

# HCFC Retrofit and Replacement in WCh Croatia Case Study

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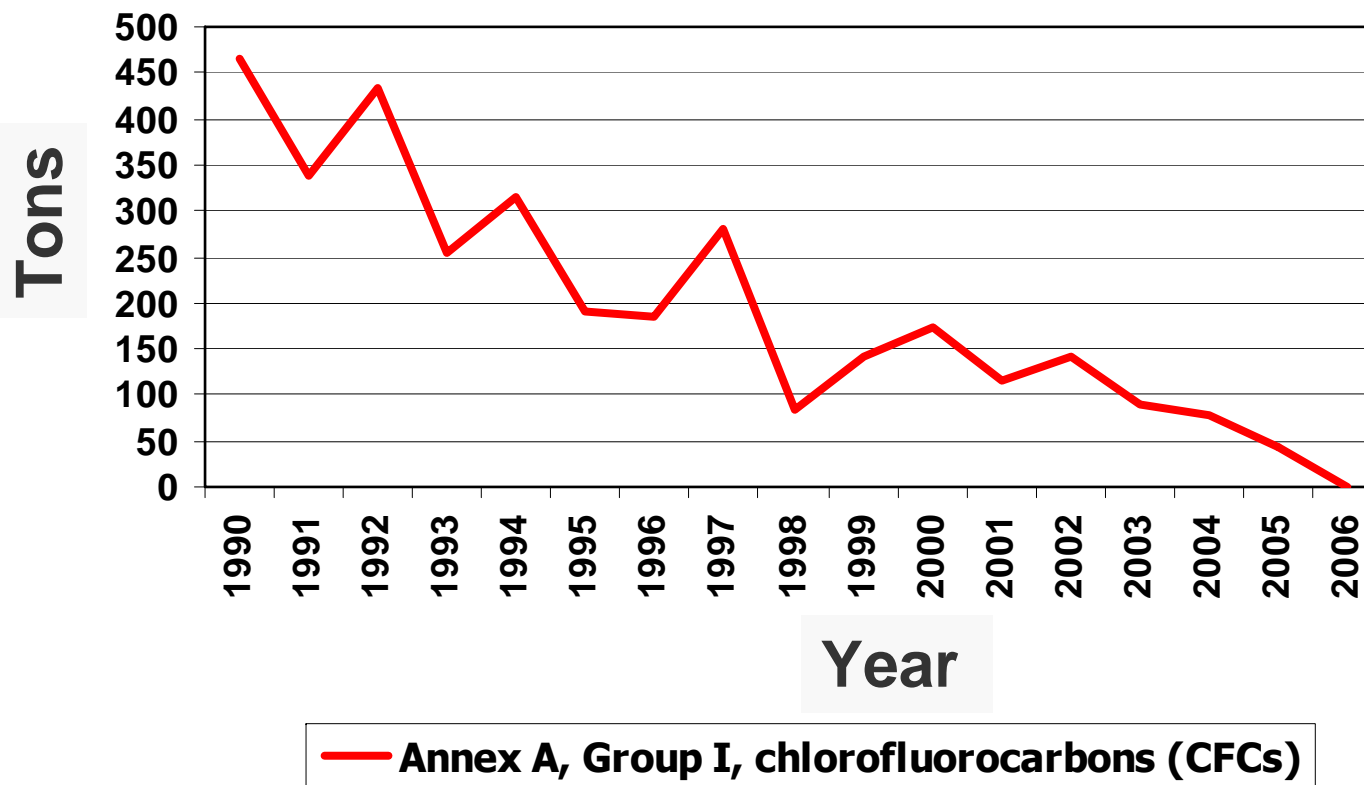
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# **HCFC phase-out Management Plan - Strategy**

