

区域供冷和制冷服务商业模式和融资机制

Business Model and Financing Mechanisms for District Cooling and Cooling as Services



DISTRICT ENERGY IN CITIES 城市区域能源倡议

A GLOBAL INITIATIVE TO UNLOCK THE POTENTIAL OF ENERGY EFFICIENCY AND RENEWABLE ENERGY

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DISTRICT ENERGY
IN CITIES
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SUSTAINABLE ENERGY FOR ALL

联合国2030可持续发展目标



ENSURING
universal access
TO MODERN ENERGY
SERVICES.



DOUBLING THE GLOBAL
RATE OF IMPROVEMENT IN
energy efficiency.



DOUBLING THE SHARE OF
renewable energy
IN THE GLOBAL
ENERGY MIX.

SDG11可
持续的城
市及社区

SDG 7
经济、清
洁能源



SUSTAINABLE
DEVELOPMENT GOALS



COPENHAGEN CENTRE
ON ENERGY EFFICIENCY
SEforALL EE HUB





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2014年联合国秘书长气候峰会发起倡议



联合国“人人享有可持续能源”

全球能效加速器2030年目标：

- 实现现代化能源普及
- 实现全球能源利用效率翻一倍
- 实现全球可再生能源占比翻一倍



GLOBAL ENERGY EFFICIENCY
ACCELERATOR PLATFORM





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SUSTAINABLE ENERGY FOR ALL

基于项目实践的加速器平台



全球六大能效加速器平台

*Drawing on
existing best
practice
networks*

建筑节能



区域能源



照明



- Think Tank
智库
- Communications
加强各加速器之间的沟通交流
- Co-ordination
合作伙伴之间的协调
- Tracking activity/results
跟踪评估各类报告、政策框架
- Cross-sectoral funding
跨平台资金支持

