FORD SITE ENERGY STUDY
TAG MEETING JULY 2015

ACTIVITY FOCUS

- **In progress**
- Activity 1.7: Financial assessment

Screening foundation for revised scope and financial assessment

- **Complete**
- Activity 1.1: Conditions, constraints and opportunities
  - Reuse of tunnels & steam plant buildings
- Activity 1.2: Best practise in car use alternatives Security of supply
- Activity 1.3: Best practise building design to reduce energy demand
- Activity 1.5: Energy technologies and district energy designs
  - Developers guide
- Activity 1.4: Implementing sustainable site-wide energy system
- Activity 1.6: Energy mix, storage and pricing – screening

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ACTIVITY 1.4: IMPLEMENTING SUSTAINABLE SITE-WIDE ENERGY SYSTEM
ACTIVITY 1.6: ENERGY MIX, STORAGE AND PRICING – **SCREENING**

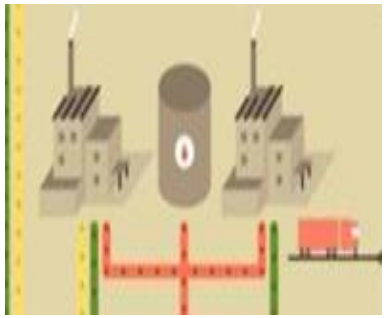
GROSS LIST

- a total 33 technologies were identified

An initial screening ruled out three technologies for various reasons:

- Wind turbines: It’s unlikely to receive permits and public acceptance for setting up wind turbines in close proximity of the site
- Waste incineration plant: The size of plant required to achieve a viable business case is not compatible with the site dimensions and the stress on the traffic system for supplying the waste is deemed unacceptable.
- Deep-geothermal: The potential and risks associated with such a project cannot be rightly evaluated through this general study.

- BAU & 8 scenarios



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SCREENING

Cost effectiveness: The technologies are evaluated primarily on the expected leveled cost of energy (LCOE) over the technical lifetime. The levels of economic risk related to the technology have been considered. There is uncertainty towards the relative value of power vs heat, which may lead to changes in evaluation later on.

Energy efficiency: Energy efficiency is evaluated on the conversion efficiencies and energy losses for the technologies. Renewable energy has not been given preference as is often the case due to a 0 primary energy factor by definition.

Net Zero: Net Zero concerns the CO_2 emissions and primary energy use of the technology. The highest score have been given to 100% renewable technologies. Other GHG emissions have also been taken into account.

Resilience: Resilience is understood as the security for energy supply that the technology delivers, in particular in case of power grid failures. On site power production has been given high rankings, but fuel diversification and -independence has also been considered.

Legacy/Innovation: Developing technologies with high potential have scored high, whereas traditional concepts with no innovation are evaluated poorly.

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SC0 - BAU

System components:

Individual gas boilers for space heating and DHW

Electric air-air heat pumps for comfort cooling.

Table 5: SC0 – Business as usual evaluation

Total	Net Zero	Resilience	Innovation	Energy efficient	Cost effective
13	3	3	1	3	3

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SC8: INDIVIDUAL ALL ELECTRIC SCENARIO

System components per individual dwelling unit:

De-central electric devices for heating/cooling and HTW.

PV (1/3 of room sf), equivalent to electricity use, 160 W/m2, 1000 h/y.

Total	Net Zero	Resilience	Innovation	Energy efficient	Cost effective
17	5	3	1	4	4

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INHERENT LOCAL RESOURCES

MISSISSIPPI RIVER

HYDRO PLANT

STEAM PLANT BUILDING

“CONTAMINATED” LAND

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ACTIVITY 1.7 (REVISED) : FINANCIAL ASSESSMENT

SCENARIOS

- Based on **development scenario 5,** estimations of the likely build out phasing of the site, and the likely energy demand and its duration throughout the year.
- - Analysis of three (3) concepts for financial viability (as agreed at the TAG meeting on 2015-29-01):
  - 0. Business as usual (BAU) scenario (Grid electricity, natural gas individual heating, and air Conditioning cooling)
  - 1. District energy scenario (DHC) (Solar Thermal, River Heat pump for heating and cooling, ATES, gas back-up, thermal storage (seasonal/daily))
  - 2. Individual (IND) scenario (Solar PV, Solar thermal, heat pump heating and cooling (ground source heat pump potentially), hot water storage)