## **Case study – Retrofit & Replacement in WCh**

# Consumption quantities of CFCs, HCFCs, and HFCs

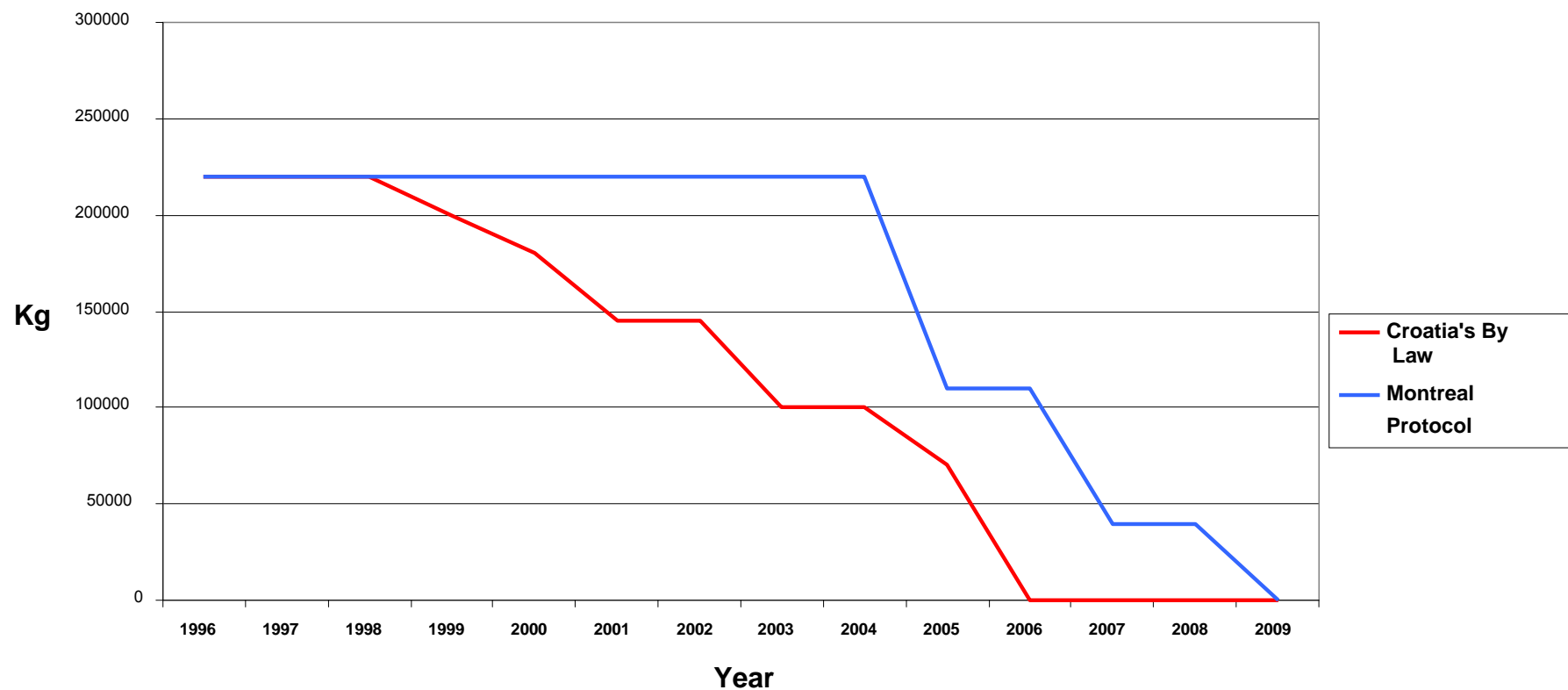
## Consumption of CFC 1990 - 2006



Dynamic of CFC consumption for the period 1990-2006

# Consumption quantities of CFCs, HCFCs, and HFCs

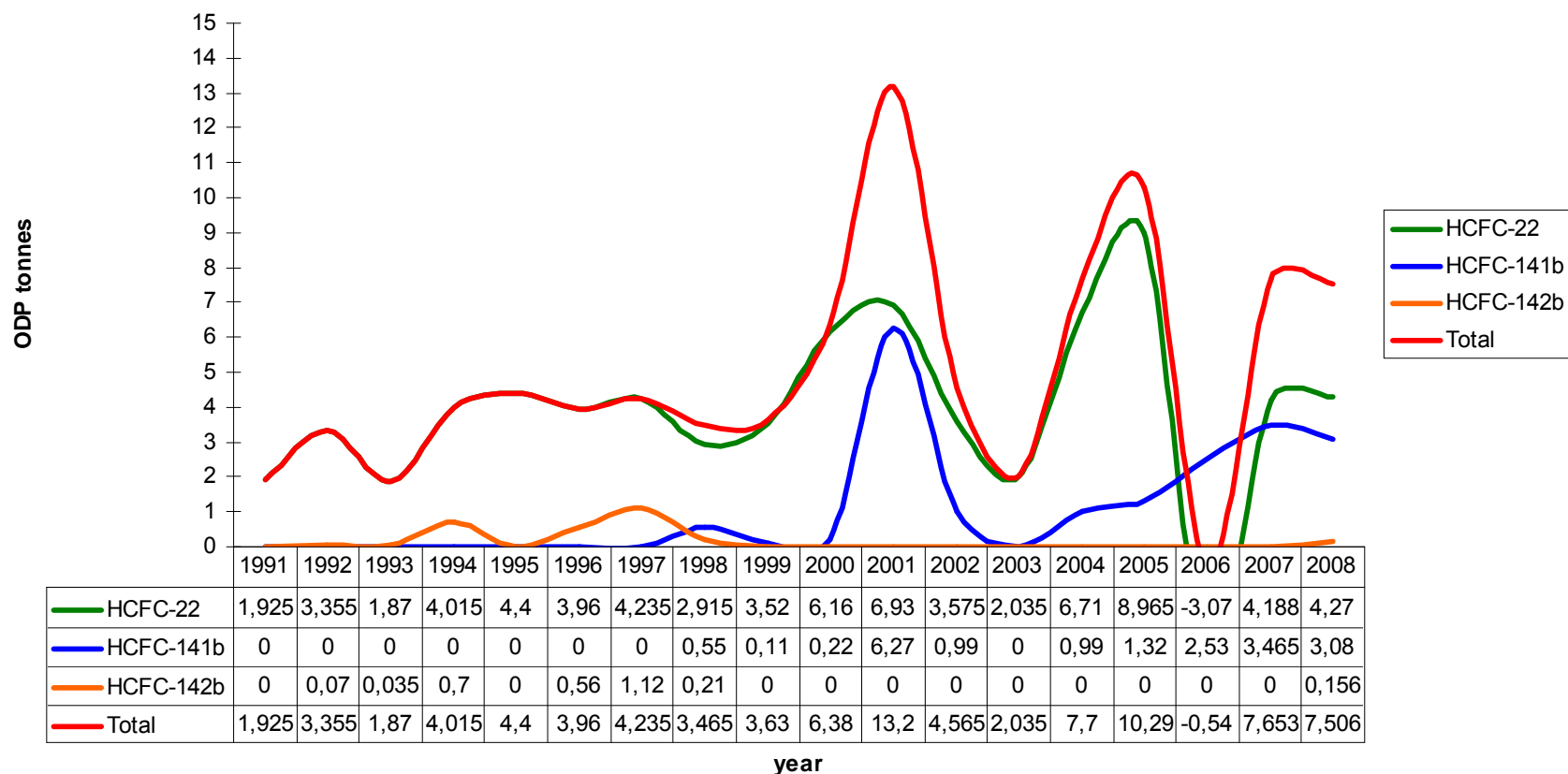
## CFC phase out



## Consumption limits specified by Montreal Protocol

# Consumption quantities of CFCs, HCFCs, and HFCs

## HCFC Consumption 1991-2008