City & Country
Commitments
to EE Action
国家或城市制定
节能行动计划

Assess
Opportunities
评估可行的节能
措施及示范项目

Develop
Strategy
and Plans
制定相关的行动计
划及激励措施

Build the
Enabling
Environment
项目培育及知识培训

Formulate
Initiatives and
Investments
项目实施及效果监
管、投资支持

Achievement of
municipal, national
and global EE
objectives
实现全球能效目标

基于现有的
最佳实践案
例及政治、
资源网络



交通运输
节能



工业节能



家用电器
及设备



区域能源是智慧城市系统增加可再生能源和能效提升的关键

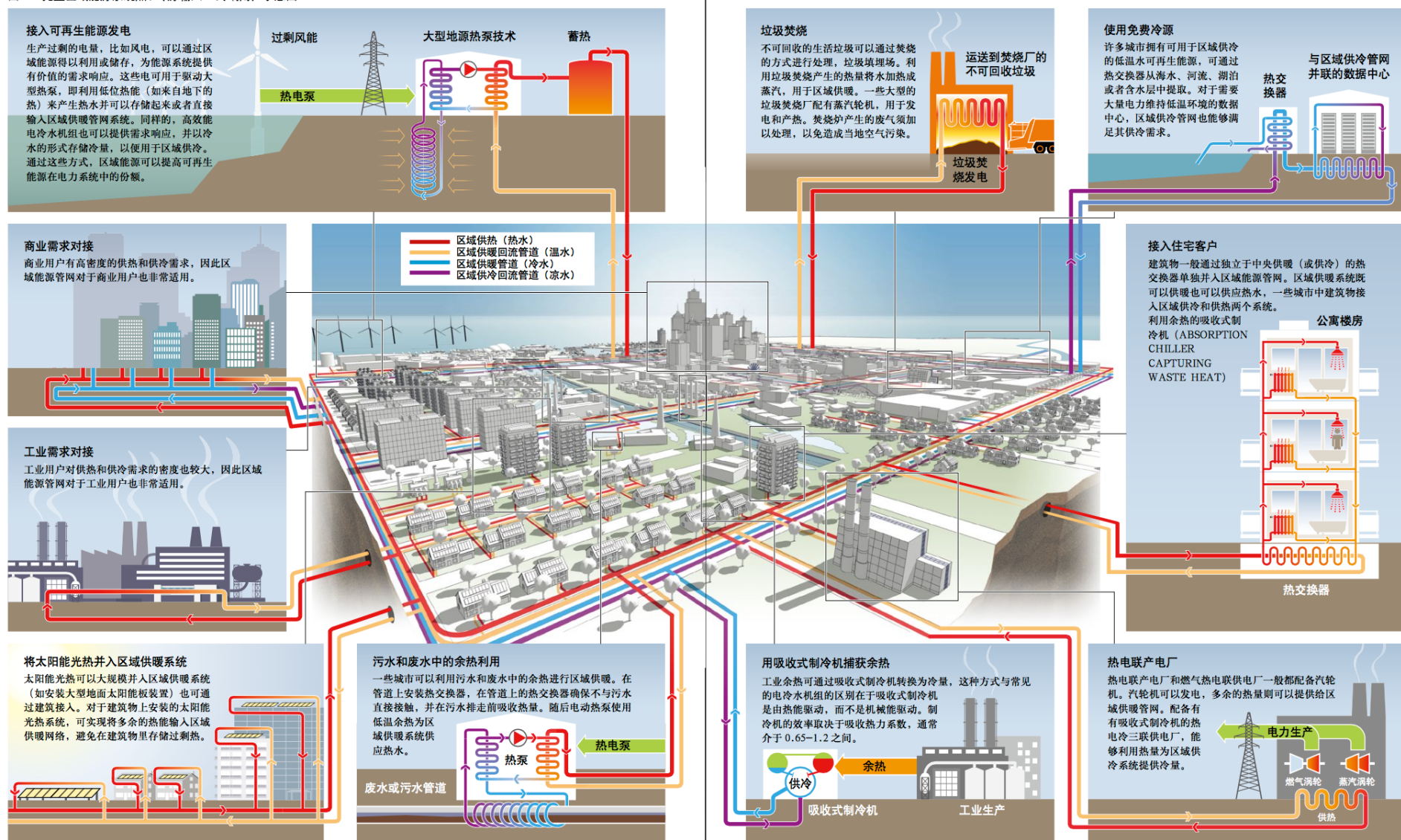


