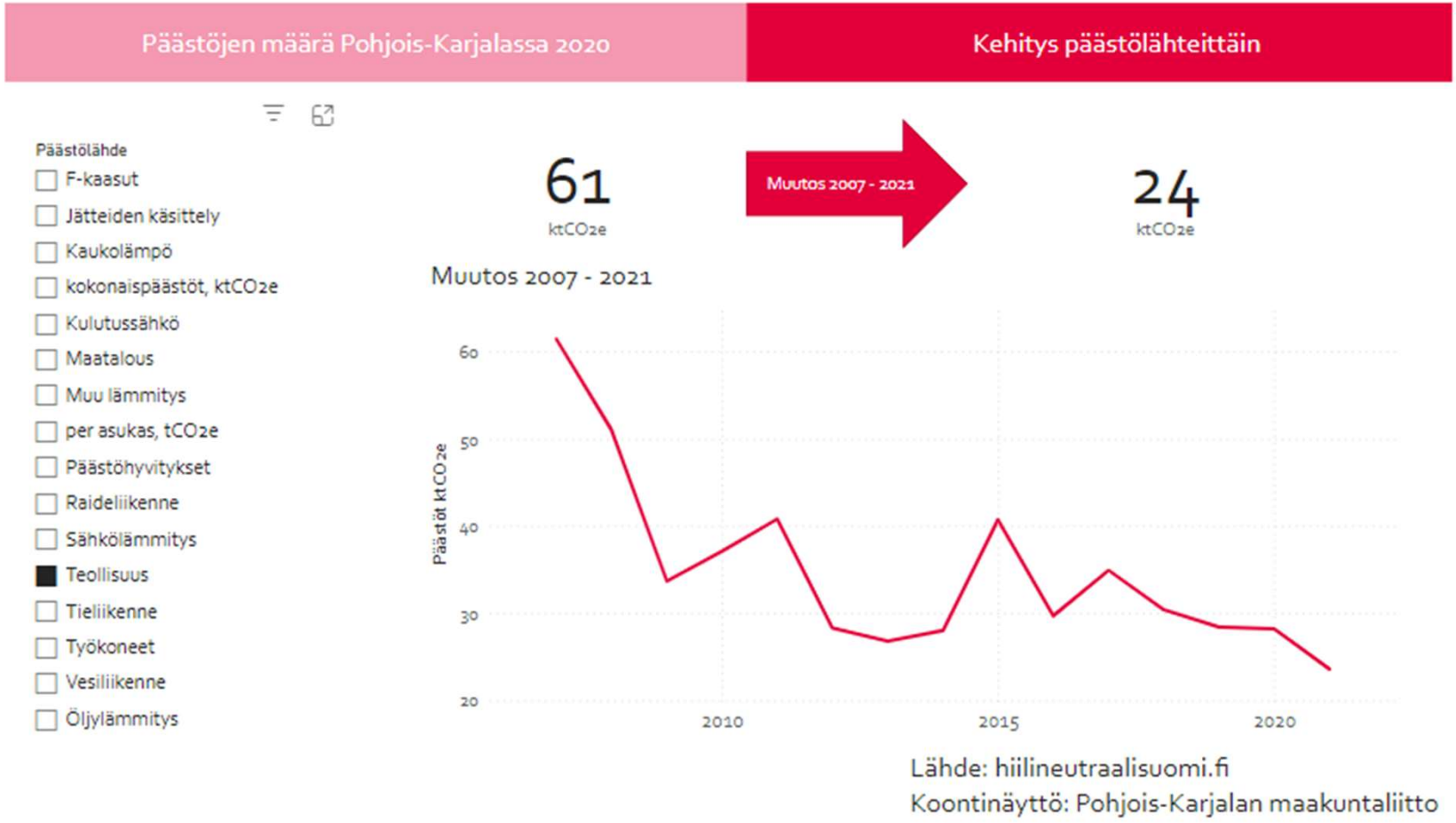
Traffic sector hard to tackle



Lähde: hiilineutraalisuomi.fi
Koontinäyttö: Pohjois-Karjalan maakuntaliitto

Industry among forerunners

(Big energy user, but utilizing own renewable side products)



