

# **Cijevi za distribucijsku mrežu centraliziranih toplinskih sustava – praktično znanje**



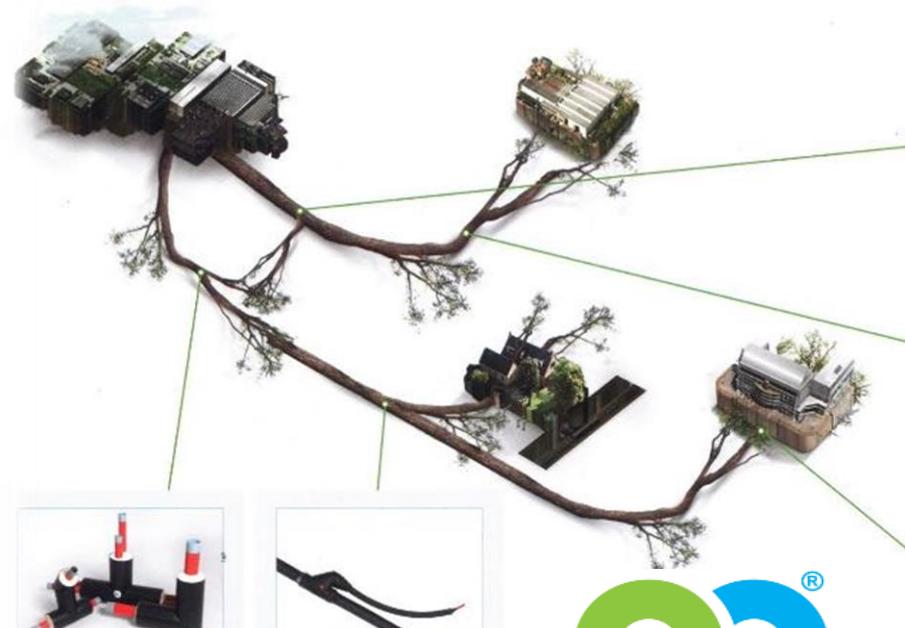
**Tomislav Martinčić**

**Sarajevo, 23.02.2017**

# Thermafex – rješenja za održive mreže centraliziranih toplinskih i rashladnih sustava



DISTRICT ENERGY  
IN CITIES  
INITIATIVE



Protectube  
Universal ducting



Pre-insulated Pipes  
Sustainable thermal networks  
for decades of service



Jointing Technology  
Sustainable thermal networks  
for decades of service

# HEATING AND COOLING

IN THE EUROPEAN ENERGY TRANSITION



Izvor: EU Brochure Heating and Cooling in the European Energy Transition

# Preporuke iz dokumenta „Heat Roadmap Europe“

## Everywhere

Heat Savings

