

# VPGEO: New Digital Energy Information in Eindhoven North Sports Complex

*VanPutten Blue Energy Observatories Inc. and  
AnMar Research Laboratories B.V.*

Why save energy?

VPGEO: creating energy awareness

VPGEO Demo, Eindhoven N. Sports Complex

VPGEO Demo results

Conclusions and Outlook

Climate is one of the most complex systems on Earth with major unknowns

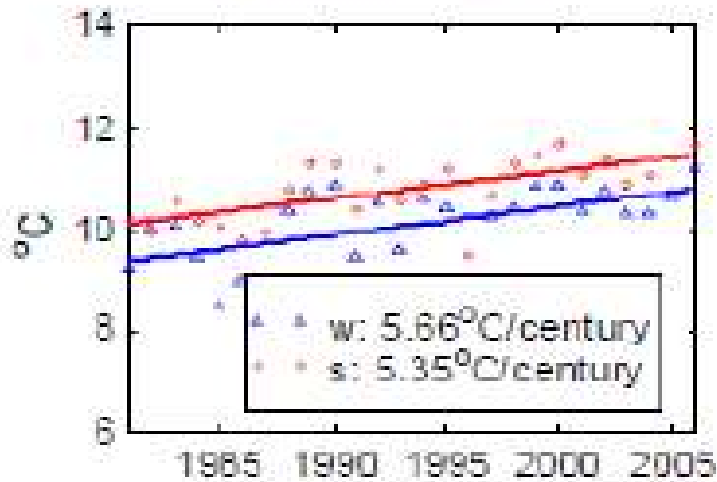
Atmospheric CO<sub>2</sub> is an important factor in the global heat balance

We continue to rely on fossil fuels for some **time to come** (oil price may rise to > 150 USD, Jeff Rubin, "Why your world is about to get a whole lot smaller: oil and the end of globalization")

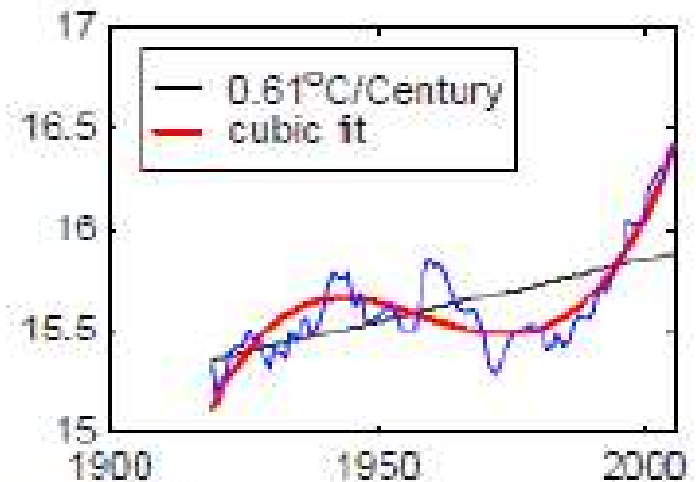
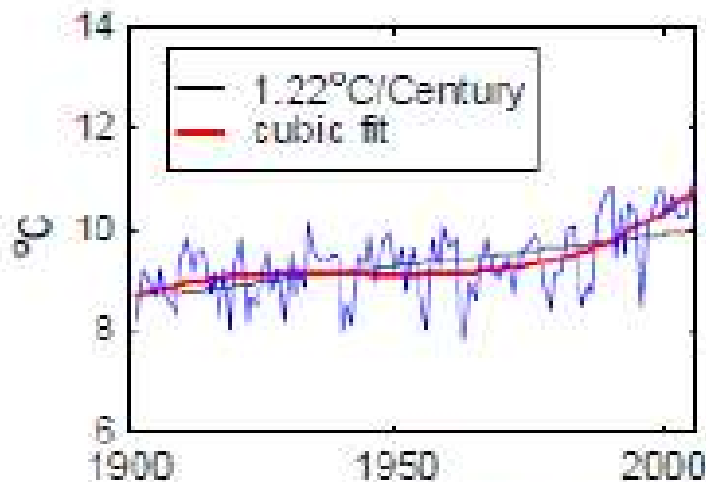
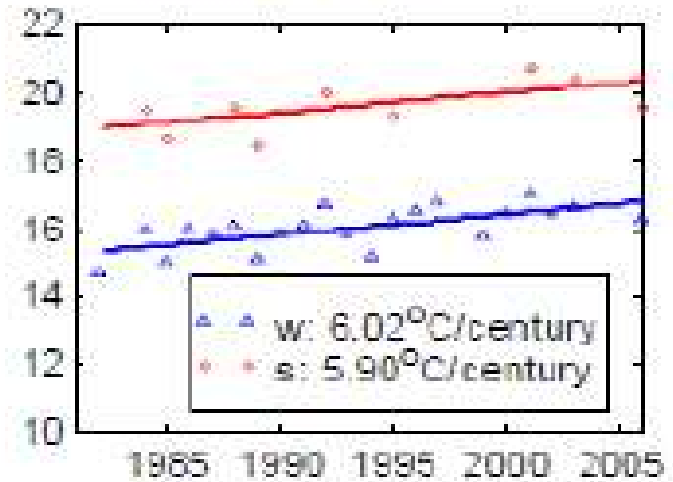
(public data)