**Actual HCFC Consumption for the period 1991-2008 in ODP tonnes**

## Consumption quantities of CFCs, HCFCs, and HFCs

### Actual HFC consumption in kg for the period 2006-2008

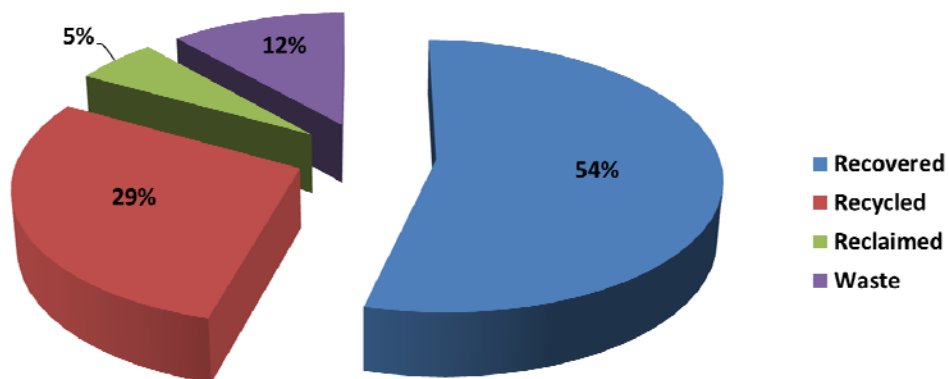
<b>Year/ Refrigerant</b>	R134a	R404A	R407C	R410A	R507	R152a
2006	63,316	74,097	23,940	11,409	1,162	0.4
2007	63,296	80,576	27,754	16,430	238	0.4
2008	79,989	93,247	34,872	30,260	1,945	0,0
<b>Current Purchasing Prices [€/kg] without VAT</b>	4.20	4.70	4.70	4.90	4.70	-