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DISTRICT ENERGY KEY TO RENEWABLES & EFFICIENCY IN SMART CITIES



图 1.7 完整区域能源系统热/冷源输入 - 终端用户示意图





区域能源加速器对区域能源系统(区域供冷&供热)的解读

- 提高可再生能源、低品位余热及废热比例，追求区域一次能源利用效率的最大化
- “温度对口、品位对应、多能互补、梯级利用”
- 释放政府在区域能源的规划、市场引导等功能，提倡政府职能部门的适度参与
- 技术为商业模式服务(Cost-effective technologies)
- 城市之间、项目之间成功经验可以互相传递与复制

区域能源加速器的工作目标

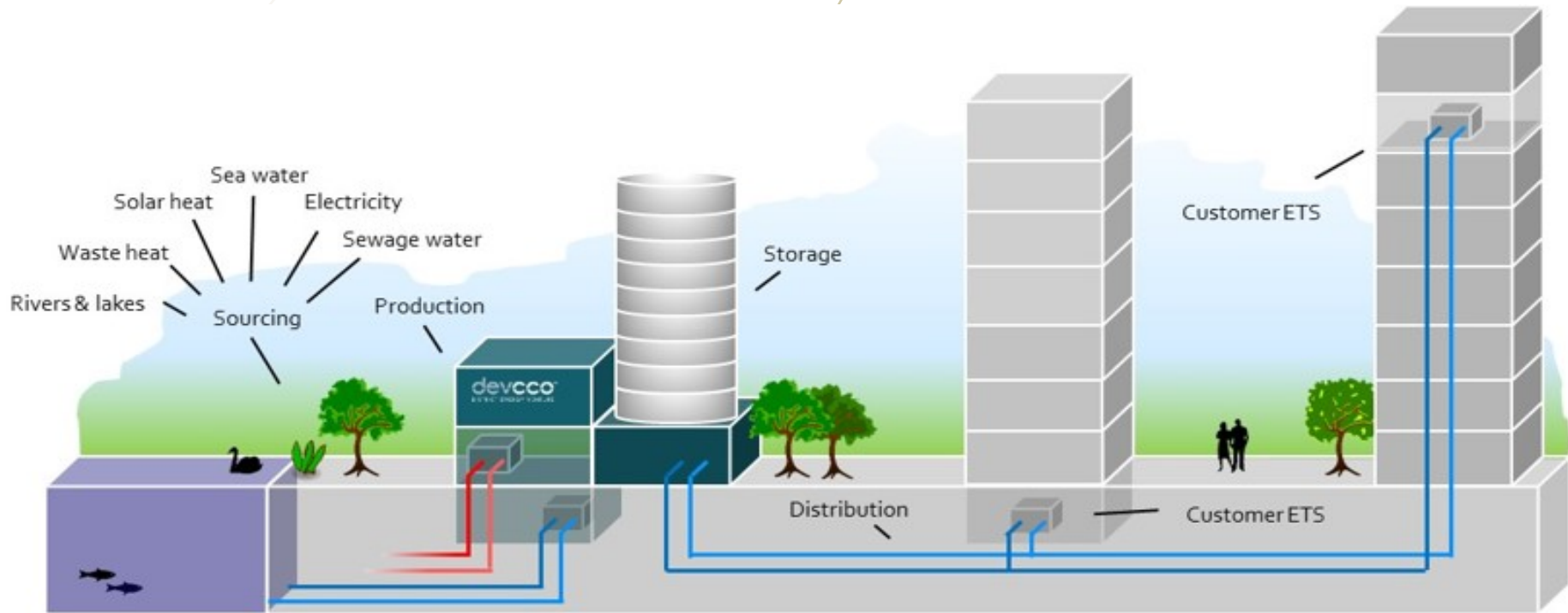
- Unlock the market of DES (解锁区域能源市场，实现0到1的转变)
- Scale up (扩大区域能源市场，实现1到10的转变)