Temperature

De Bilt (NL)



Davis (CA)

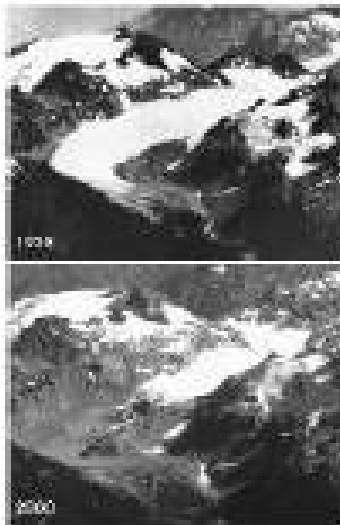
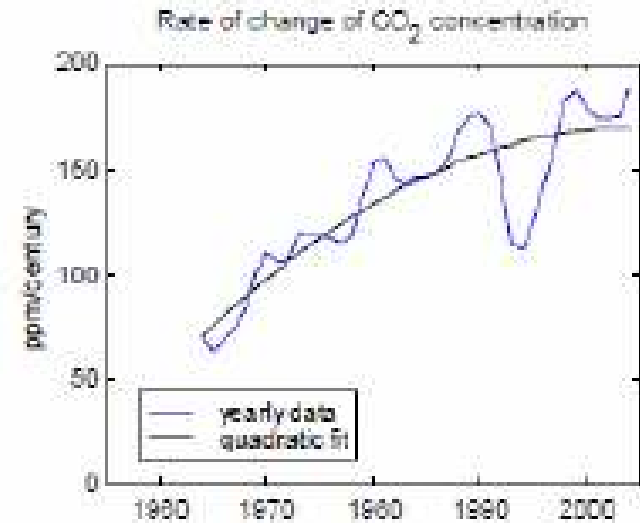
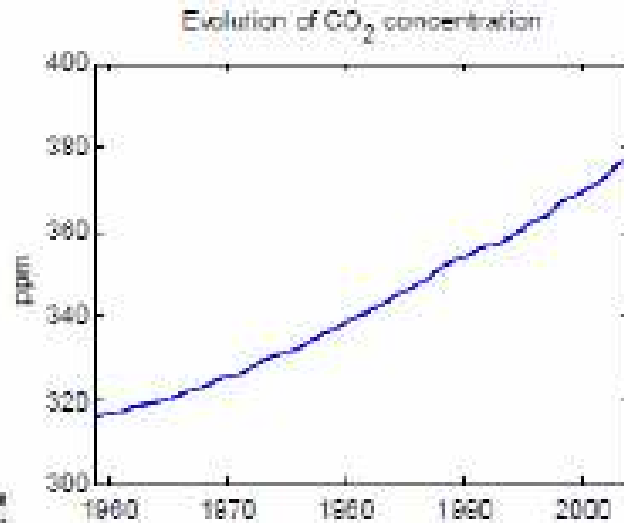


