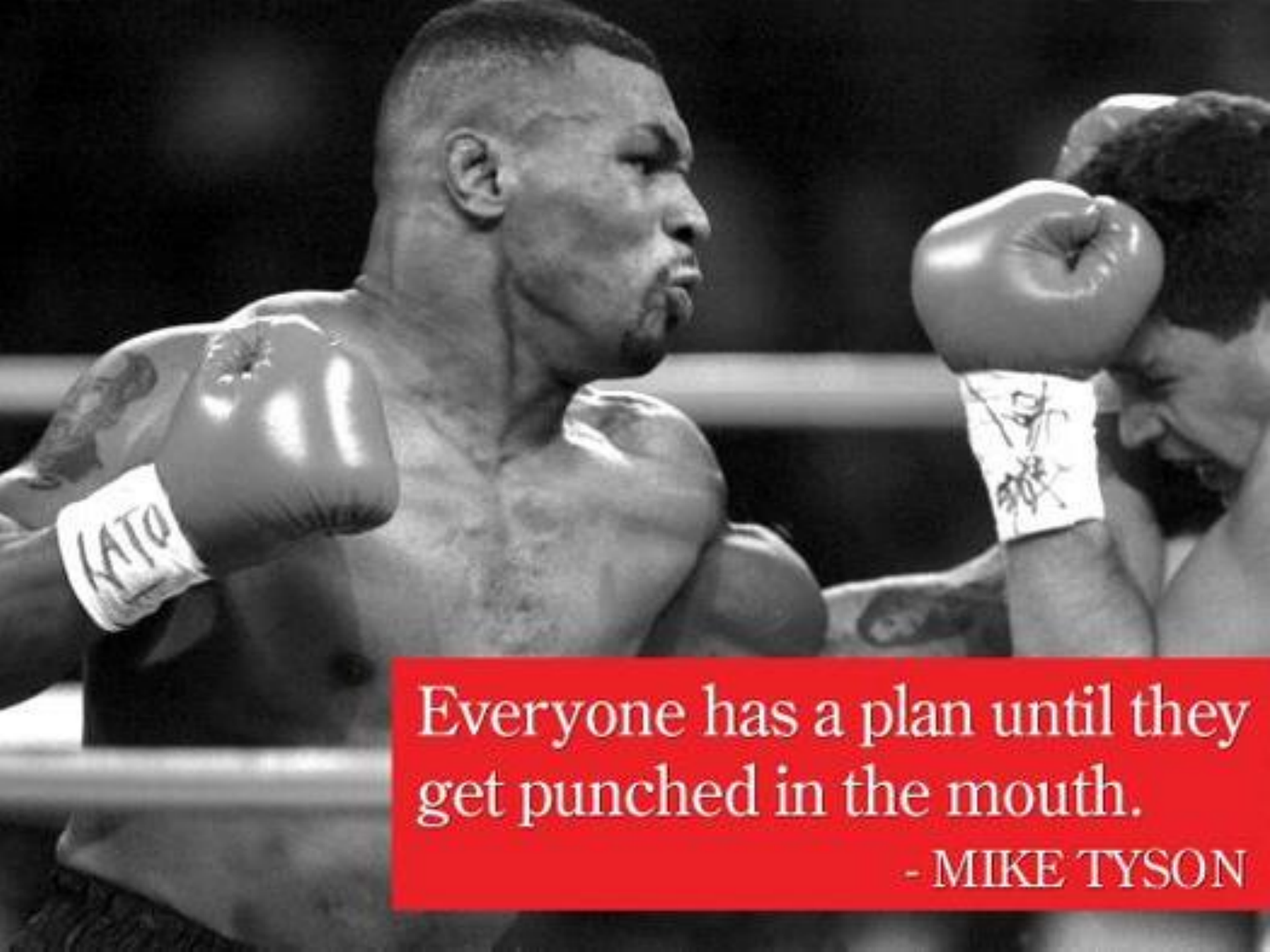
A New Nordic Model

Driving and Implementing District Energy

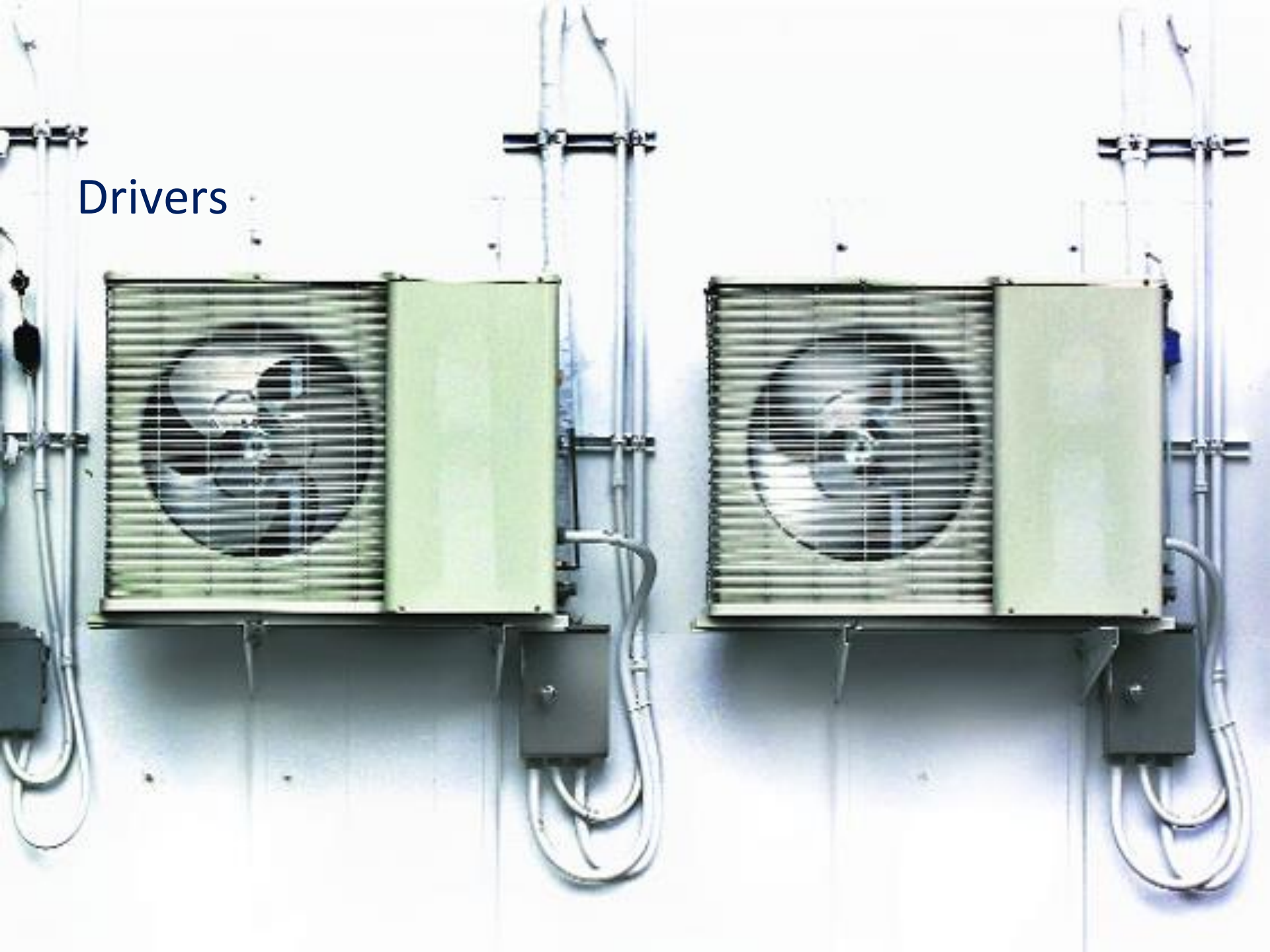
Agenda

- Background
- Drivers
- Implementation
- Best Practices

Background


Everyone has a plan until they get punched in the mouth.
- MIKE TYSON

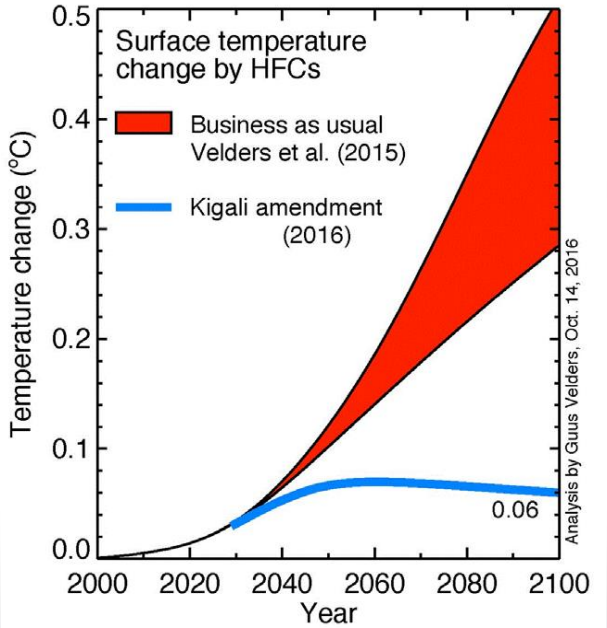
Drivers



Macro Drivers – Kigali Amendment

The Kigali amendment to the Montreal Protocol, November 2016:

- Global commitment to phase down HFC refrigerants
- EU F-gas directive, phase down starts now



Global Impact

- Up to 0,5 ° C from HFC phase down and
- 0,5 ° C due to energy efficiency improvements
- Total potential 0,5 – 1 degree C

Business Impact

- Existing cooling installation become obsolete
- Chillers become more expensive – greater economy of scale

