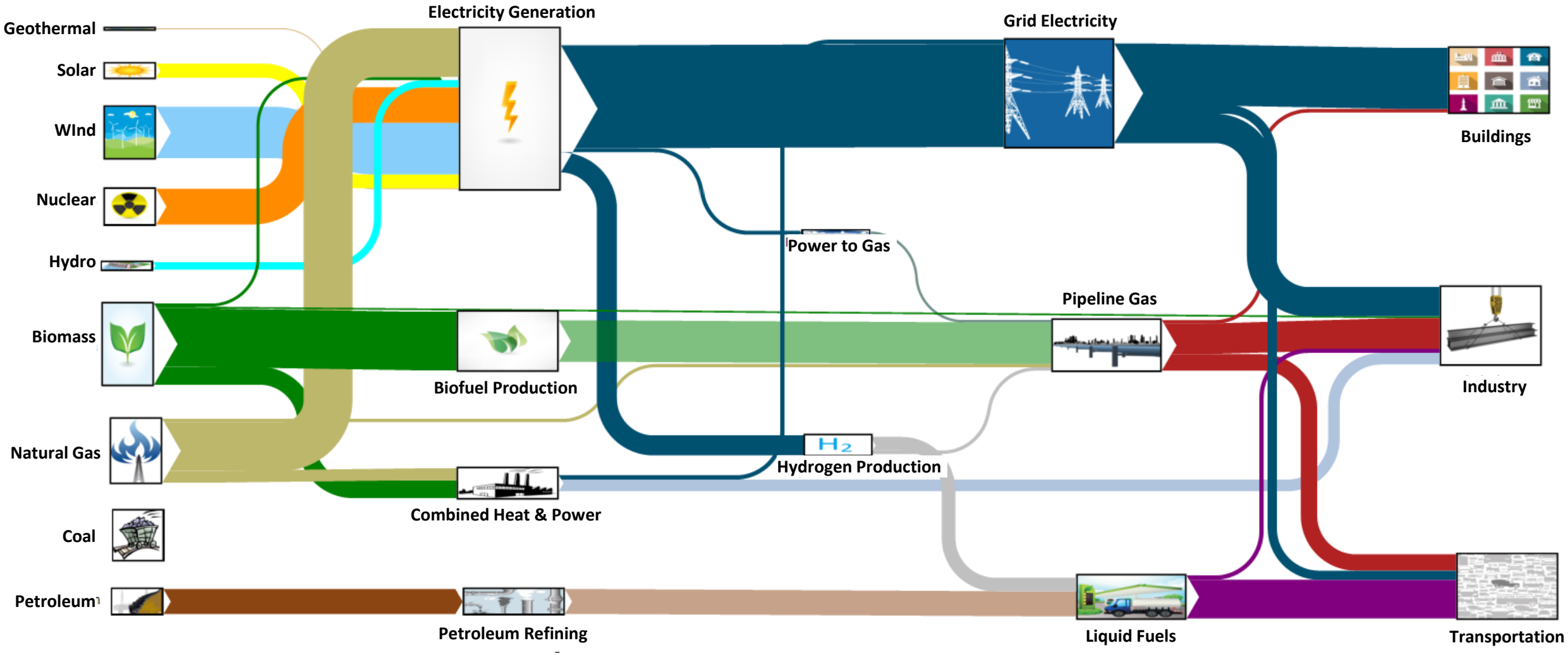
Emerging Gas Technologies for Lower GHG Emissions

Growing public and policy discussion on how to meet Paris commitments to 80% GHG reduction (COP21)

Sankey diagram for U.S. energy system in 2050 – Mixed Case



Various source/process/end use scenarios can achieve 2050 GHG emission goals. Mixed case generally less costly.

Source: Deep Decarbonization Pathways Project, 2015

Emerging gas technologies can make substantial and cost-effective contributions to GHG reduction goals

~100

Innovative Gas Technologies for Residential / Small Commercial identified from around the world

25-40%

GHG reduction potential on a customer basis by integration of these technologies and other efficiency practices

60-80%

GHG reduction – sufficient to meet COP 21 goals – with inclusion of future CHP technologies and Renewable Gas

- Policy goals for sustainable energy can be achieved at significantly lower consumer cost through integrating innovative gas solutions into long-term resource planning, while offering customers more choice and improved affordability and reliability.
- Gas technologies can enhance energy system reliability (system-wide and as a local backup) and efficiency, while reducing the need for new electric generation and T&D infrastructure and preserving the future value of gas infrastructure.
- Electric technologies will also improve, and are supported by incentives, but their GHG impacts depend on the generation fuel mix. In some regions electrification will increase GHG emissions through the 2030s.

Emerging Gas Technologies for Lower GHG Emissions

MODERATOR:
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Director, Enovation Partners

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Chief Financial Officer, BoostHEAT

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MICH HEIN
CEO, Electrochaea

finno Energy

Presentation

—

2018

Better Ways for Methane than Flaring

GAS TURBINE

POWER

EFFICIENCY

BEYOND

BELIEF

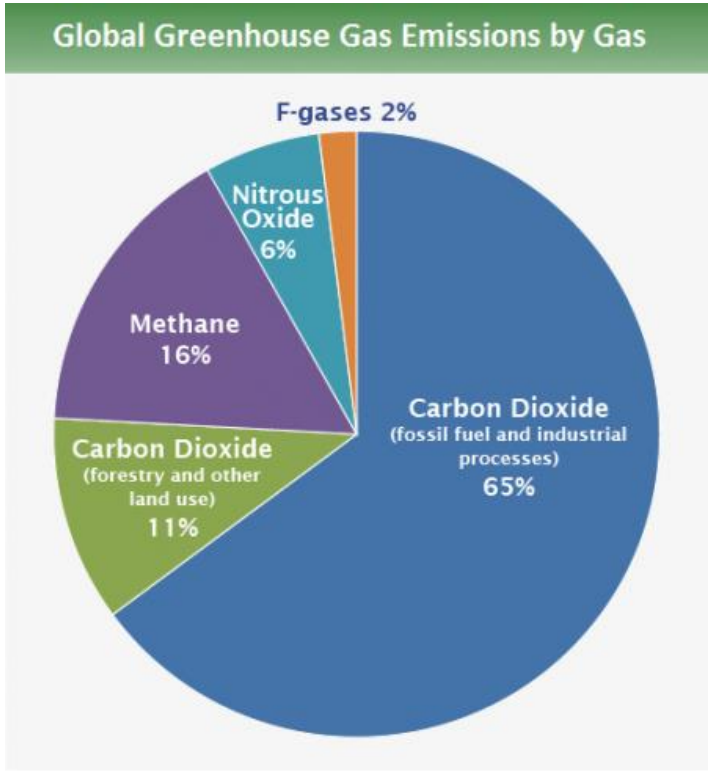
METHANE IS A PROBLEM

Methane is produced as a side product from the oil and gas fields, and also generated via biogas by fermentation of manure, waste and other biodegradable feedstock

After rising slowly from 2000 to 2006, the concentration of methane in the air has climbed 10 times more quickly in the last decade

Methane is far more potent than CO2 as a greenhouse gas, capturing more of the sun's radiative force, but it persists for less time in the atmosphere

Scientists calculate that over a 100-year period the "global-warming potential" of the gas is 28 times greater than for CO2



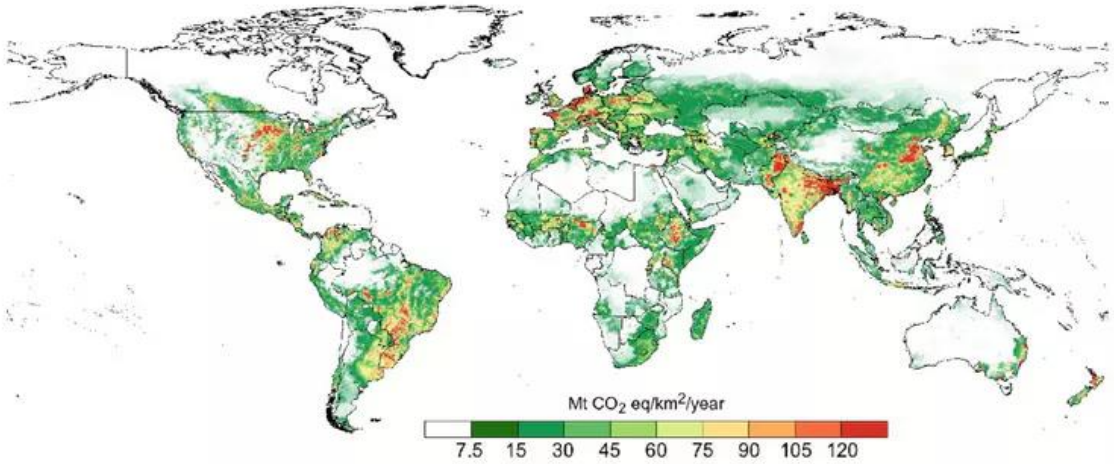
Source: IPCC (UN's Intergovernmental Panel for Climate Change) Climate Change 2014: Mitigation of Climate Change

LIVESTOCK CONTRIBUTES TO 14.5% OF GLOBAL EMISSIONS

Global demand for livestock products is expected to double by 2050, mainly due to improvement in the worldwide standard of living

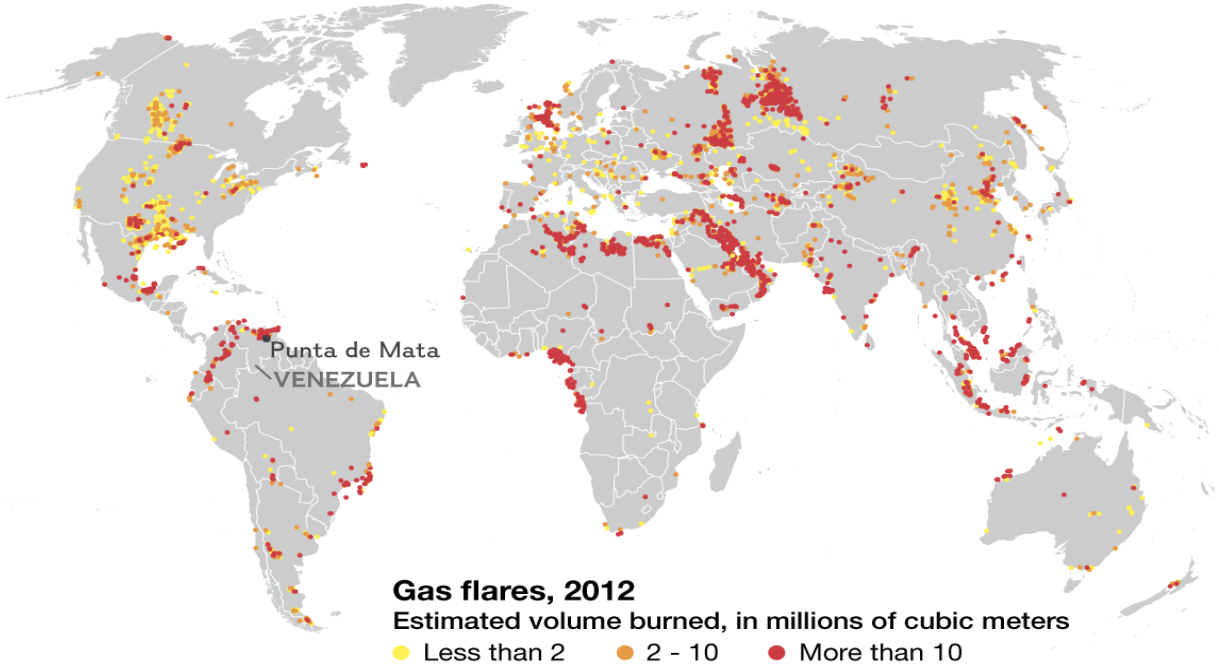
Research estimates that livestock accounted for 44% of human-induced methane and 16% of human-induced greenhouse gas emissions

Contribution on global emissions is expected to raise sharply



Greenhouse gas emissions from global livestock 1995-2005. Red areas represent more greenhouse gases. Herrero et al 2016 Nature Climate Change

FLARING IS ONE WAY TO SOLVE THE PROBLEM WITH METHANE…



Flaring the excess gas provides an opportunity to reduce emissions.

Process creates CO2 but it destroys methane which is 21 times more potent than CO2

The combustion of methane gas releases 50.1 kJ/g

Turning the heat from flaring into electricity does not stop CO2 from being emitted, but it recycles the heat to be used as power.

…BUT IT STILL CONTRIBUTES TO CO2 EMISSIONS

Flaring of gas contributes to climate change and impacts the environment through emission of CO2, black carbon and other pollutants.

It wastes a valuable energy resource that could be used to advance the sustainable development of producing countries.

Annual waste could provide about 750 billion kWh of electricity, or more than the African continent's current annual electricity consumption

"Zero Routine Flaring by 2030" initiative, introduced by the World Bank, aims to eliminate routine flaring no later than 2030.

Coal (anthracite)	228.6
Coal (bituminous)	205.7
Coal (lignite)	215.4
Coal (subbituminous)	214.3
Diesel fuel and heating oil	161.3
Gasoline (without ethanol)	157.2
Propane	139.0
Natural gas	117.0

Pounds of CO2 emitted per million British thermal units (Btu) of energy for various fuels

THERE ARE WAYS TO SOLVE THE PROBLEM WITH LIVESTOCK….

Argentina's National Institute of Agricultural Technology (INTA) has come up with a solution

The backpack captures and collect the gases emitted through the cow's mouth or intestinal tract via a tube inserted through the cow's skin

The gas is then condensed and ready to use to provide power for the farm on which the cow lives

Tthe 300 liters of methane per day a cow emits can be used to operate a fridge capacity of 100 liters at a temperature of between two and six degrees for a full day

…BUT THERE IS A BETTER OVERALL SOLUTION

Finno Energy has developed a clean, pressure-gain combustion process for power generation in micro turbines

We are first to successfully employ the Humphrey cycle (pressure-gain) technology in microturbine size range

Our **PULSE TURBINE** achieves an electrical efficiency over 40%

PULSE TURBINE can utilize methane and other biogas as fuel, with tolerance for high levels of water

Units are fully remotely monitored and controlled, and can be brought close to the fuel source and energy production needs

IDEAL FOR DISTRIBUTED ENERGY PRODUCTION

Industry Parks

Food Productions

Biogas Producers

Hotels & Real Estate

Airports

Data Centers

Water

Hotels

CONCLUSIONS

Excess methane flaring produces huge waste of energy across oil and gas production and livestock industry

Flaring will be eventually reduced

We will solve the problems with excess methane to enable utilizing it efficient fuel for CHP production with distributed units close to the energy needs

THANK YOU

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boostHEAT,
A global player
for energy transition

boostHEAT

PIONEER OF A NEW WORLD OF ENERGY

BOOSTHEAT MANUFACTURES THE WORLD'S MOST ENERGY-EFFICIENT BOILER. THANKS TO BIOGAS THIS BOILER IS 100% GREEN TODAY.

The innovative combination of a standard condensing heating unit with a CO2 heat pump cycle driven by **thermal compression** instead of mechanical work sums up to a condensing heating unit supplying 20kW heat at 65°C and a seasonal gas utilization (SGUE) of up to 200%.

This heating system hence comes with up to 50% renewable ambient thermal energy available all year round.

The heat pump cycle is driven by external combustion heat. It can be operated with what ever type of gas: natural, liquid, biogas, fluegas or even hydrogen.

The development was started in the year 2004 and supported by strong partners holding stakes in the gas sector. The market entry will take place in mid 2018.

A brief history of boostHEAT

2004
Starting Research and Development

2009
Thermal compressor concept validation

2011
boostHEAT incorporation - 1st patent

2013
1st compressor prototype

2015
1st boiler prototype

2017
Vénissieux (Lyon FR) Industrialization

2018
Boiler launch for residential market

2019
Boiler launch for commercial & tertiary market

boostHEAT

A STARTUP IN TRANSFORMATION

boostHEAT fundamentals

14 years of Research & Development

7 FAMILIES OF PATENTS

OWNER of its technology

Shareholding

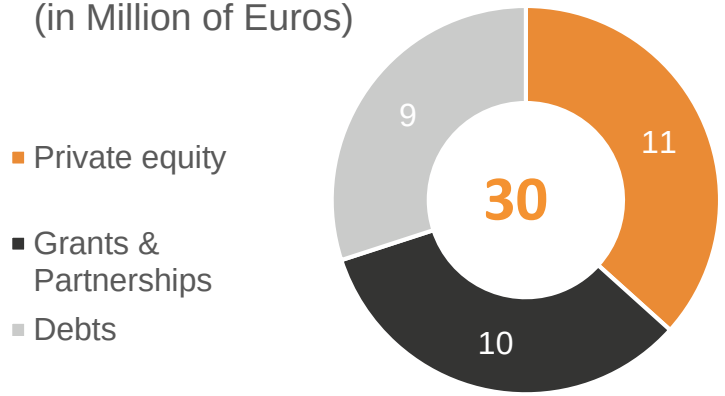
2 co-founders, Fluxys, Holdigaz and 3 family officies focused on energy representing more than 70% of the shareholding.