"kink" around 1970-1980

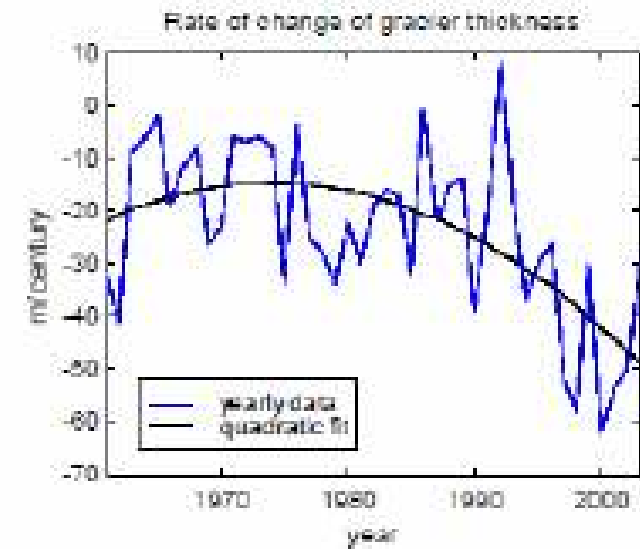
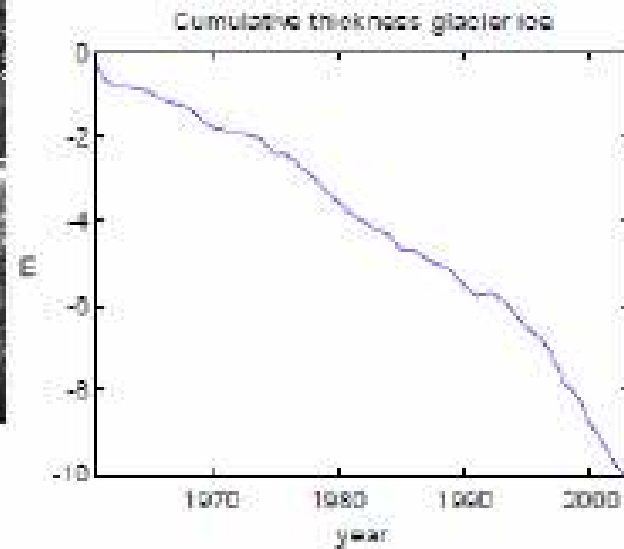
(public data)

# Snapshot of climate observations

Keeling & Whorf  
(Scripps Inst.  
Oceanography,  
2005)



Durgenov & Meier  
(Inst. Arctic and  
Alpine Res., 2004)



There will be no “bailout” for a disturbed  
climate system

Don't gamble, live responsibly

*Be safe*

*Stimulate energy awareness*

*Save energy*

# Roadmap for new energy awareness

## New Information Technology

## Start in Eindhoven

# VPGEO: Embodiment of a new law of heat transfer

## Discovery of linear asymptotic behaviour at micro-Kelvin resolution in a modulated Rayleigh–Bénard chamber

BY MAURICE H. P. M. VAN PUTTEN\* AND ANTON F. P. VAN PUTTEN  
*ANMAR Research Laboratories B.V., PO Box 1200, 5602 BE Eindhoven,  
The Netherlands*