区域能源是智慧城市系统增加可再生能源和能效提升的关键



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DISTRICT ENERGY KEY TO RENEWABLES & EFFICIENCY
IN SMART CITIES

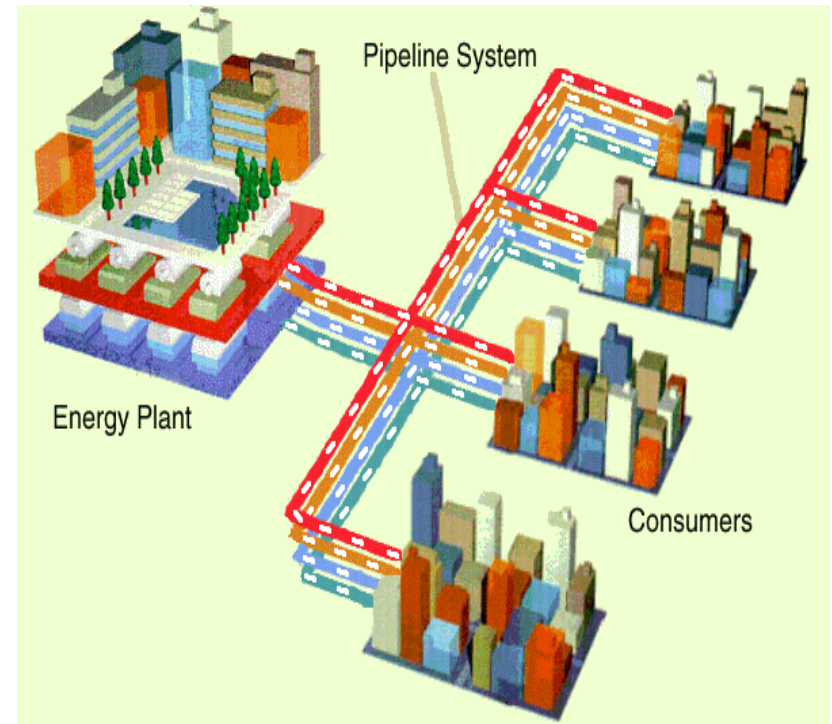


District cooling aims to use local energy sources that otherwise would be wasted or not used, in order to offer for the local market a competitive and high-energy-efficient alternative to the traditional cooling solutions.



Definition of District Cooling:

- A system to combine heating/cooling station and end-users through pipeline network
- Belongs to **public service**, similar to electricity, water, gas etc.
- Cooling sources could include waste heat, electrical cooling, free cooling etc.
- Targeted customers: industrial/process cooling (warehouse, data centre), city complex, public buildings (hospital), commercial buildings, luxury residential buildings



DISTRICT COOLING VS. OTHER COOLING TECH



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Cooling system type	Primary Energy Efficiency	Peak load shifting factor-Electricity
Split AC, VRF/VRV	25%-30%	0
Conventional Central (water-cooled elec. chiller+ FC/AHU)	20%-30%	10%-15%
Conventional Central (air-cooled elec. chiller + FC/AHU)	15%-30%	10%-15%
District cooling (all elec. chiller)	25%-30%	15%-25%
District cooling (free cooling+elec. chiller)	30%-60%	30%-50%
Tri generation (electricity, district heating, district cooling, domestic hot water)	60%-80%	30%-50%
Tri generation (30%TES)	55%-75%	40%-60%

*Assumption: Grid electricity PEF=35%, cooling factor=0.15, heating factor=0.2, electricity=0.5, all equipment reaches A-level under Energy Star or ASHRAE/ASME