Balance Savings vs.  
Supply

30-50% Total  
Reduction

## Urban Areas

District Heating  
Networks

High Heat Density  
Areas

Supply 40-70% of  
the Heat Demand

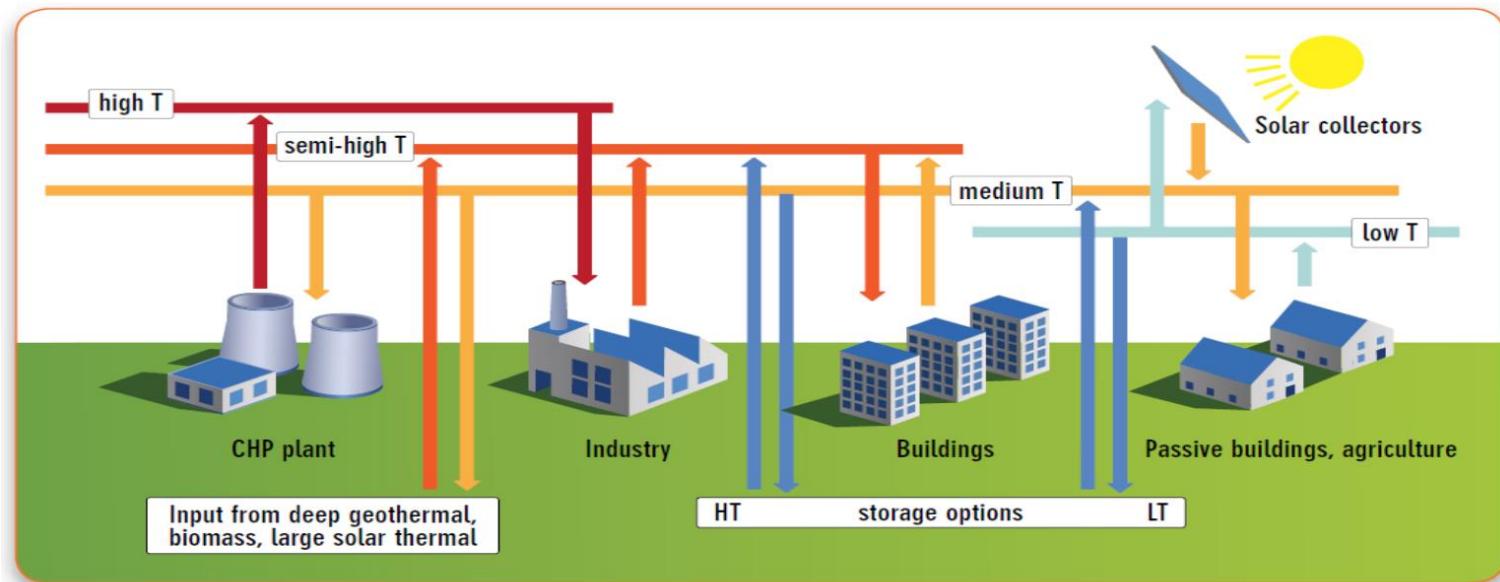
## Rural Areas

Primarily Electric  
Heat Pumps

Smaller Shares of  
Solar Thermal &  
Biomass Boilers

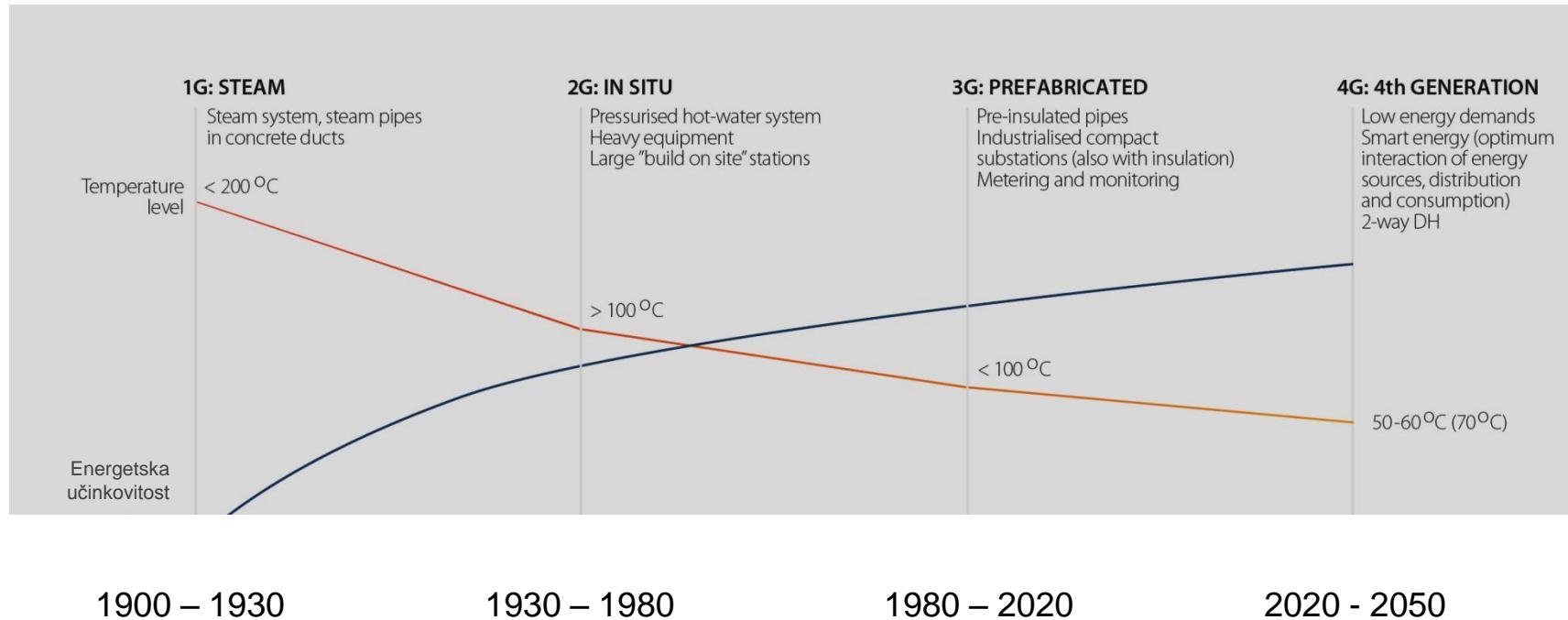
Remaining 30-60%  
of the Heat  
Demand

# KAKO?



Izvor: RHC 2013 Strategic Research and Innovation Agenda for Renewable Heating & Cooling

# 4. generacija CTS-a : niskotemperaturne mreže



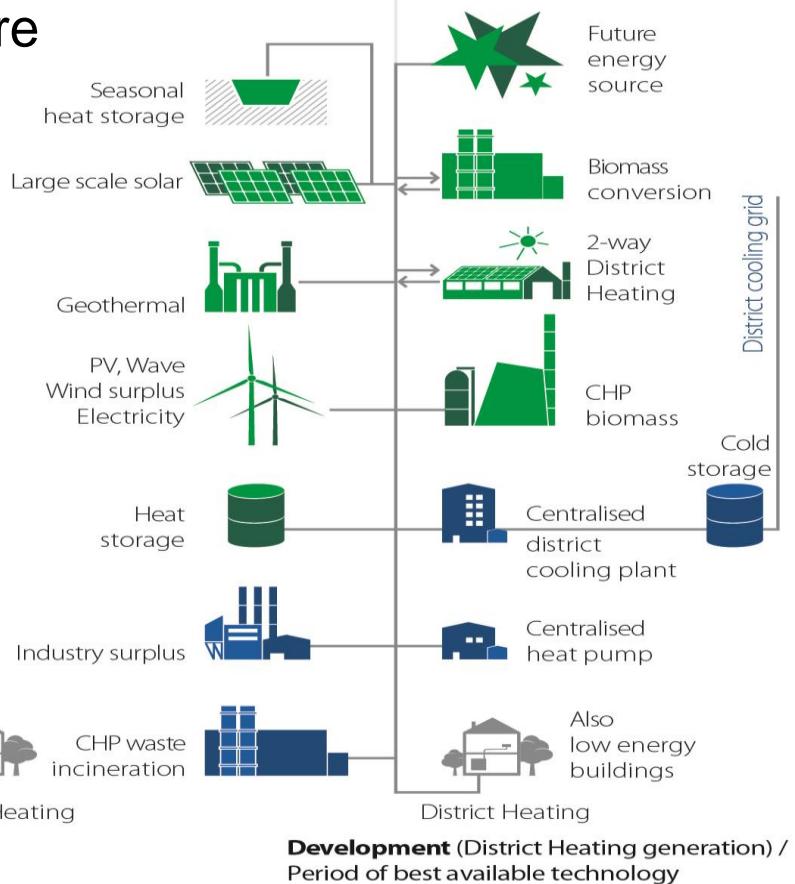
## 4. generacija CTS-a : niske temperature u mreži 50-60°C (70°C)