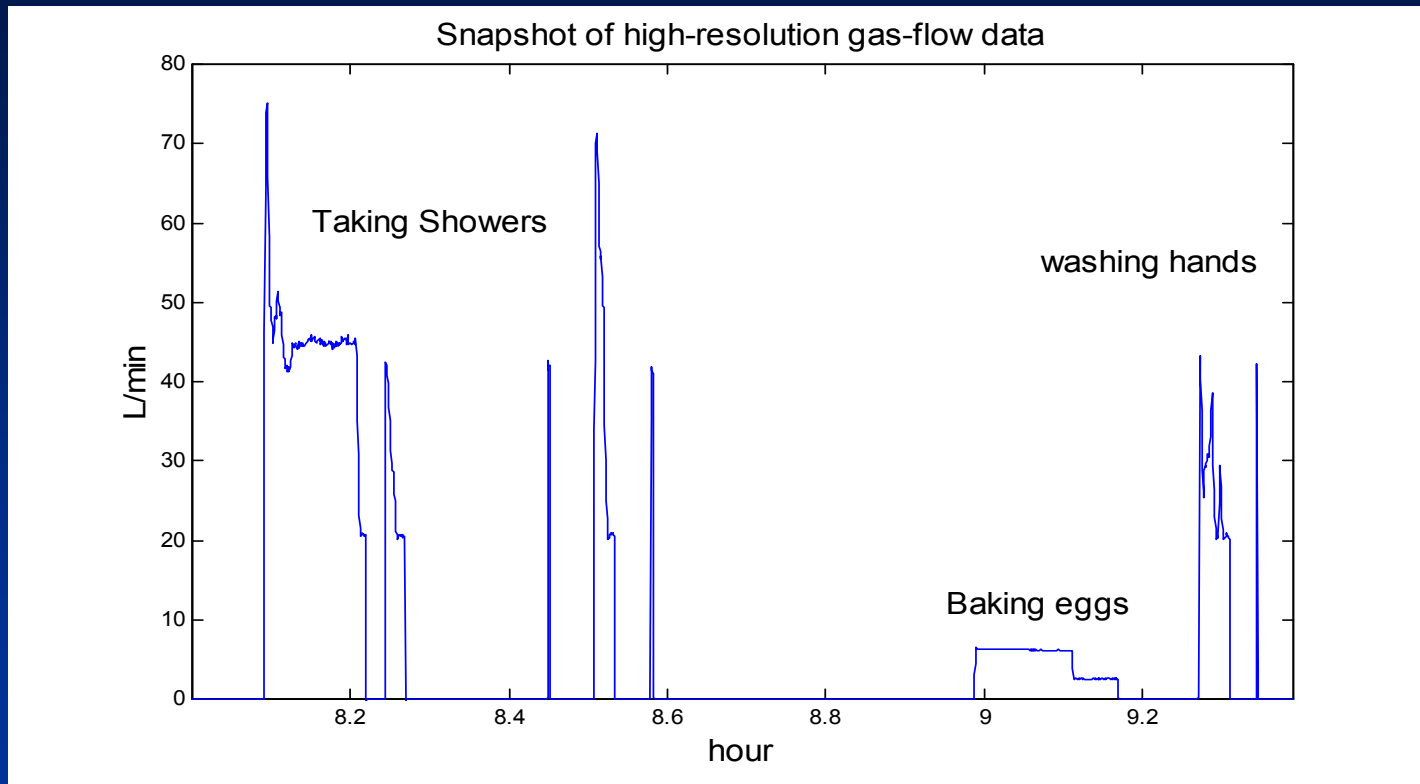
A new experiment is described on heat transfer in a Rayleigh–Bénard chamber modulated by an external flow. The results show a linear response of thermal gradients to small Reynolds numbers, here resolved with micro-Kelvin resolution at room temperature. It approaches a hyperbolic behaviour at large Reynolds numbers. This response is nowhere reminiscent of singular behaviour in boundary layer theory. It may, instead, represent a cellular model for describing heat transfer in porous media. An application to correlating residential gas-energy usage and local weather data is included.