## HCFC consumption in the refrigeration and air-conditioning service sector

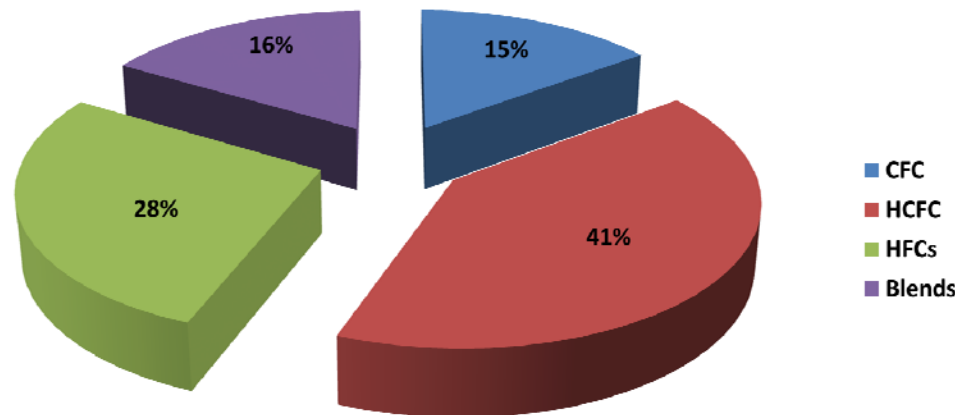
### Recovered and recycled refrigerant in the period 2002-2008

Year	Recovered [kg]					Recycled [kg]	Reclaimed [kg]	Waste [kg]
	CFC	HCFC	HFCs	Blends	Total			
2002	1265,54	2766,23	1652,93	948	6632,7	3765,3	637,65	1265,4
2003	1187,98	2543,94	1723,07	936,58	6391,57	3218,75	657,21	1402,73
2004	1378,81	3943,67	1534,82	1117,32	7974,62	3954,02	801	1643,29
2005	1274,06	3675,19	2330,05	1547,27	8826,57	4389,97	934,54	1826,51
2006	1129,17	4322,76	2987,00	1769,04	10207,97	5026,56	997,05	2005,93
2007	1468,02	4361,95	3182,59	1912,77	10925,33	5547,21	1032,08	2223,6
2008	1541,33	3978,02	3672,16	2005,89	11197,4	7348,9	1176,84	2879,43
<b>Total</b>	<b>9244,9</b>	<b>25291,7</b>	<b>17082,6</b>	<b>10236,9</b>	<b>62156,1</b>	<b>33250,7</b>	<b>6236,37</b>	<b>13246,9</b>

Recovered and recycled refrigerant (in kg) in the period 2002-2008



Recovered refrigerant by type in the period of 2002 - 2008



## HCFC consumption in the refrigeration and air-conditioning service sector – Chiller Sector

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**Water chiller in the hospital  
„Sestre Milosrdnice” in Zagreb**



**Water chiller in the hotel  
„Mozart”**

➤ Total amount of refrigerant R-22 in chiller sector is 68.000 kg



## HCFC consumption in the refrigeration and air-conditioning service sector – Commercial and industrial refrigeration sectors

### R-22 in the commercial and industry sectors

Application	R-22 mass [kg]	Percentage [%]
Cold Stores	43,000.00	55.5
Display cases	23,000.00	29.7
Vending machines	6,000.00	7.7
Medium and large size refrigerators, ice makers	5,500.00	7.1
<b>TOTAL</b>	<b>77,500.00</b>	<b>100</b>