1980

3G / 1980-2020

4G / 2020-2050



Izvor: Danfoss

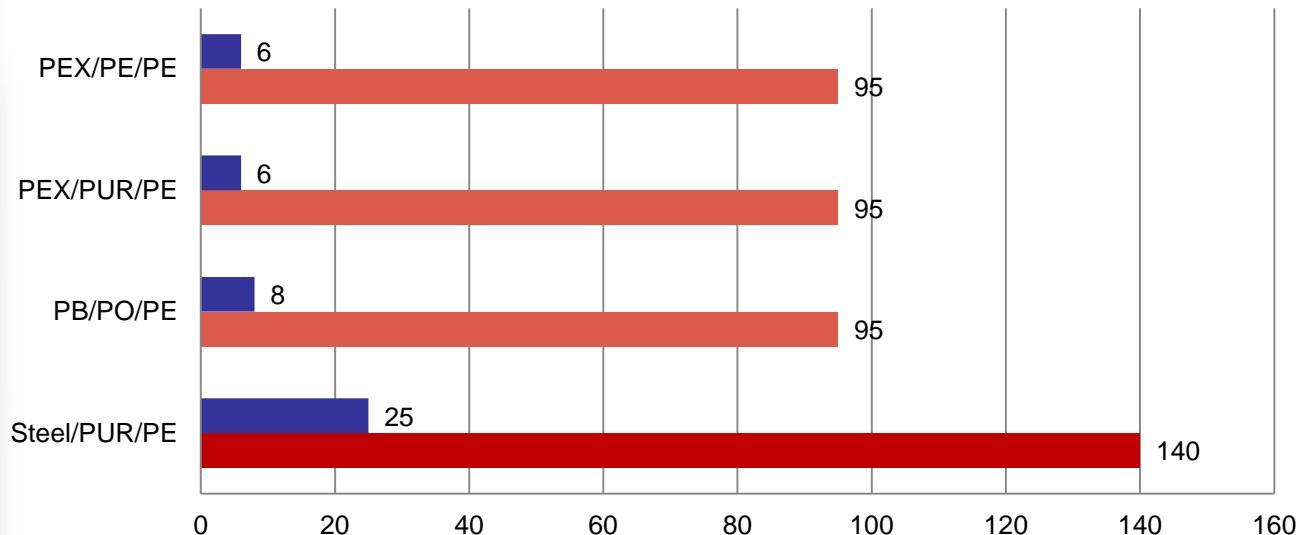
# Teme:

- Različite vrste cijevi, prednosti i nedostaci
- Uobičajeni toplinski gubici
- Koja razina tlaka bi se trebala koristiti?
- Temperaturne razine
- Kvaliteta vode
- Uobičajeni investicijski troškovi po metru, uključujući kopanje rovova
- Što treba uzeti u obzir tijekom planiranja
- Što treba uzeti u obzir prilikom postavljanja cijevi
- Stečena iskustva (savjeti i praktično iskustvo)

# Primjena cijevi u mreži CTS-a



Vrsta cijevi ovisno o temperaturama i tlakovima



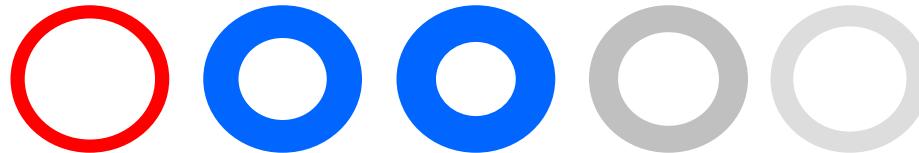
# Osnovna usporedba predizoliranih cijevi



	Čelik/PUR/PE	PB/PO/PE	PEX/PUR/PE	PEX/PE/PE
Otpornost na visoku temperaturu	++++	++	++	++
Otpornost na tlak	++++	++	+	+
Zavarljivost	++++	++++	+	+
Fleksibilnost	+	++++	++	+++
Težina cijevi	+	++++	+++	+++
Vrijeme ugradnje	+	++++	++	+++
Kemijska postojanost	+	+++	+++	+++
Vlačne sile	+	+++	+++	++
Otpornost na puzanje	++++	+++	++	++
Izvrsno ++++ Dobro +++ Prosječno ++ Loše +				

# Karakteristike cijevi

Izračunato za životni vijek od 50 god na temperaturi od 70°C, 10bara



	PB-1	PP-R (1)	PP-R (2)	PE-X	PVC-C
Pipe OD, mm	40	40	40	40	40
Pipe ID, mm	32.6	26.6	24.0	29.0	31.0
Pipe wall thickness, mm	3.7	6.7	8.0	5.5	4.5
Standard Dimension Ratio (SDR)	11	6	5	7.3	9
Pipe inner section area, mm <sup>2</sup>	835	556	452	661	755
Flow speed @ 2 liters/second, m/s	2.4	3.6	4.4	3.0	2.6
Pressure loss @ 2 liters/second, mbar/m	18	50	81	33	24

# Usporedba plastičnih cijevi

## Pipe Weight and Hydrodynamic Efficiency

	PB-1	PE-X PE-RT II	PE-RT I	PP-R	PVC-C
Flexibility	100%	50%	45%	32%	10%
Pipe weight	100%	140%	166%	166%	195%
Pressure loss @ V=2 l/s	 18 mbar/m	 33 mbar/m	 50 mbar/m	 80 mbar/m	 24 mbar/m

Izračunato za  
životni vijek od  
50 god na  
temperaturi od  
70°C, 10bara

(Calculated for application class 2, based on ISO 15874 / 15875 / 15876 / 15877, 22391)

# Usporedba plastičnih cijevi

Comparison of polymers used in piping systems

	PB-1	PP-R	PE-X	PVC-C
Impact Toughness	+++	++	+++	+
Chemical Resistance	+++	+++	+++	+++
Flexibility	++++	++	+++	+
Creep Resistance	++++	+++	+++	+++
Pressure Resistance	++++	++	+++	+++
Weldability	++++	++++	+	++

Excellent ---- Good --- Fair -- Poor +



# Korozija



# Korozija

1 mg O<sub>2</sub> će reagirati  
sa 7mg čelika

---

Nastaje 10-13 mg  
korozivnih naslaga

> Potrebna je  
obrada vode koja se  
koristi u CTS-u!



# Naslage/kamenac

U cijevima za  
potrošnu toplu vodu  
može doći do  
stvaranja naslaga

Kod PB cijevi ne  
dolazi do ove  
pojave zbog efekta  
pulsacije



# Važni parametri za projektiranje mreža

# Ključni faktor : mrežni toplinski gubici



	Average service temperature [°C]	20	30	40	50	60	70	80
3,527	5,878	8,230	10,581	12,932	15,284	17,635		
3,258	5,421	7,880	9,758	11,928	14,095	16,263		
3,608	6,013	8,418	10,824	13,229	15,634	18,039		
2,497	4,162	5,827	7,492	9,157	10,822	12,487		
2,992	4,987	6,981	8,976	10,971	12,965	14,960		
3,826	6,177	8,928	11,478	14,029	16,569	19,131		
2,743	4,636	6,529	8,421	10,314	12,207	14,100		
3,356	5,688	8,004	10,328	12,652	14,971	17,300		
4,374	7,476	10,579	13,683	16,785	19,887	22,990		
4,374	7,804	11,226	14,652	18,078	21,504	24,930		
Heat loss [W/m]								



## 1. Temperatura:

- 12% smanjenje toplinskih gubitaka pri smanjenju temperature polaza i povrata za 10 °C