Key partners

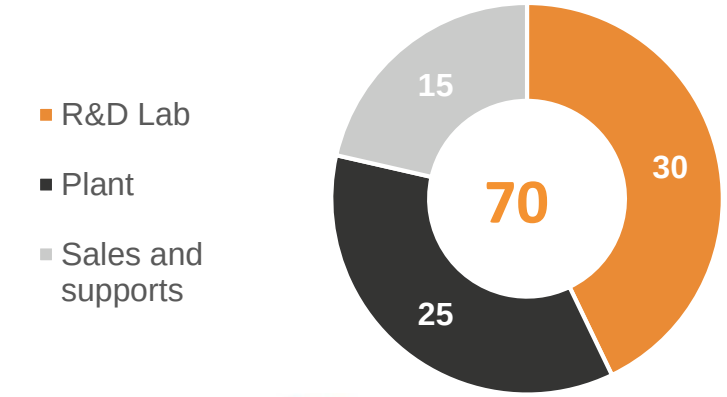
Supported by famous partners

Financial supports

Financial summary
(in Million of Euros)



Human Resources as of today
(employees)



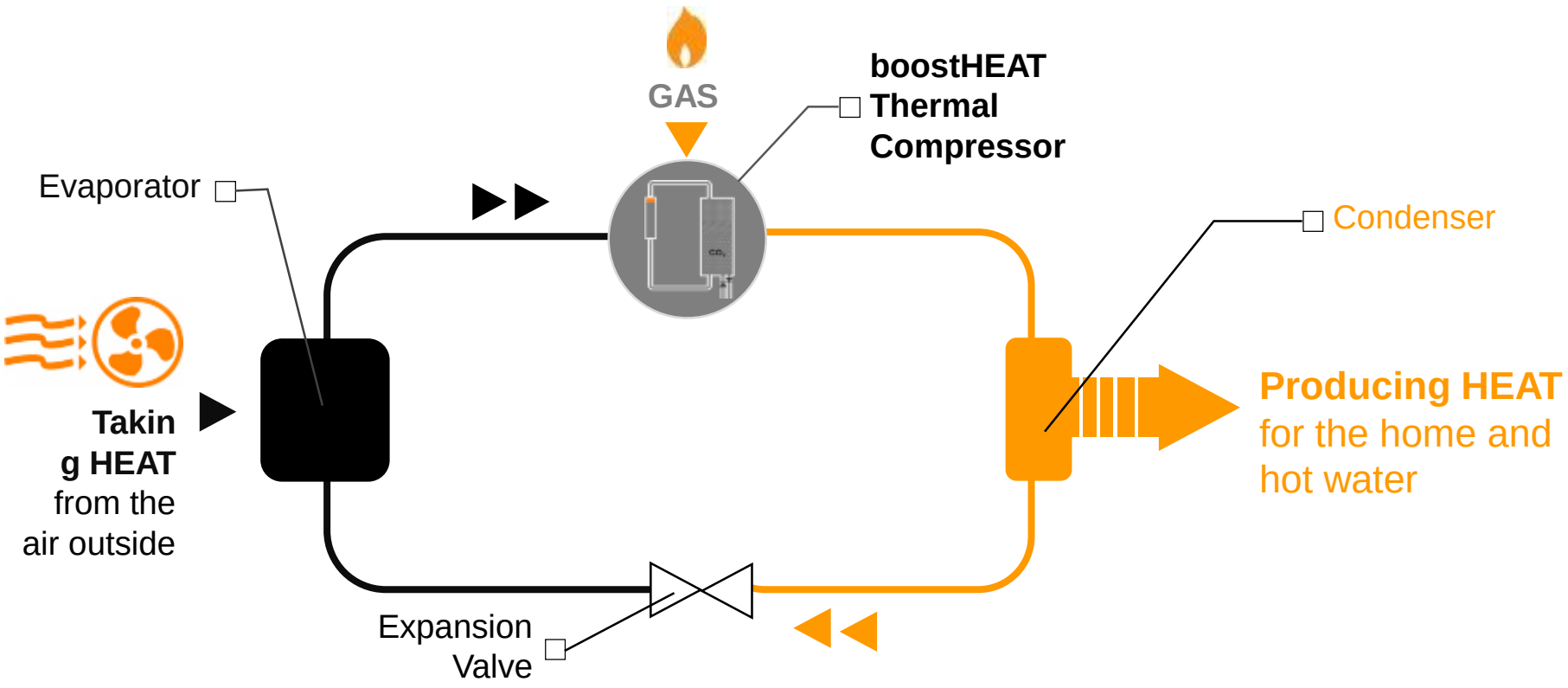
2018 : START OF SALES

Innovation

A thermal compressor at the service of the heat pump

boostHEAT

A design using the boostHEAT thermal compressor to activate the heat pump cycle



The boostHEAT heat pump boiler principle

General architecture : an association of technologies

3 MODULES
made separately and interconnected by the installer at the end customer :

- INDOOR UNIT brings comfort
- The THERMODYNAMIC CHARIOT brings energy efficiency
- OUTDOOR UNIT for renewable energy capture.

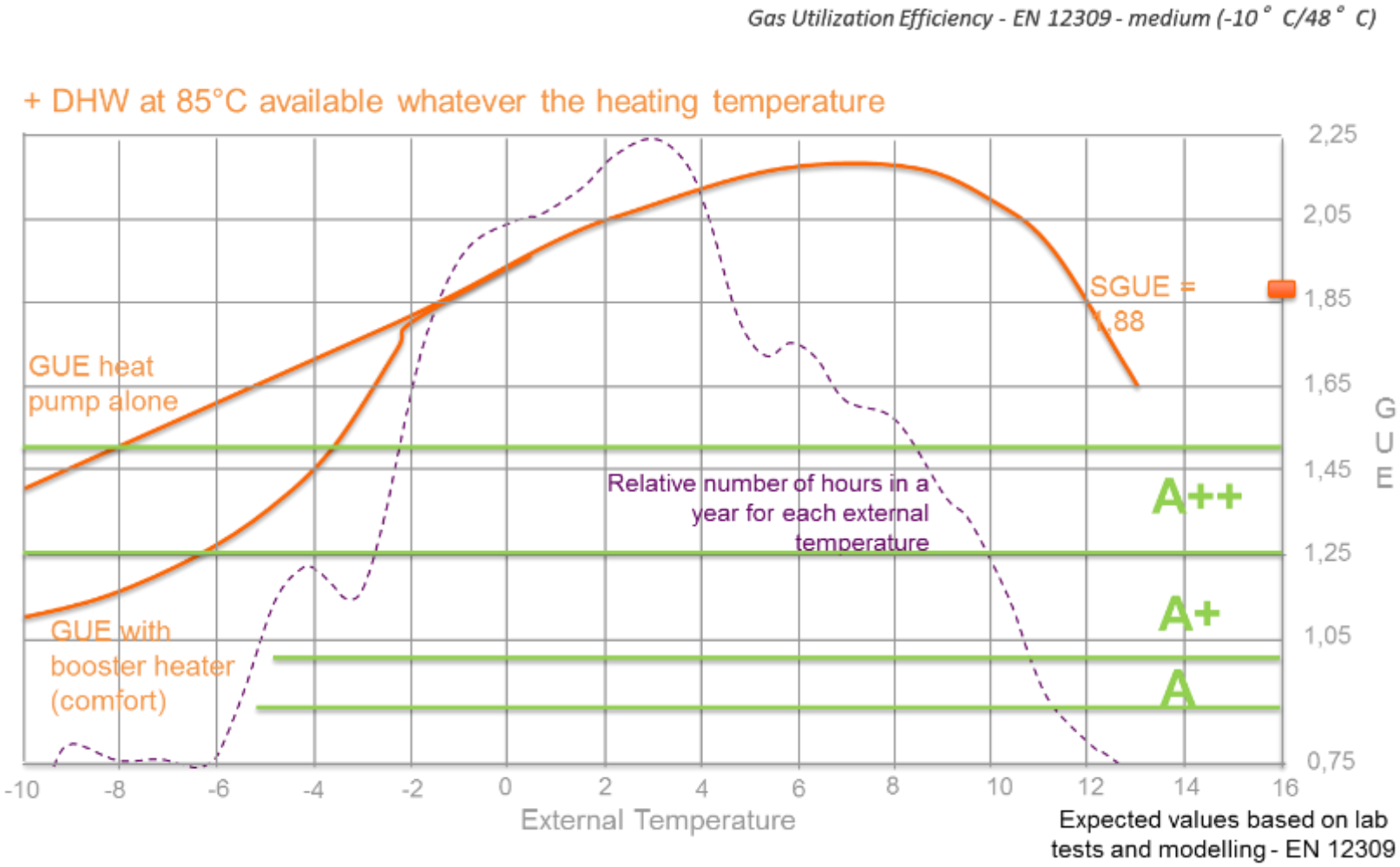
Performance Up to 200%*

* Compared to the best current boilers

boostHEAT

Performance curve – seasonal performances

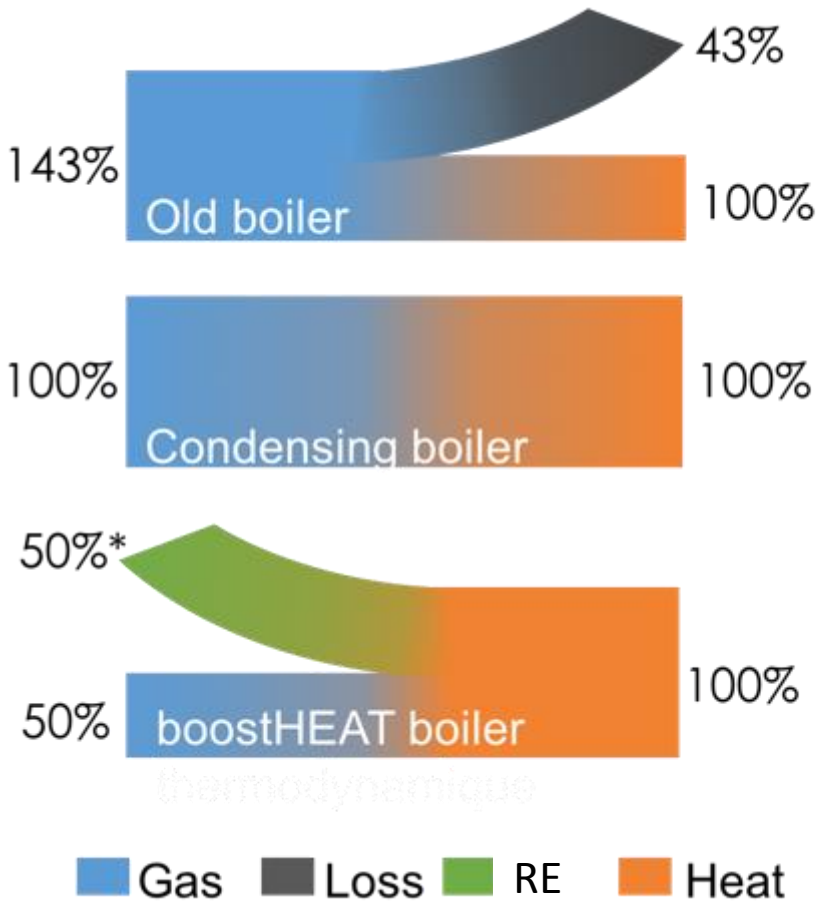
AUDIT BY GDF SUEZ JUNE 2013

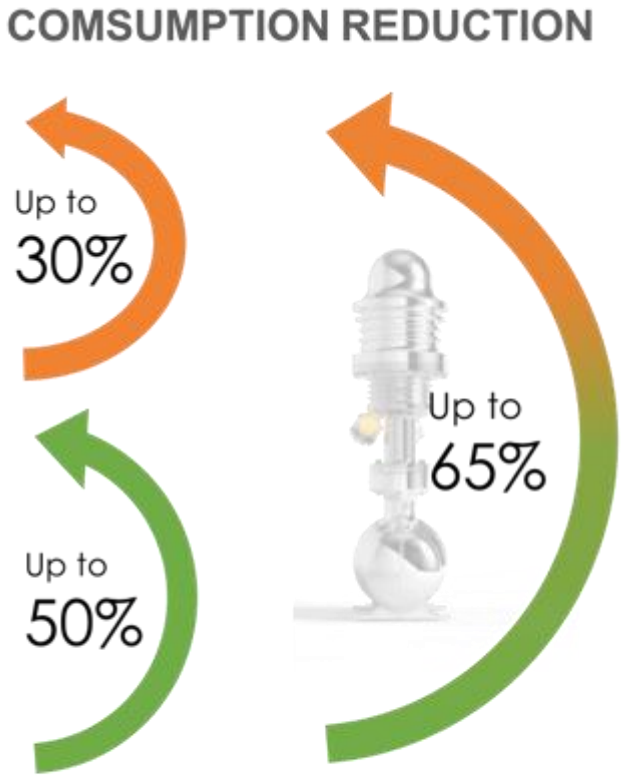


boostHEAT

boostHEAT, a disruptive innovation contribution

- **Divide by 2 energy consumption** compared to the condensing boiler, **divide by 3** compared to the old boiler
- We provide **up to 50% of renewable energy**
- **Perfomance up to 200%** VS primary energy





*capturing calories in the air

Industrialization

A production plant in Vénissieux (LYON) FRANCE

boostHEAT

A PRODUCTION PLANT IN VÉNISSIEUX (LYON), FRANCE

An industrial site of excellence in Lyon

- An industrial site **in the heart of a city** with industrial sensitivity
- **An exceptional site** for its transport **access**, for its **highways** and its **logistical interests**
- Very fast access to our **ecosystem of suppliers**
- **35% of the HVAC industry** is made in Lyon
- At the heart of an industrial campus of 11 ha

Key dates

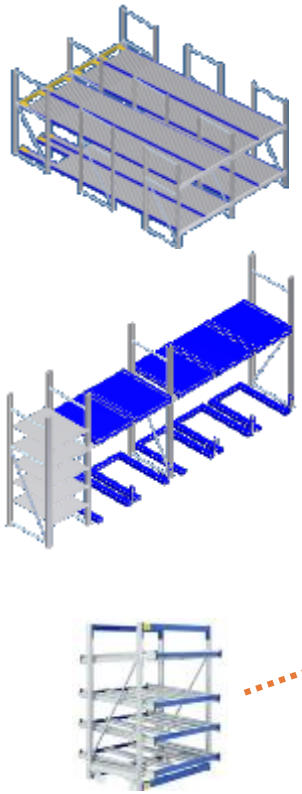
2016
BOSCH REVITALIZATION AGREEMENT

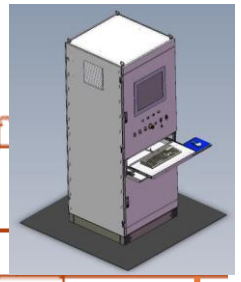
SEPTEMBER 2016 :
INSTALLATION

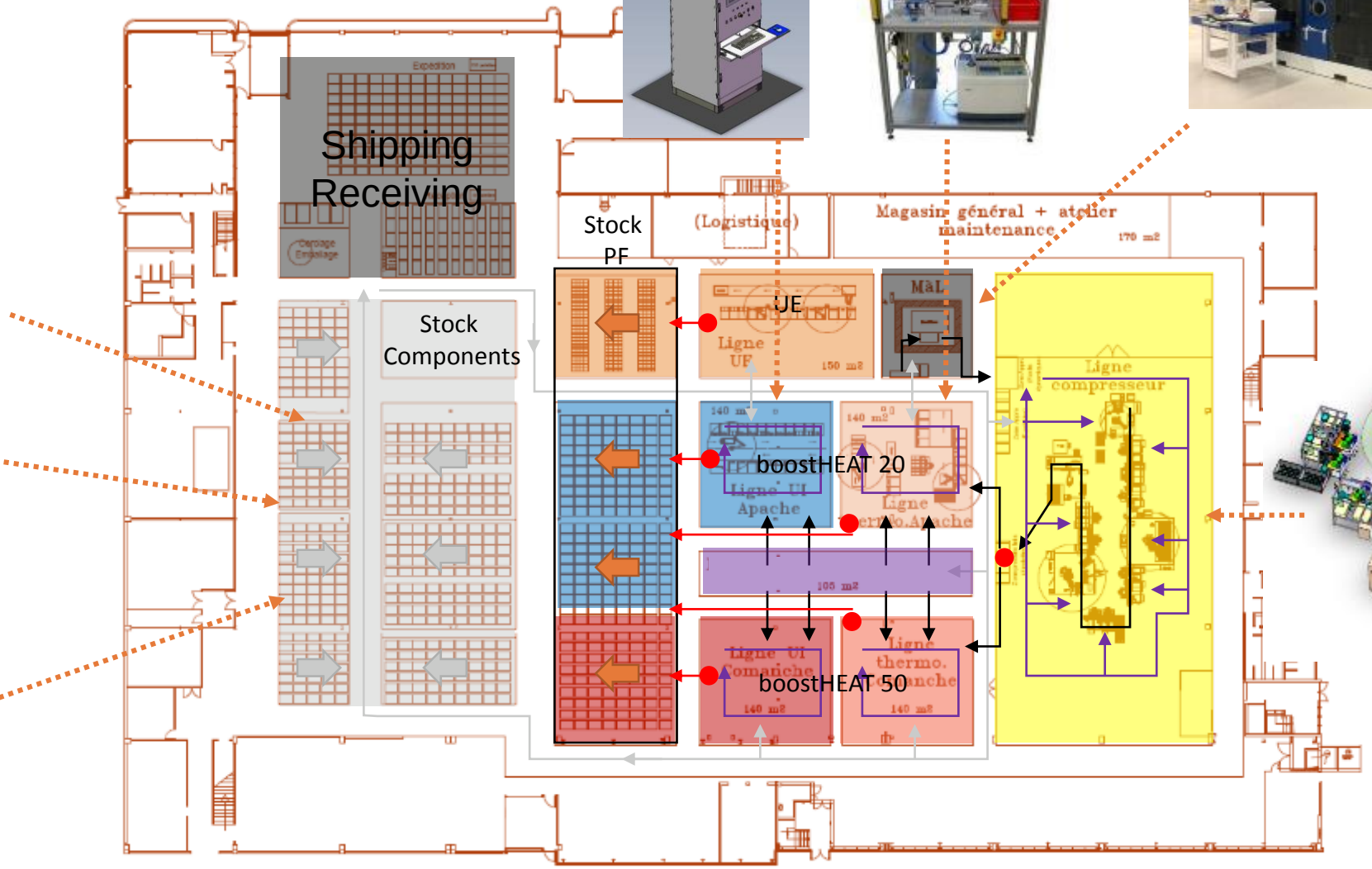
SPRING 2017 :
PIAVE & BANKS INDUSTRIALIZATION FINANCING

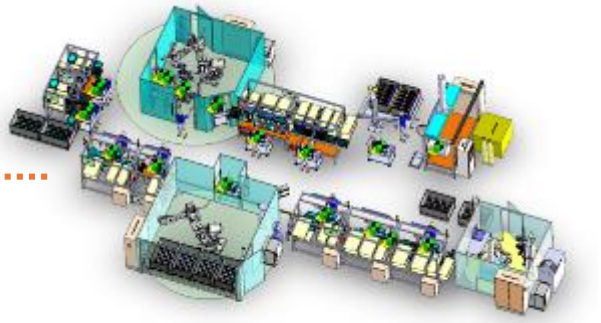
JUNE 2017
COMPRESSOR PRODUCTION LINE ORDER

