



VISUALIZING THE ENERGY DEMAND OF FUTURE URBAN TRANSPORT

Breakfast meeting Urban Transport ("Transport i by")

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Calculating the energy demand

An aerial photograph of a city, likely Trondheim, Norway. The image shows a dense urban area with a mix of residential and commercial buildings. A large river, the Nidelva, flows through the city, and a multi-lane highway (E6) runs alongside it. The city is surrounded by green hills and forests. In the background, a large body of water (the sea) is visible under a clear blue sky. A semi-transparent blue rectangle is overlaid on the top part of the image, containing the title text.

Foto: Trondheim kommune

Calculating the energy demand

- Comparable energy units
- Speed and energy model
- Calculated for road network



Scaling up the calculations



- Number of trips: Observed or modelled
- Vehicle park composition
- PT lines and frequencies



Additional data

- Address points
- Energy stations
- Household Travel Survey (RVU)



Visualization of data

Country	Number of People using rail transport (not including metro) (in million)	Passenger kilometres per head of population	Cargo carried (billions of tons)
Malaysia	5.9	770	22.2
Canada	0.3	80	28.20
China	27	1980	23.01
UAE	5.5	78	1.9

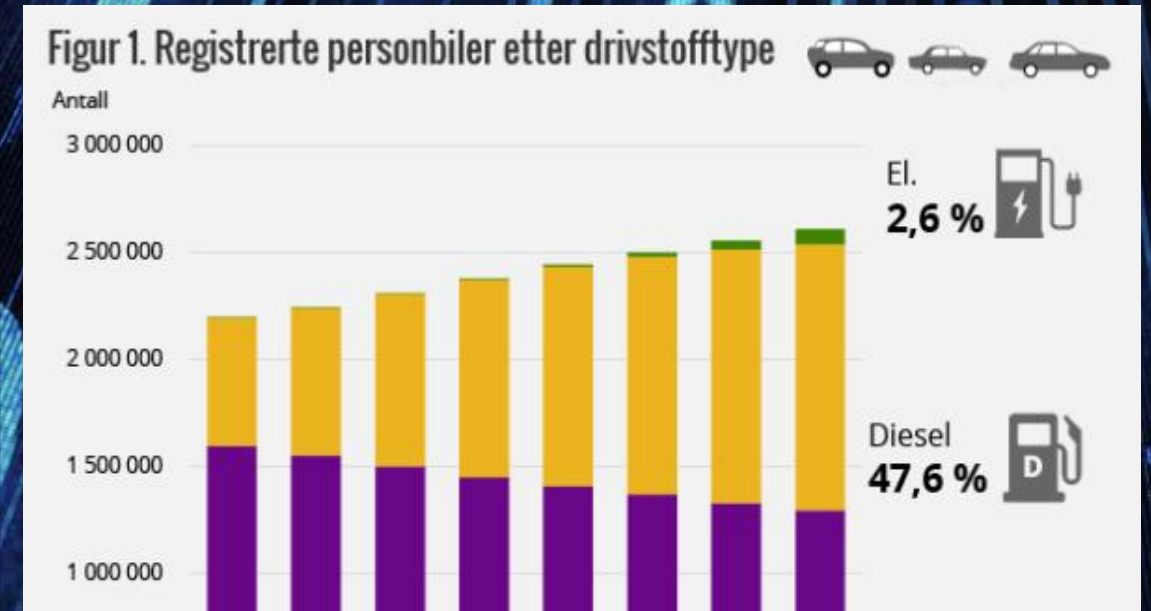
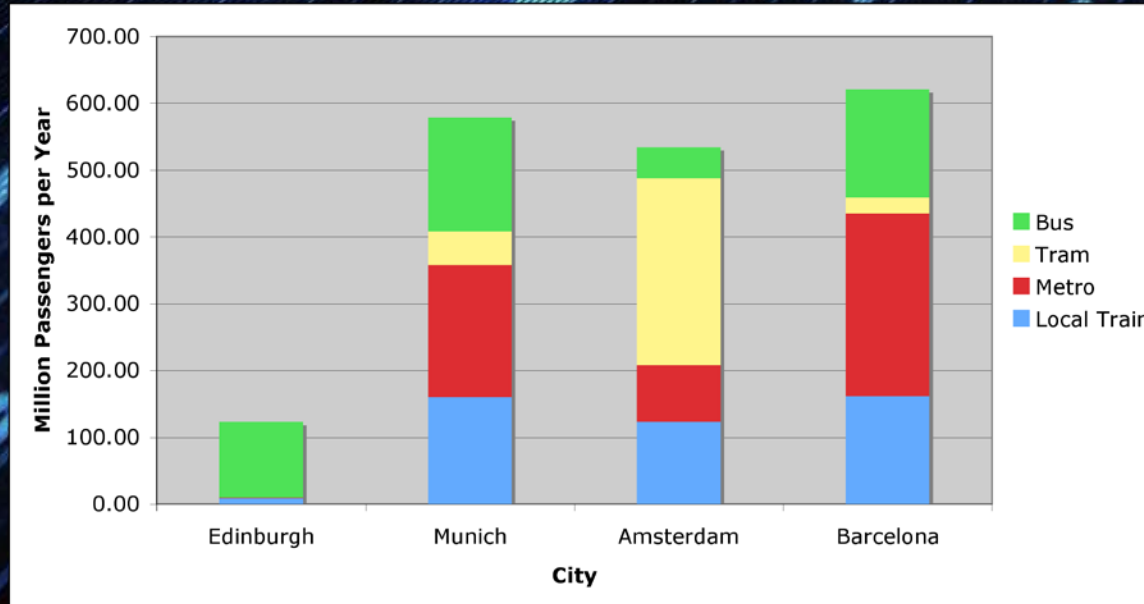
	1985	2005
Walking	255	23
Bicycle	51	41
Car	3199	4806
Local bus	429	274
Local distance bus	54	124
Train	239	366
Taxi	13	42
Other	450	585
All modes	4740	6475