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FINANCIAL ASSESSMENT - ASSUMPTIONS

- SITE BUILD OUT AND CONNECTIONS
- ENERGY DEMAND

- ENERGY CONCEPTs

- DHC Network

- FINANCIAL ASSUMPTIONS
- OPERATIONAL COSTS AND TARIFFS

Concept 0: (BAU) Business As Usual - Individual Energy Production per Building

Individual Concept	Heating	Cooling	Electricity
Plant type	Natural gas boiler Individual or Common	AC unit Individual or Common	Grid
Plant size, MW	Depending on Building type and size	Depending on Building type and size	
Plant efficiency, %	94% (HHV)	400% (COP = 4)	
Equivalent Full Load Hours	1800	Retail, office, civic: 1500 Apartments: 1200	

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Concept 1: District Energy – Centralized Energy Production

Heating

Base load units	Intermediate load units	Peak and reserve load units
1. Flat plate solar thermal 2. Combined heat pump/chiller unit 3. Dedicated heat pumps	4. Flat plate solar thermal (Boost to increase HP efficiency) 5. Short term storage	6. Natural gas boiler

Cooling

Base load units	Intermediate load units	Peak and reserve load units
1. Free cooling (ATES) 2. Combined heat pump/chiller unit 3. Dedicated chiller units	4. Pre cooling (ATES) 5. Free cooling (River) 6. Short term storage	7. Dedicated chiller unit (N + 1)

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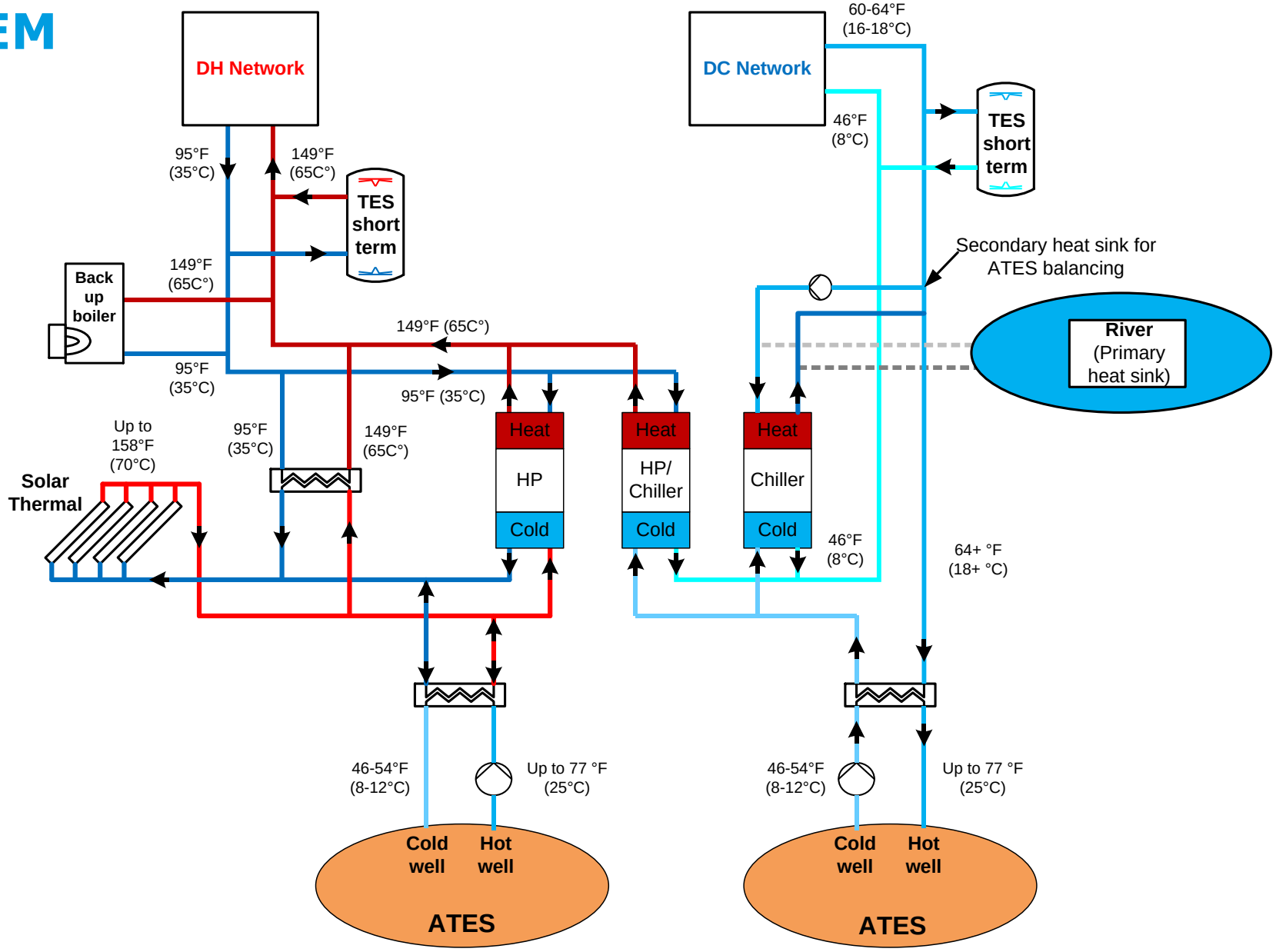
DHC SYSTEM