Flows blue print









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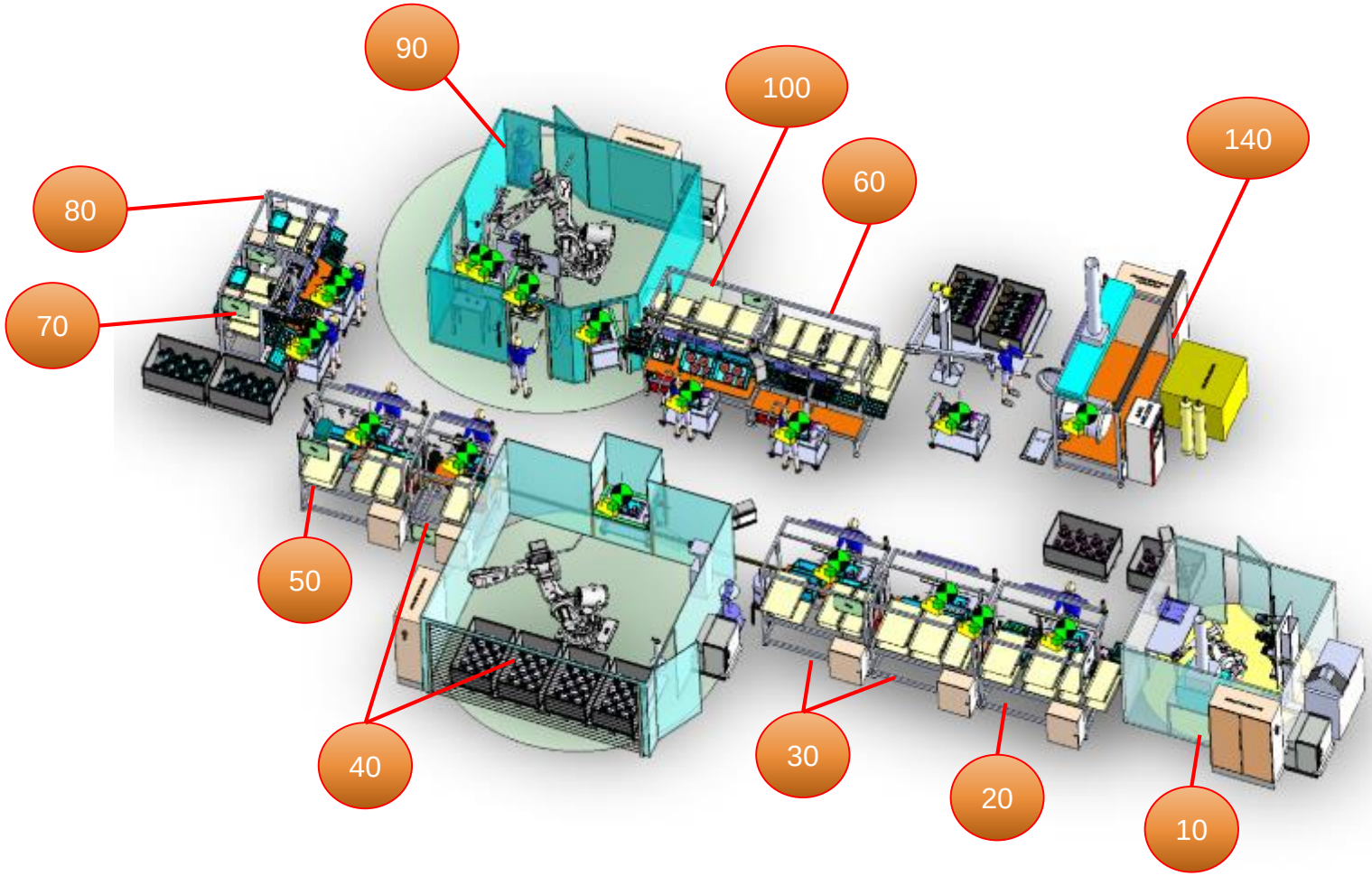
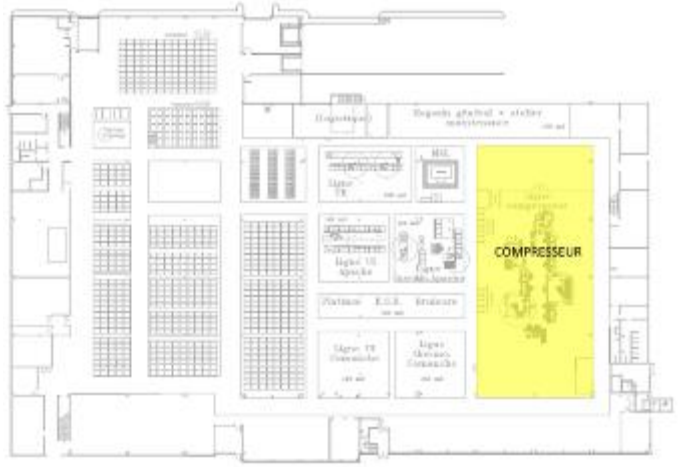
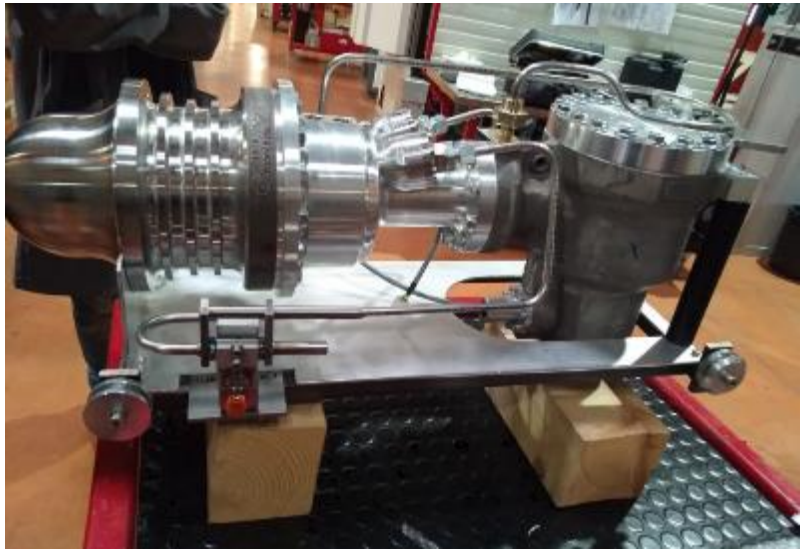
Compressor production line





Pressure + Leak test bench



Product Marketing

Two products for two major market segments

boostHEAT

TWO PRODUCTS FOR TWO MAJOR MARKET SEGMENTS

1 technology : 2 products

boostHEAT 20 kW

START OF PRODUCTION :
Q4 2018

boostHEAT 50 - 250 kW

START OF PRODUCTION :
Q4 2019

boostHEAT

SALES AND MARKETING STRATEGY BOOSTHEAT 20KW

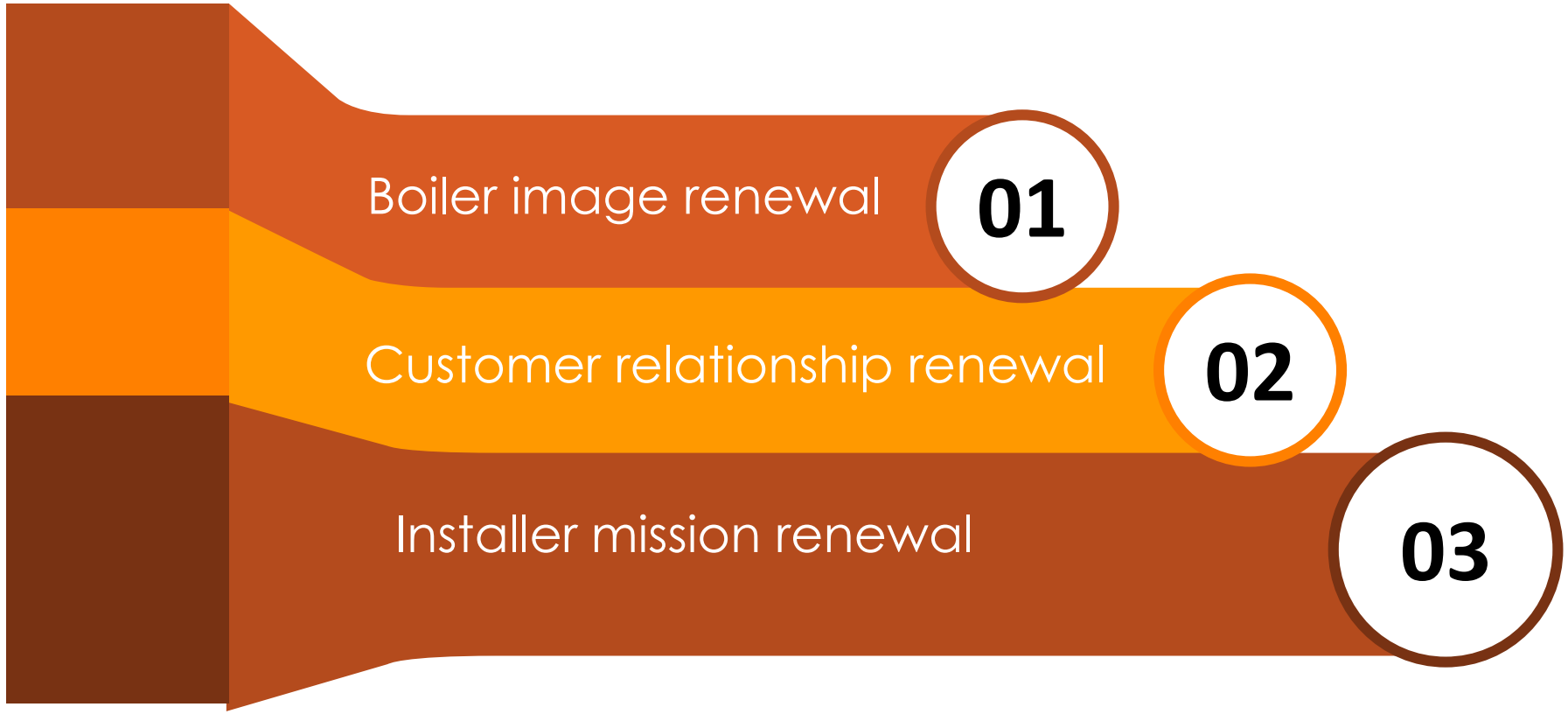
A disruptive approach

boostHEAT

Breaking business strategy

BOOSTHEAT CONTROLS ITS ENTIRE VALUE CHAIN

Axes of renewal



A targeted offer for a calm decision

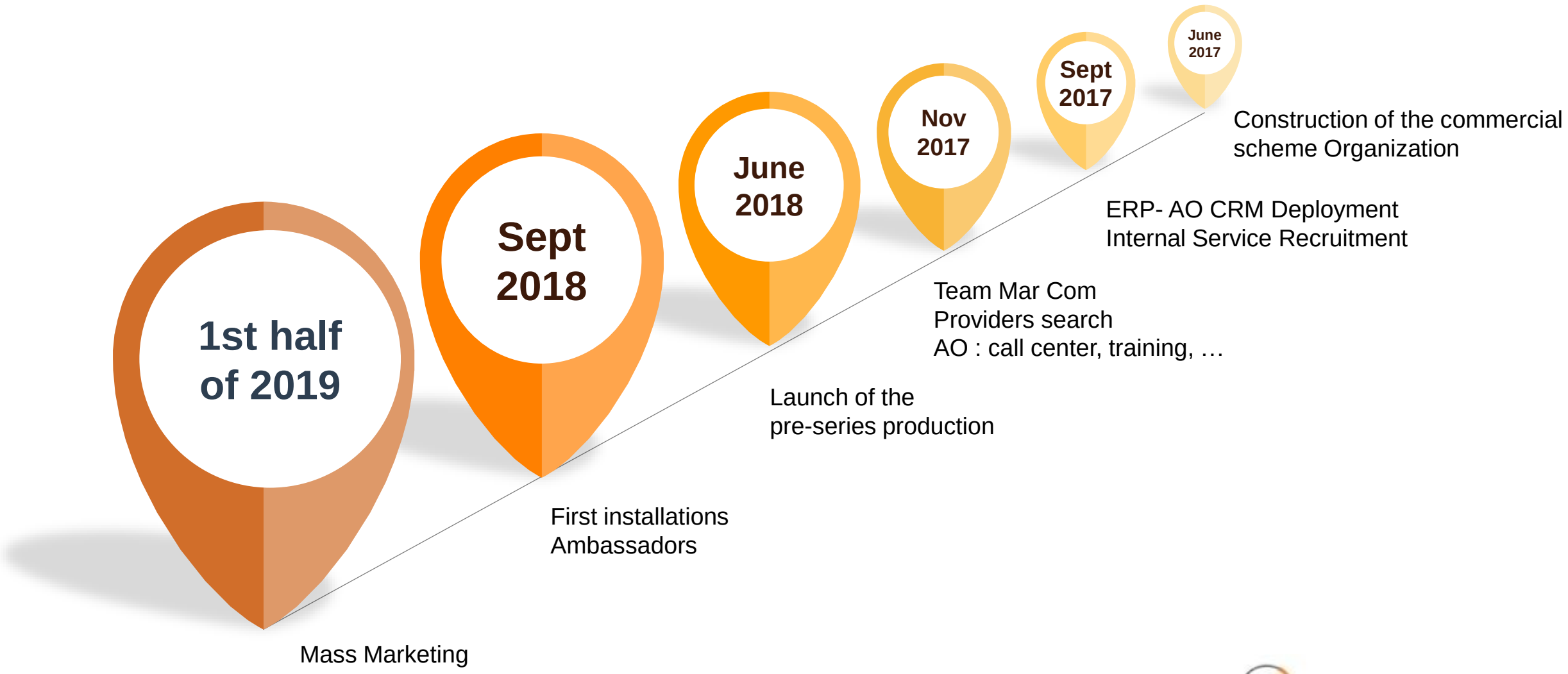
A turnkey heating solution, with :

- Financing with a boostHEAT partner
- The boostHEAT boiler supplied, installed
- A maintenance contract
- A warranty extension
- A green Gas supply option

- Easy to understand
- Easy to use
- Comfortable a single interlocutor : the manufacturer
- *Reassuring* : leading partners

A PRECISE, PERSONALIZED PROCESS, WITH SLOW MATURATION AND THOUGHTFUL DECISION

Objective & planning



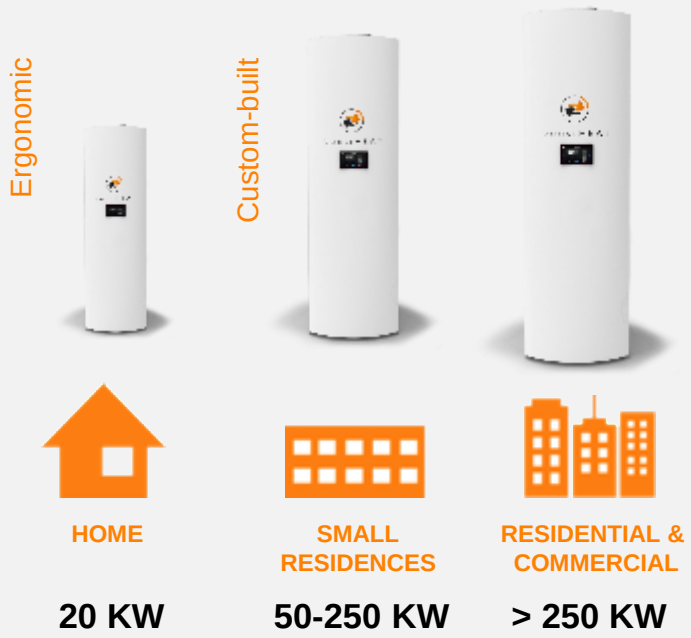
boostHEAT

The future
By boostHEAT

boostHEAT

boostHEAT: the biotech of the energy

Initial offer



Future developments

Reversible range with cooling system

Micro-cogeneration

Integration in **Smart-Grid** networks, remote control, free energy billing…

A 100% owned technology platform for multiple applications : industry, chemical, HVAC,…