..instead of communication through words

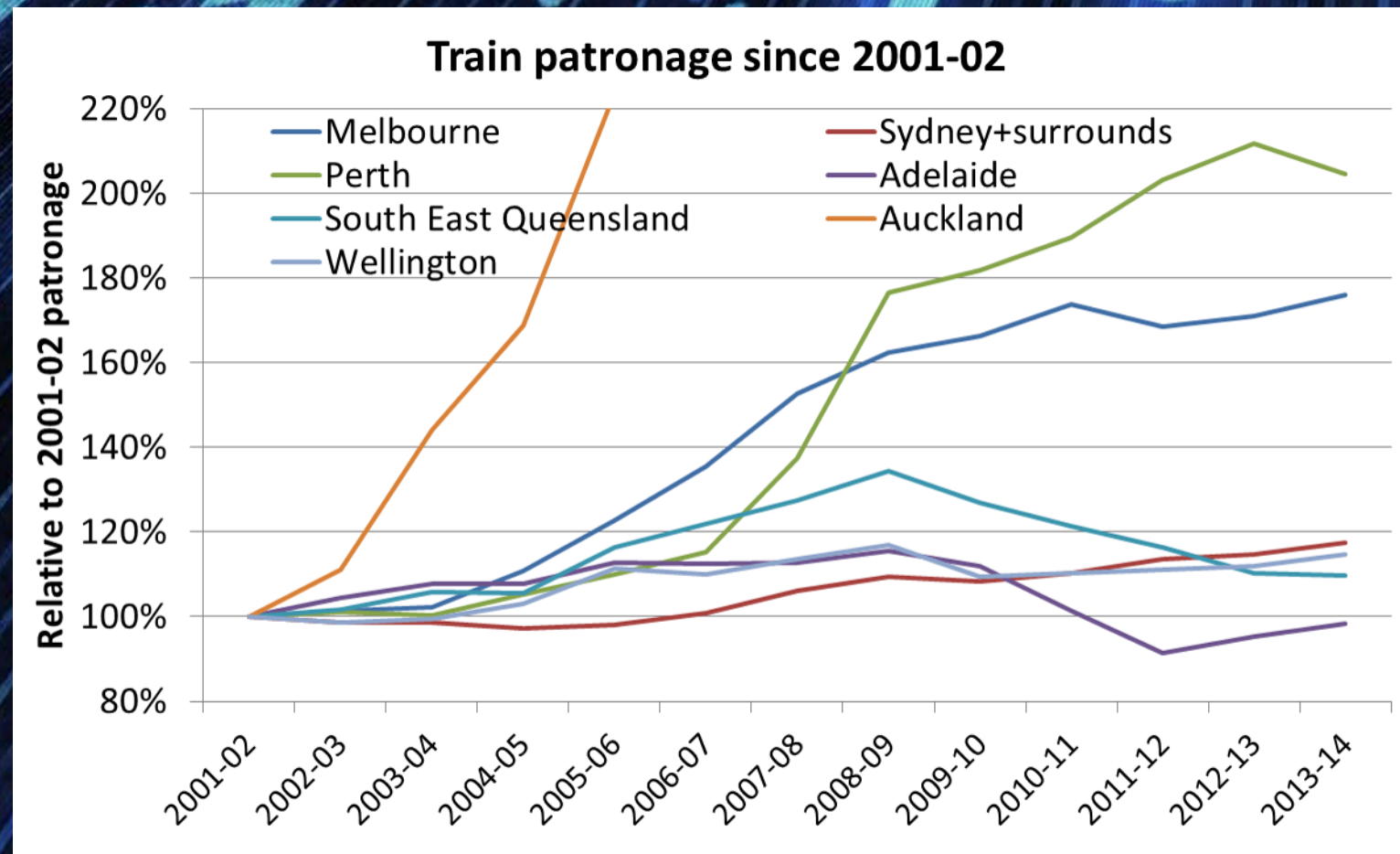
Method	Variables	n	Average	Var. coef. (%)
Ultrasound	V_{ult} (m s ⁻¹)	312	5305.89	3.87
	E_{ult} (MPa)	312	10,181.6	13.10
Induced vibration	V_{vib} (m s ⁻¹)	312	4880.96	4.38
	E_{vib} (MPa)	312	7363.07	14.7
Flexural strength	MOI (MPa)	312	7044.65	16.24
	MOI (MPa)	312	(7044.65) ^a	
Density at 12% EN 408:2004	ρ_{12} (kg m ⁻³)	312	36.88	27.47
			(21.69) ^a	
Moisture content EN 13183	Moisture (%)	312	361.29	10.88
			(315.30) ^a	
Ring width	Rw (cm)	312	9.71	7.49
			1.08	21.39

^aCharacteristic value.