## HCFC consumption in the refrigeration and air-conditioning service sector – Transportation refrigeration sector

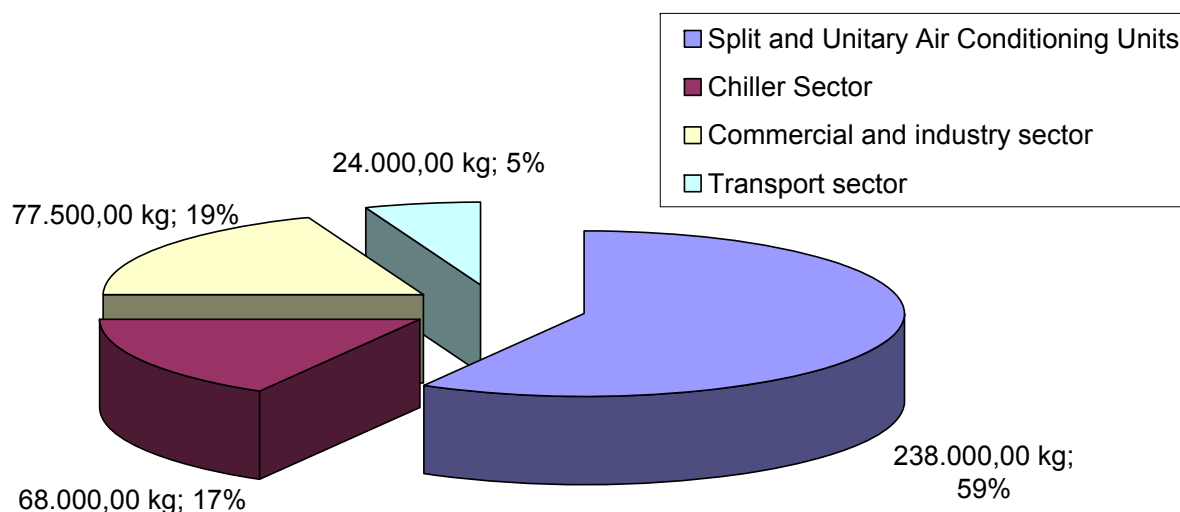
### R-22 in the transport sector

Application	R-22 mass [kg]	Percentage [%]
Shipping	12,500.00	52.1
Railway, buses	4,000.00	16,6
Vehicles	7,500.00	31.3
<b>TOTAL</b>	<b>24,000.00</b>	<b>100</b>

# HCFC consumption in the refrigeration and air-conditioning service sector – Summary

## Summary of refrigeration and air-conditioning sector

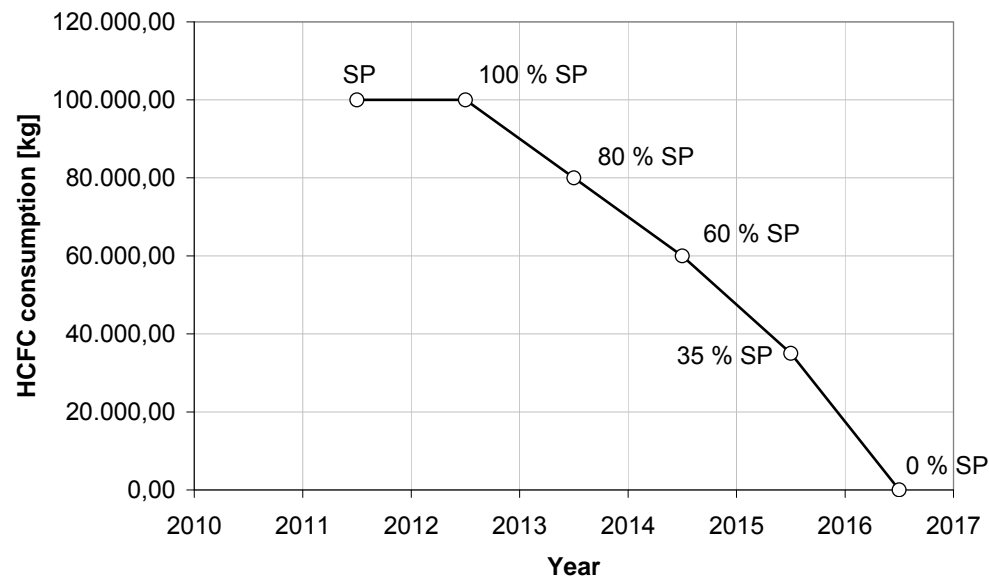
Application	R-22 charge [kg]	Annual leakage rate [%/year]	Annual need for servicing [kg/year]
Split and unitary Air-conditioning units	238,000.00	15	35,700.00
Chiller sector	68,000.00	25	17,000.00
Commercial and industry sectors	77,500.00	25	19,375.00
Transport sector	24,000.00	35	8,400.00
<b>TOTAL</b>	<b>407,500.00</b>		<b>80,475.00</b>



# Strategy and measures for the phase-out of HCFCs

Action	Amount [kg]	Year
Starting Point HCFC consumption in 2009/2010	100,000.00	
Freeze at the baseline level	100,000.00	2012
20 % reduction	80,000.00	2013
40 % reduction	60,000.00	2014
65 % reduction	35,000.00	2015
100 % reduction	0.00	2016

EU membership ???



HCFC phase-out schedule

## Strategy and measures for the phase-out of HCFCs

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The strategy and plan for a gradual reduction and phase-out of HCFC consumption by 2016 should include:

- Legislative aspects:
  - Import quotas, permits and tax,
  - Logbooks for the equipment containing 3 kg or more of refrigerants,
  - Introduction of re-usable cylinders,
  - Decreasing the needs for virgin HCFCs in the refrigeration and air-conditioning sector through an improved RRR scheme,
  - Training and certification of technicians and companies,
  - Reporting system.
- Education and trainings:
  - Training of technicians,
  - Retrofit projects and demonstration of new technologies,
  - Customs officers training,
  - Vocational schools,
  - Promotion and implementation of natural refrigerants.
- Raising awareness:
  - Technical seminars and workshops,
  - Web site,
  - Refrigeration Association,
  - Update of the Code of Good Practice.