**Keywords:** Rayleigh–Bénard; heat transfer; asymptotic behaviour; thermodynamics anemometry; gas energy-usage; saving energy

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Proc. Roy. Soc. London A , 463, 2495 (2007)

# VPGEO: real-time digital energy information



Van Putten & Van Putten,  
2007, Proc. Roy. Soc.  
London A, 463, 2495

State of California  
Department of Food and Agriculture  
Division of Measurement Standards

Certificate Number: 5554-08  
Page 1 of 2

*California Type Evaluation Program  
Certificate of Approval  
for Weighing and Measuring Devices*

**For:**

Hydrocarbon Gas Vapor Measuring Device  
Model: A01  
G4 – G6 Type  
Maximum flow rate capacity: 10 cubic meters/hr  
Volume display capacity: 99 999.999 cubic meters  
Volume display resolution: 0.001 cubic meters (one liter)

**Submitted by:**

Van Putten-Gas Energy Observatory (VPGEO)  
266 Pearl Street A  
Cambridge, MA 02139  
Tel: (617) 864-7268  
Fax: (617) 864-7268  
Contact: Maurice H.P.M. van Putten Ph.D.  
[info@VPGEO.com](mailto:info@VPGEO.com)

**Standard Features and Options**

Transparent acrylic glass meter casing (Polymethyl methacrylate, PMMA)  
Silicon integrated sensor enclosed in an aluminum chamber  
Two line digital electronic display for flow rate (in liters per minute) and volume (in cubic meters)  
Two permanently attached 90 degree G3/4" union flat F connections (inlet and outlet connections)  
Maximum operating pressure: 130 psig  
Pressure and temperature (PT) compensating  
For indoor installations only  
Optional remote display

This device was evaluated under the California Type Evaluation Program (CTEP) and was found to comply with the applicable technical requirements of California Code of Regulations for "Weighing and Measuring Devices." Evaluation results and device characteristics necessary for inspection and use in commerce are on the following pages.



Effective Date: April 14, 2008

Edmund E. Williams, Acting Director

VPGEO measures normal volume within -3% +1.5% (Handbook 44 of NIST)

Intrinsic PT compensation

Designed for G4-G10

Dutch National DTe norm: +/- 7% bellow meters with no PT compensation

Typical overpayment: 6% (420 M Euro/yr nationwide)