Examples of visualization: Charts



Examples of visualization: Time series



Examples of visualization: 3D-charts and models



Foto: Trondheim kommune

Examples of visualization: Heatmaps

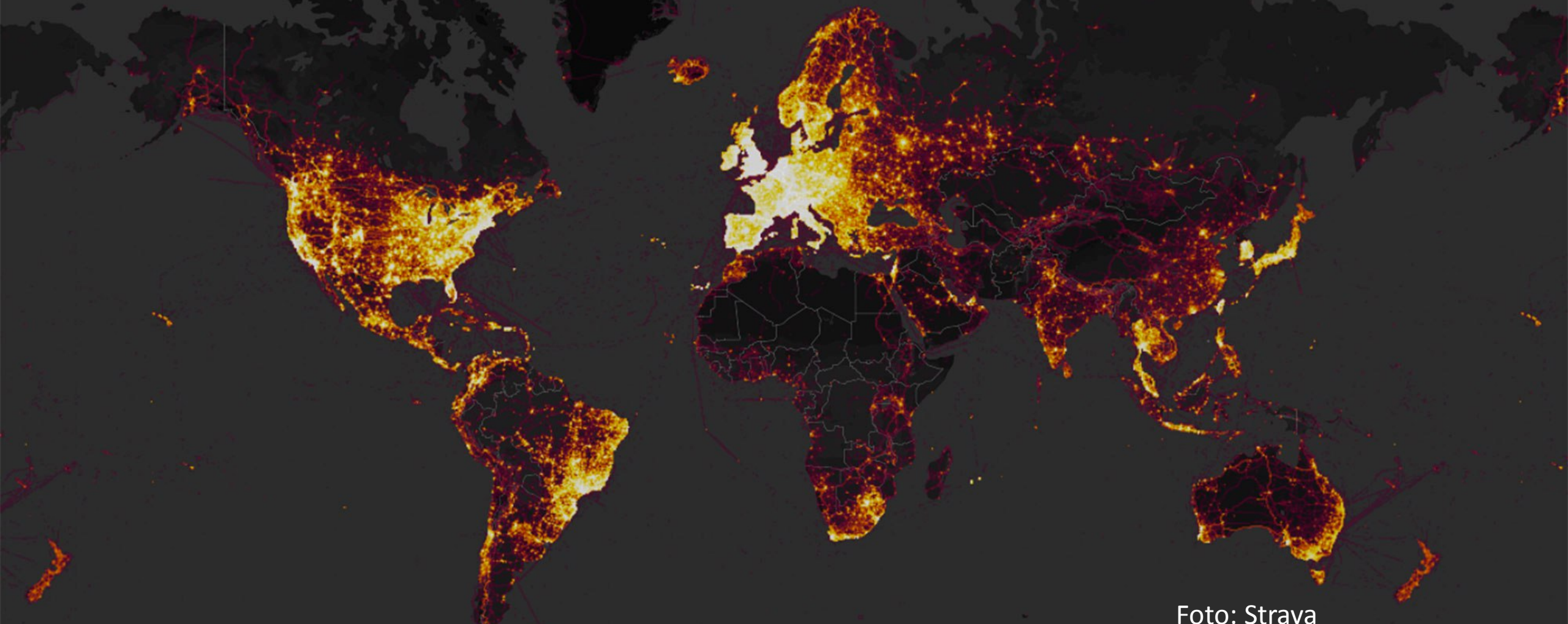
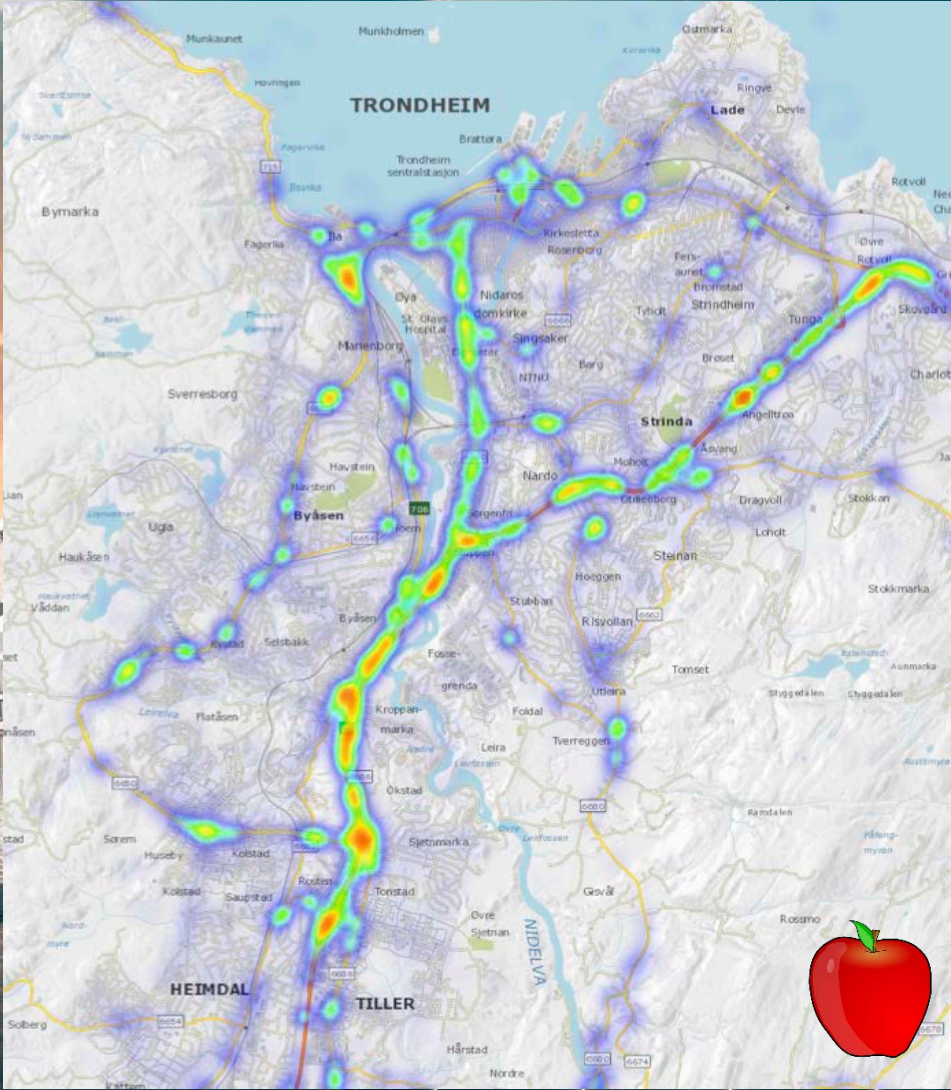
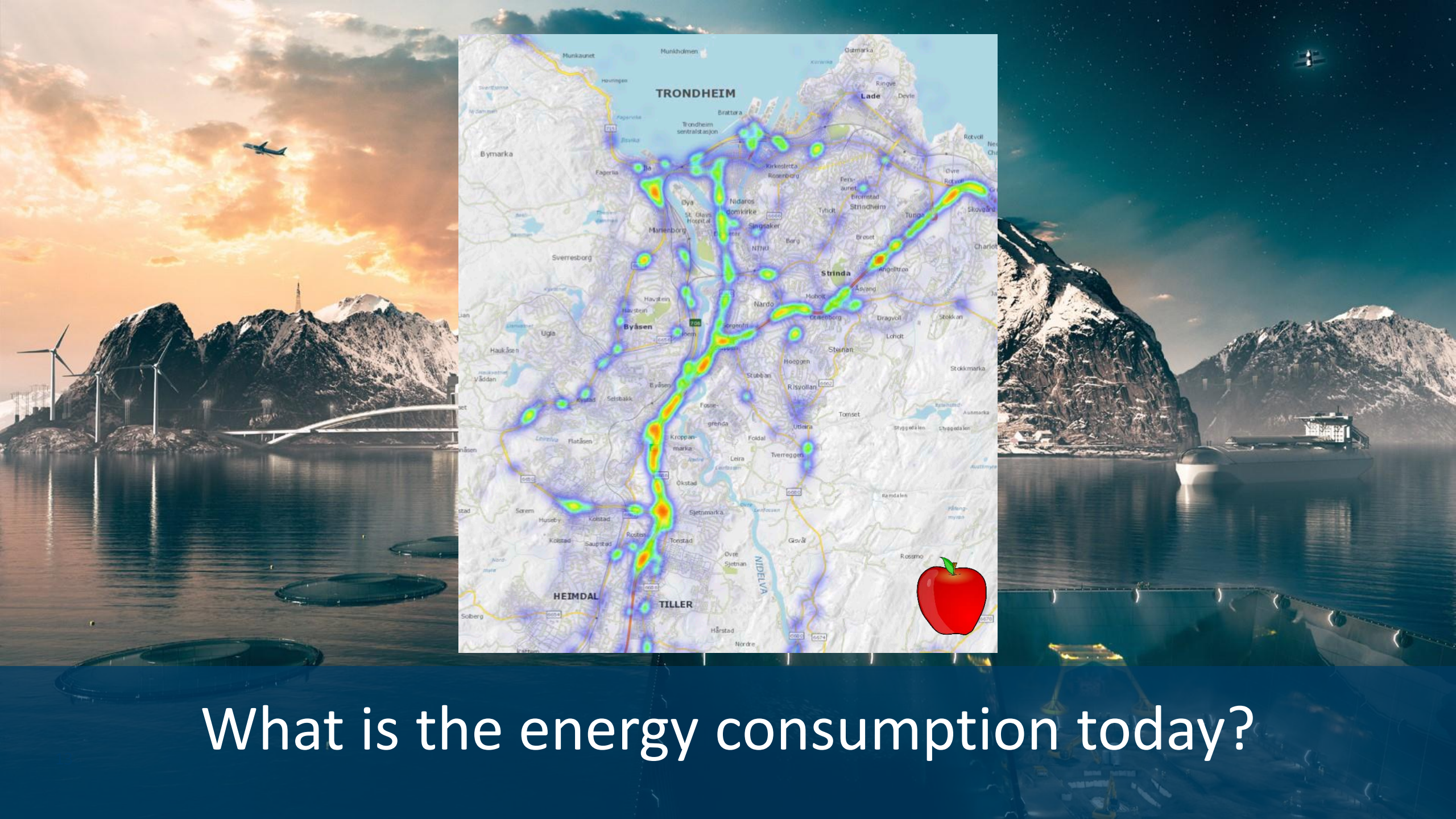