DISTRICT COOLING: DELIVERING

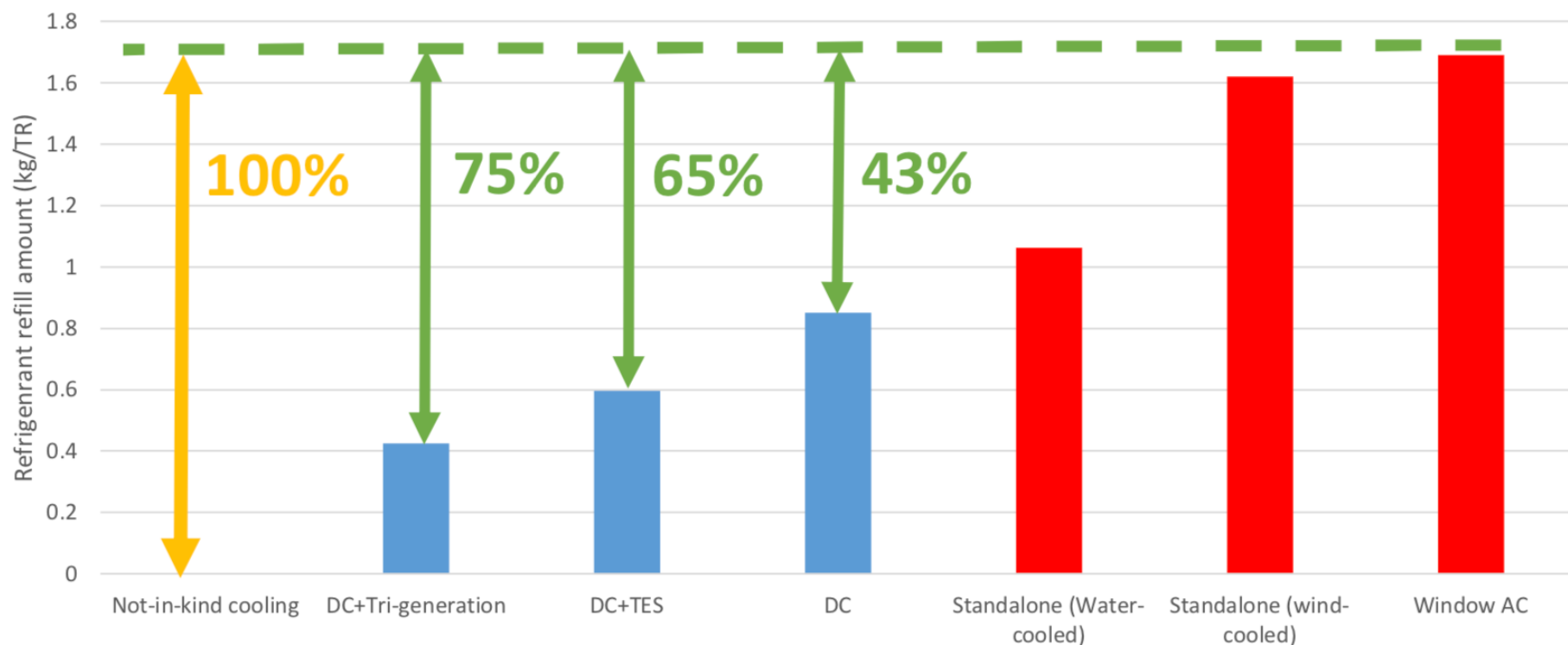


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HFC PHASEDOWN



Life-cycle (15-year) Refrigerant Refill Amount





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区域能源倡议全球进展



区域能源倡议全球伙伴关系



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A GLOBAL PARTNERSHIP ON DISTRICT ENERGY



国家/城市政府

私营企业/部门

公共事业公司

行业协会



热力规划
分享最佳实践
培训研讨会
本地协调管理

支持国际和国内
专家提供预可研
和可行性分析

提升意识

技术援助

市场转型

能力建设

政策建议

提供考察访问计划
提供磋商和咨询

支持地方制定规划政策
城市级区域能源规划
支持地方和国家规划
价格机制

国际机构

城市网络

金融机构

智库、大学

研究机构

16 COUNTRIES

4+1 Pilot countries: China, India, Serbia, Chile, Morocco

区域能源倡议全球伙伴关系



**DISTRICT ENERGY
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A GLOBAL PARTNERSHIP ON DISTRICT ENERGY



3.9

**TOTAL
FUNDING**
(\$ MILLION)

9.7

**TOTAL CO-FINANCE
UNLOCKED**
(\$ MILLION)

36

**NUMBER OF
CITIES**

45

**NUMBER OF
PARTNERS**

215

INVESTMENT COMMITTED
(\$ MILLION)

22

**INVESTMENT
ACHIEVED**
(\$ MILLION)

290 000

**CO₂ PROJECTED
REDUCTIONS**
(tCO₂/yr)

CHILE **15** INDIA **200**



2018

KIGALI
BUILDING EFFICIENCY PROGRAM

MINISTERO DELL'AMBIENTE
E DELL'ENERGIA
DEL TERRITORIO E DEL MARE



Ministry of Natural Resources and Environment
DANIDA



区域能源加速器在发展中国家的工作路线:



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“自上而下(中央政策到示范项目落实) VS
自下而上(改进既有项目到形成激励政策)”

自上而下：激发区域能源市场的潜力，实现从无到有

自下而上：扩大区域能源市场（在国家 and 区域层面推广示范项目），实现从一到多

国家政府（主管气候变化、空气污染和能效的相关部委）

城市政府和地区管委会，
以及城市规划主管部门

区域能源示范项目、公共基础设施建设方、建筑单体业主、开发商以及终端用户

国家目标行动方案

区域能源促进政策

供冷供热能耗基准

能源地图

城市中远期区域能源规划

设计指南和标准

快速评估：技术性和经济性分析

商业模式

预可研/可行性分析

本土化技术研究

绿色金融及区域能源种子基金



- Global Environment Facility (GEF-7)
- Green Climate Fund (GCF)
- IFC
- Kigali Cooling Efficiency Program (K-CEP)
- NAMAS FACILITY
- Support from development banks (EBRD, ADB, AfDB)
- Seed funding opportunities



KIGALI
COOLING EFFICIENCY PROGRAM



IFC

International
Finance Corporation
WORLD BANK GROUP

DISTRICT COOLING/TRI GENERATION IN INDIA



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TOP-DOWN APPLICATION



National Cooling Action Plan

National DES Potential Study

National energy
conservation target
for 2030 (MoP)

Refrigerant phasing
target (MoEF)