## 2. Konstrukcija mreže:

- Optimalno dimenzioniranje mreže može znatno smanjiti investicijske i pogonske troškove

## 3. Izolacija sustava

## 4. Karakteristike tla ima veliki utjecaj pri dugoročnom pogonu:

- Vлага, mokro tlo, blizina podzemnih voda
- Otpornost na difuziju vode

# Karakteristike izolacije

**Poliuretanska (PUR) izolacija 94% zatvorenih ćelija**

Otpornost na difuziju vode  $\mu$  30 – 100



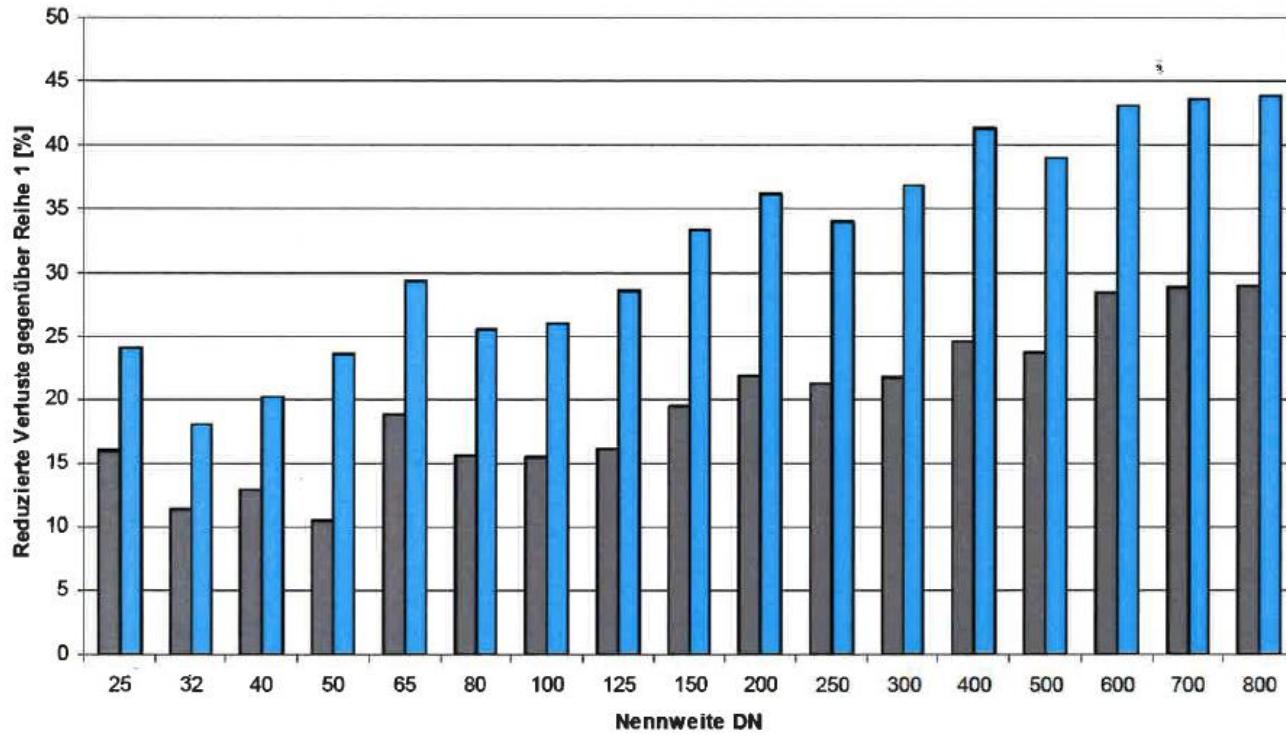
**Polietilenska (PE/PO) izolacija s zatvorenim ćelijama**

Otpornost na difuziju vode  $\mu \geq 3500$



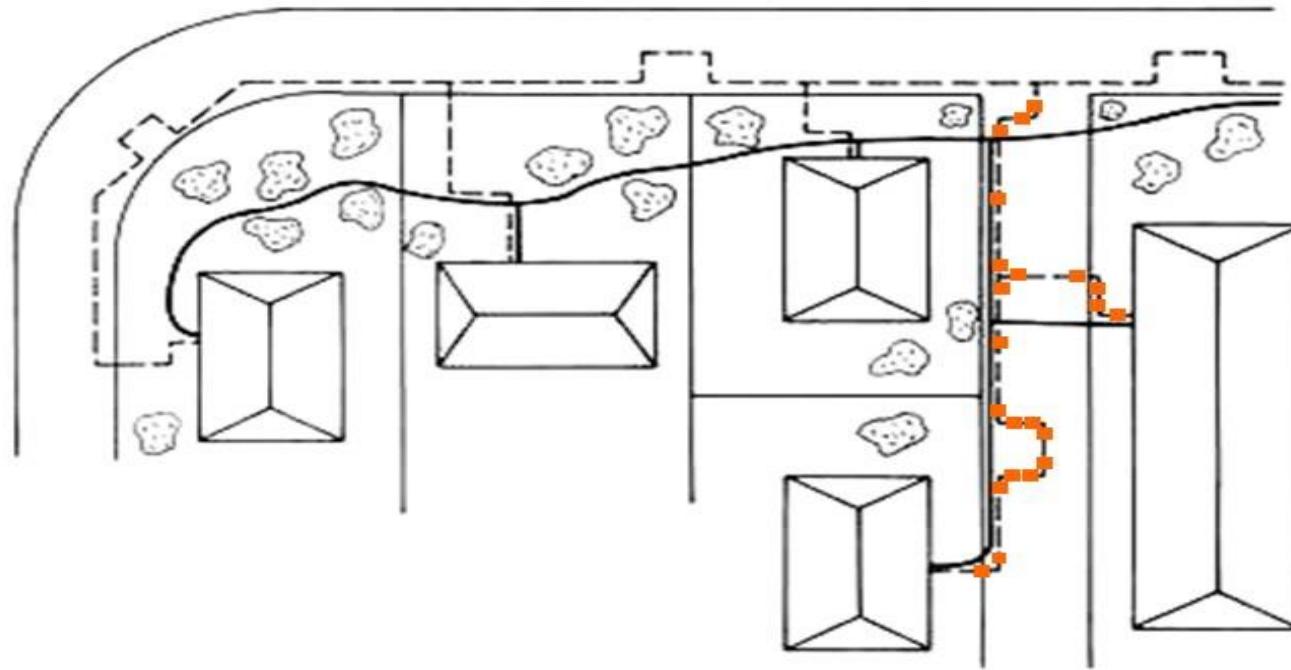
Različite vrste izolacije različito funkcioniraju tijekom vremena ( ovisno o temperaturi medija i okolnoj temperaturi )