*Source Pär Dalin, DEVCCO

Micro Drivers – Decarbonisation

"Green" as competitive advantage and branding

- Organisations and companies commit to decarbonisation
- Moving on from power purchase agreements to thermal

Impact

- New developments go for carbon neutralality
- Exploration into alternative solutions to chillers and gas boilers
- Still need to prove bankability

Implementation

Implement - Nodal/Hub Development

Basics

- Local adaption + Champions
- Start out as small networks
- Commercial developers
- Co-production and synergies of heating and cooling
- Low temperatures
- Utilize local waste-heat and other sources
- Quick turn-over rates
- Industry partnerships

Project	Energy Efficiency multiple	Type
Reference	1	Conventional Chillers and Split systems
Lusail, Qatar	2	Centralised chillers
Västerås	3-4	MIX: heatpump cooling/absorption/lake free cooling
Gothenburg	4-5	MIX: chillers/absorption/sea water free cooling
Linköping	5-6	MIX: NH3 chillers/absorption/river free cooling
Stockholm, Sweden	5-6	MIX: heatpump cooling/sea water free cooling
	7-10	
Maldives	>10	SWAC (deep sea water cooling)

Implement - KISS Model

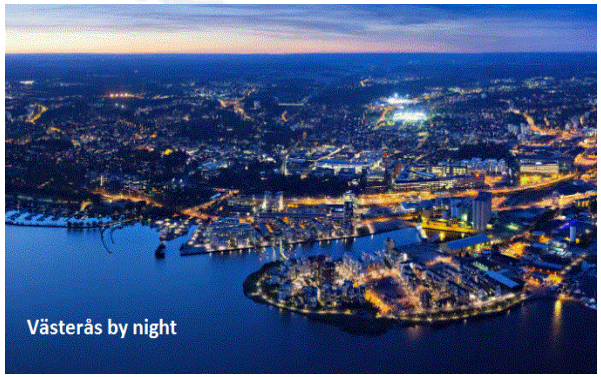
Simplicity is key

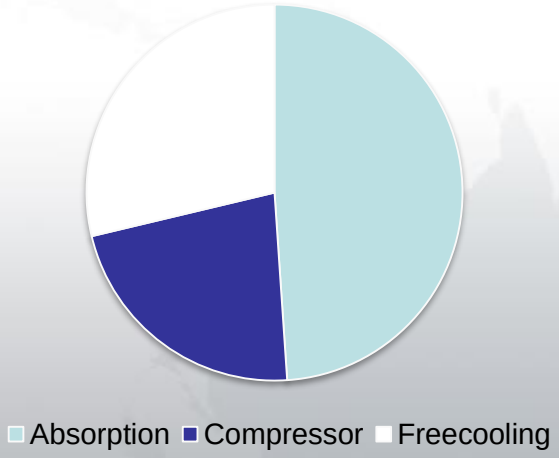
- Few offtake contracts – only large customers
- Easy permitting (little combustion and use of public areas)
- Replicability and transferable engineering
- Preferred partnerships (finance, manufacturers, engineering etc.)
- Small stakeholder group
- Standartized contract structures
- Future integration with other networks/sources