Foto: Strava

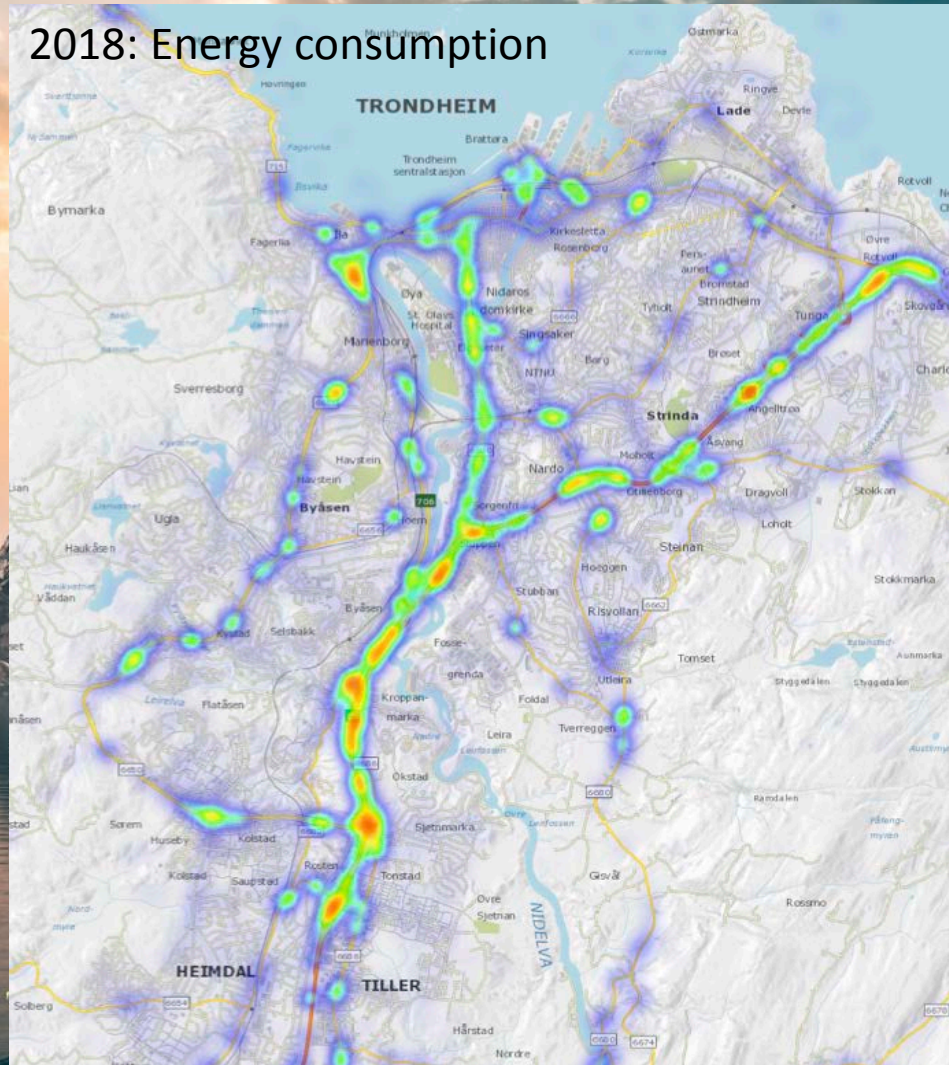
Examples of visualization: Animations



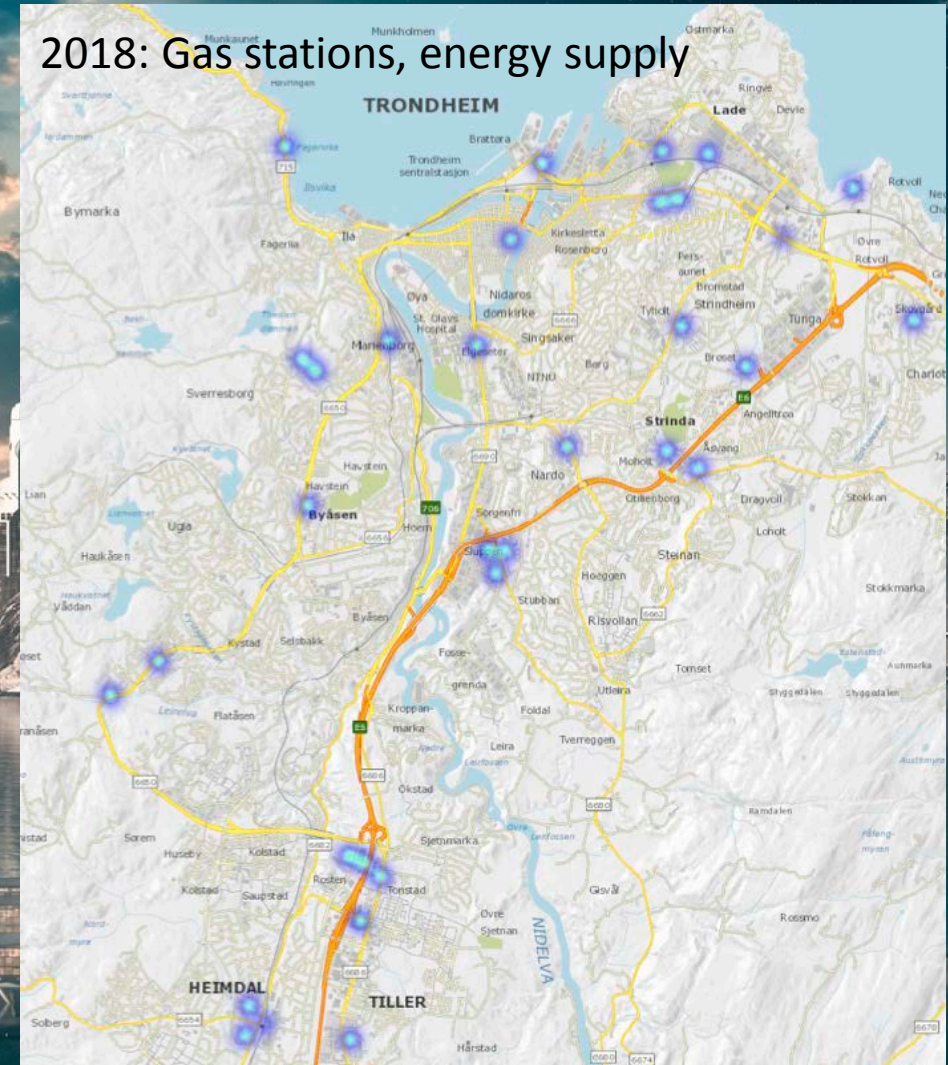


What is the energy consumption today?