National Steering Committee: UNEP, MoP, MoEF, BEE, EESL

Energy mapping & benchmark

Policy analysis

Rapid assessment tools
for tech-eco

Training modulars

Urban planning for new township

Building energy conservation target

Smart city/Renewable energy mission

Incentive policies for DES engagement

City Steering Committee: UNEP, municipality, EESL, other partners

Pre-/ feasibility study

Business model, technical / financial
analysis

Funding opportunities

Call-for-tender, procurement plan

Design guidelines, standards, MRV &
metering strategy

Knowledge transportation



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印度区域供冷/三联供 自上而下的推广模式



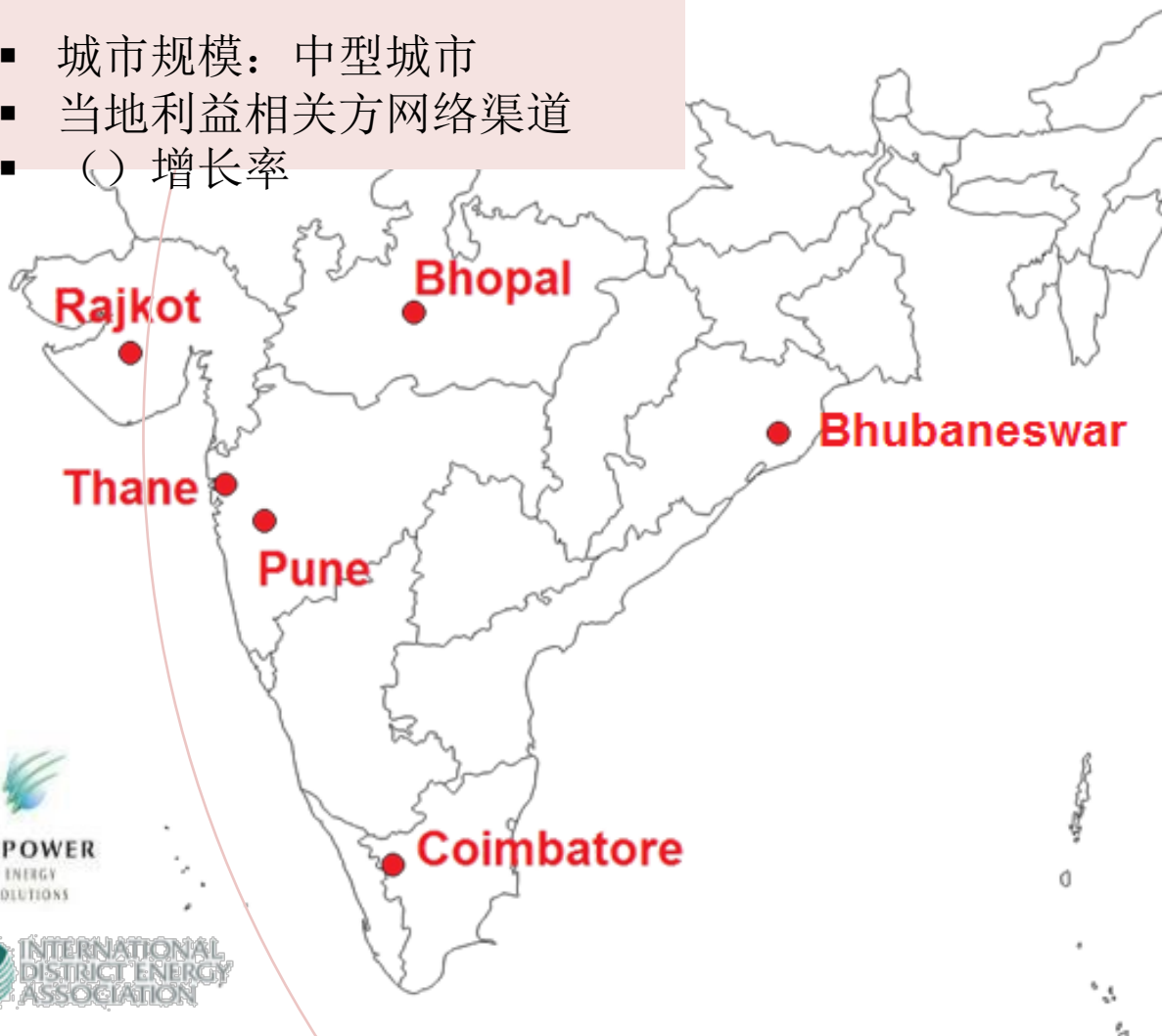
六个城市的筛选考量因素：

- 地理位置多样性
- 城市规模：中型城市
- 当地利益相关方网络渠道
- () 增长率
- 咨商合作伙伴
- 智慧城市目标

报告起草单位：



合作伙伴支持及调研：

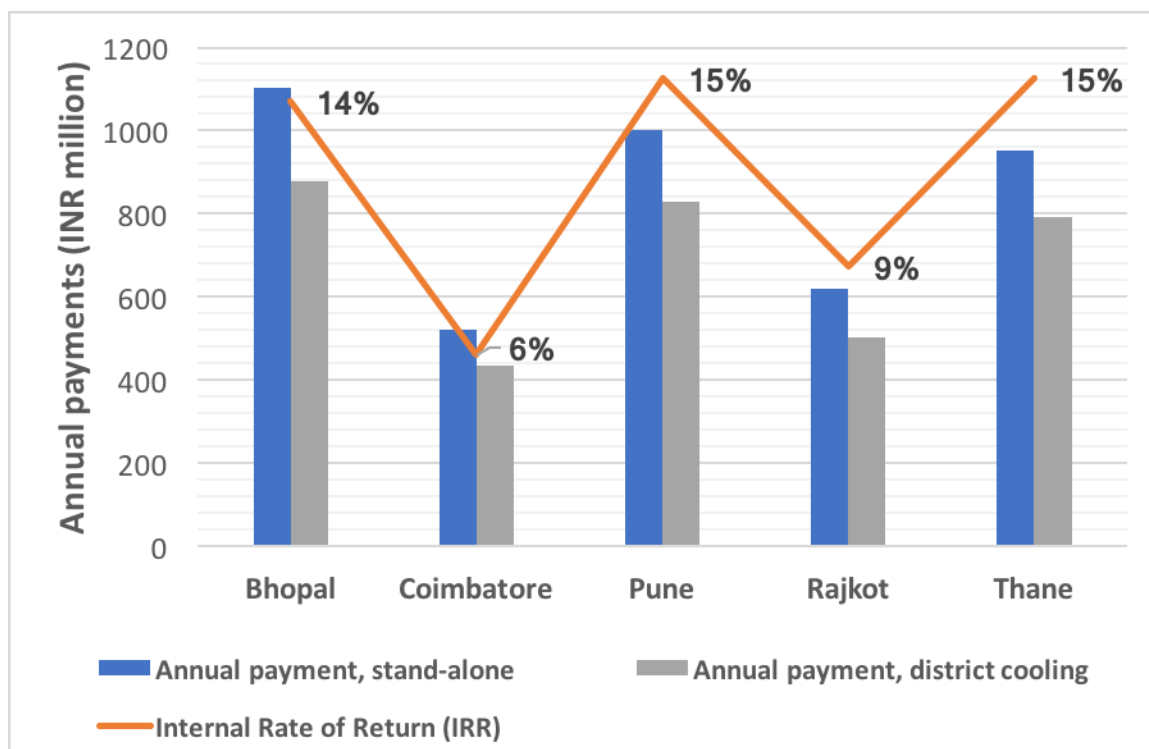




GENERIC ARCHETYPE ANALYSIS

ACROSS FIVE CITIES

Comparison of IRR and of annual district cooling payments made by consumers vs payments by those using stand-alone systems