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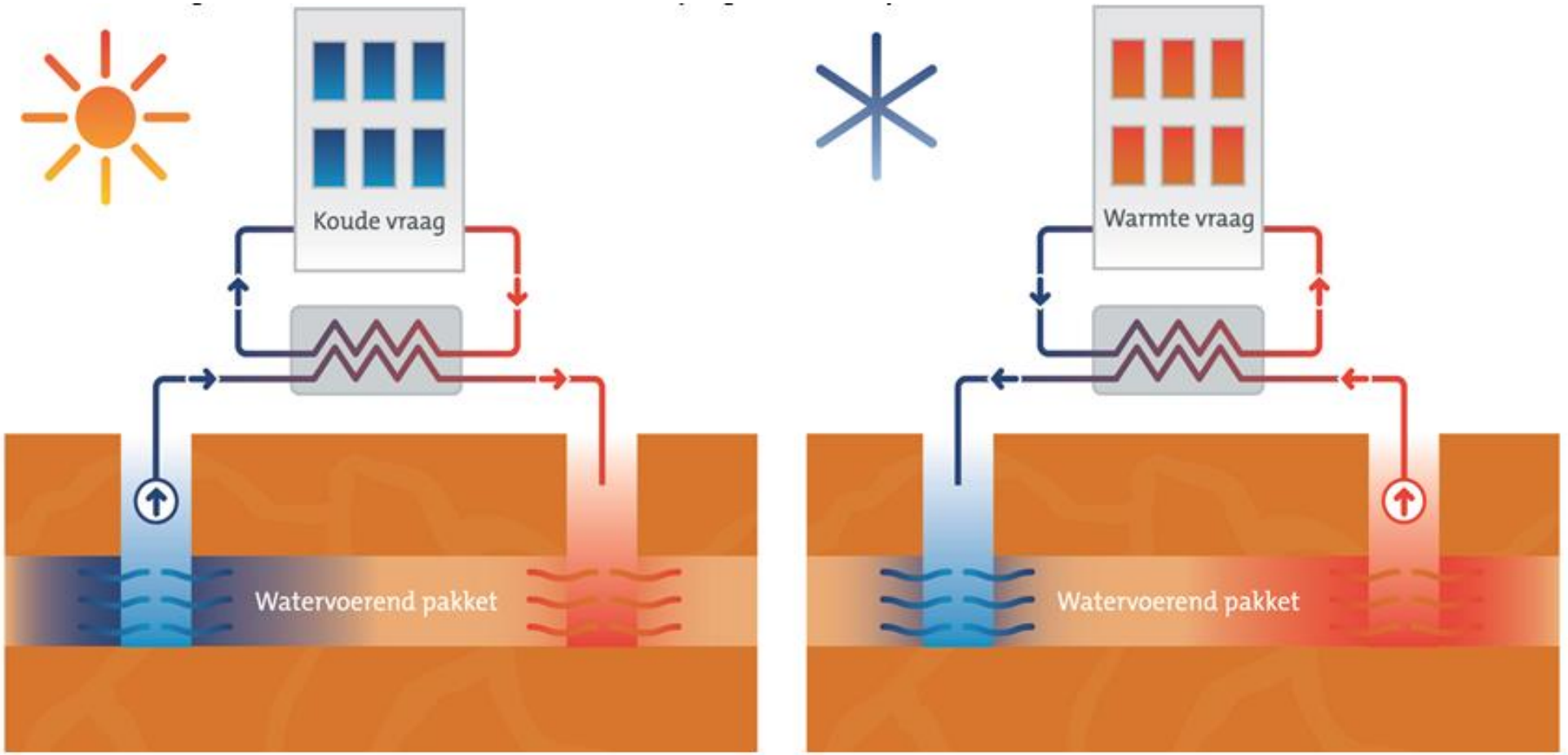
ATES