2018: Energy consumption

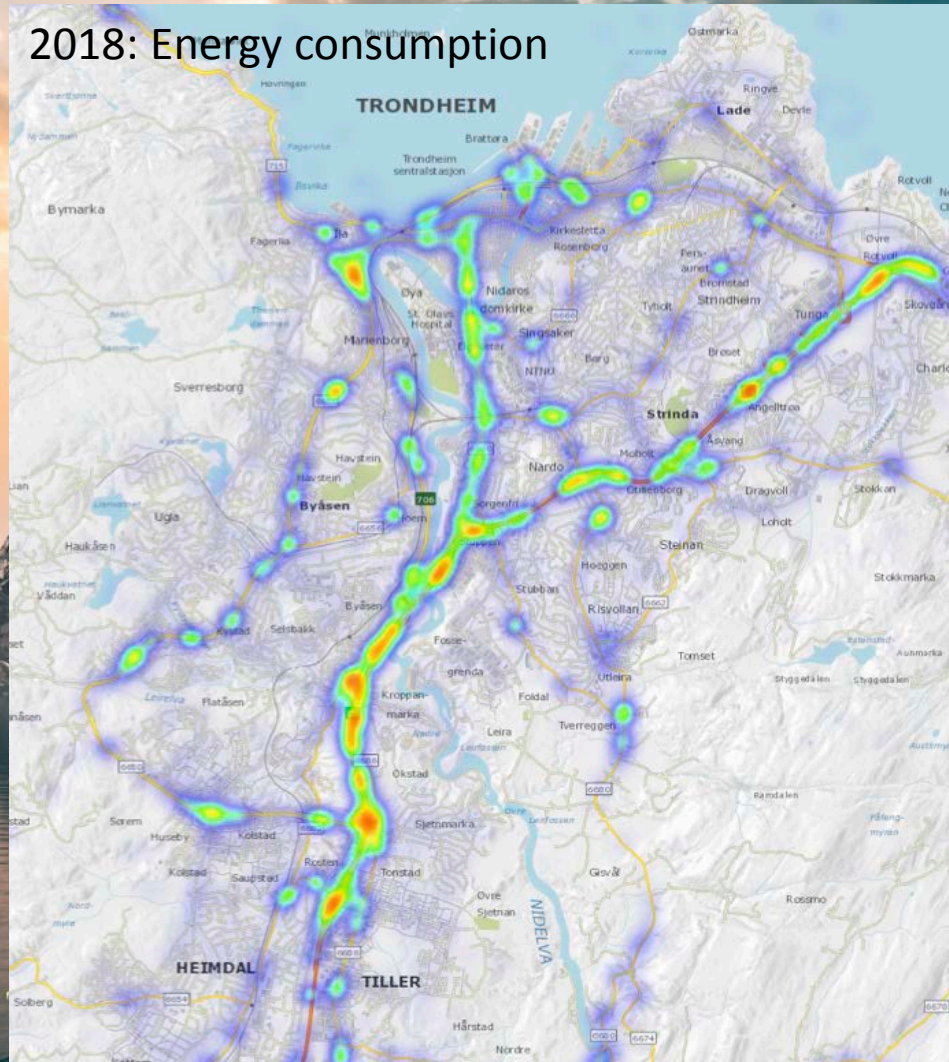


2018: Gas stations, energy supply

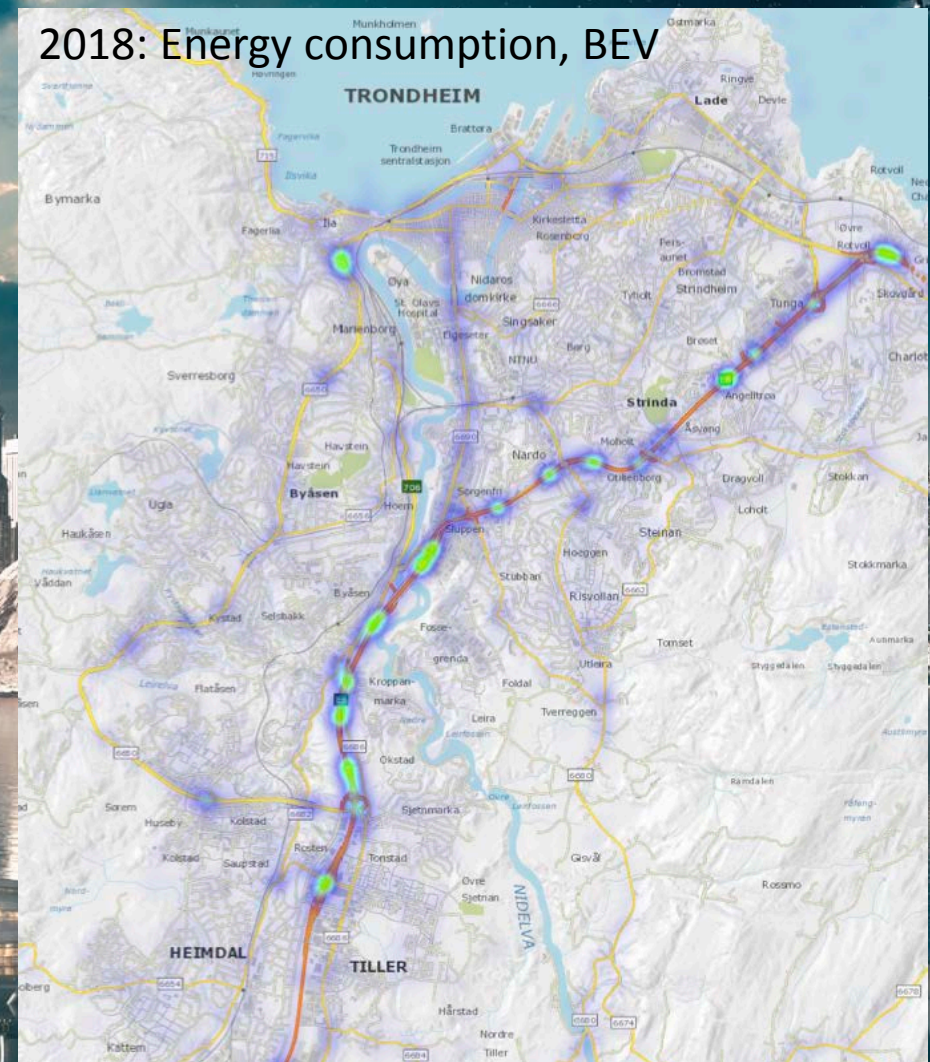


Energy source: gas stations