# Smanjenje toplinskih gubitaka (%) boljom izolacijom



■ Reihe 2 gegen R 1 ■ Reihe 3 gegen R 1

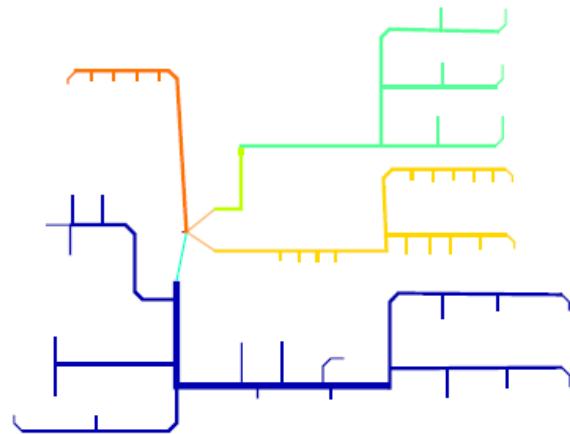
## Trase cjevovoda



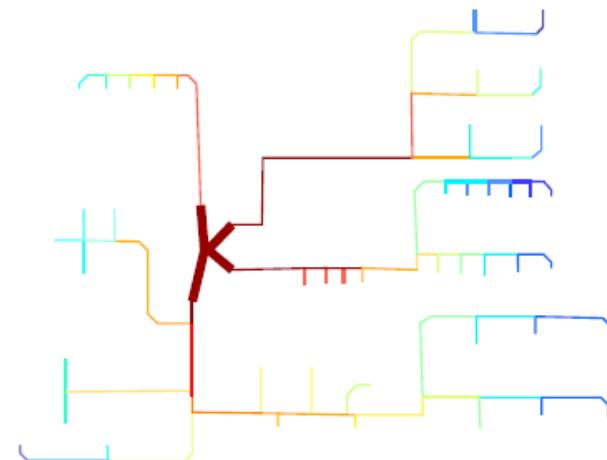
Iskustvo pokazuje da se s fleksibilnim cijevnim sustavima postiže cca 5-10% manja ukupna duljina cjevovoda

# Projektiranje & planiranje

Original Design



Thermafex Intelligent Network Design



## Stečena iskustva:

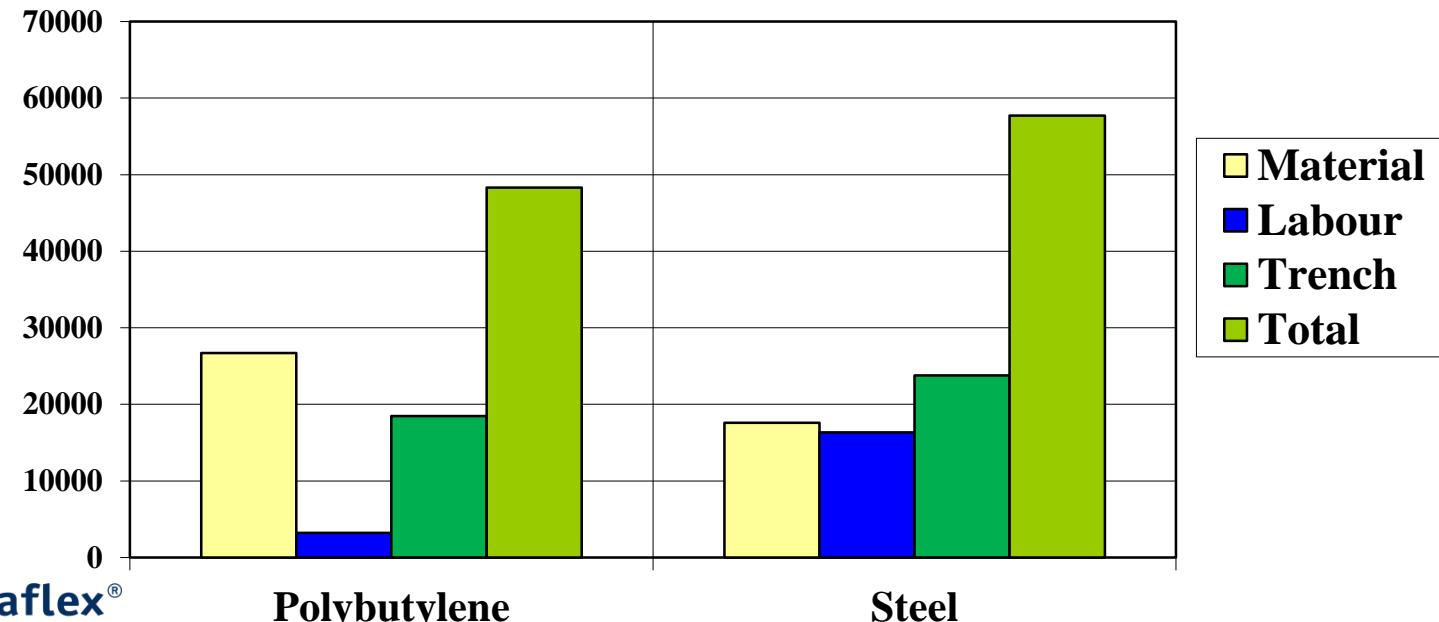
- Pratiti pravila iz EN13941-1 i AGFW FW401
- Za proces planiranja zaposliti iskusnu inženjersku tvrtku koja se bavi CTS-om