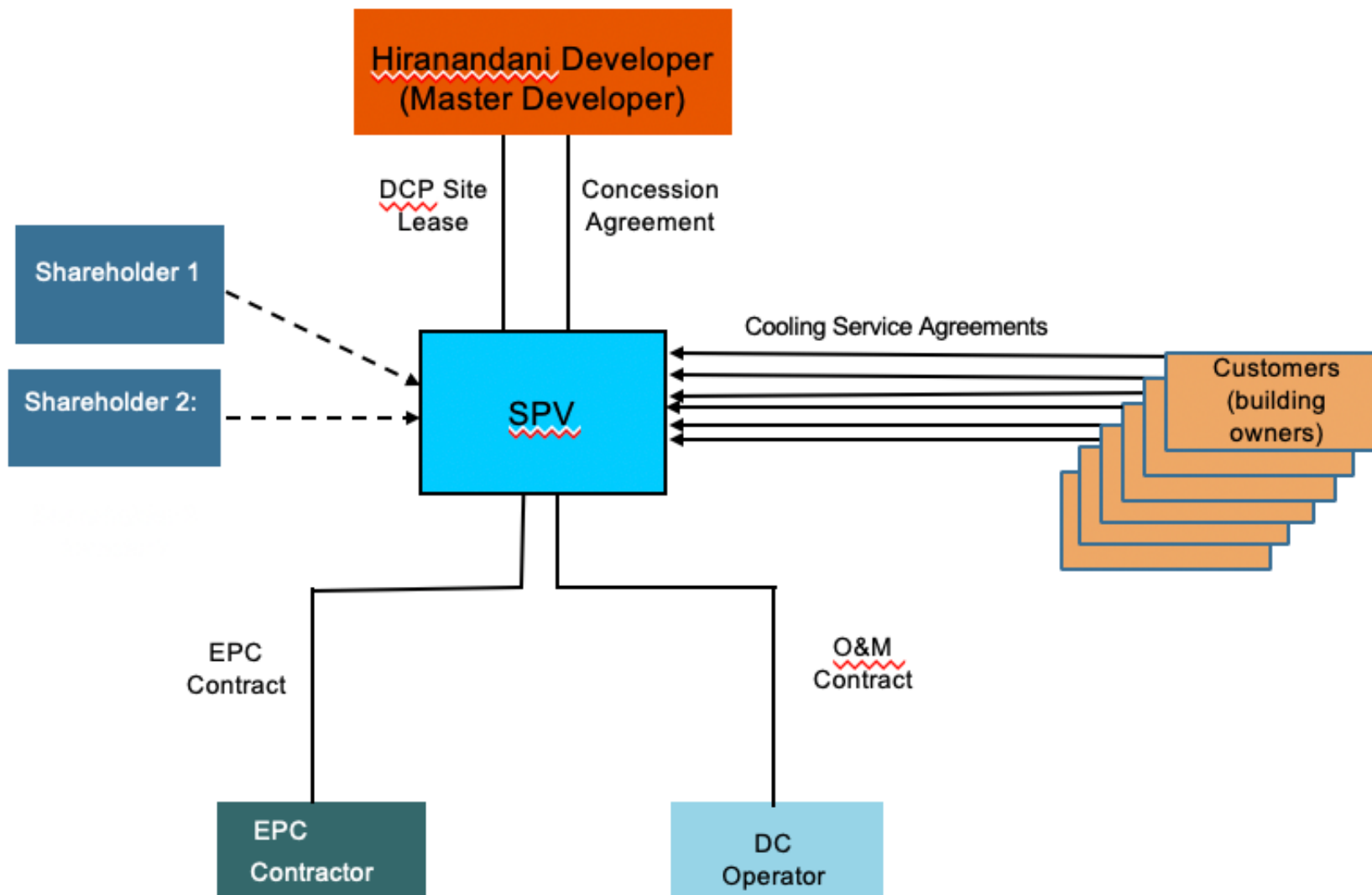


驱动因素:

- Power prices 电价
- Cooling load 供冷负荷

提高投资回报率的方式:

- Lower power costs (e.g. solar provision) 降低成本
- VAT pricing 增值税率
- Project design 项目设计



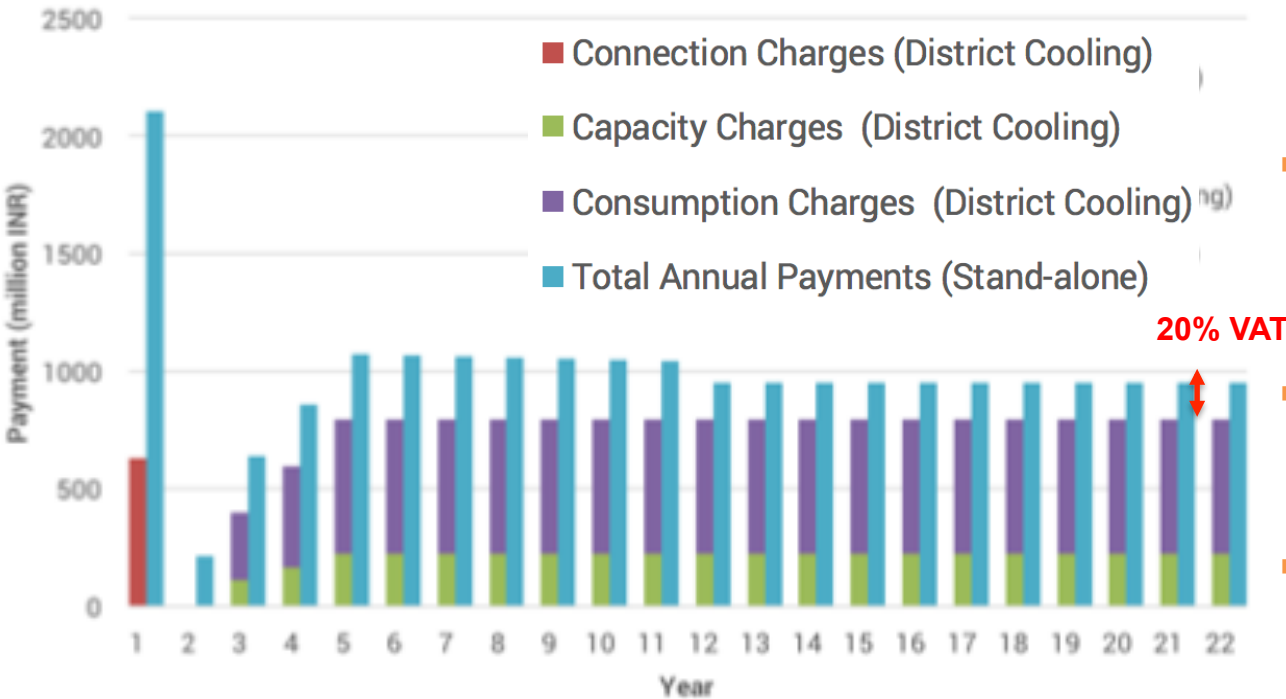
- Pricing system
 - Type 1: metering charge
 - Type 2: 1)+2)
 - 1) Capacity charge
 - 2) Metering charge
 - Type 3: 1)+2)+3)
 - 1) Connection charge
 - 2) Capacity charge
 - 3) Metering charge

融资模式分析



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APPROACH TO FINANCIAL ANALYSIS



- Modelling of cooling loads based on building efficiency, occupation and climate
- Conservative cost and cooling load inputs
- High-level operational & financial analysis
- District cooling tariffs set to below stand-alone cooling costs

Development archetype details:

	Ground Floor Area (sqm)	Floor area ratio (FAR)	Built-up area (sqm)
- Hotel	20,000	2.5	50,000
- Office	70,000	3	21,000
- Shopping Mall	30,000	3	90,000
- Hospital	5,000	2.5	12,500