boostHEAT

boostHEAT,

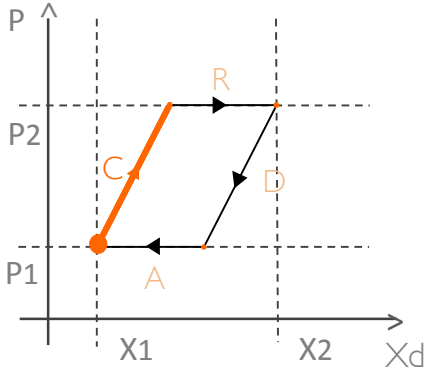
THE POSITIVE ENERGY

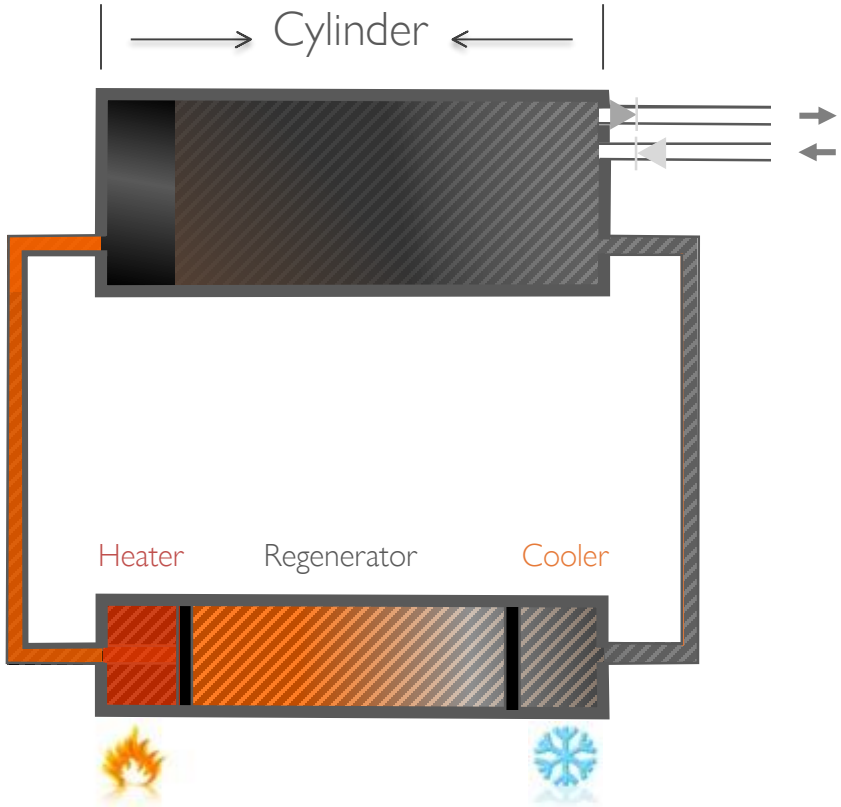
THANK YOU

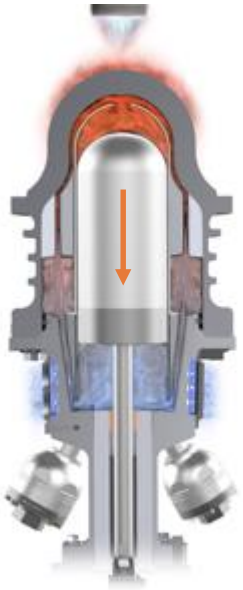
boostHEAT

The regenerative thermal compressor

> COMPRESSION

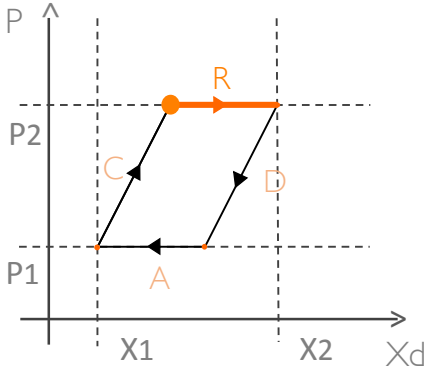


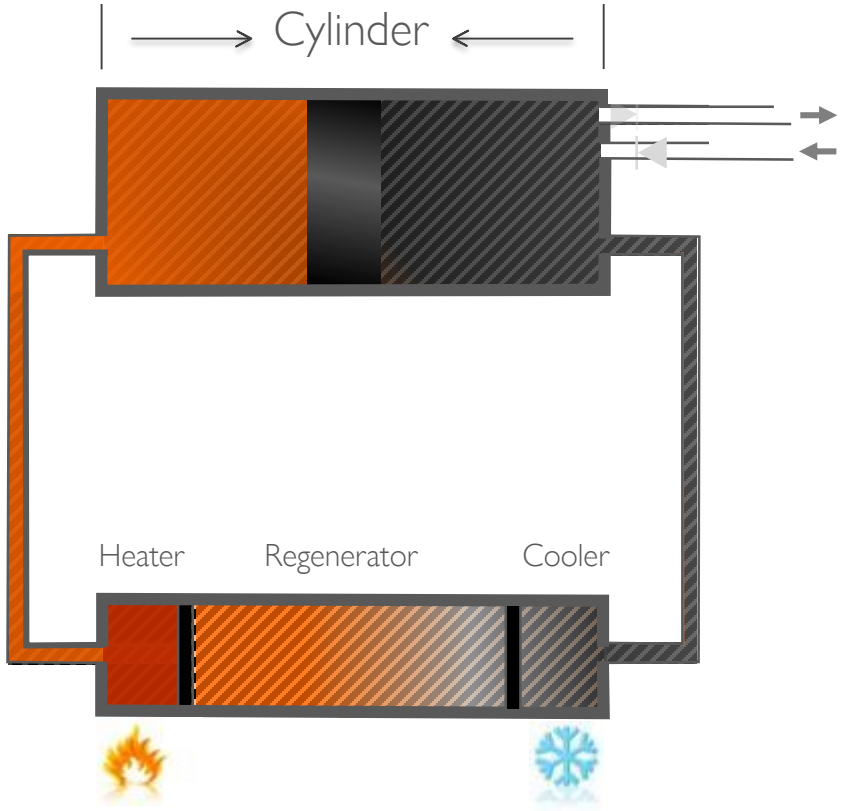


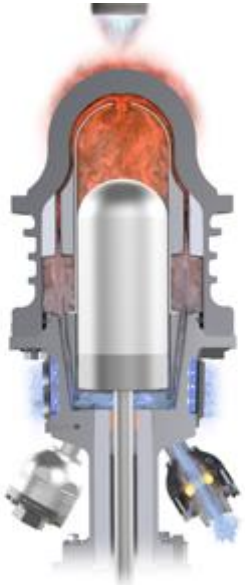


The regenerative thermal compressor

> DISCHARGE

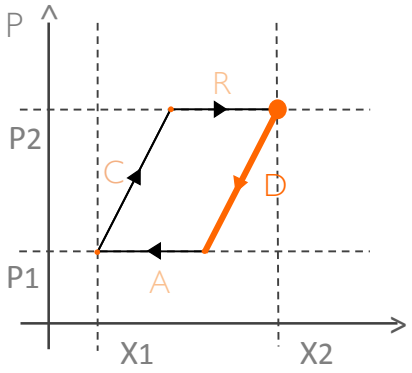


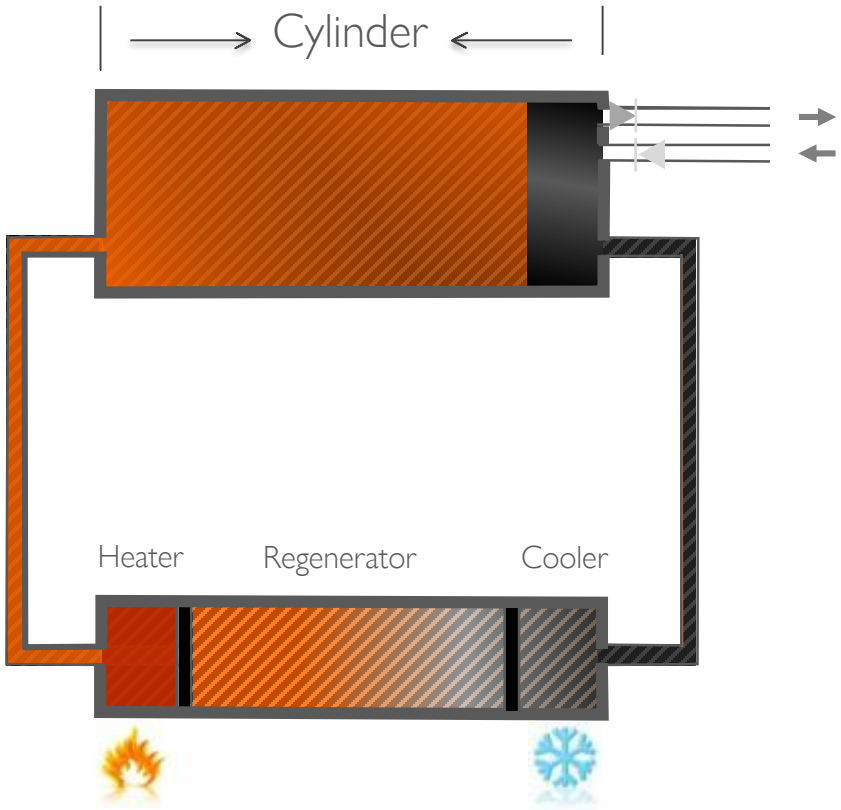


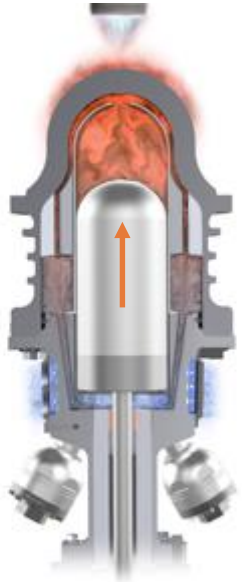


The regenerative thermal compressor

> EXPANSION

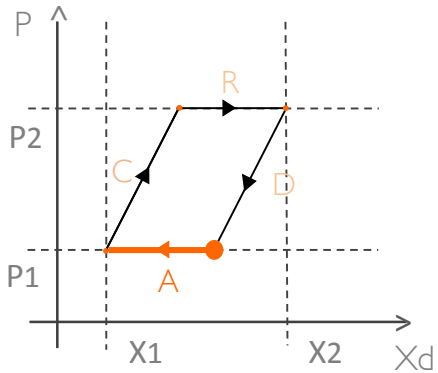


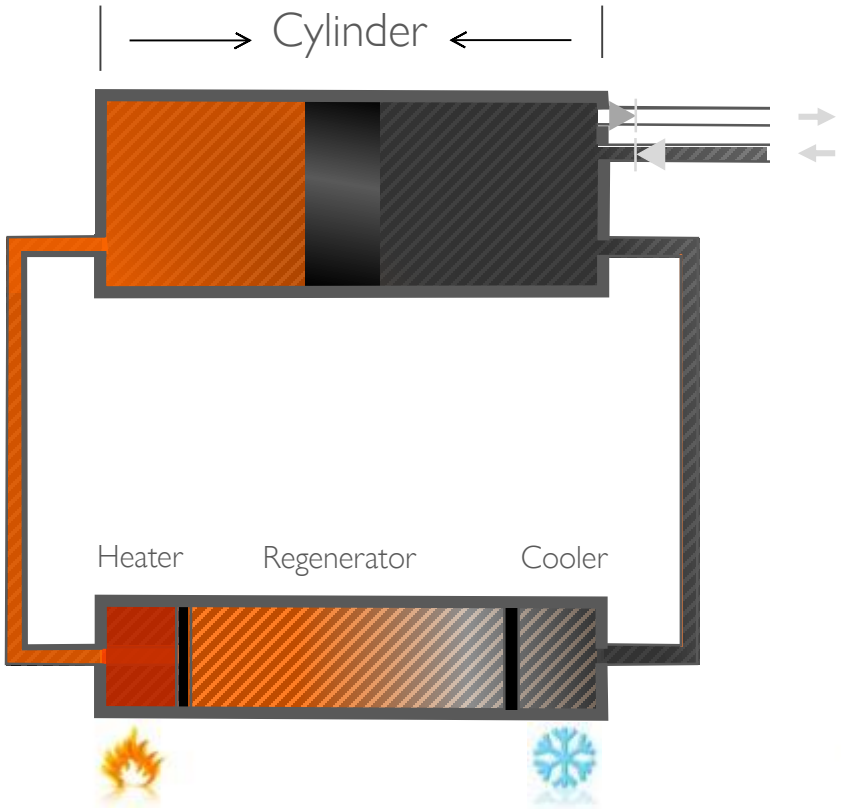


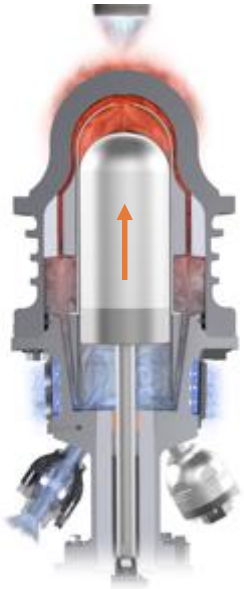


The regenerative thermal compressor

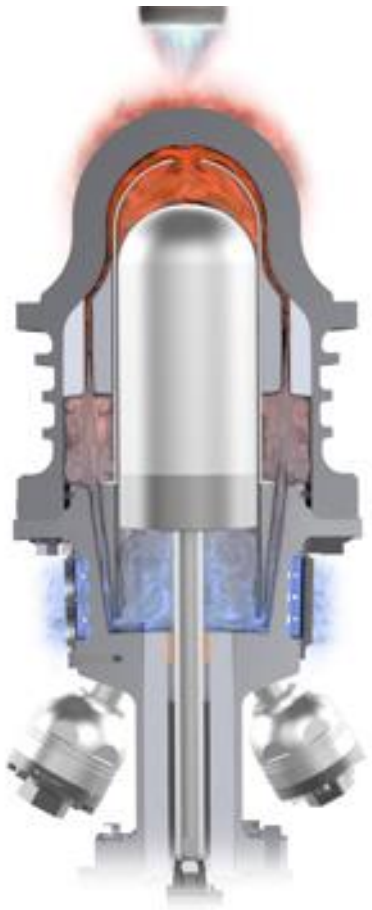
> INTAKE







The regenerative thermal compressor



No mechanical power

+

- Technology from engines and compressors
- Simplicity and reliability
- Lifetime greater than 50 000 hours without maintenance
- Economic (replace an engine and a compressor)
- Performance

A UNIQUE SOLUTION from 10 years of research

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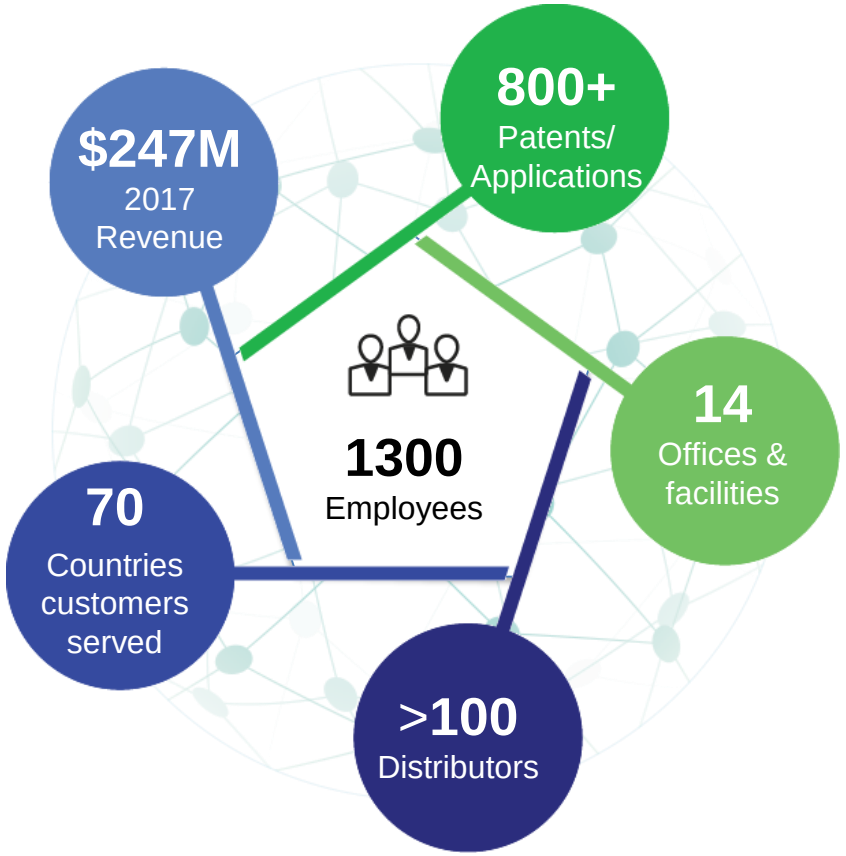
Lower GHG Emissions with Gas Technology Innovations in the Transportation Sector

Cleantech Forum Europe, 16 May 2018

Nadège Leclercq – Director, Market Development, Europe

Westport™ Fuel Systems

THE WORLD OF WESTPORT FUEL SYSTEMS



Broad Applications

Alternative Fuels

Locations

Key Priorities

- Broaden product offering
- Deploy market-ready solutions
- Continue to focus on cash management
- Increase engagement with key OEMs and industry partners

Driving innovation to power a cleaner tomorrow

Note: Approximate number of employees and products as of December 31, 2017

DELIVERING THE WORLD'S MOST ADVANCED NATURAL GAS TECHNOLOGIES FOR COMMERCIAL TRANSPORTATION

Westport™

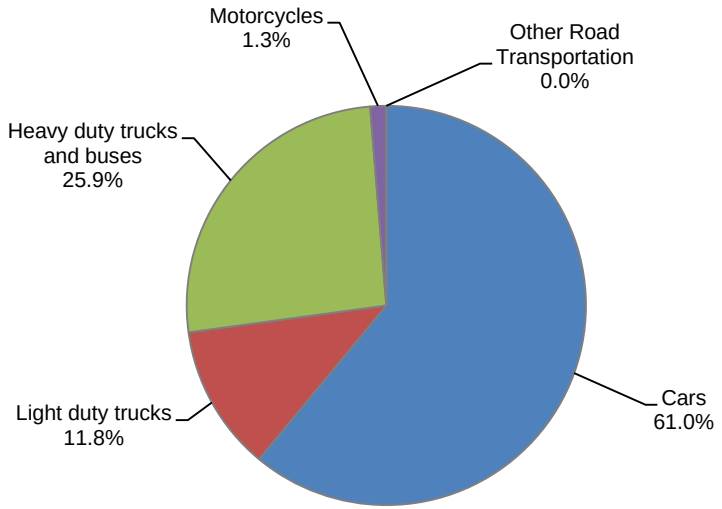
- Leadership and focus on natural gas technologies for commercial transportation
- Reduced environmental footprint without compromising performance
- Agile and collaborative partnerships
- The fierce pursuit of science and innovation

TRANSPORTATION GHG EMISSIONS IN EUROPE

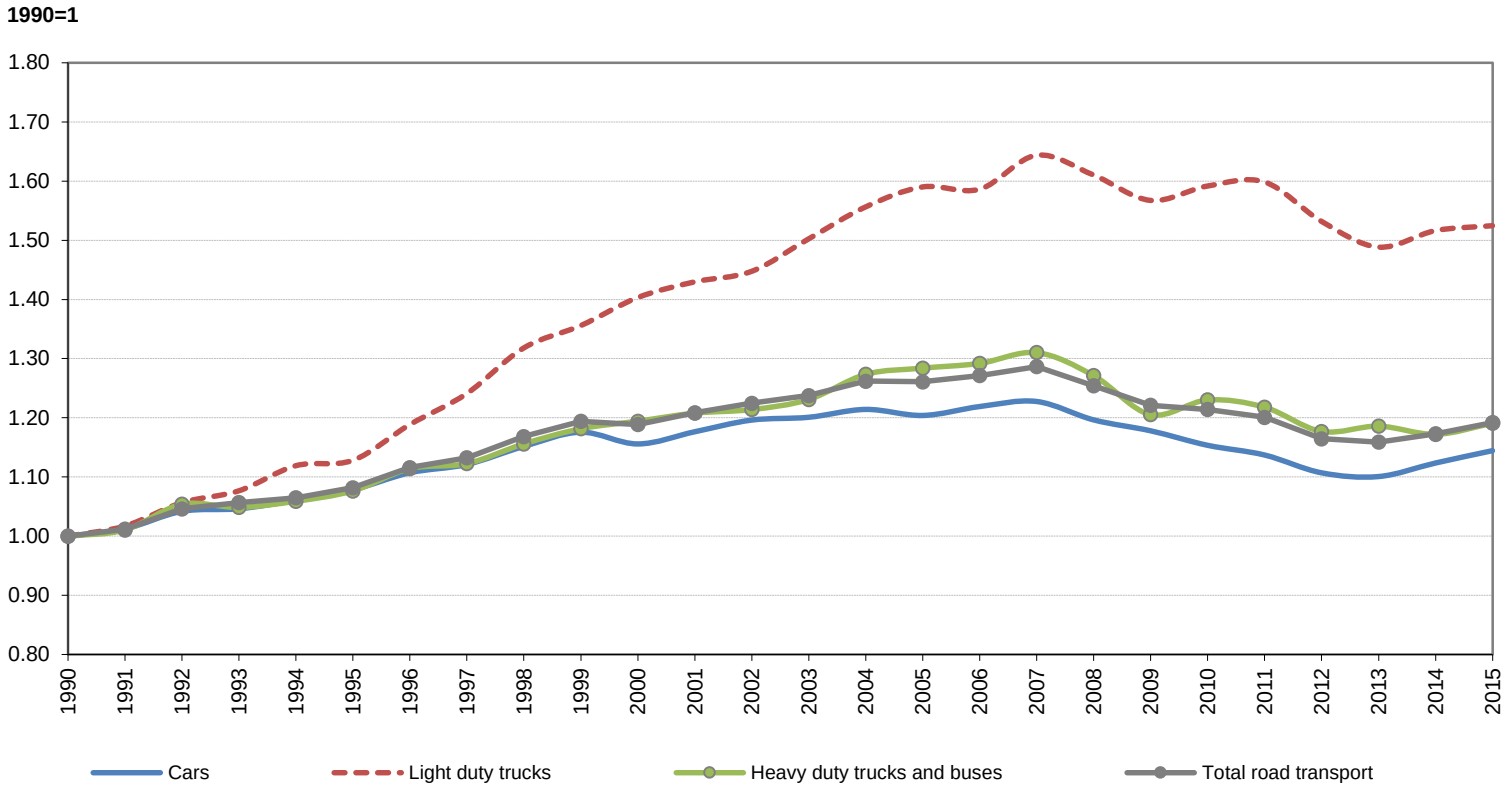
The Need and Challenge for Reducing GHG Emissions