# Troškovi



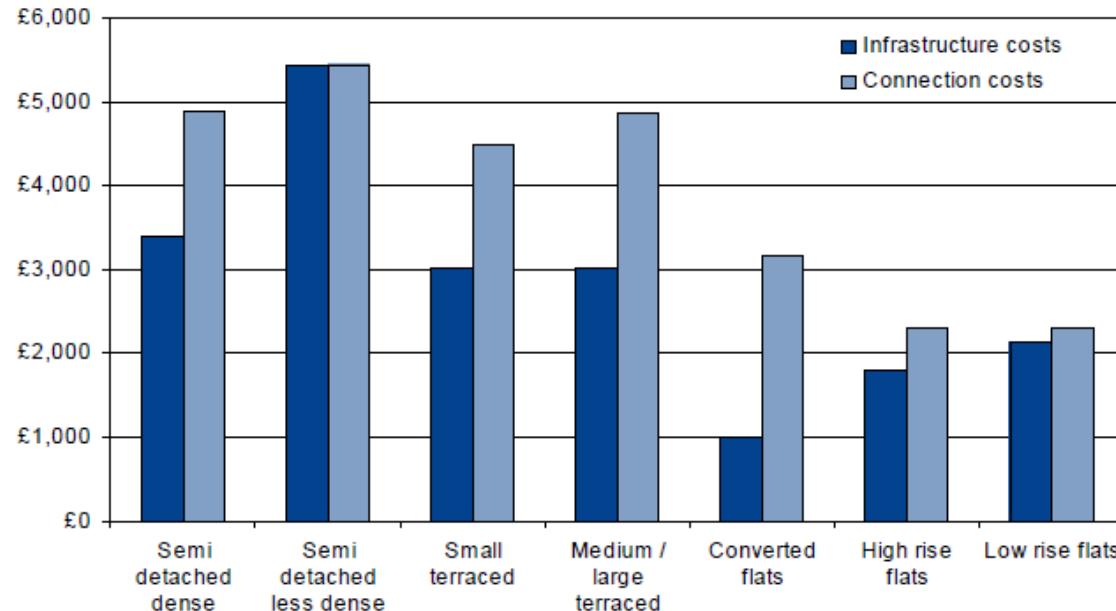
# Komparacija osnovnih troškova pri investicijskom planiranju

Važna napomena i preporuka :  
ne generalizirati i svakako proračunati troškove za  
pojedinačni projekt ! Svaki projekt ima određene  
specifičnosti koje treba uzeti u obzir!