## Plan for a gradual reduction in the HCFC consumption

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The plan consist of following steps:

- Technician training project – **accomplished**
- Project to improve the RRR scheme – **accomplished**
- Customs officer training project – **accomplished**
- ***Retrofit projects and the demonstration of new technologies – in progress***
- ***Chiller replacement projects – in progress***
- ***Vocational school project – propane AC split units (8 schools)***

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***Case Study:***

**Replacement of water chillers, retrofit projects and the demonstration of new technologies**

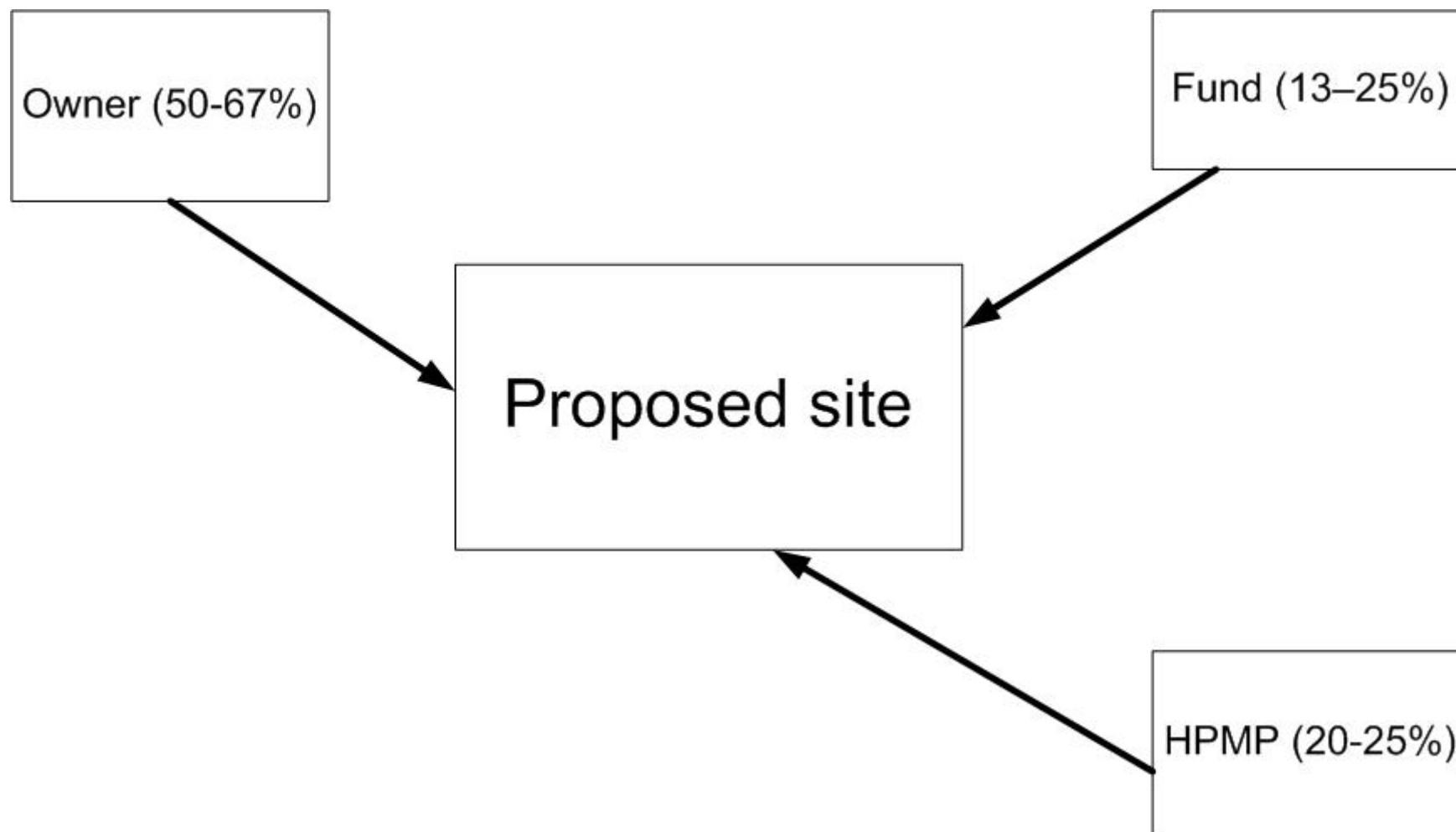
## Chiller replacement projects – planned actions