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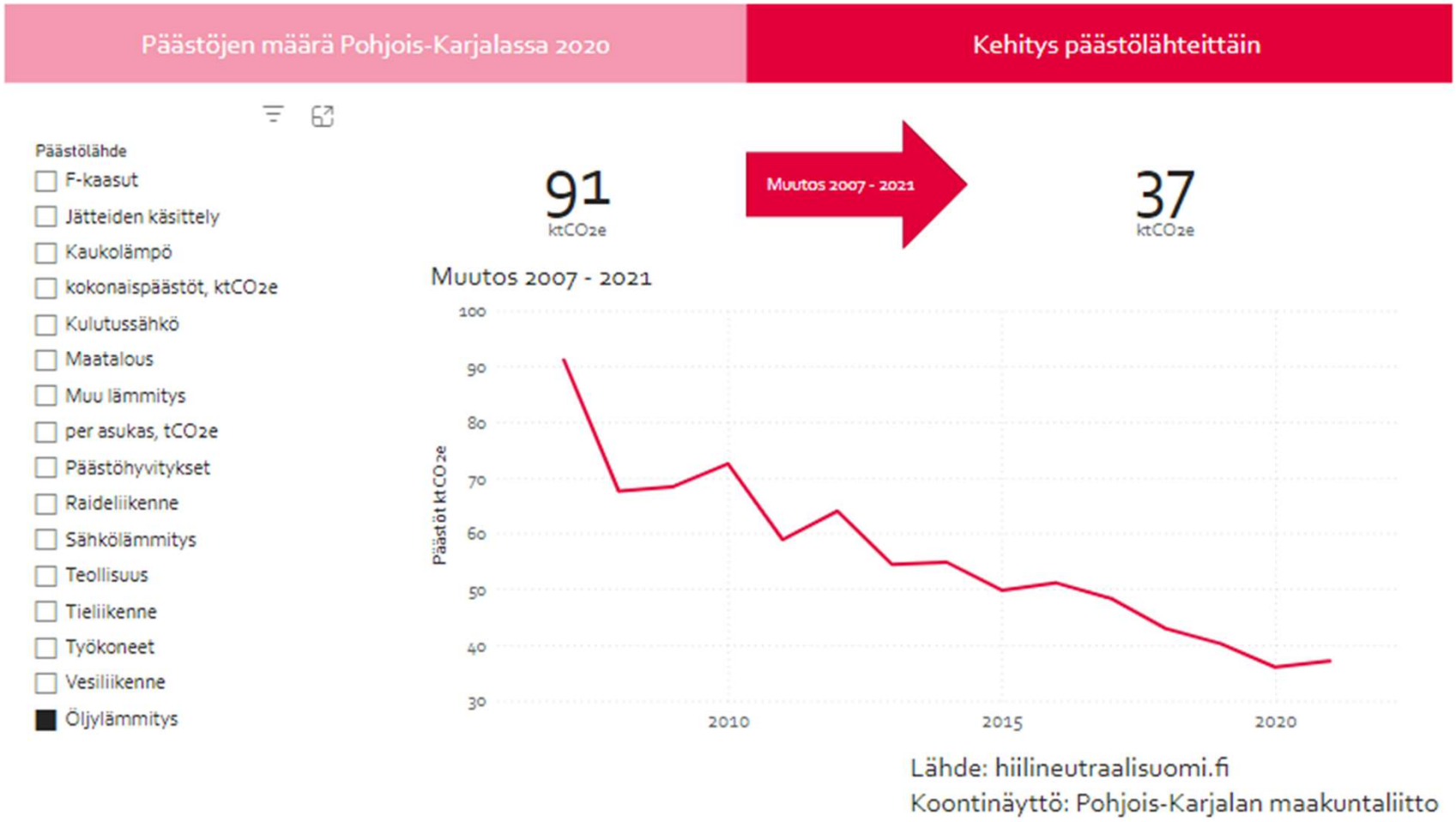