Koude vraag
Watervoerend pakket
Warmte vraag
Watervoerend pakket

Concept 2: (IND) Individual Renewable Energy Supply

Individual Concept	Heating		Cooling	Electricity
Plant type	Heat Pump Individual or Common	Oil-fired boiler (as back-up)	Chiller Individual or Common	Solar PV + Grid
Plant size, MW	Depending on Building type and size		Depending on Building type and size	Depending on roof space
Plant efficiency, %	500%	95%	400%	-
Operating hours	1800		1200	1300

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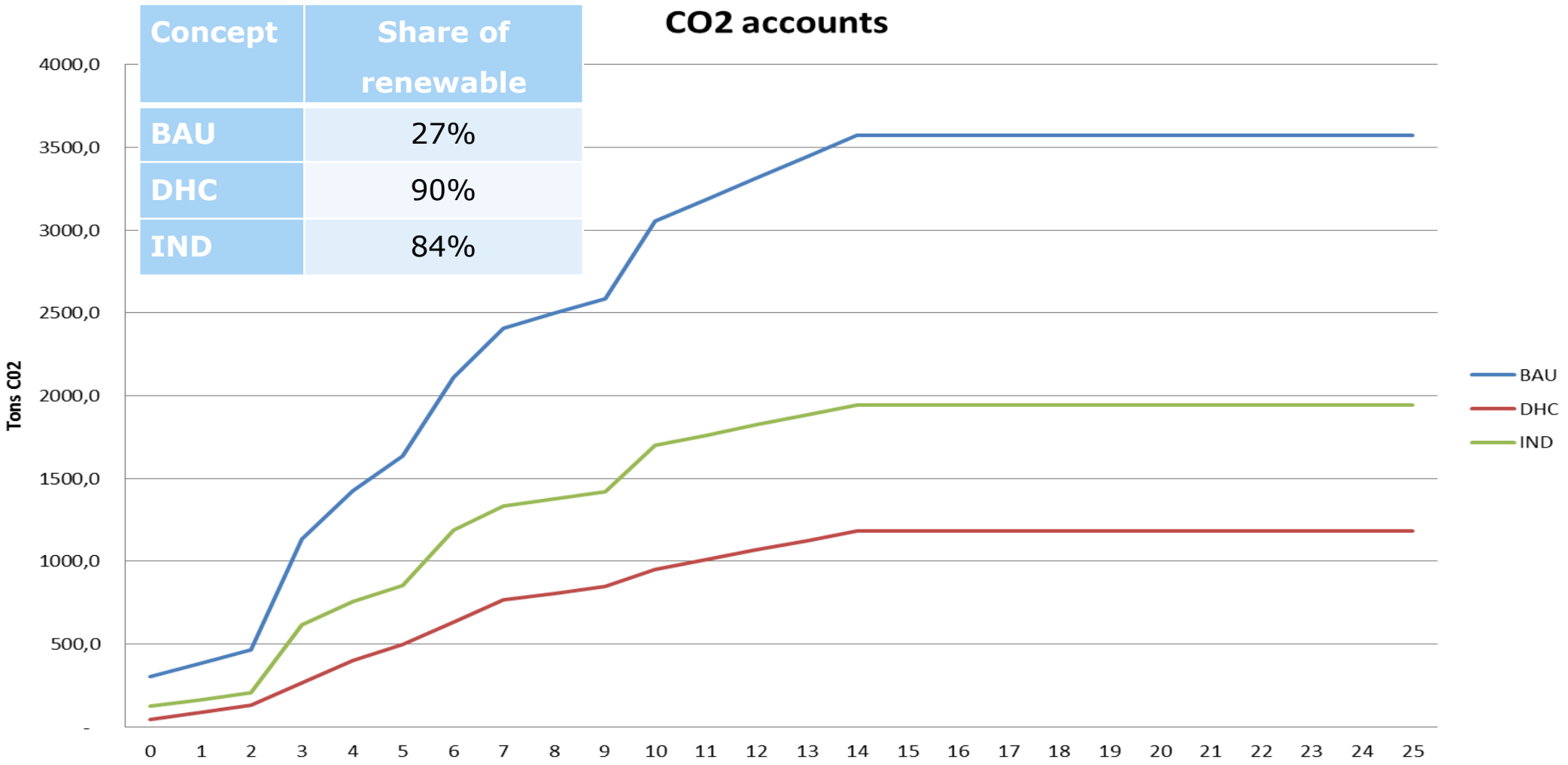
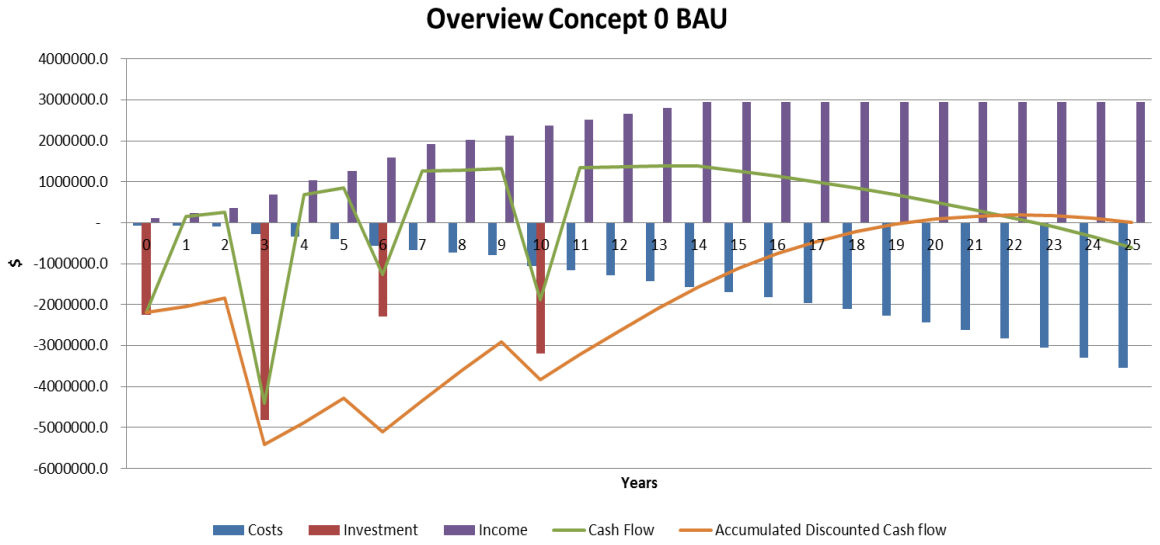
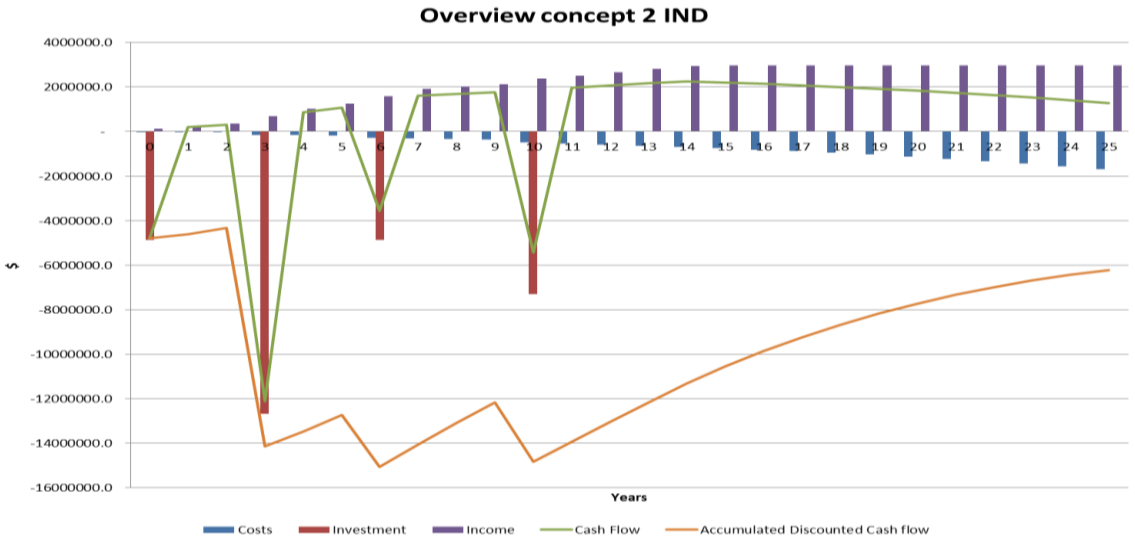
CO_2 & SHARE OF RENEWABLES