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- In order to decrease the R-22 consumption and at the same time to increase energy efficiency and lower the GWP impact of existing systems, it is recommended to replace the largest, state-owned R-22 systems in the Republic of Croatia
  
- According to the conducted survey, the following potential public sites are recognized and proposed:
  - Clinical Hospital "Josip Bencevic" Slavonski Brod,
  - Clinical Hospital "Sestre Milosrdnice" Zagreb,
  - Public hospital Šibenik,
  - Public hospital Pula,
  - Public hospital Dubrovnik,
  - Public hospital Varaždinske toplice,
  - Clinical Hospital "Šalata" Zagreb,
  - Clinical Hospital Osijek.



## Chiller replacement projects – planned actions



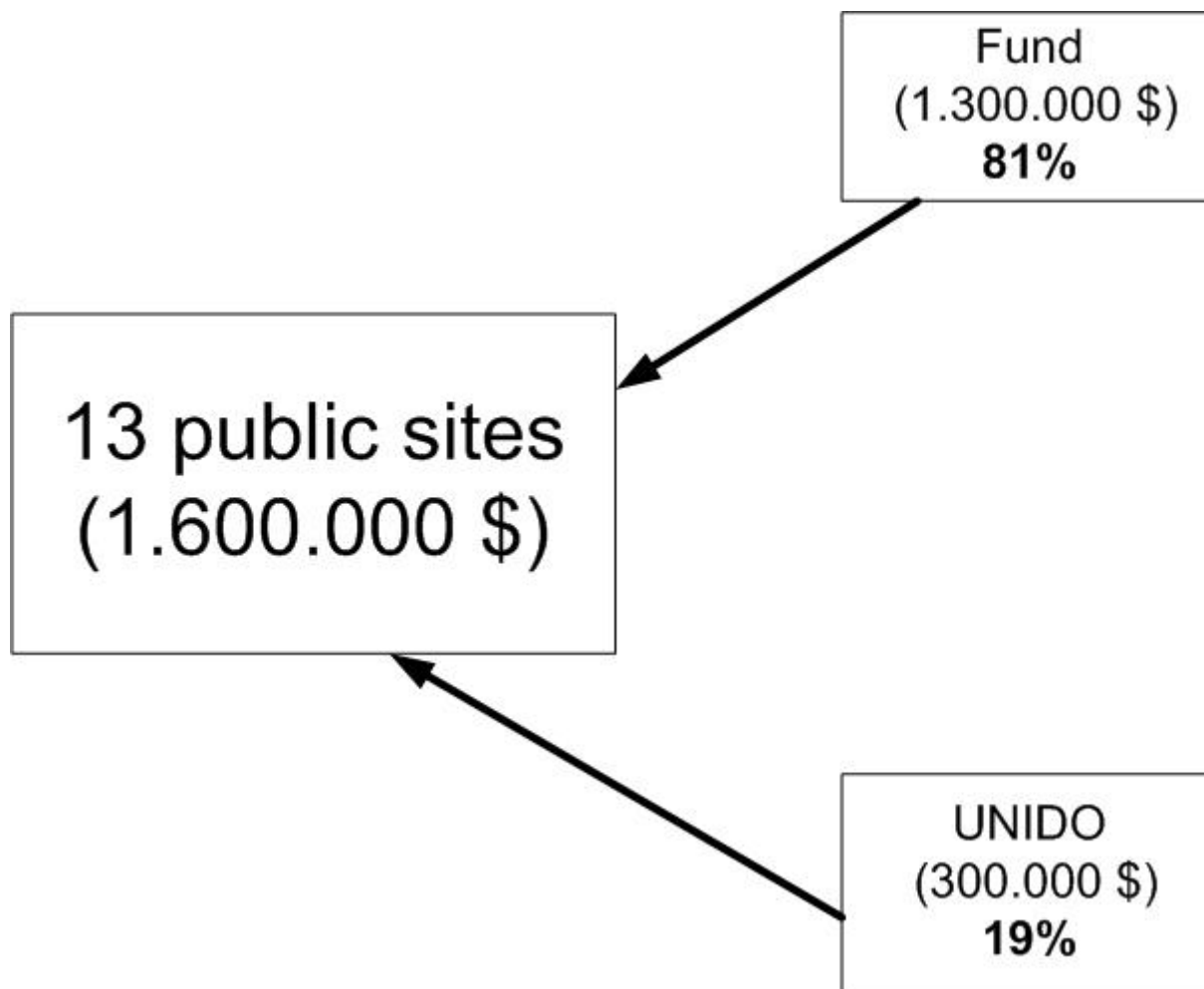
**Proposed financial scheme**

## Chiller replacement projects – actual actions

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- On the following public sites water chillers are going to be retrofitted or replaced:
  - Clinical Hospital "Josip Bencevic" Slavonski Brod (1 unit),
  - Nacional Park Brijuni Pula (1 unit),
  - Klovićevi dvori Gallery Zagreb (2 units),
  - Ministry of Interior of the Republic of Croatia, Police administration Zagreb (2 units),
  - Clinical Hospital "Sestre Milosrdnice" Zagreb (1 unit),
  - Croatian National Theatre in Split (2 units),
  - Clinical hospital Split (1 unit),
  - Clinical Hospital Osijek (3 units).

## Chiller replacement projects – actual actions



**Actual financial scheme**

# Chiller replacement projects – actual actions

## Retrofit Sites

No.	General information			Before refurbishment			After refurbishment	Estimated investment funds [HRK]
	Name of the Beneficiary	Seat (postal code and town)	Adress	Production year	Amount of HCFC R22 [kg]	Annual consumption of HCFC R22 [kg]	Refrigerant	
1	Klovićevi dvori Gallery	10000 Zagreb	Jezuitski trg 4	1982	90	50	HFC R-422D	48.817,50
2	Brijuni National Park	52100 Pula	Brionska 10, Fažana	1986	115	11	HFC R-407C	47.764,00
3	Clinical Hospital "Josip Benčević"	35000 Sl. Brod	Andrije Štampara 42	1990	110	0	HFC R-422D	310.333,00
4	Klovićevi dvori Gallery	10000 Zagreb	Jezuitski trg 4	1982	90	50	HFC R-422D	48.817,50