EU28 goal to reduce transport GHG by 80-85% from 1990 levels by 2050*

Share in Road Transport Greenhouse Gas Emissions (GHG) by Transport Mean : EU-28 (2015)



Greenhouse Gas Emissions (GHG) from Road Transport, by Transport Mean: EU-28



Source: European Commission: "Statistical Pocketbook 2017"
*Source: European Commission, A European Strategy for Low-Emission Mobility, 2016

WELL-TO-WHEEL CO_2 REDUCTION

No Single, Golden Bullet

"Heavy Duty Commercial Vehicles: only natural gas drives offer potential (…for meaningful GHG reductions…) until 2026"

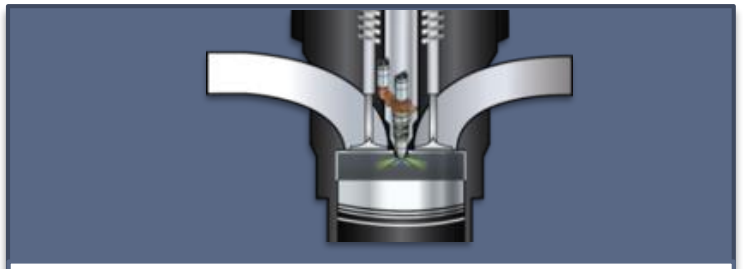
Deloitte, Global Truck Study 2016 – The truck industry in transition

CO_{2eq} emissions	=	WTW carbon intensity of fuel	×	Powertrain efficiency	×	Transport activity	×	Transport efficiency
g/ton km		*g/kWh*				*kWh*		*1/ton km*

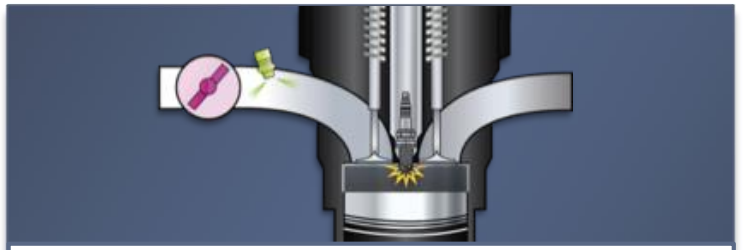
Natural gas offers an attractive pathway towards sustainable fuels like biomethane and e-methane

WESTPORT ENGINE TECHNOLOGY SOLUTIONS

APPLICATION	FUEL CHOICE	ENGINE TECHNOLOGIES
High Horsepower • mining • rail • marine	**LNG***	**high pressure direct injection**
Heavy-Duty Vehicles • on-highway trucks		
Medium-Duty Vehicles	**CNG****	**high efficiency spark ignited**
Light-Duty Vehicles		



Westport™ HPDI 2.0



Westport™ HESI 1.0

* Liquefied natural gas
** Compressed natural gas

WESTPORT™ HPDI 2.0 HIGHLIGHTS

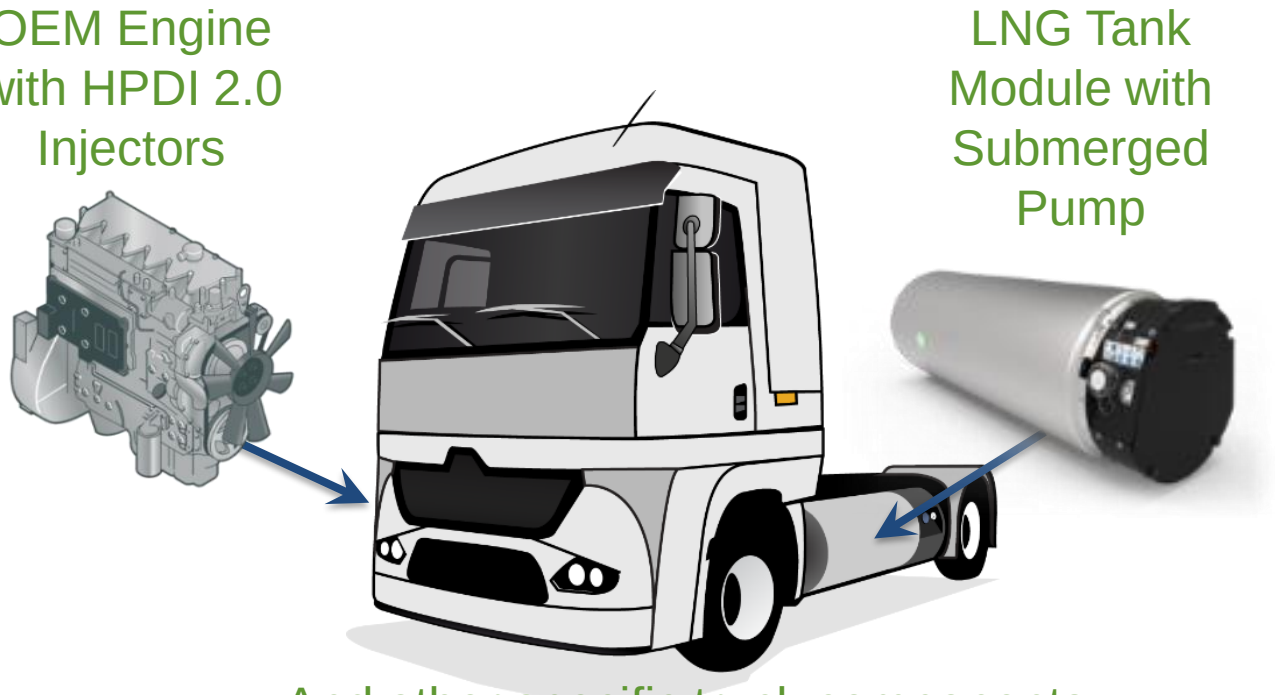
Westport™ HPDI 2.0

THE RIGHT FIT FOR HEAVY-DUTY TRUCKS

Long Distance, >400hp Euro VI engines, LNG

- High Pressure Direct Injection (HPDI) gas technology
  - Natural gas >90% of the total fuel consumption*
  - <10% diesel*, for ignition only
- Diesel engine performance remains
  - Same high power and torque
  - Similar efficiency (fuel economy) ±1%
  - Same drivability and engine braking
- 18-20% tailpipe GHG emissions reduction vs. diesel**
- Commercially available, preliminary sales in 2017

A FULLY OEM INTEGRATED SYSTEM



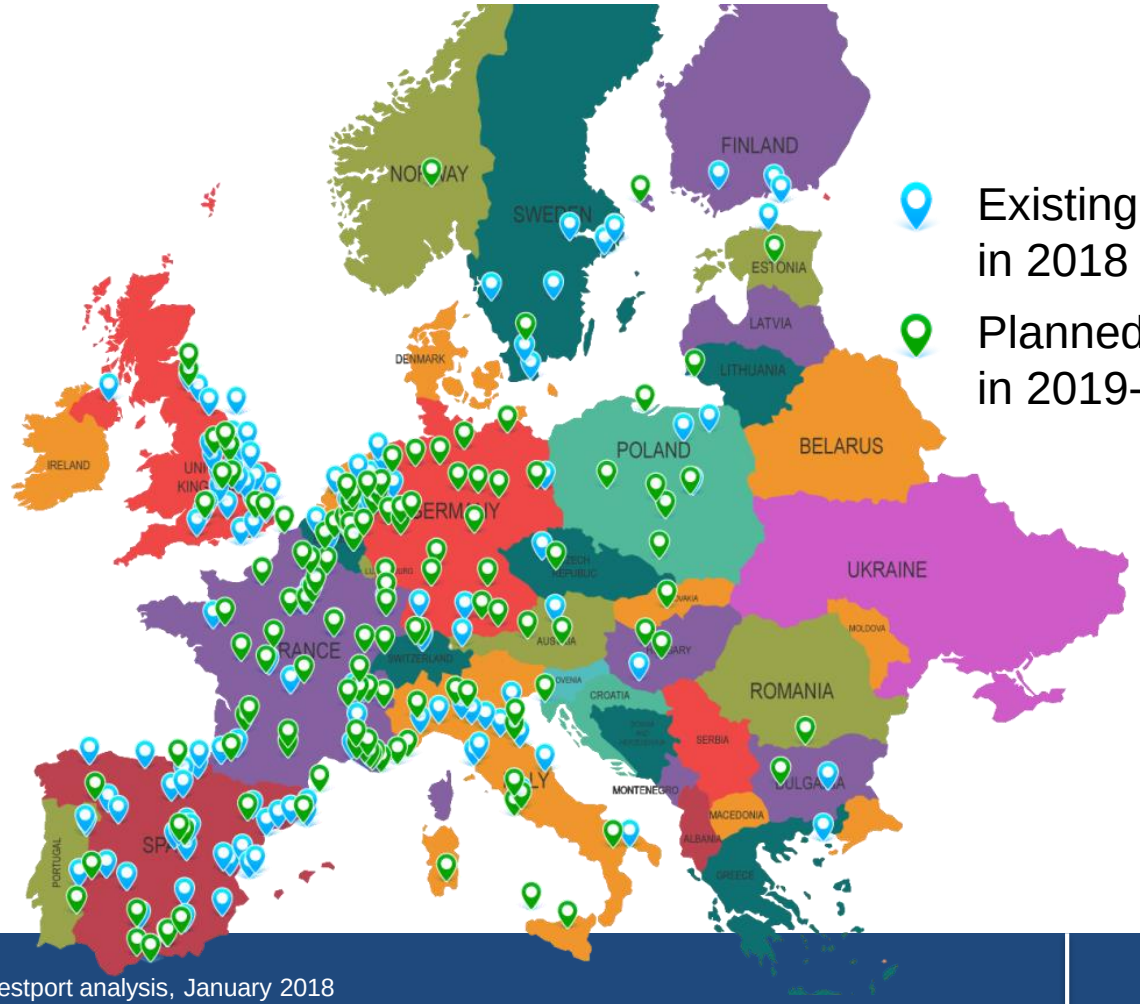
* Over vehicle operating cycle

** Over various transient cycles, including methane emissions; also varies with natural gas composition

HPDI 2.0 READY FOR LARGE SCALE DEPLOYMENT

- First OEM product featuring Westport HPDI 2.0™ commercially available
- Economically viable solution today
- Fully renewable gas compatible
- LNG fueling infrastructure is being built
  - >150 stations in operation today
  - And over 400 stations planned to be in operation by 2021*

LNG STATIONS NETWORK IN EUROPE



Existing stations in 2018

Planned stations in 2019-2021

Source: Westport analysis, January 2018
* based on projects announced as of Jan 2018

THE HPDI 2.0 OPPORTUNITY

Well-to-Wheel GHG Reduction

Westport HPDI 2.0™

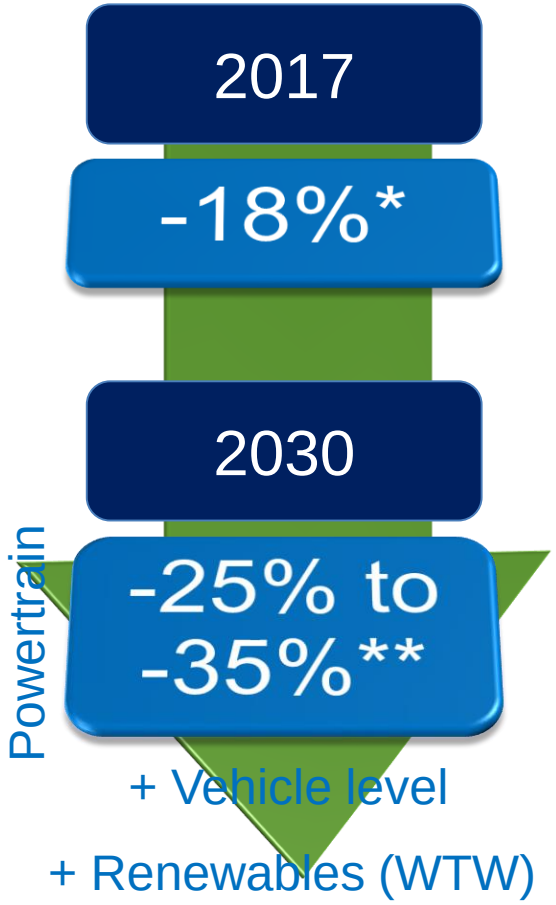
2017	2020	2025
-15%*	-26%*	-31%*
Fossil LNG	20% BioLNG blend	10% BioLNG & 10% E-Gas blend^

Source: Thinkstep "Greenhouse Gas Intensity of Natural Gas", on behalf of NGVA Europe, 2017
* Well-to-Wheel Analysis ^ Calculated based on EU-28 2030 Electricity grid mix.

GOING FURTHER WITH WESTPORT HPDI IN THE 2020'S

Potential for GHG Emissions Reduction

Tank-to-Wheel GHG



> Increased engine efficiency thanks to injection pressure increase and other technology improvements

- Further optimized combustion, improved power density and system efficiency, exceeding diesel engine attributes
  - E.g. by injection pressure increase, multiple injections of both pilot and gas
- Further system simplification including ignition improvement (Westport combustion sensor strategy to better adapt to fuel quality)
- Transfer of other diesel engine technology improvements to HPDI (after-treatment efficiency, waste heat recovery, etc.)

> Combined with vehicle level technology improvements as for diesel

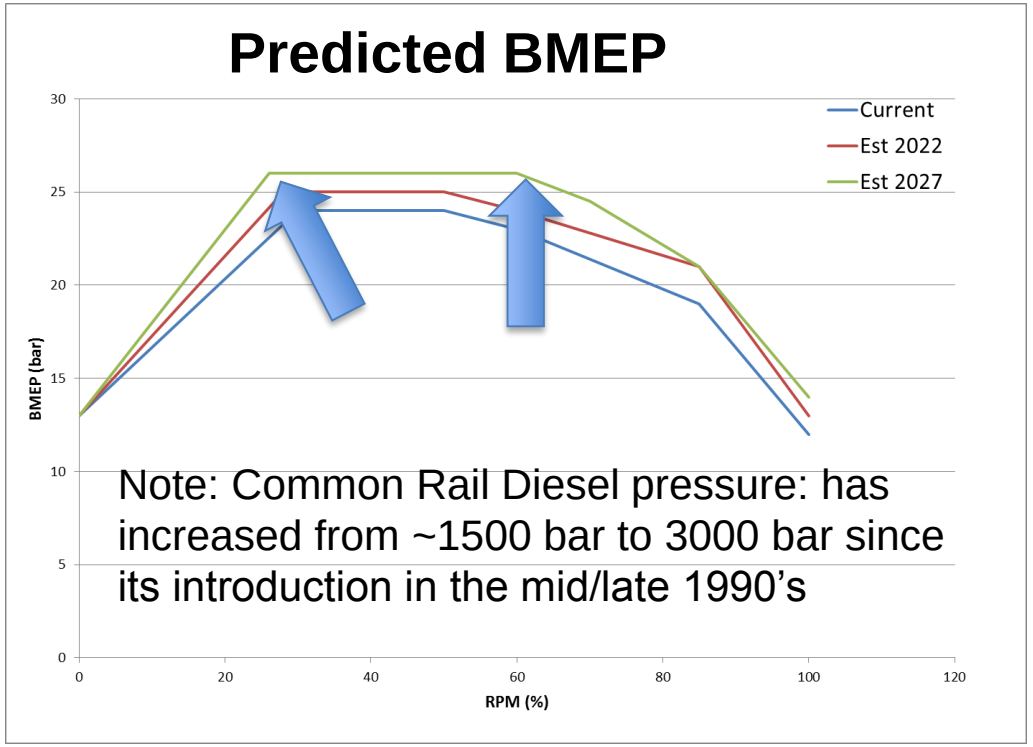
- Driveline efficiency, aerodynamics, tires, mass reduction, hybridization, etc.