2018: Energy consumption

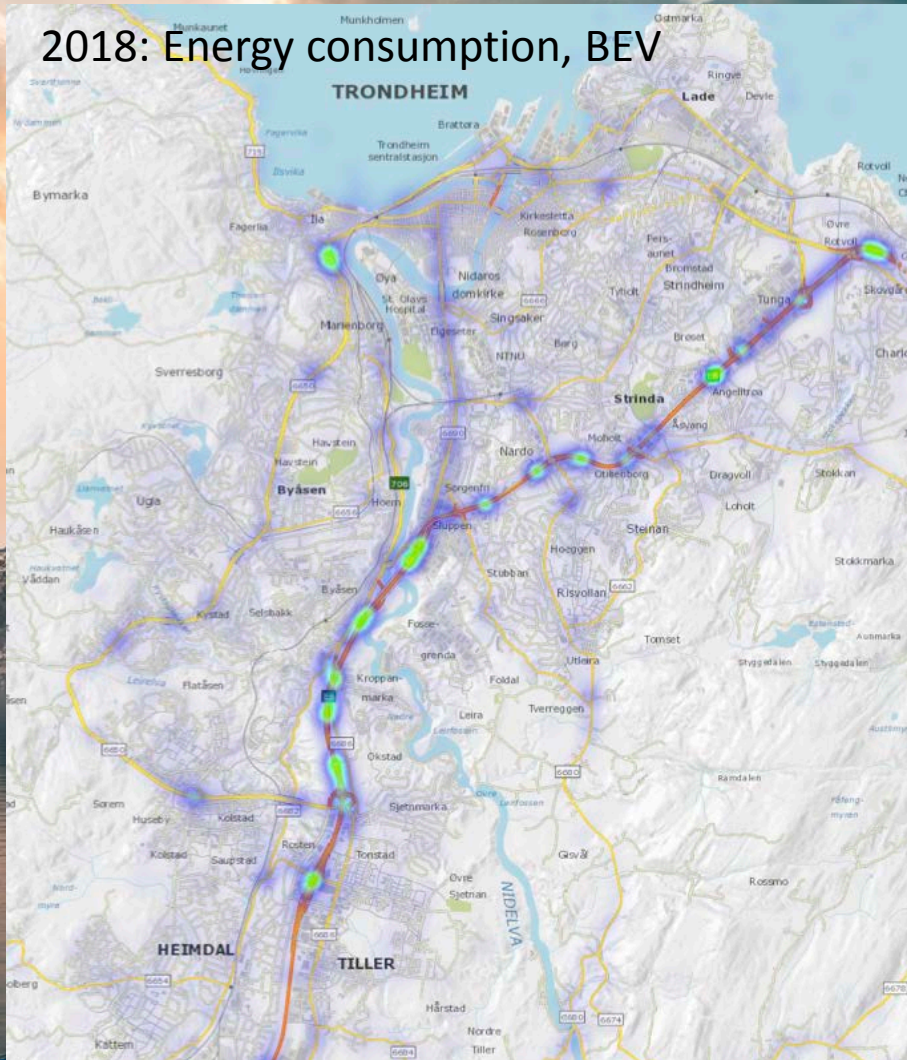


2018: Energy consumption, BEV

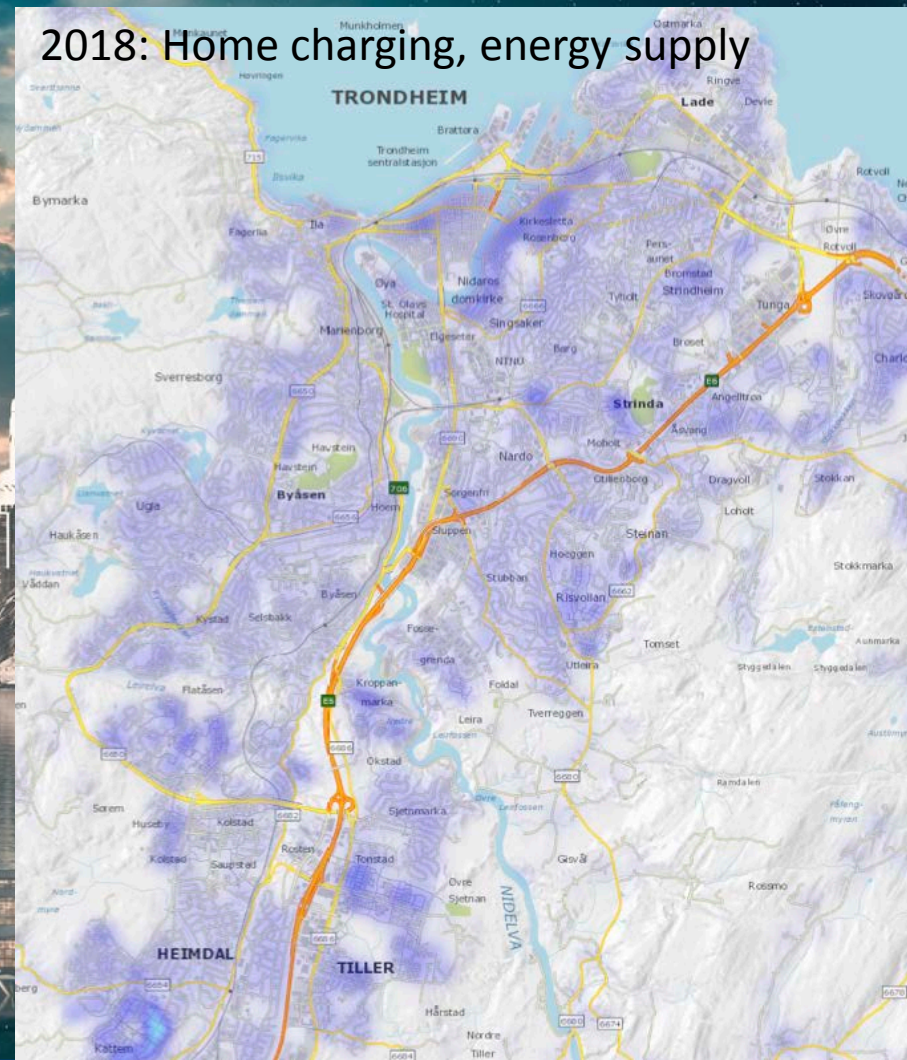


What if all vehicles were electric?