Best Practice

Best Practise – Linköping, Sweden

Linköping





General Information

- Linköping is city in Sweden with 150.000 inhabitants.
- The first cooling delivery was made in 1997 in collaboration between the Tekniska Verken (the city energy utility) and Linköping University and triggered by the Swedish early phase out of R12&R22 (CFC&HCFC) and to make use of the summertime surplus heat
- In 2016 the network provided cooling solutions to 140 customers with a total demand of 55 MW (16.000 RT) with an output of total 100 GWh/year.
- Total investment is about 30 M€

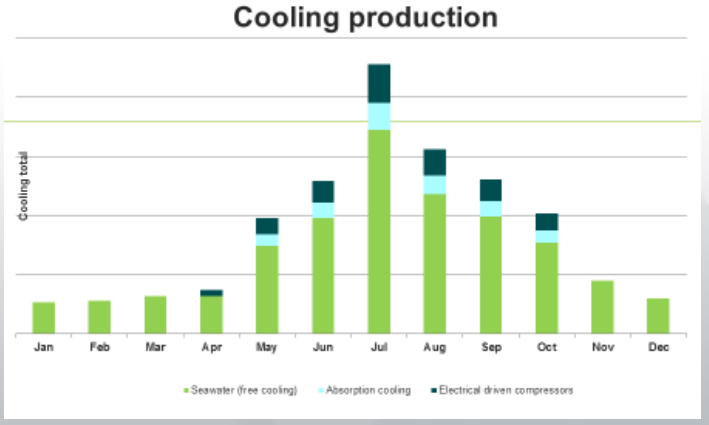
Key Figures

1. HFC phase down: 100
2. Energy Efficiency: SSEER* = 10,7

*SSEER: Seasonal System Energy Efficiency Ratio

Best Practise – Copenhagen

Copenhagen



General Information

- Copenhagen is the Capital in Denmark with 1.300.000 inhabitants.
- The first cooling delivery was made in 2010 when the first plant owned by the utility was put in operation.
- No use of R12&R22 (CFC&HCFC) – ammonia as media was mandatory to obtain building permission
- In 2017 the network provide cooling to 68 customers with a total demand of 50 MW (14.500 RT)
- Total investment is about 70 M€

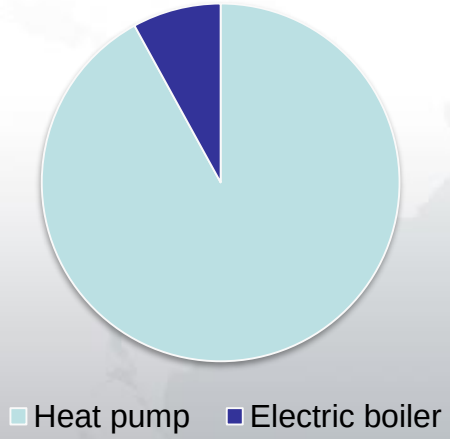
Key Figures

1. HFC phase down: 100%
2. Energy Efficiency: SSEER* = 7

*SSEER: Seasonal System Energy Efficiency Ratio

Best Practise – Juneau, Alaska

Juneau



General Information

- Juneau is the state Capital of Alaska with 32.000 inhabitants.
- The city receives around 1,1 mio. tourist annually from cruise ships.
- Hydro-power is serving the islanded power grid and the city is primarily heated (and cooled) by heating oil. With the new sea-water heat pump the down-town core will recieve sustainable heat and the cruise ships will recieve comfort cooling while in harbor.
- When completed in 2019 the project will be close to 100% renewable as the electricity comes from a newle established hydro-dam.

Key Figures

1. HFC phase down: 100%
2. Heating Oil phase out
3. Energy Efficiency: SSEER* = 3-8

*SSEER: Seasonal System Energy Efficiency Ratio

Thank You!

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