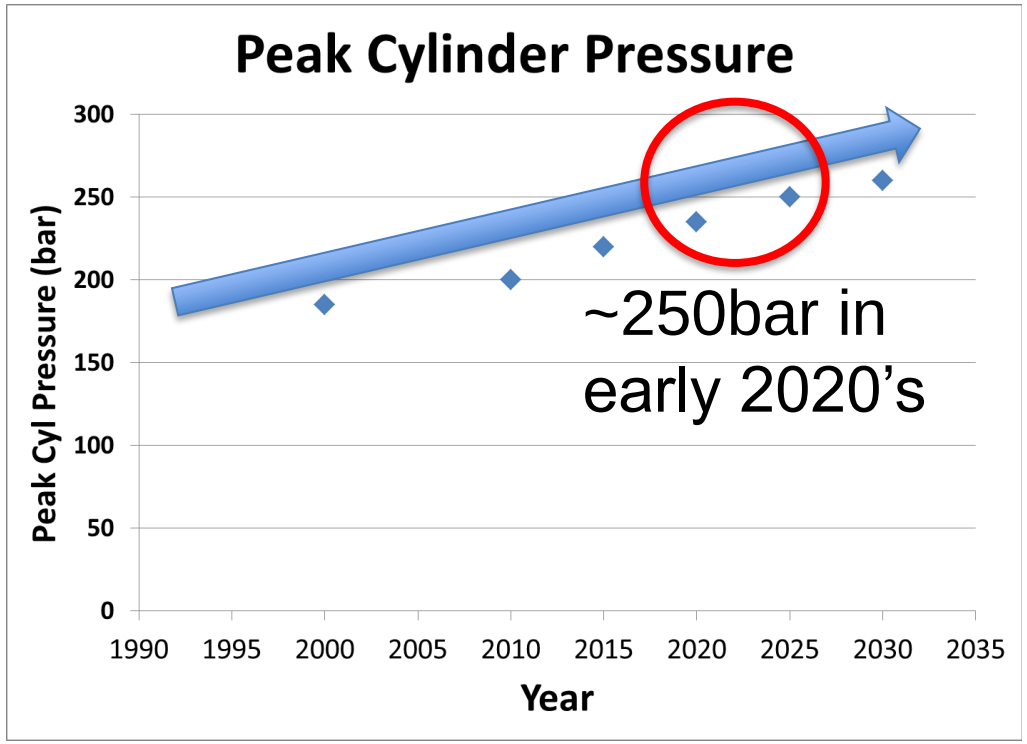
> Compatibility with future renewable fuels e.g. e-fuels, maximizing Well-to-Wheel GHG emissions reduction

* Current product Tank-to-Wheel GHG emissions reduction, Source: Thinkstep "Greenhouse Gas Intensity of Natural Gas", on behalf of NGVA Europe, 2017
** Indicative range of Tank-to-Wheel GHG emissions reduction potential related to engine level technology improvements (without accounting for vehicle level improvements), compared to 2015 diesel engine, based on preliminary Westport analysis and 2017 ICCT data

THE FUTURE OF NATURAL GAS ENGINES

Next Generation HPDI





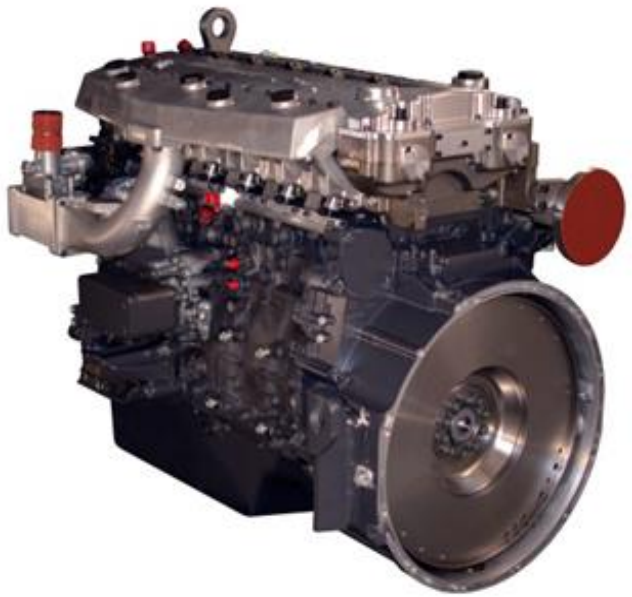
- HPDI 2.0 is the ideal natural gas solution for 85% of the current commercially available HD truck engines*
- The primary change from HPDI 2.0 will be an increase in the available fuel system pressure coupled with incremental improvements to the entire system to improve efficiency and cost, leveraging Westport's 20+ years of HPDI experience

* Arnberger, A., Golini, S., Mumford D., Hasenbichler, G., "Commercial Natural Gas Vehicles: Tomorrow's Engine Technologies for most stringent NOx and CO2 Targets", Internationaler Motorenkongress 2018, Baden-Baden

WESTPORT HESI FOR MEDIUM DUTY ENGINES

High Efficiency Spark Ignited Natural Gas Technology

Westport™ HESI 1.0

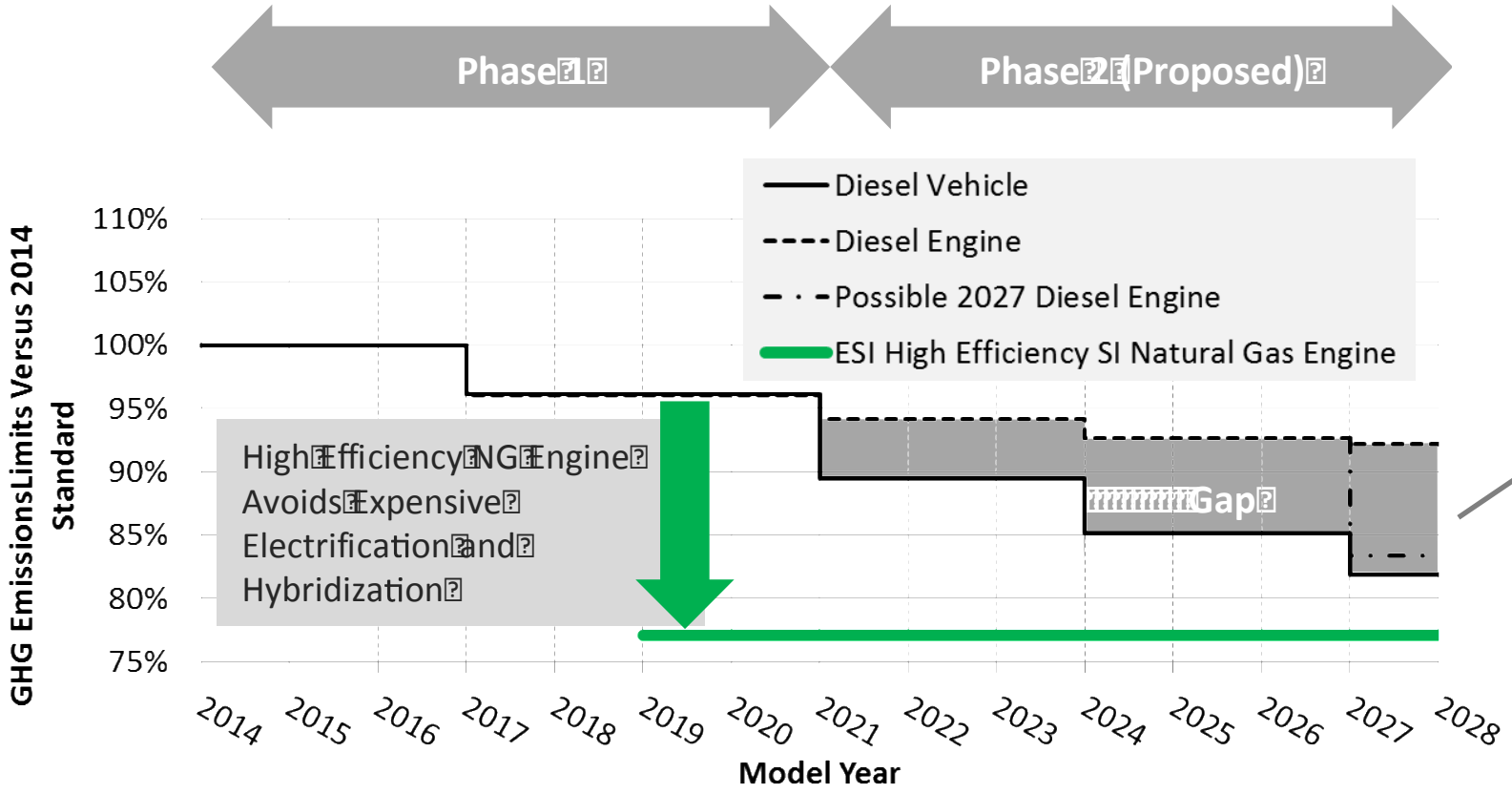


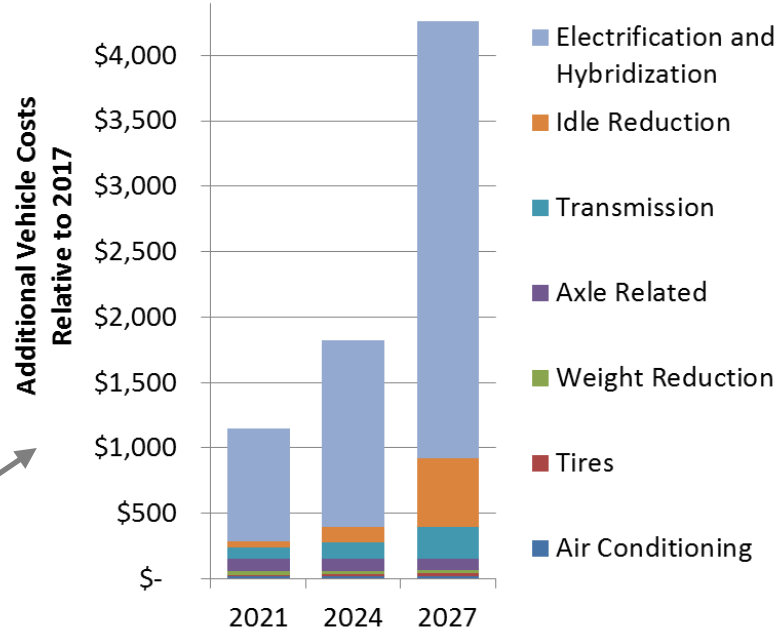
- Game changing solution that allows natural gas medium duty engines to:
  - Match the performance of the donor base engine – same power and torque with a downsized engine solution – 4 cylinder HESI engine matches 6 cylinder diesel engine
  - Improve the fuel economy by 8-10%, resulting in 20% lower GHG emissions vs. base diesel engine (Tank-to-Wheel)
  - In a cost competitive way – 15% product cost reduction compared to diesel engine & after-treatment
  - Meet most stringent emission requirements – lowest US standards thru MY 2027 and CARB Optional Low NOx Standard
- Dramatic technology shift comparable to introduction of gasoline turbocharged direct injection engines in passenger car market
- Concept running on engine test now and in various stages of development with several vehicle and engine OEMs

Performance comparison for HESI 5.2L engine (4 cylinder, 264 hp) vs. 2018 MY 7.XL base diesel engine (6 cylinder)

WESTPORT HESI GHG EMISSIONS

Vs. EPA HD Phase 2 GHG Rules



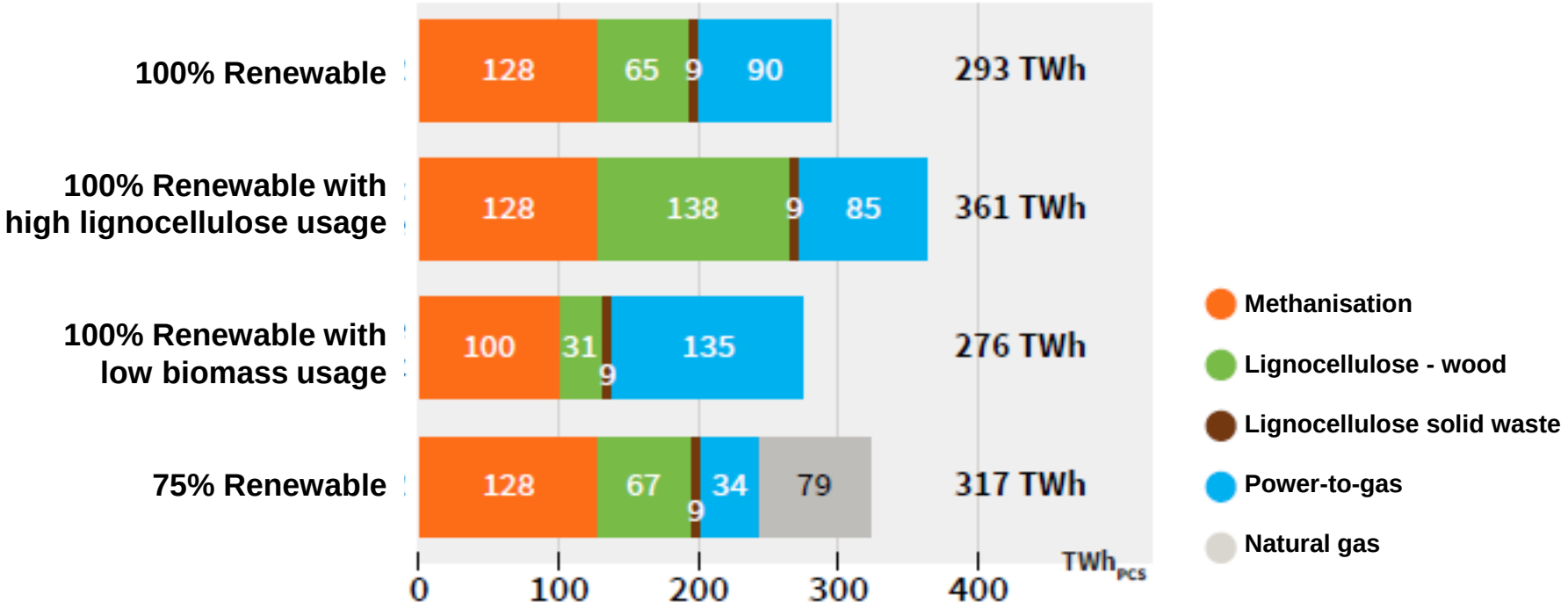


RENEWABLE GAS POTENTIAL

100% Renewable Gas in 2050?*

> In France, up to 460 TWh of renewable gas could be produced in 2050, which would be sufficient to cover 100% of the 2050 gas demand

FIGURE 3: RENEWABLE GAS MIX IN THE FOUR SCENARIOS



> Of this renewable gas, over 100 TWh is expected to be used in the transport sector in 2050

> A 30% share of renewable gas in the grid is realistically achievable by 2030 according to GRTgaz**

** Source: GRTgaz (French gas transport network operator) , January 2018 (http://www.environnement-magazine.fr/energie/article/2018/01/17/116979/consommation-francaise-gaz-augmente-2017.php)

* Source: ADEME study published January 2018 “Un mix de gaz 100 % renouvelable en 2050 ? – Étude de faisabilité technico-économique », accessed from http://www.ademe.fr/sites/default/files/assets/documents/france-independante-mix-gaz-renouvelable-010503.pdf

SUMMARY OF LOWER GHG EMISSIONS WITH GAS TECHNOLOGY INNOVATIONS IN THE TRANSPORT SECTOR

- Reduction of GHG emissions from transport is needed but challenging
- Decarbonizing the trucking sector will require several alternatives, with natural gas being one of the most attractive options
- Next generation of Westport technologies will be as transforming as Westport HPDI 2.0™, already providing 18% Tank-to-Wheel GHG emissions reduction vs. Euro VI diesel today
- Gradually transitioning to a greater share of renewable gas is expected to be an effective and cost-efficient way to decarbonize heavy duty transport

THANK YOU!

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Emerging Gas Technologies for Lower GHG Emissions

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MICH HEIN
CEO, Electrochaea

Emerging Gas Technologies for Lower GHG Emissions

Mich Hein, CEO, Electrochaea GmbH

CleanTech Forum Antwerp - May 16, 2018

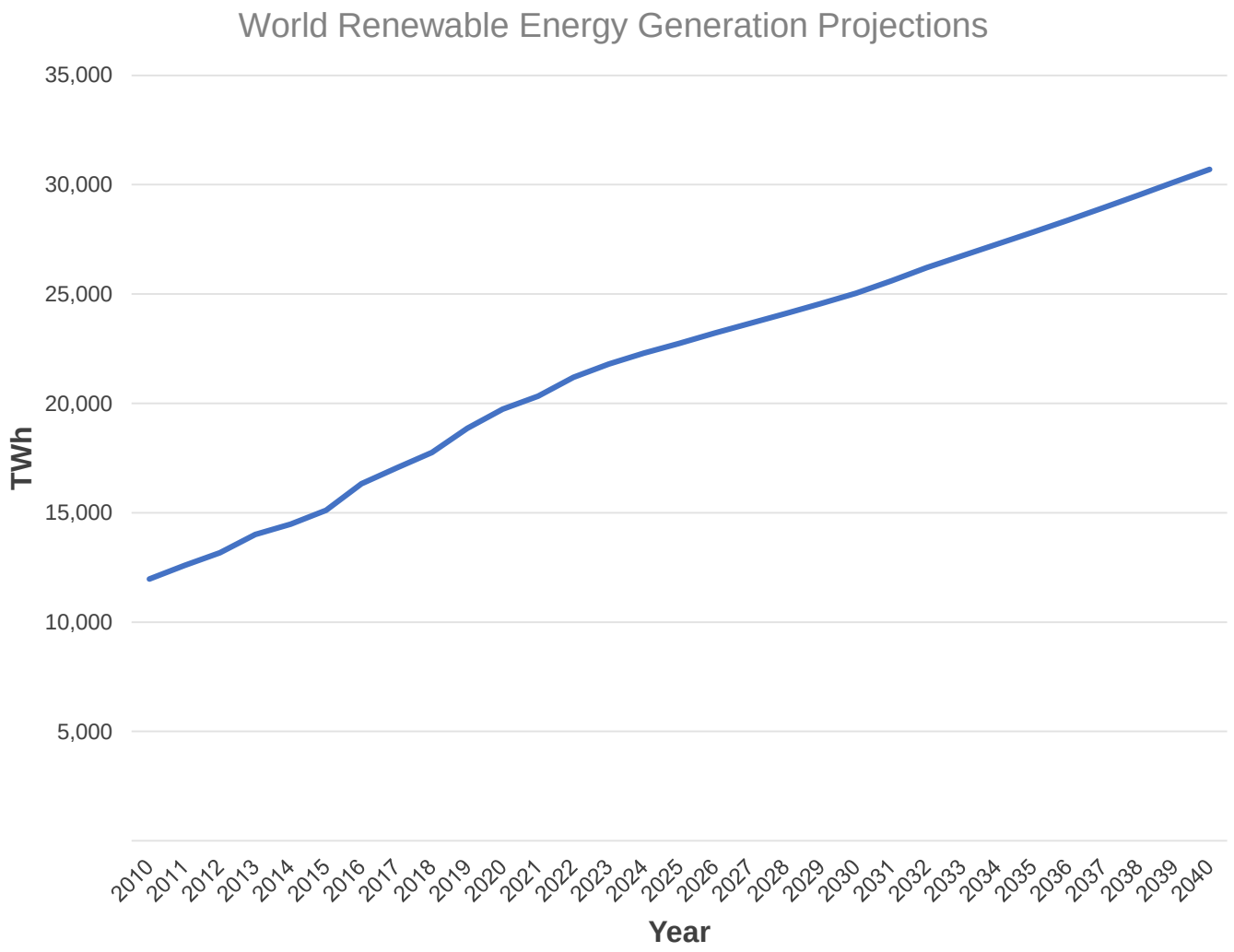
Electrochaea

How much energy can you afford to lose?

What are we doing to lower the world's carbon footprint?

What if methane becomes the perpetual renewable fuel?