<b>Total</b>					<b>405</b>			<b>455.732,00</b>

# Chiller replacement projects – actual actions

## Replacement of water chillers

No.	General information			Before refurbishment			After refurbishment	Estimated investment funds [HRK]
	Name of the Beneficiary	Seat (postal code and town)	Adress	Production year	Amount of HCFC R22 [kg]	Annual consumption of HCFC R22 [kg]	Refrigerant	
5	Clinical Hospital "Sestre Milosrdnice"	10000 Zagreb	Vinogradska cesta 29	1987	75		R290	600.000,00
6	Ministry of Interior of the Republic of Croatia, Police administration	10000 Zagreb	Ulica grada Vukovara 33	1997	68	48	R290	485.000,00
7	Croatian National Theatre in Split	21000 Split	Trg Gaje Bulata 1	1979	80		R290	1.264.062,50
8	Clinical hospital Split	21000 Split	Spinčićeva 1	1992	110	240	R290	1.100.000,00
9	Clinical hospital Osijek	31000 Osijek	Huttlerova 4	1989	130	55	R290	1.400.000,00
10	Ministry of Interior of the Republic of Croatia, Police administration	10000 Zagreb	Ulica grada Vukovara 33	1997	68	48	R290	485.000,00
11	Croatian National Theatre in Split	21000 Split	Trg Gaje Bulata 1	1979	80		R290	1.264.062,50
12	Clinical hospital Osijek	31000 Osijek	Huttlerova 4	1984	50	30	R290	550.000,00
13	Clinical hospital Osijek	31000 Osijek	Huttlerova 4	1984	50	30	R290	550.000,00
				<b>Total</b>	<b>711</b>			<b>7.698.125,00</b>

# Chiller replacement projects – environmental impact

## Environmental impact

		Retrofitting	Unit Replacement	Total
Phased out quantity of HCFC R22	kg	405	711	1.116
	ODP eq	20	36	56
	GWP eq (kg CO <sub>2</sub> )	688.500	1.208.700	1.897.200
Avoided yearly emission of HCFC R22	kg/year	156	606	762
	ODP eq/year	8	30	38
Reduction of direct impact on GWP [kg CO <sub>e</sub> /year]	Leakage	265.200	1.030.200	1.295.400
	Losses during R & R	132.600	515.100	647.700
Reduction of non-direct impact on GWP [kg CO <sub>e</sub> /year]	Consumed Energy	0	211.233	211.233
Reduction of TEWI	[kg CO <sub>e</sub> ]	397.800	1.765.523	2.154.323
<b>Total contribution on GWP reduction</b>	[kg CO <sub>e</sub> ]	<b>1.086.300</b>	<b>2.965.223</b>	<b>4.051.523</b>

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**THANK YOU FOR YOUR ATTENTION!**

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