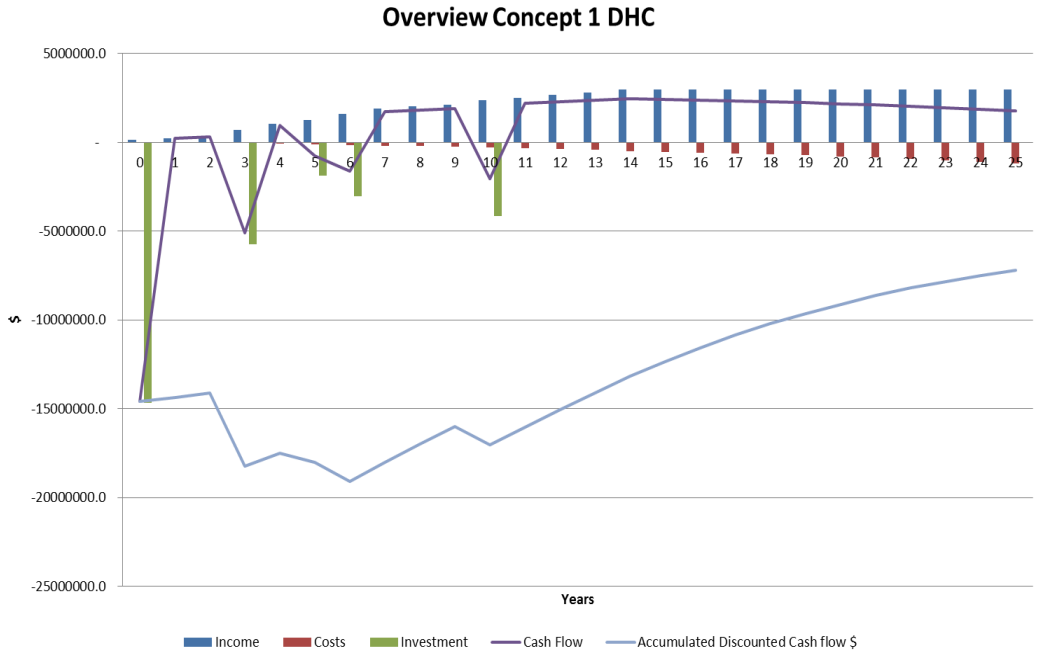
Concept	Share of renewable
BAU	27%
DHC	90%
IND	84%



FINANCIAL OVERVIEW







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FINANCIAL ASSESSMENT RESULTS