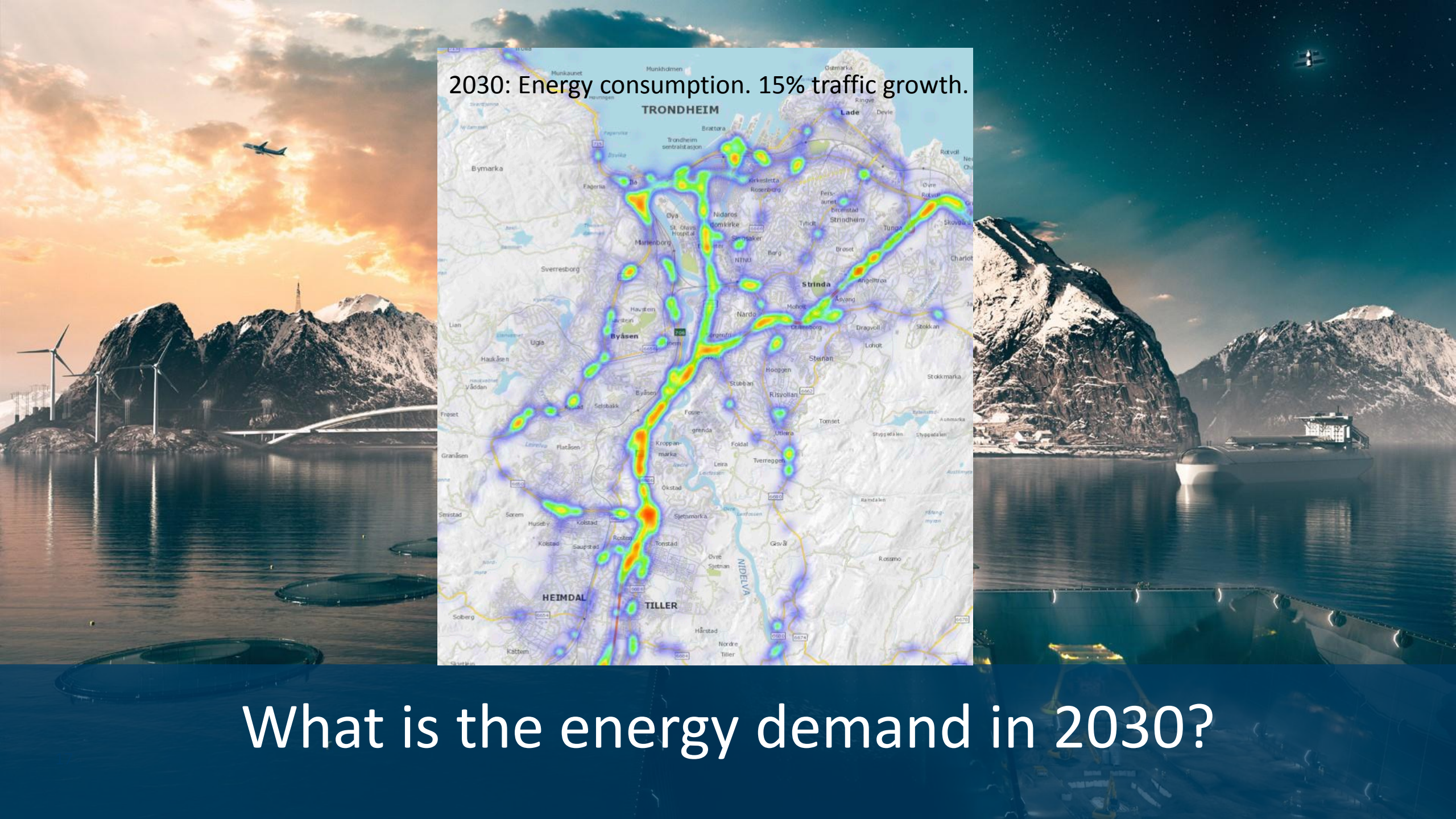
2018: Energy consumption, BEV



2018: Home charging, energy supply



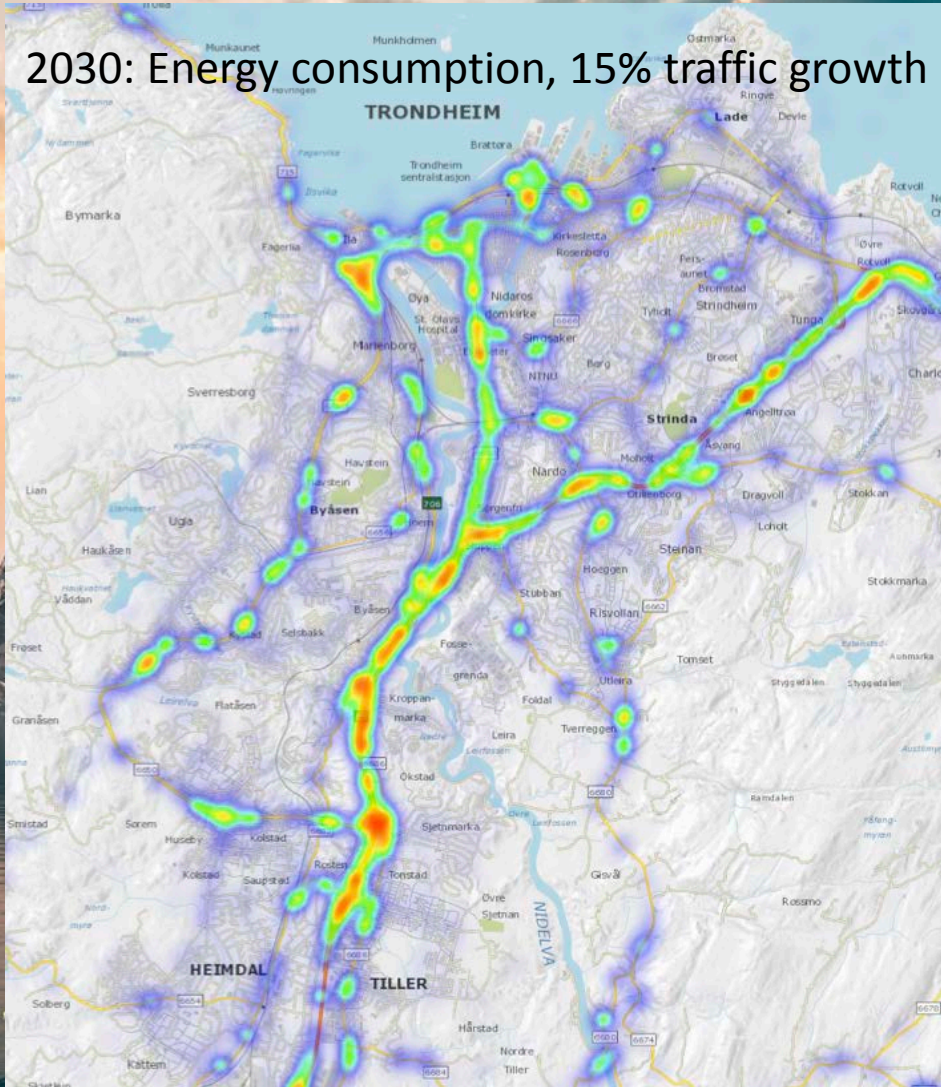
Energy source: home charging



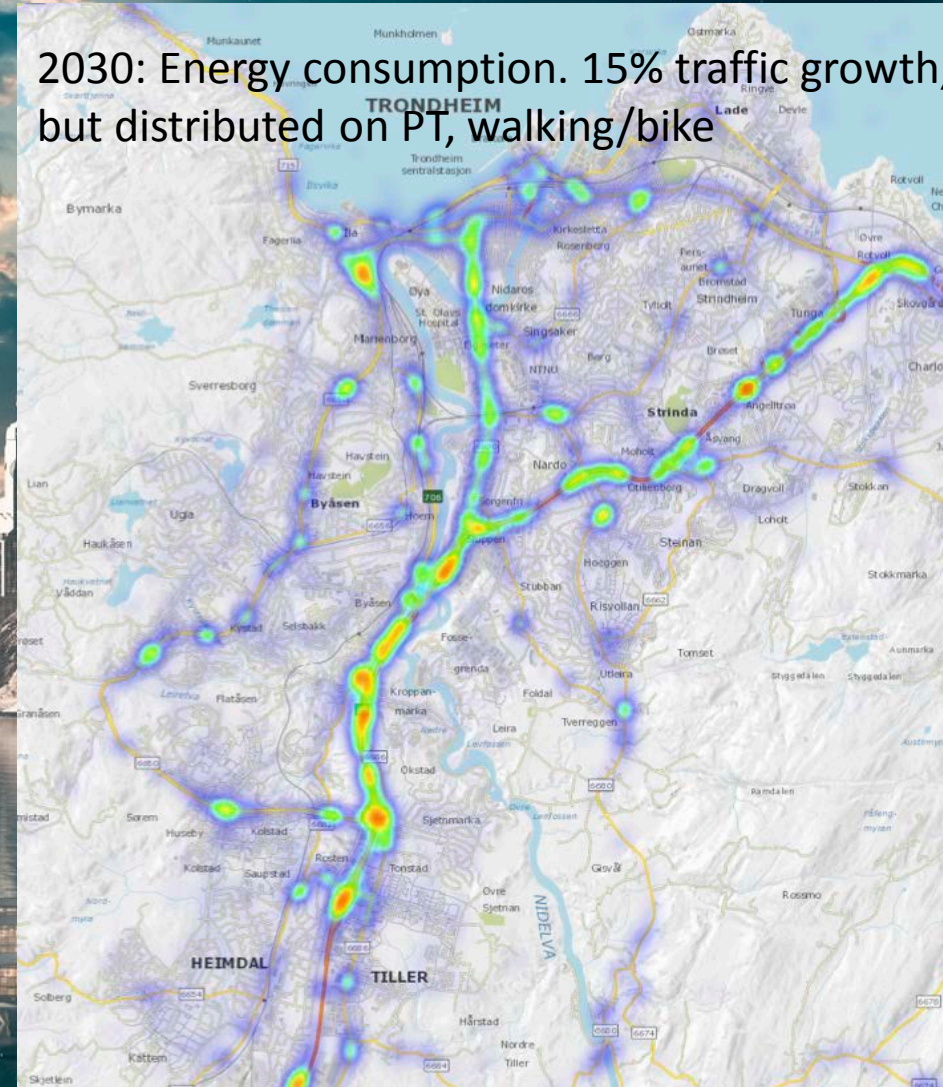
2030: Energy consumption. 15% traffic growth.