融资模式分析

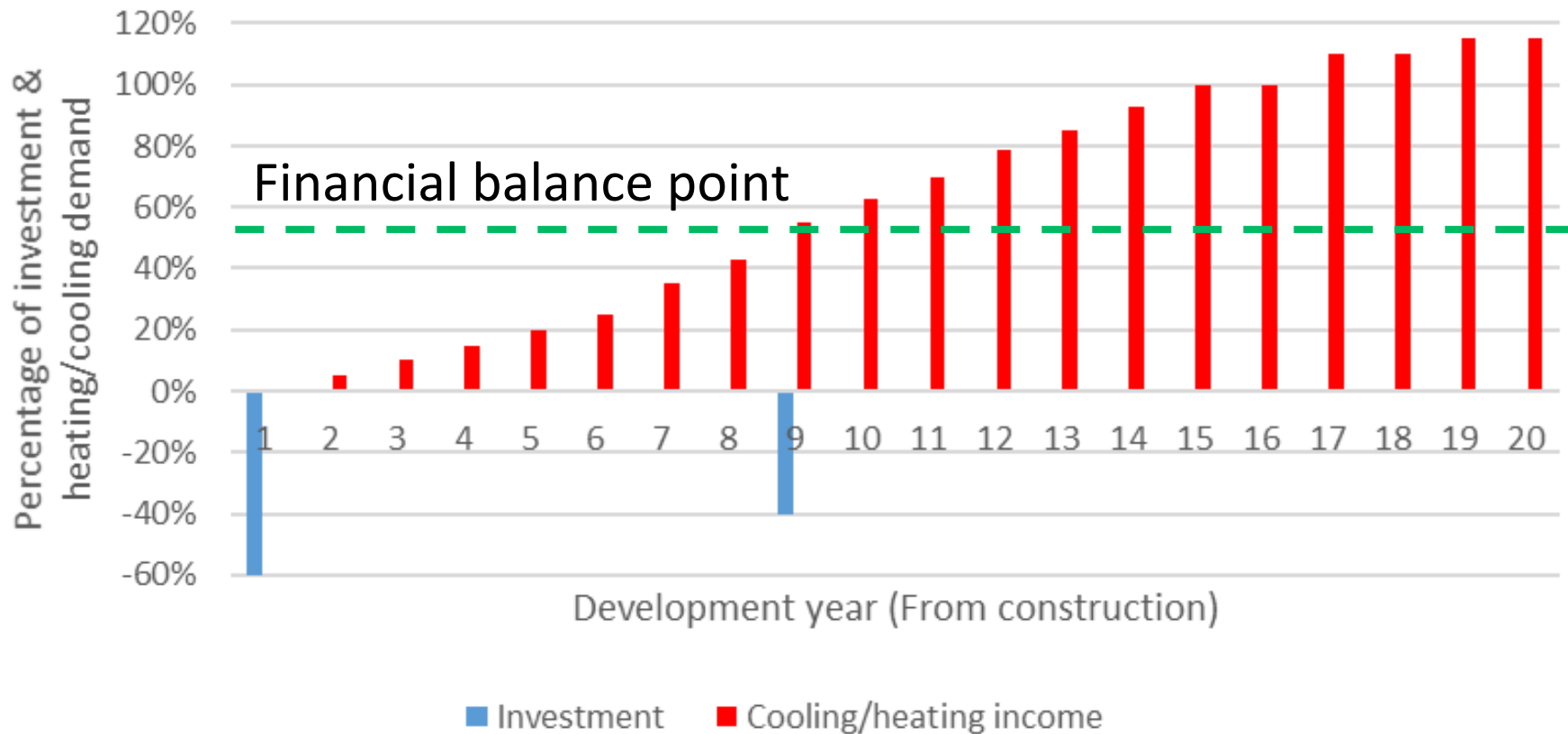


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APPROACH TO FINANCIAL ANALYSIS



20-year consession of DES project development





- District heating and cooling is **defined as public service**, like electricity and fresh water. It means the investment should be **paid back in a longer term** (20-40 years) but the **income is steady and secure**.
- District heating and cooling **needs more time (normally 5-7 years from beginning) for the demand to grow**, and the benefits become steady and secure afterwards.
- **Seed funding idea**: Financial institutions buy-in in first year, bought out in 8th-9th year with higher price by SPV. Funding **reverts back to the seed funding pool and invests in other** district energy projects.
- **Win-win situation**: Municipalities achieve their energy saving targets, end-users get cheaper heating/cooling, financial institutions get steady payback.



- 试点城市：孟买塔纳Thane of Mumbai
- 1) 试点项目：Hiranandani Estate (新建区域) & Downtown (既有区域)
- 2) 资金：100% 由EESL投资 (World bank 种子基金)
- 3) 商业模式：PPP/ESCO (TMC+EESL+房地产开发商)
- 4) 区域能源城市规划管理
- 5) 区域供冷协调小组：TMC+EESL长期协调机制





THANK YOU!



For more information on the **Global District Energy in Cities Initiative**, please visit the website or contact:

- Dr. **Zhuolun Chen**, Senior Advisor, Email: zhchen@dtu.dk