Renewable Energy Generation is Growing…

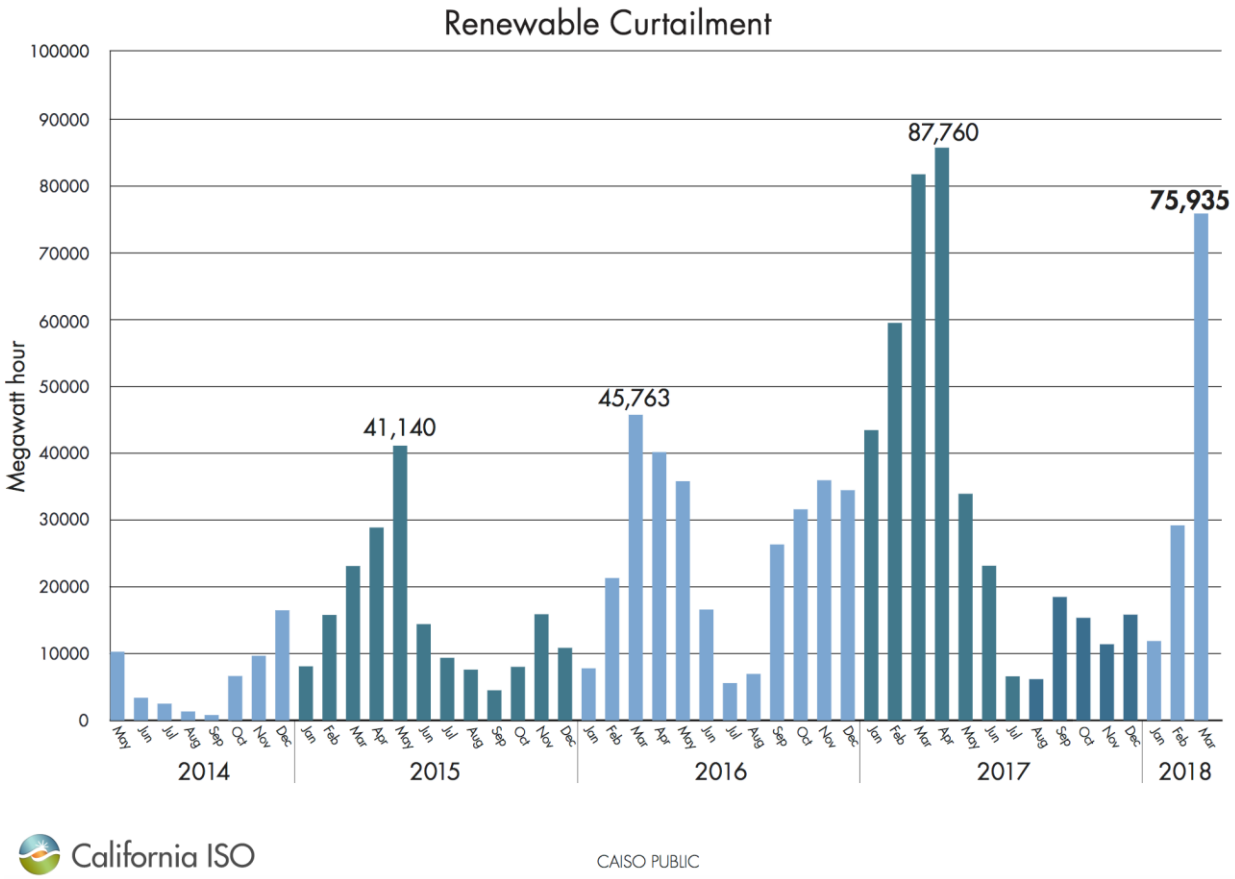


- Growth in renewable power generation will continue near the current rate, (EIA)
- This power is intermittent, not responsive to demand
- Challenges increase with greater renewable energy production

… we need to store it or lose it

Own elaboration from, https://www.eia.gov/outlooks/aeo/data/browser/#/?id=15-IEO2016&region=4-0&cases=Reference&start=2010&end=2040&f=A&linechart=Reference-d021916a.48-15-IEO2016.4-0&ctype=linechart&sourcekey=0
From, http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/the-new-economics-of-energy-storage

How much energy can you afford to lose?



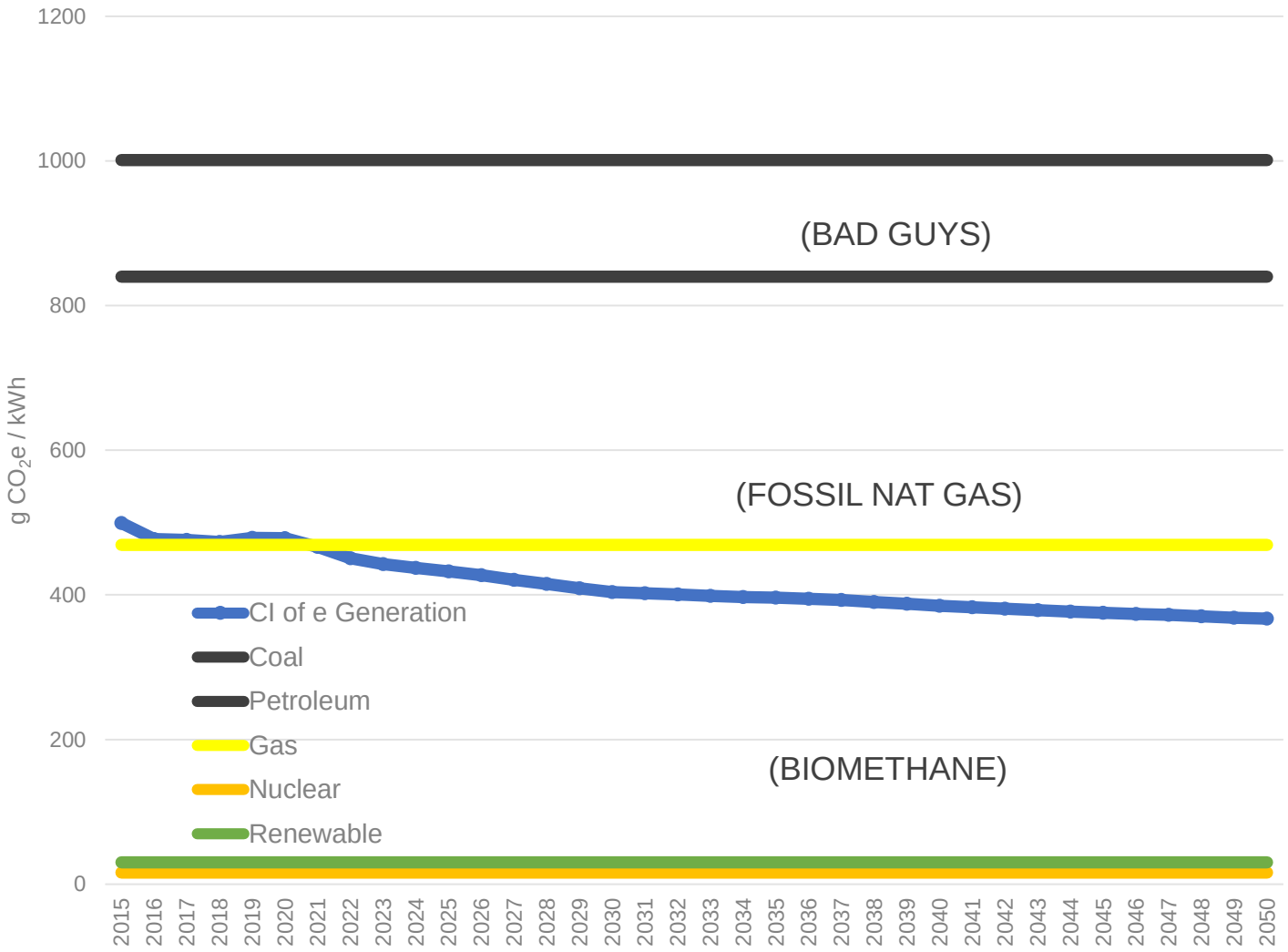
2017 Curtailment:

California ~ 400GWh

Denmark ~ 102GWh

Electrochaea‘s technology allows you to indefinitely store 65% of the currently curtailed energy

Fossil Gas has a limited role as a ‘good guy’

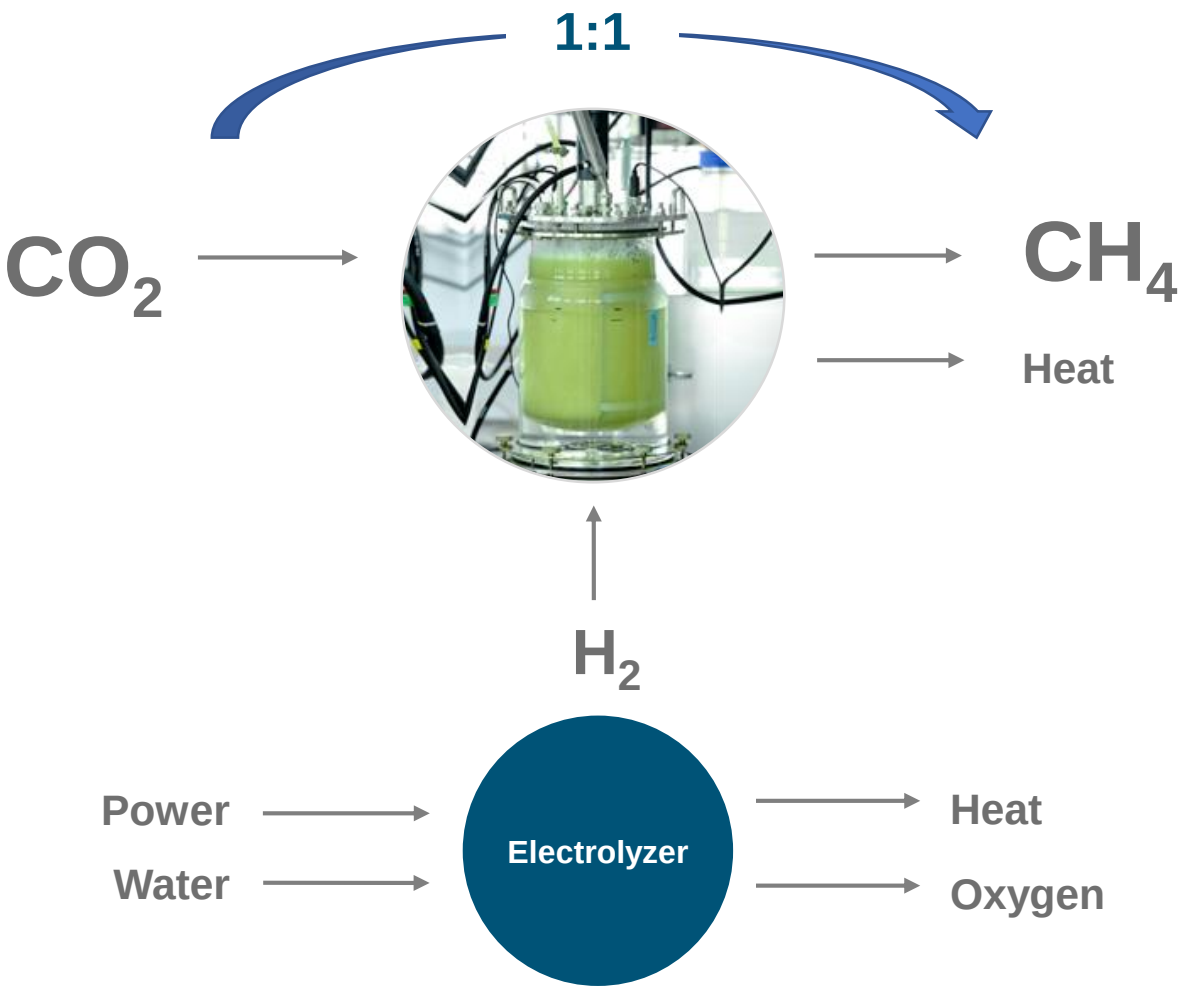


- Carbon intensity of power generation is declining due to renewable energy
- Fossil methane is a good guy until ~2020, then it’s a bad guy (*this is an existential threat to the NG industry*)
- Renewable gas is a good guy for the future
- Renewable natural gas makes GAS GREAT AGAIN!

Own elaboration from, International Energy Outlook 2016, EIA, accessed on 17.08.2017, https://www.eia.gov/outlooks/ieo/
http://www.edwardtdodge.com/wp-content/uploads/2014/11/2014_11_24_CO2-intensity-of-fuels.png
**Own Eleaboration, from IEA, *An assessment of the potential of biogas from digestion in the EU beyond 2020, CE Delft, 2016*

What are we doing to lower the world's carbon footprint?

Electrochaea

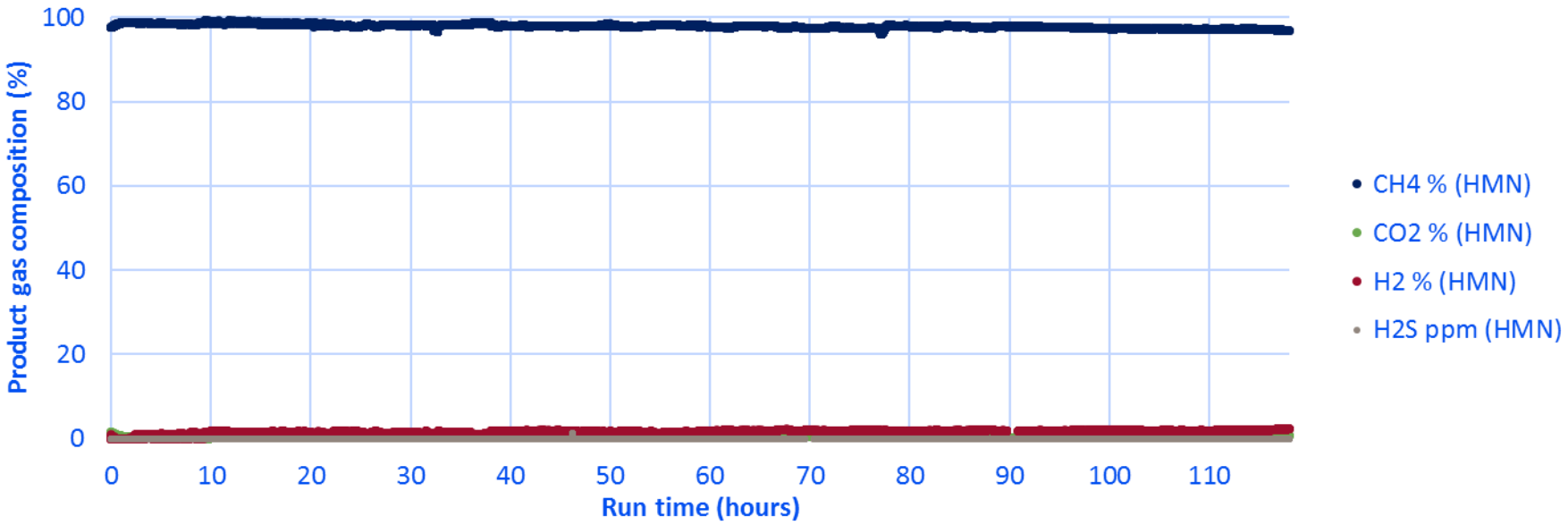


Our archaea transform virtually every molecule of CO_2 into a molecule of methane

They produce high quality gas

Electrochaea

OD: 50 | **pH:** 7.5 | **Mixing energy:** 1.2 kW/m³culture | **Pressure:** 9 bar | **Flows:** H2: 67 Nm³/h & Biogas: 42 Nm³/h



Measurement	Required value for grid injection	Average product gas BioCat
CO2 mole % (Carbon dioxide)	Max. 3,0	1
Methane mole %	Min. 97	97
H_2S (Hydrogen Sulfide) mg/ m_n^3	Max. 5	0
Hydrogen % vol.	Max. 2	2

What if methane becomes the perpetual renewable fuel?

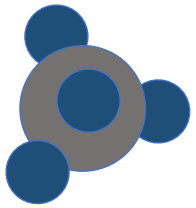
Electrochaea

Germany (2018)
Grid capacity: 300 TWh (28 bil Nm^3)
Value: ~9.6bio€

Denmark (2018)
Grid capacity: 11 TWh (1.0 bil Nm^3)
Value: ~350mio€

California, US (2018)
Grid capacity: 117 TWh (10.6 bil Nm^3)
Value: ~2.5bio€

- Limited capacity
- Limited storage cycles
- Short duration storage
- Fixed installation



- Virtually unlimited capacity
- Unlimited storage cycles
- Long term storage
- Extensive distribution network

Electrochaea eliminates the time factor from the energy storage equation

A 50 MW BioCat System…

Electrochaea

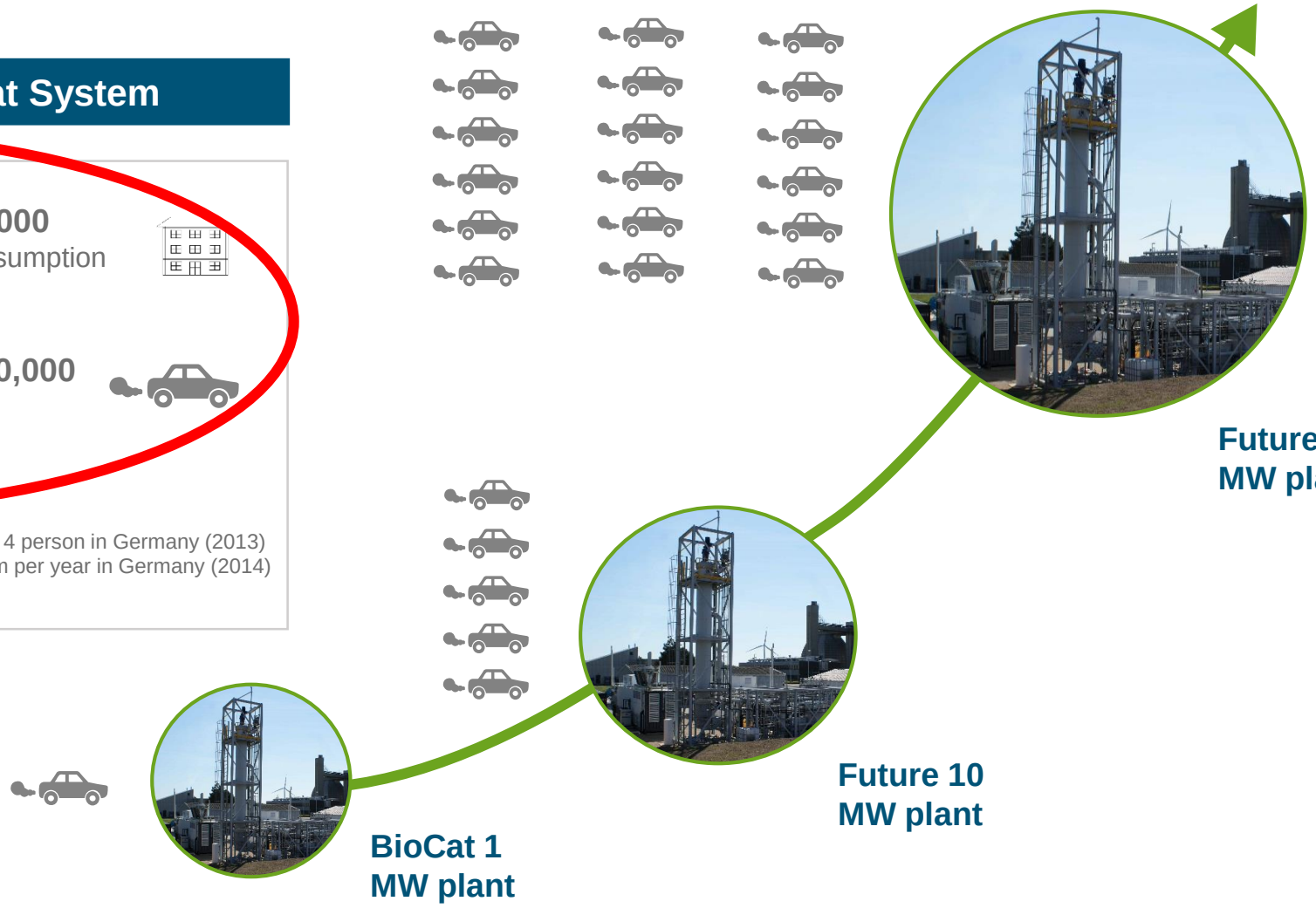
Capabilities of a 50 MW BioCat System

Storing **400 GWh/a** of electrical energy* = More than **125,000** households consumption per year