	NPV	IRR
Concept 1, DHC	$-6.1M	3.81%
Total investment	$ 23M	-

	NPV	IRR
Concept 2, IND	$-5.7 M	3.13%
Total investment	$19.7M	-

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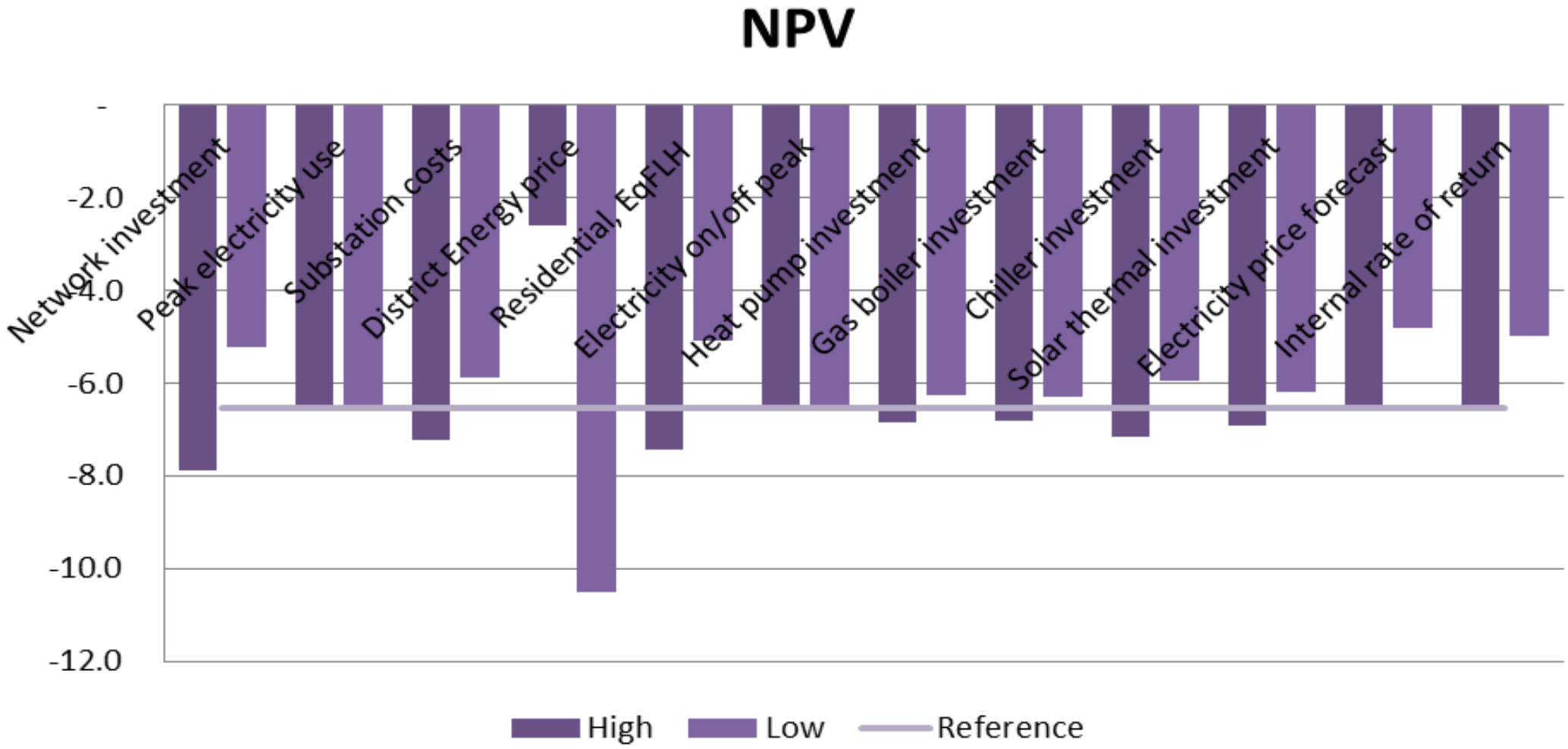
SENSITIVITY – DHC CONCEPT