What is the energy demand in 2030?

2030: Energy consumption, 15% traffic growth

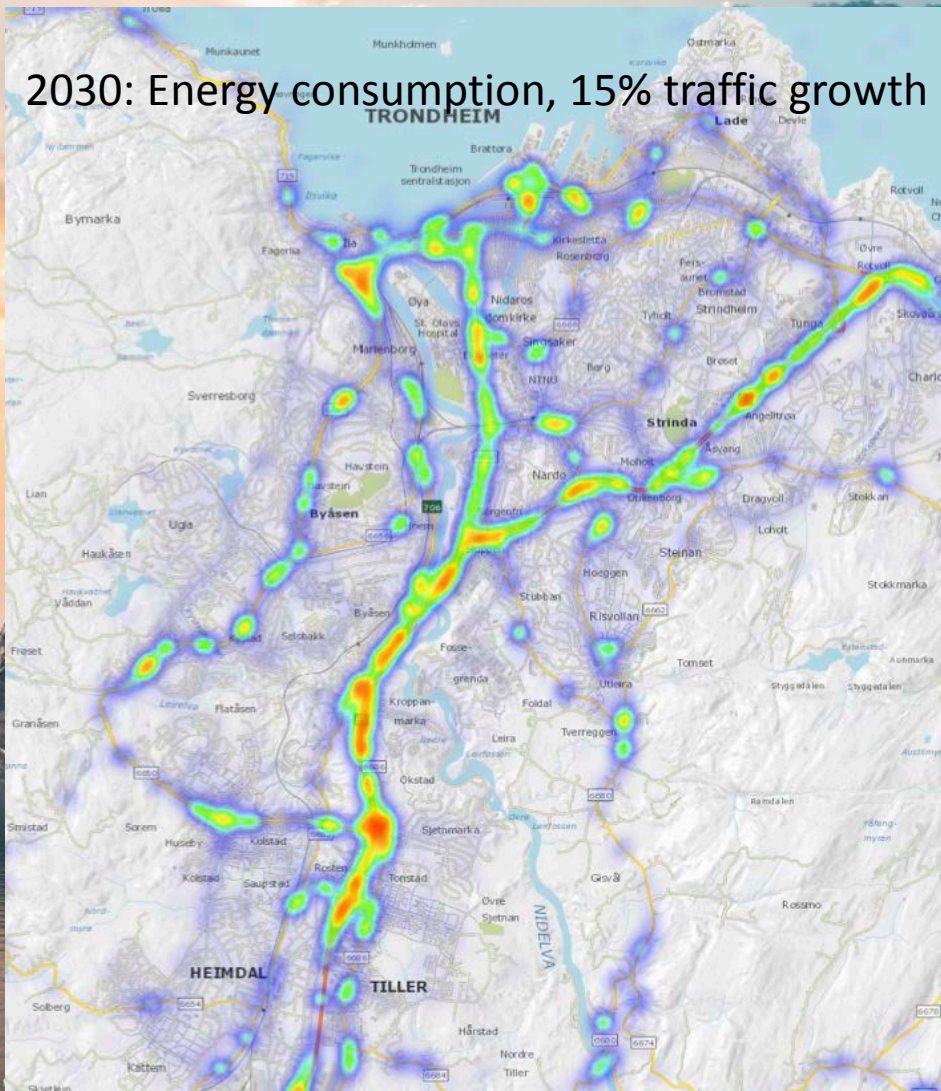


2030: Energy consumption. 15% traffic growth, but distributed on PT, walking/bike

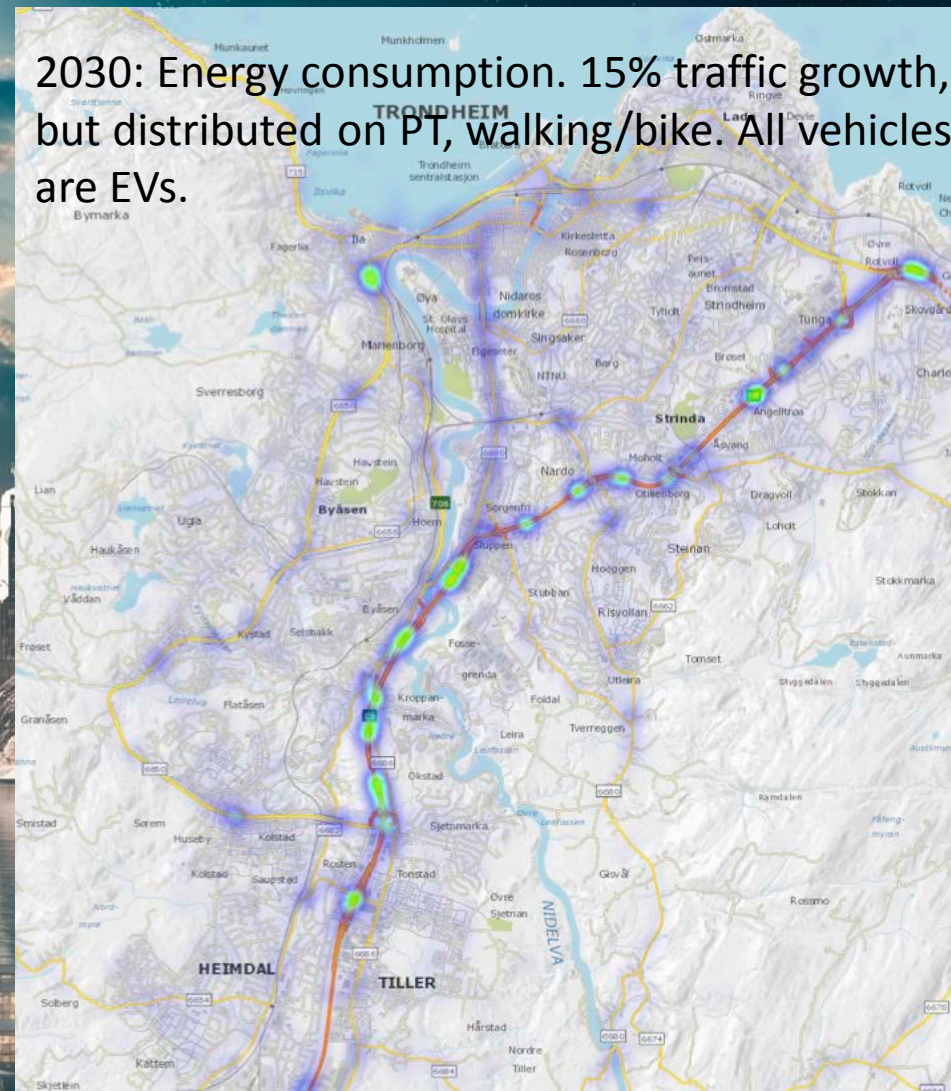


What if there is no increase in "vehicle" traffic?

2030: Energy consumption, 15% traffic growth



2030: Energy consumption. 15% traffic growth, but distributed on PT, walking/bike. All vehicles are EVs.



What if there is no increase in "vehicle" traffic,
and all vehicles are electric?



What if..



Teknologi for et bedre samfunn