# Applications

Homes / Energy Label

Restaurants

Sports Complexes

Your home or business

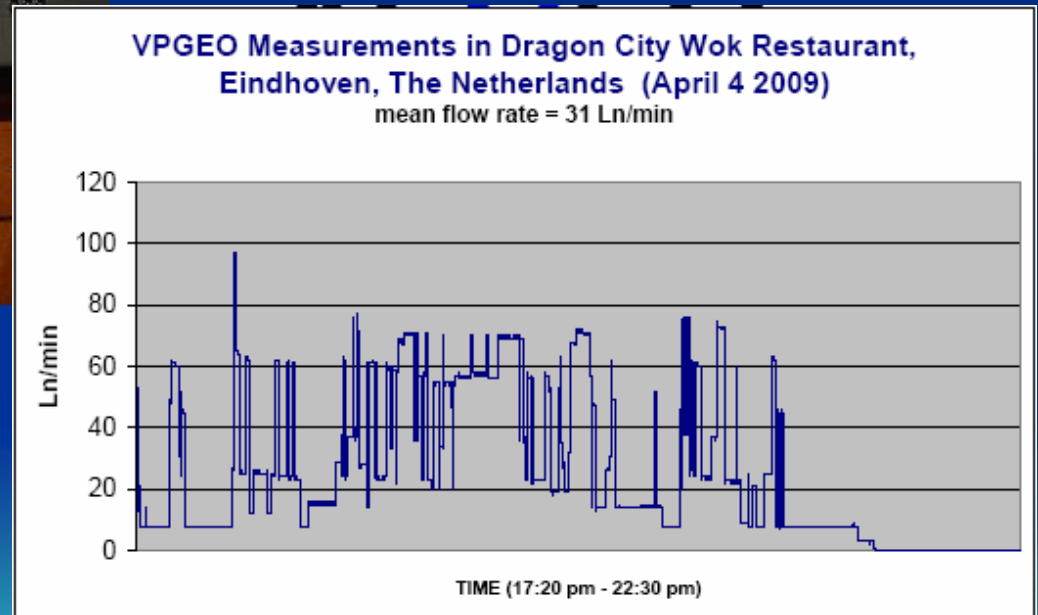
*Spin-off:* Hydrogen metering



# VPGEO in a Wok Restaurant



Ln=normal liters,  
compensated for  
temperature and pressure



- digitale gasmeter brengt besparing -

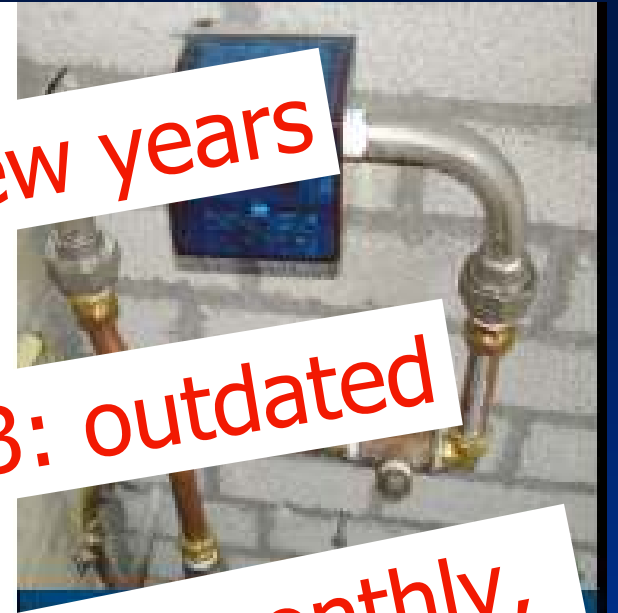
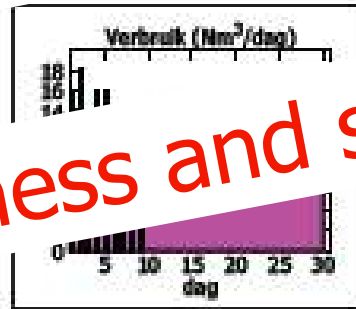
## Weer wereldprimeur

Eindhoven was de eerste stad die met digitale gasmeters is uitgerust. Het is dat nu ook met digitale gasmeters. 'Deze nieuwe gasmeter spaart de clubs en onszelf veel geld, dus die heb in een paar jaar terug verdiend', zegt projectmanager Henny Beekwilder trots. 'Want ik merk al wel een zuiniger energieverbruik.'

Het milieu wordt ontlast, de meters rekenen loemp... meters, ze zijn druk- en temperatu... op een monitor... midden in de... chroomstaal va... kunt besparen... na 5 dagen... Toen bleek dat de... was blijven staan. Kijk, zo zie je nog eens wat, want je... nu pas ziet waar het probleem zit, aldus de sportparkbeheerder

'Het is toch logisch dat de halgenmeter uit 1843 met zijn hopeloo... nooit netjes kan meten? Dat is precies wat je alle... discussies met de clubs meer over... stuk aardiger zijn...

... met een bos  
... van Putten  
... van AnMar Research  
... de gemeente Eindhoven de crux van zijn  
... de VPGEQ, exact ingezien: dagelijks bemaat...  
... afleesbaar: 'Men krijgt voor het eerst e...  
... verbruik per dag en ne...  
... heid'. Inderdaa...  
... Zo heeft Eindh...