Achieving a CO_2 sequestration of **37,000 tons/a*** = Emissions of **~20,000** cars per year

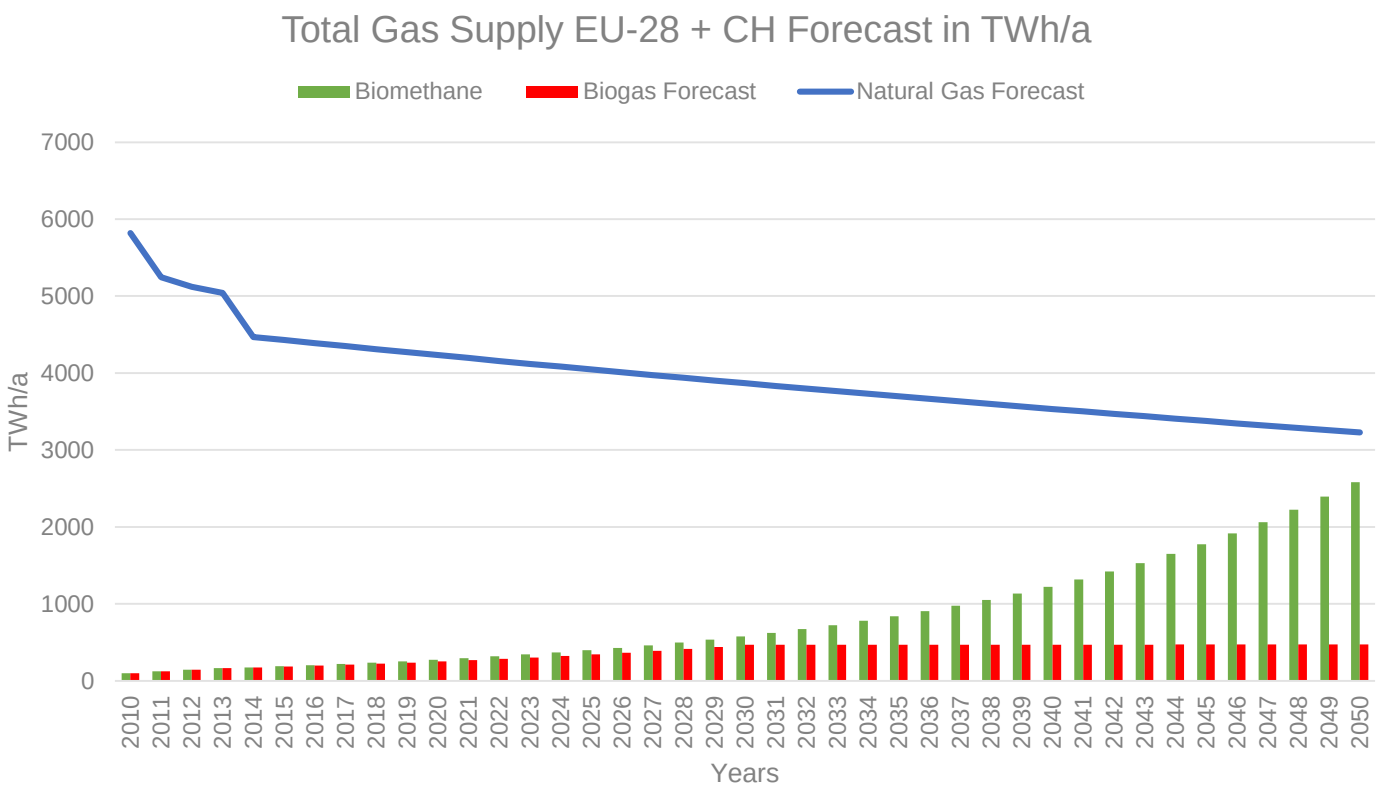
*assumptions:

- Heat and electricity for one year 3,200 kWh in a household with 4 person in Germany (2013)
- 132.6 gr/km emission per car and 14,000 km driving average km per year in Germany (2014)
- 8,000 h/a of operation, electrolysis included



…sequesters 37,000 tons/a of CO_2

The EU Prognosis for renewable gas…



Estimated Market Value of renewable gas products (9.5 €cent/Kwh)			
Product/Year	2020	2030	2040
Biogas	€ 24 bio	€ 44 bio	€ 45 bio
Biomethane	€ 26 bio	€ 55 bio	€ 116 bio

NG Domestic Supply EU: http://www.iea.org/statistics/statisticssearch/report/?country
Biogas Domestic Supply EU: http://www.iea.org/statistics/statisticssearch/report/?country

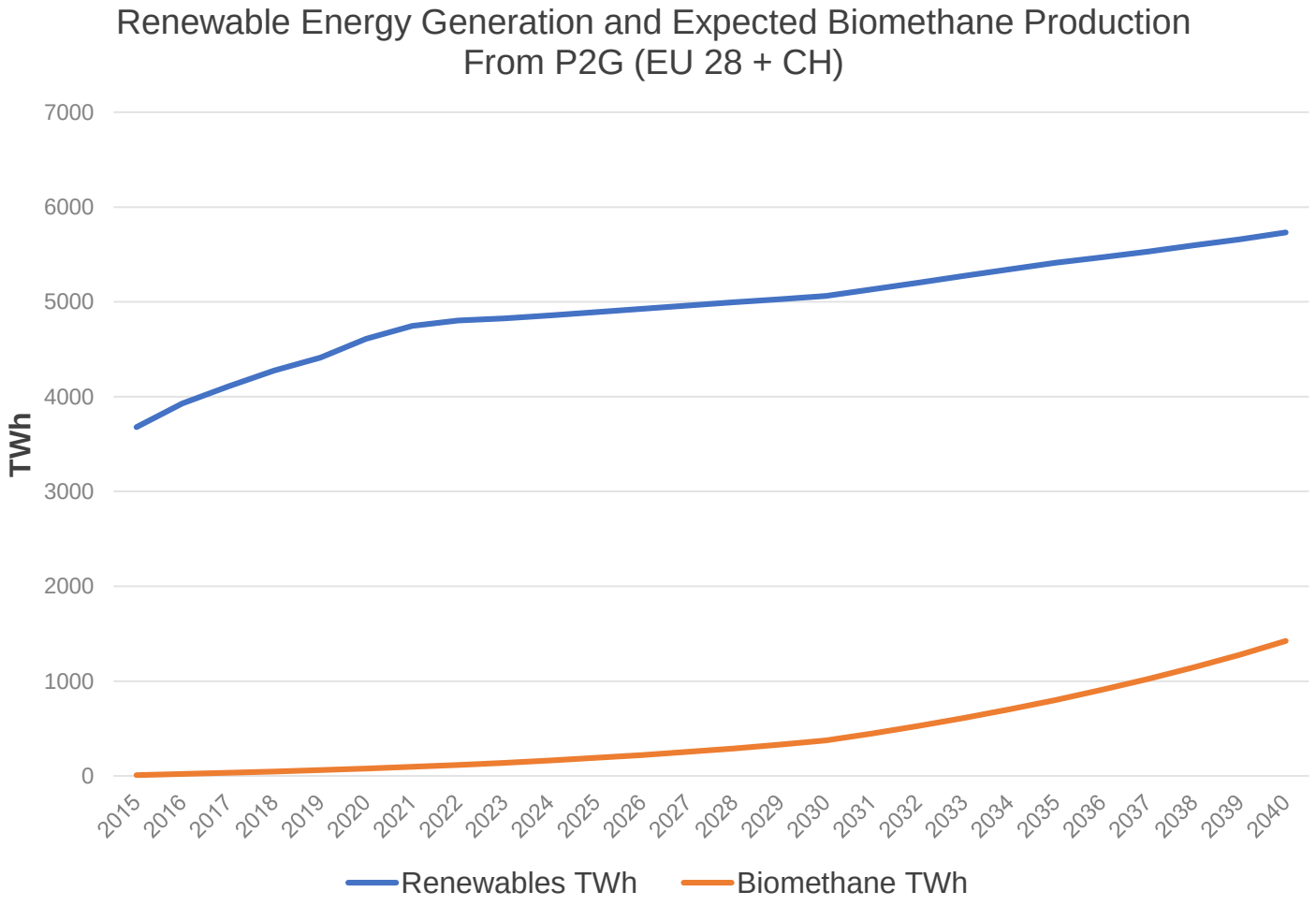
Assumptions

- RNG will replace Natural Gas to fulfill decarbonization policies
- Biogas production is constrained by available biomass
- Biomethane produced by Power-To-Gas with available CO2

2050 Energy Policies	
Country	% Renewable/Green gas
Denmark	100%
Germany	80%
UK	80%
Italy	80%
Sweden	100%
Switzerland	80%
Norway	80%
France	80%
EU-28 + CH	80%

… requires a scalable solution

There is sufficient power…



- Renewable gas target for EU + 28 is less than 10% of renewable power generation through 2035
- Curtailed renewable power can provide capacity for renewable gas in the current power environment

… to charge the grid

Own elaboration from, https://www.eia.gov/outlooks/aeo/data/browser/#/?id=15-IEO2016&region=4-0&cases=Reference&start=2010&end=2040&f=A&linechart=Reference-d021916a.48-15-IEO2016.4-0&ctype=linechart&sourcekey=0
Own elaboration from, Biogas Domestic Supply EU: http://www.iea.org/statistics/statisticssearch/report/?country
*European Gas consumption expected to decline

Addressable markets are large: up to €195 bn by 2030

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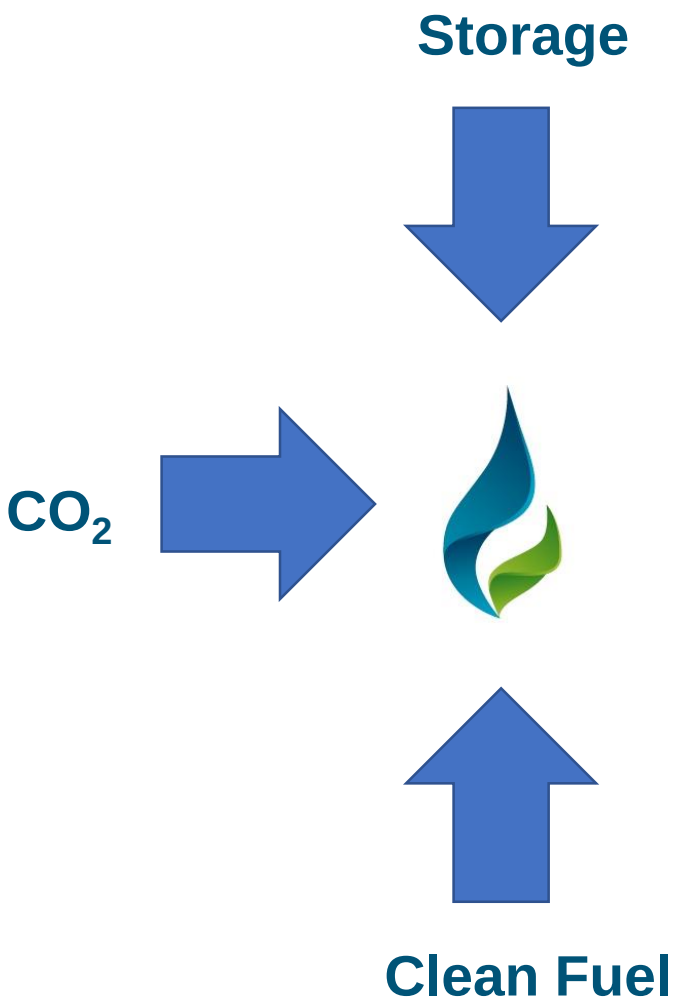

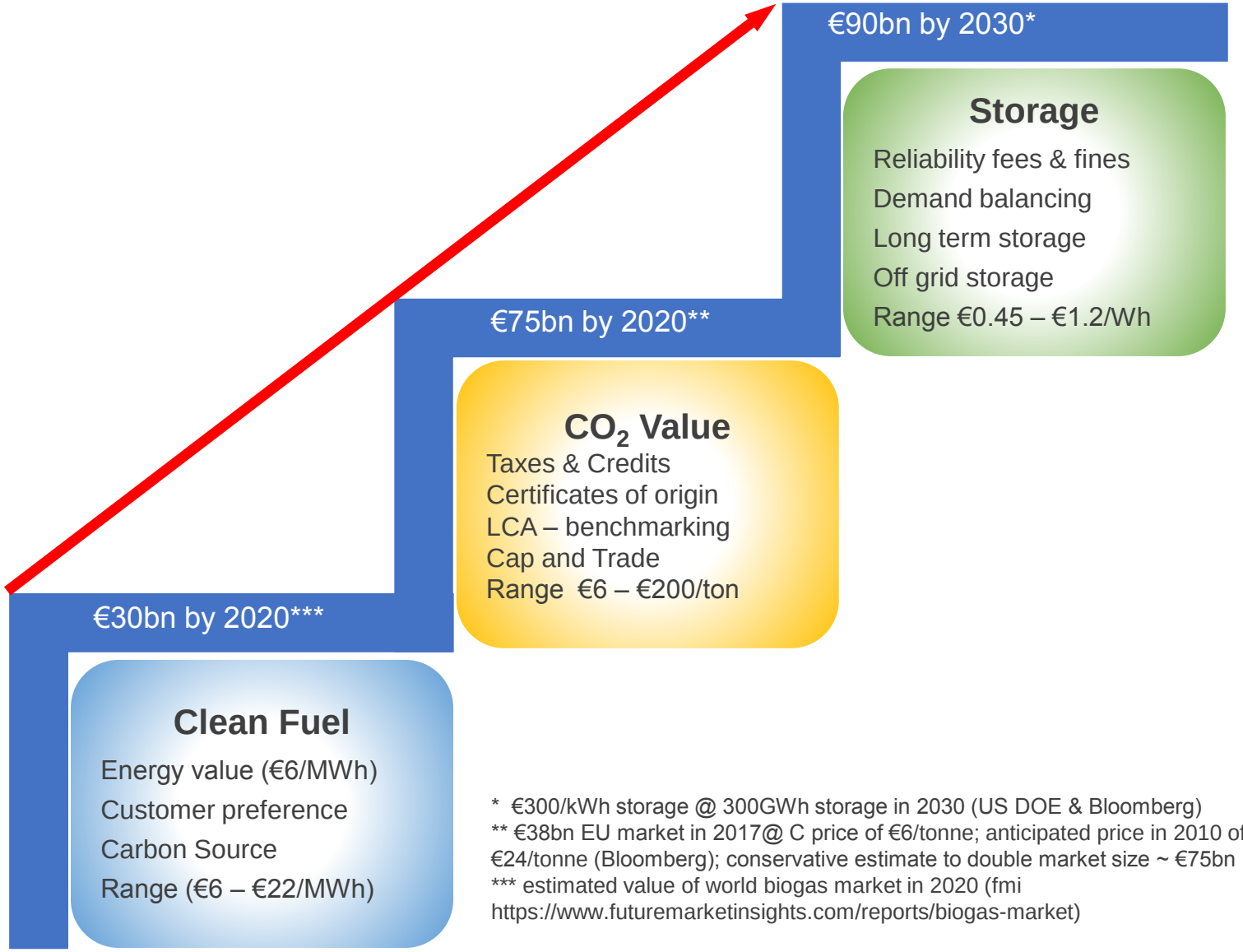

* €300/kWh storage @ 300GWh storage in 2030 (US DOE & Bloomberg)
** €38bn EU market in 2017@ C price of €6/tonne; anticipated price in 2010 of €24/tonne (Bloomberg); conservative estimate to double market size ~ €75bn
*** estimated value of world biogas market in 2020 (fmi https://www.futuremarketinsights.com/reports/biogas-market)

Renewable Gas meets a market need

Electrochaea

- Low carbon gas to fill the grid
- Large scale storage from renewable energy
- Low risk, low cost, long term energy storage
- Opportunities are large, worldwide, growing in size and number– *‘go big, or go home’*

Our Vision

Electrochaea

Electrochaea's Vision Is to Become the Leading Provider of Power-to-Methane Technology for Carbon and Energy Storage

- The time is now and the place is here to invest in this disruptive technology
- Support Electrochaea to reduce the world's carbon footprint!

Experienced Executive Team

Electrochaea

Mich Hein, PhD

Managing Director, CEO

Co-founder and managing partner
at Nidus Partners
Passionate entrepreneur
Raised $70 mn for start-ups

Doris Hafenbradl, PhD

Managing Director, CTO

20 years of experience in biotech, biofuels
and pharmaceutical industries
Expert in hyperthermophilic
archaea

Francesco di Bari

Director of Business Strategy, CFO

24 years of experience in finance, business
development, M&A and change management
Expert in building up and establishing
businesses

Strong Network and Collaborations

Electrochaea

Investors

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b·to·v
Sirius Venture Partners
CALIZA
energie360°
kfw
NIDUS

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FORSKEL

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DBU Deutsche Bundesstiftung Umwelt
POWERSTEP YOUR FLUSH, OUR ENERGY
Energistyrelsen
EUDP
STORE&GO
NREL NATIONAL RENEWABLE ENERGY LABORATORY

Thank you

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Germany

Ausgezeichnete Orte im Land der Ideen
Winner 2017

STEP AWARD
Winner 2017

Start Up Energy Transition Award
Finalist 2017

ECOSUMMIT AWARD
Fame and Fortune for the Best Smart Green Startups
Bronze Medalist 2016

2014 Global Cleantech 100 TOP 100 COMPANY