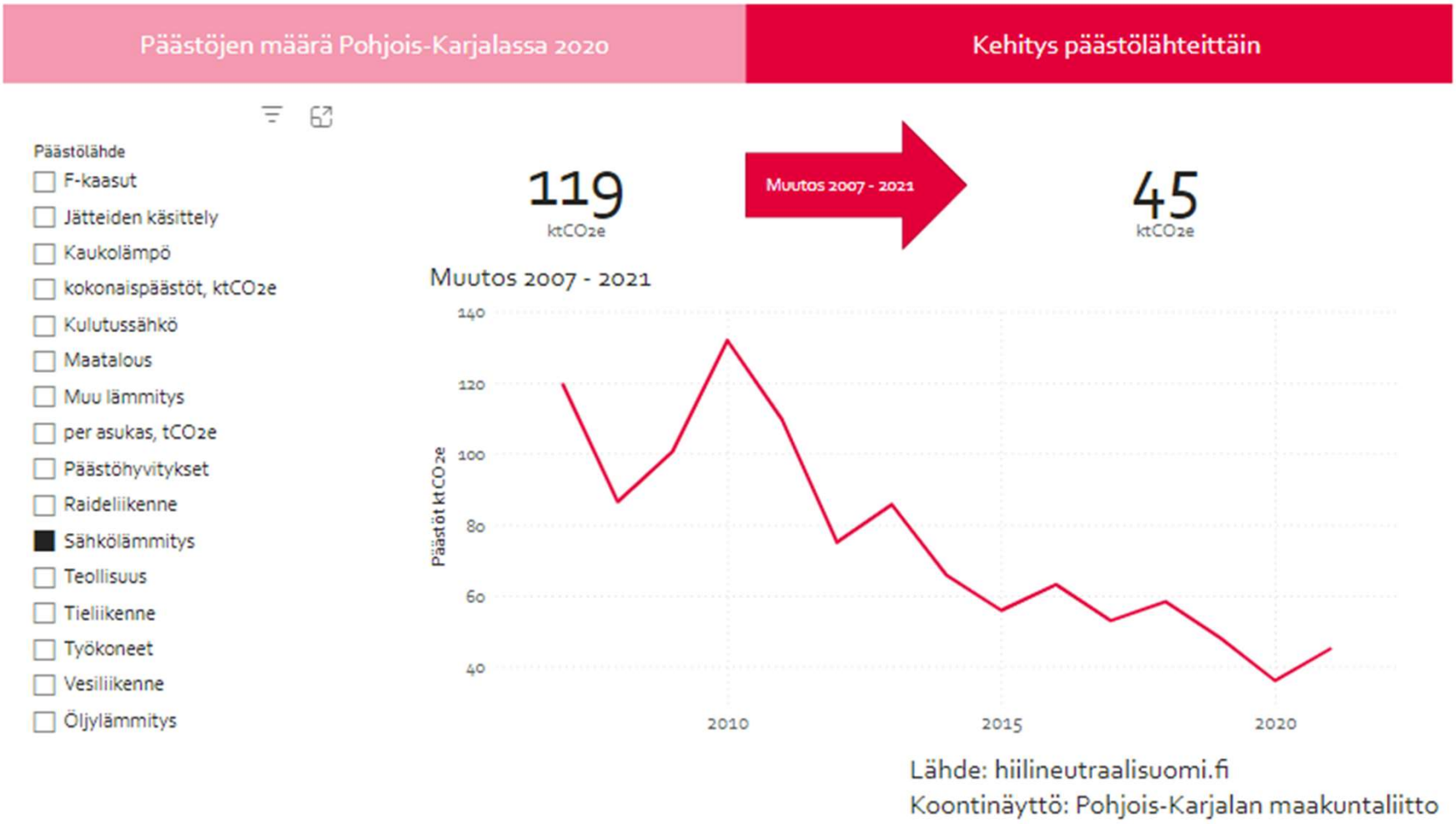
”Oil-free North Karelia” campaign has worked well!