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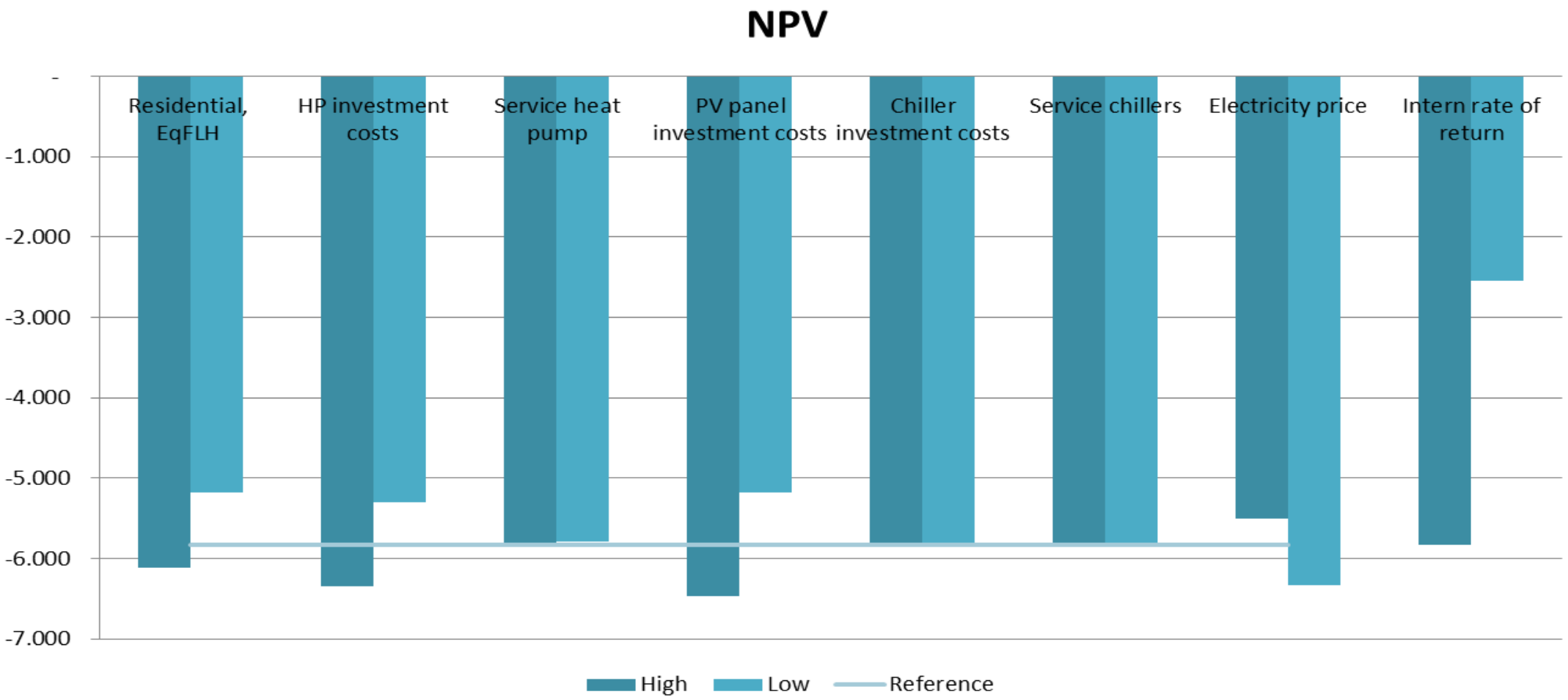
SENSITIVITY – IND CONCEPT



THE HEADACHES

<u>DHC Concept:</u>

Cost of the energy (heating and cooling)

Network investment costs

<u>IND Concept</u>

Investment costs in chillers and PVs

High electricity price and forecast increase

No subsidises accounted

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OVERALL ASSESSMENT AGAINST OBJECTIVES

Scenario	(net zero) CO_2	Resilience	Legacy / Innovation	Energy Efficiency	Cost effective	Total Score
0. BAU	3	3	1	3	3	13
1. DHC	5	4	5	5	3	22
2. IND	4	3	3	4	3	17

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THANK YOU