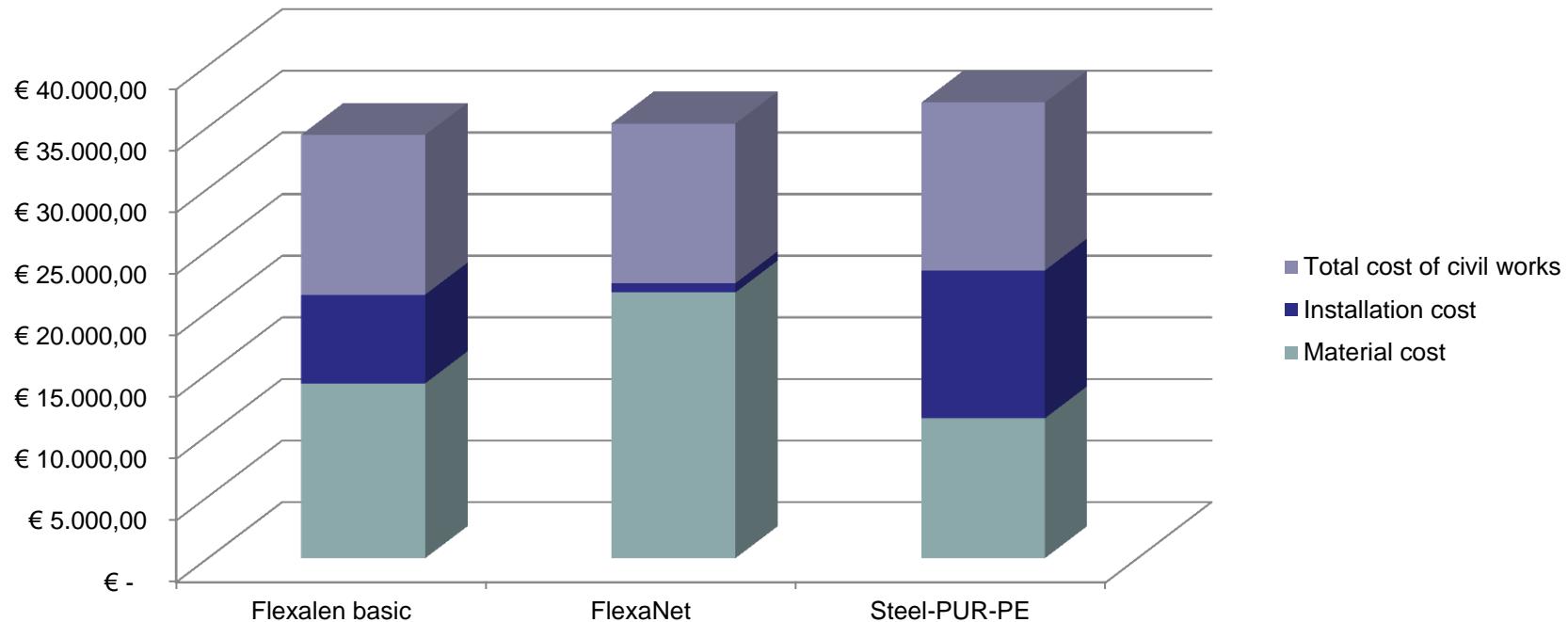
# Primjer : trošak po priključku u UK

Figure 7 – District heating infrastructure and connection costs by built form

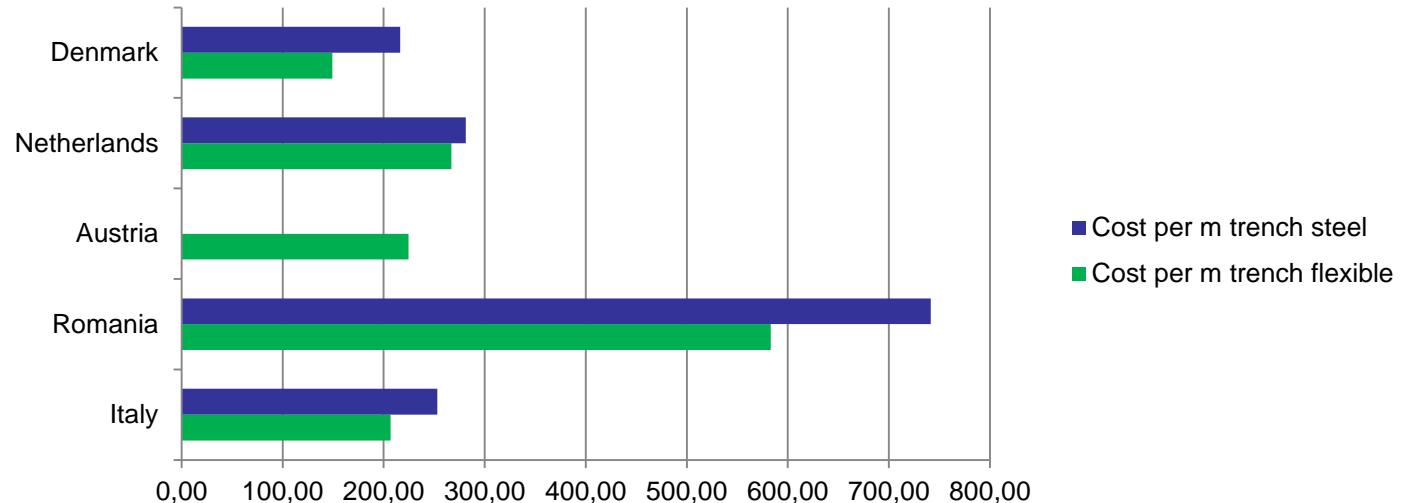


Source: Faber Maunsell and Pöyry Energy Consulting

# Trošak za mrežu sa 20 priključaka



# Usporedba investicijskog troška €/m iskopa



Izbjegavajte pojam "tipični troškovi"; projektni troškovi mogu se značajno razlikovati ovisno o raznim parametrima poput veličine ceste, prometne – vodovodne – plinske – elektro - DTK infrastrukture, lokacije (povijesni centar ili predgrađe), gustoće mreže, dimenzija cijevi, vrste tla, dubine ukopa i slično )

# **Montaža cjevovoda i sigurnost pogona**

# Stečena iskustva– montaža



## Stečena iskustva:

- potrebno je pratiti pravila u EN13941-2 i AGFW FW401
- potrebno je surađivati sa iskusnom građevinskom i montažerskom tvrtkom
- nikada ne eksperimentirati sa jeftinim rješenjima
- potrebno je odabratи certificirane cijevne sustave

EN-253      EN-15632



# Sigurnost u pogonu

1. Kvaliteta i kondicioniranje vode :

AGFW FW 510 i CEN/TR 16911.

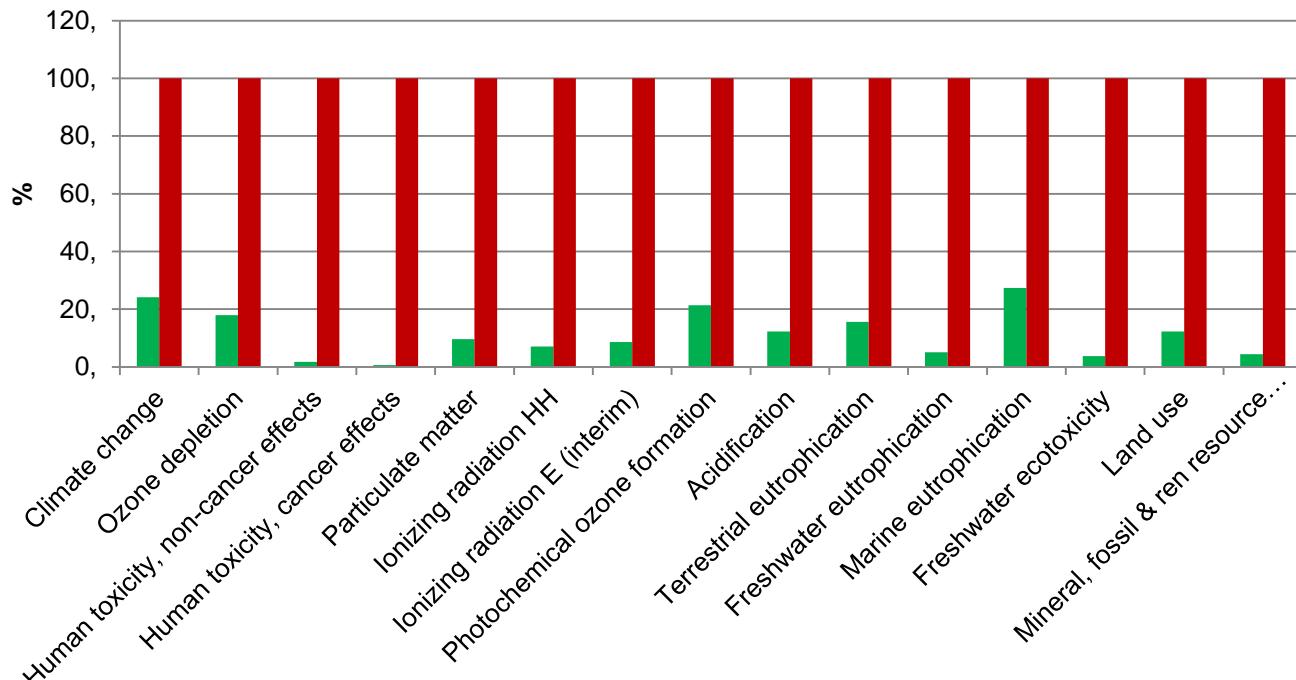
2. Sustav nadzora ( nordic sustav ) :

Važan kod predizoliranih čeličnih cijevi za rano  
otkrivanje vlage u mreži

Sustav nadzora nije potreban za plastične cjevovode

# Budućnost distribucijskih mreža CTS-a

# Održiva rješenja: LCA Analiza



Comparing 1 p 'FLEXALEN for A2A project' with 1 p 'Steel/PUR/HDPE for A2A project';

Method: ILCD 2011 Midpoint+ V1.06 / EU27 2010, equal weighting / Characterisation

# DISTRICT ENERGY IN CITIES INITIATIVE



## LAUNCH AT CLIMATE SUMMIT



Sustainable Energy for All (SE4All) Sub-Committee's



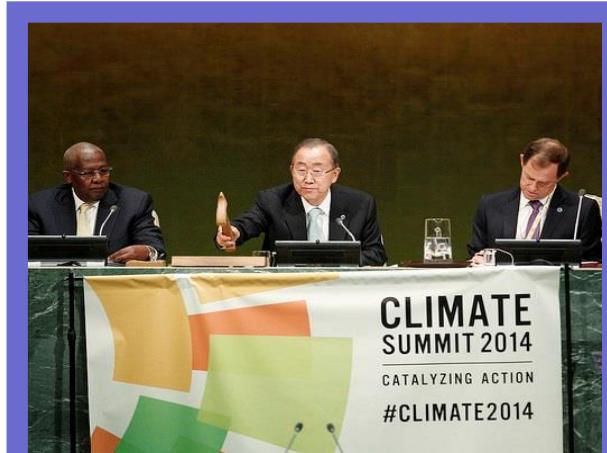
Co-chairs:

- UNEP Executive Director
- CEO Accenture
- Minister for Trade and Development Cooperation, Denmark

Global Energy Efficiency Accelerator Platform: to scale up efficiency gains and investments at the national, sub-national and city levels through technical assistance, support and public-private sector collaboration

Individual accelerators focus on specific energy efficiency sectors

- Buildings
- Transport
- **DISTRICT ENERGY**
- Lighting
- Appliances & Equipment



GLOBAL ENERGY EFFICIENCY  
ACCELERATOR PLATFORM

Double Global Rate of Improvement of Energy Efficiency by 2030



## LIGHT TOUCH

16 CITIES GLOBALLY

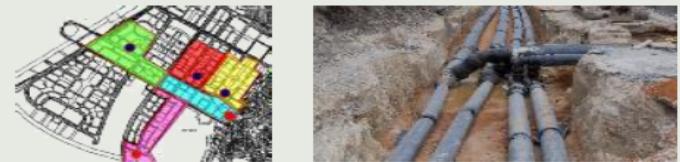
- RAPID ASSESSMENTS
- NATIONAL WORKSHOPS
- NEW ACTIONS, PROJECTS OR POLICIES



## DEEP DIVE

4 CITIES GLOBALLY  
*1 in each country*

- DEEP ASSESSMENT
- TRAINING
- PROJECT TENDERS
- DES CITY-WIDE PLANS
- MRV SYSTEM

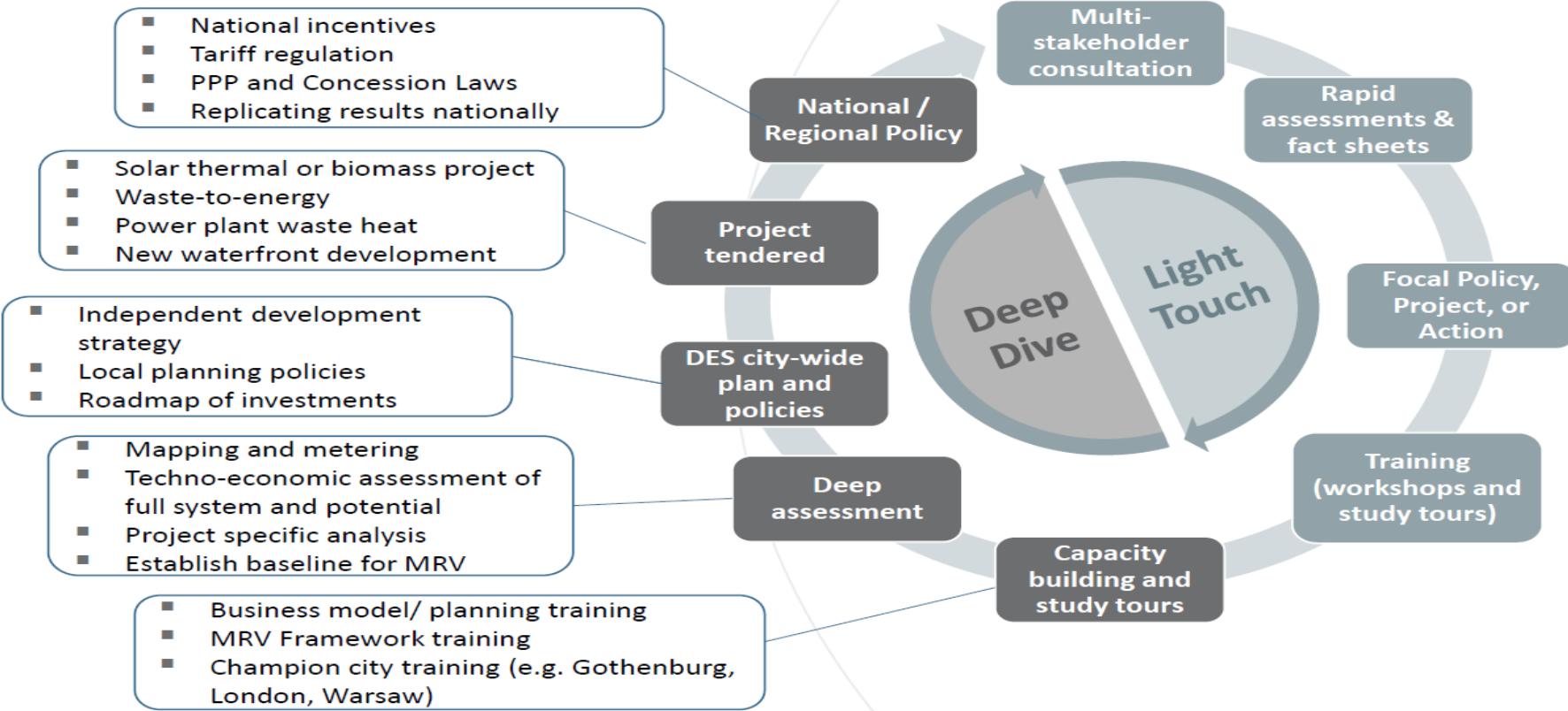


## REPLICATION

> 15 CITIES  
*e.g. in Colombia, BIH, Brazil, Mexico etc.*

- NEW CITIES
- RAPID ASSESSMENTS
- VIRTUAL PLATFORM
- MENTOR CITIES
- MATCHMAKING





# A GLOBAL PARTNERSHIP TO SCALE-UP



DISTRICT ENERGY  
IN CITIES  
INITIATIVE

## MODERN DISTRICT ENERGY



SUSTAINABLE  
ENERGY FOR ALL



SSG SUSTAINABILITY  
SOLUTIONSGROUP



GGLO DESIGN

COFELY  
GDF SUEZ

GDF SUEZ devient ENGIE



UN@HABITAT  
FOR A BETTER URBAN FUTURE

IFC International  
Finance Corporation  
WORLD BANK GROUP

# Hengelo, NL – dinamičan grad



Primjer: Park Veldwijk

70°C/40°C

Industrijska otpadna toplina za  
5.000 novih stanova



Izvor: <http://www.parkveldwijkhengelo.nl/>

# Hengelo – toplovod postavljen u jednom danu: 10 priključaka unutar 1,5 sata



Značajno smanjen utjecaj radova na životni ritam stanara

# Regionalni Thermaflex partneri

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# Pouzdan i učinkovit CTS



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