Remarkable reductions in electric heating



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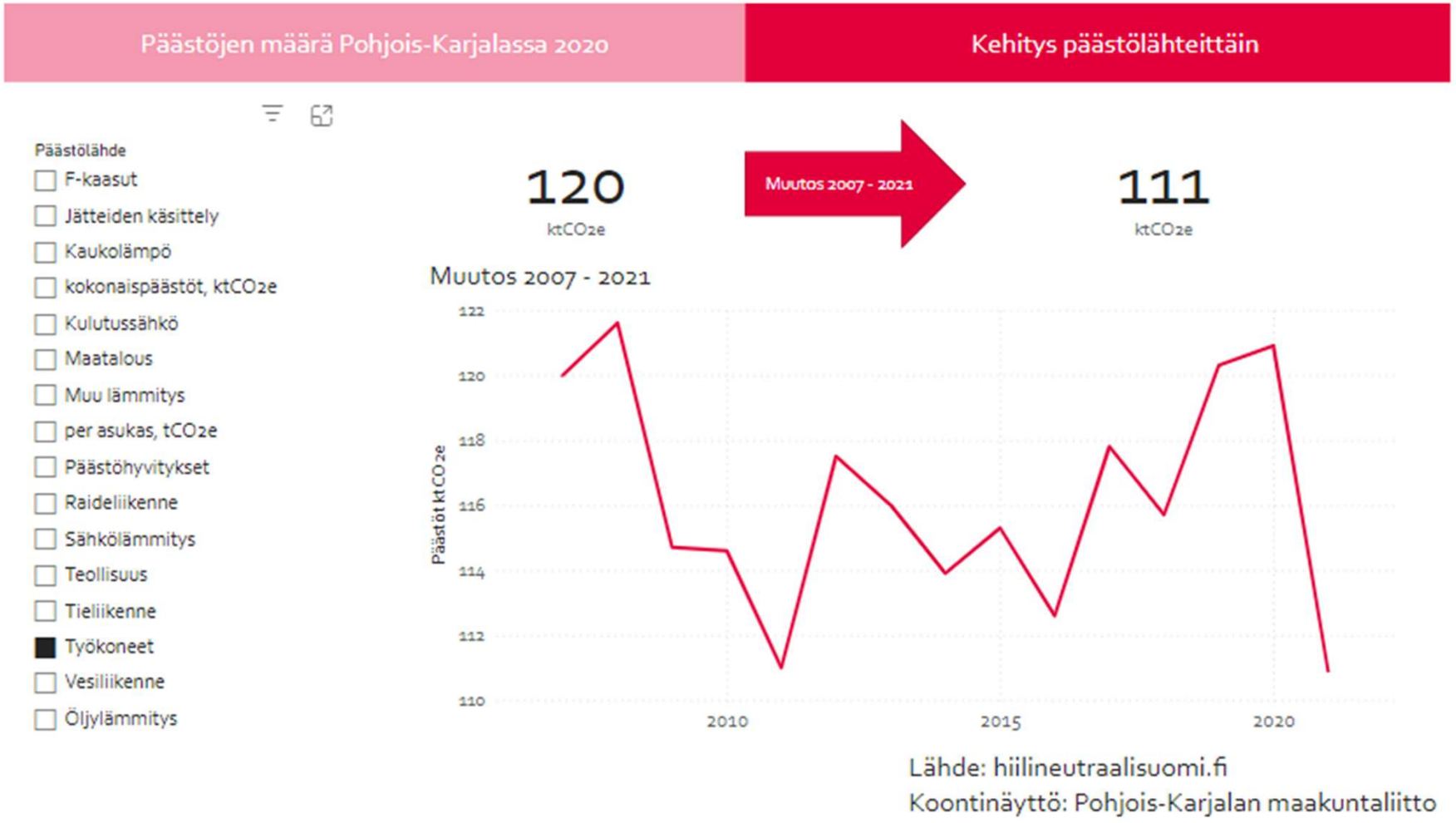
No change in working machine / motor oils



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Huge potential for renewable wind power & green hydrogen

The first hydrogen economy roadmap for the region in 2022

Theorethical wind power potential 43,6 TWh (about half of the current electricity consumption in Finland)

- supplementing large solar power potential is 1,4 TWh