Return on investment: few years

Bellow meters since 1843: outdated

Fair and accurate metering, daily, monthly, conveniently via Internet

Energy awareness and sustainability

# VPGEO-G10 in Eindhoven North Sports Complex

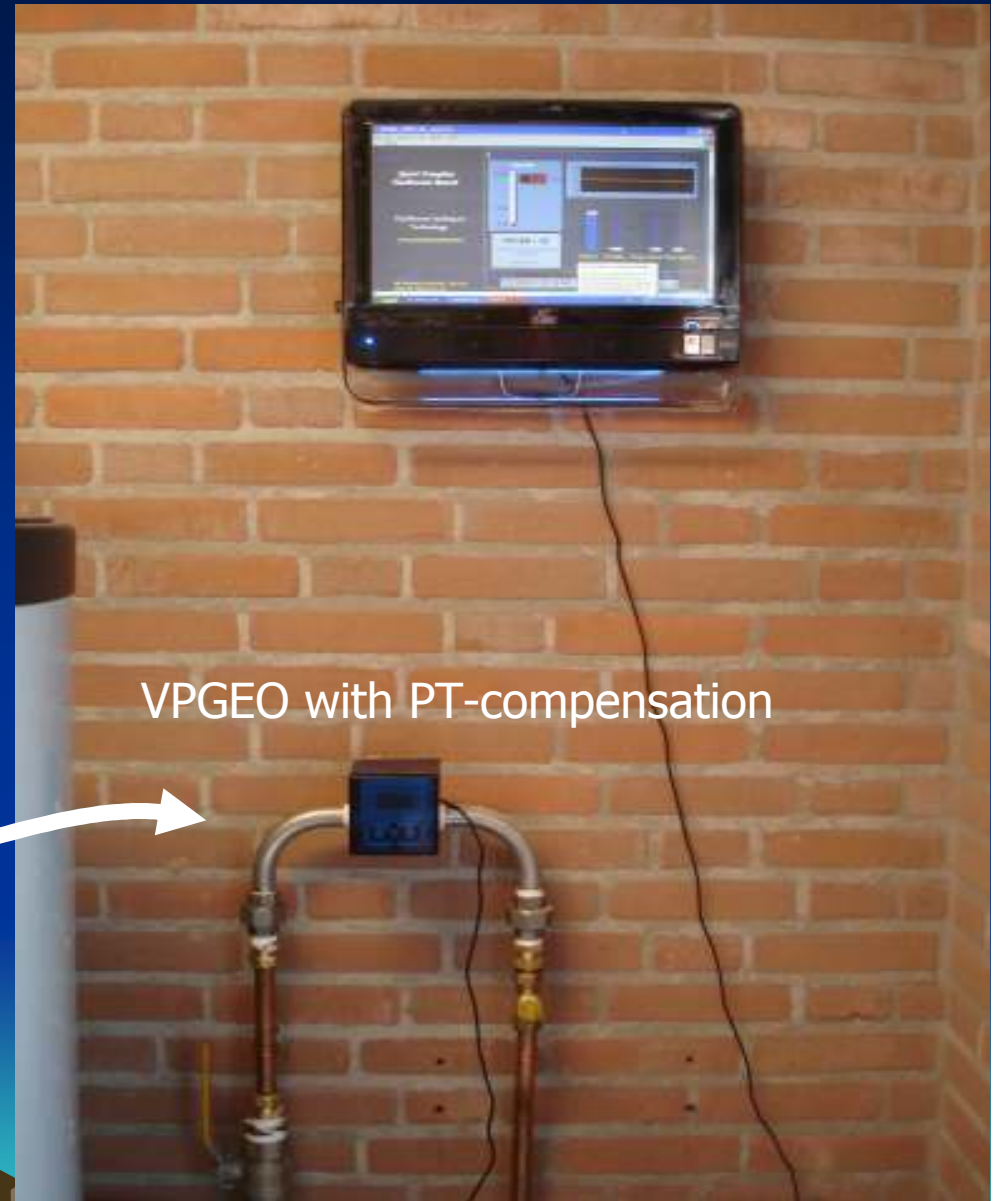
*Direct Savings: 10% by accurate reading*

Bellow meter at 30 degrees Celsius  
with no T-compensation



Replaced!

VPGEO with PT-compensation



Past (since 1843)

VPBEO Inc. - ARL B.V.

Present

# VPGEO Data via Cloud Computing

Measuring of gas-energy usage and outside temperature

Real-time local energy monitoring on a Dashboard at 1 Hz

Remote reading and billing monthly

Calculating VPGEO Views in \*.pdf sheets

Calculating Home Energy Efficiency every day, week or month

Compare energy usage and efficiency across different tenants

Distribute information to selected users and administrators in \*.csv

Automatic monthly payments (PayPal, ...)

***Heterogeneous and distributed data  
processing: ideal for a new Cloud***

# The Power of Cloud Computing

100% scalable in size, to millions of computing nodes

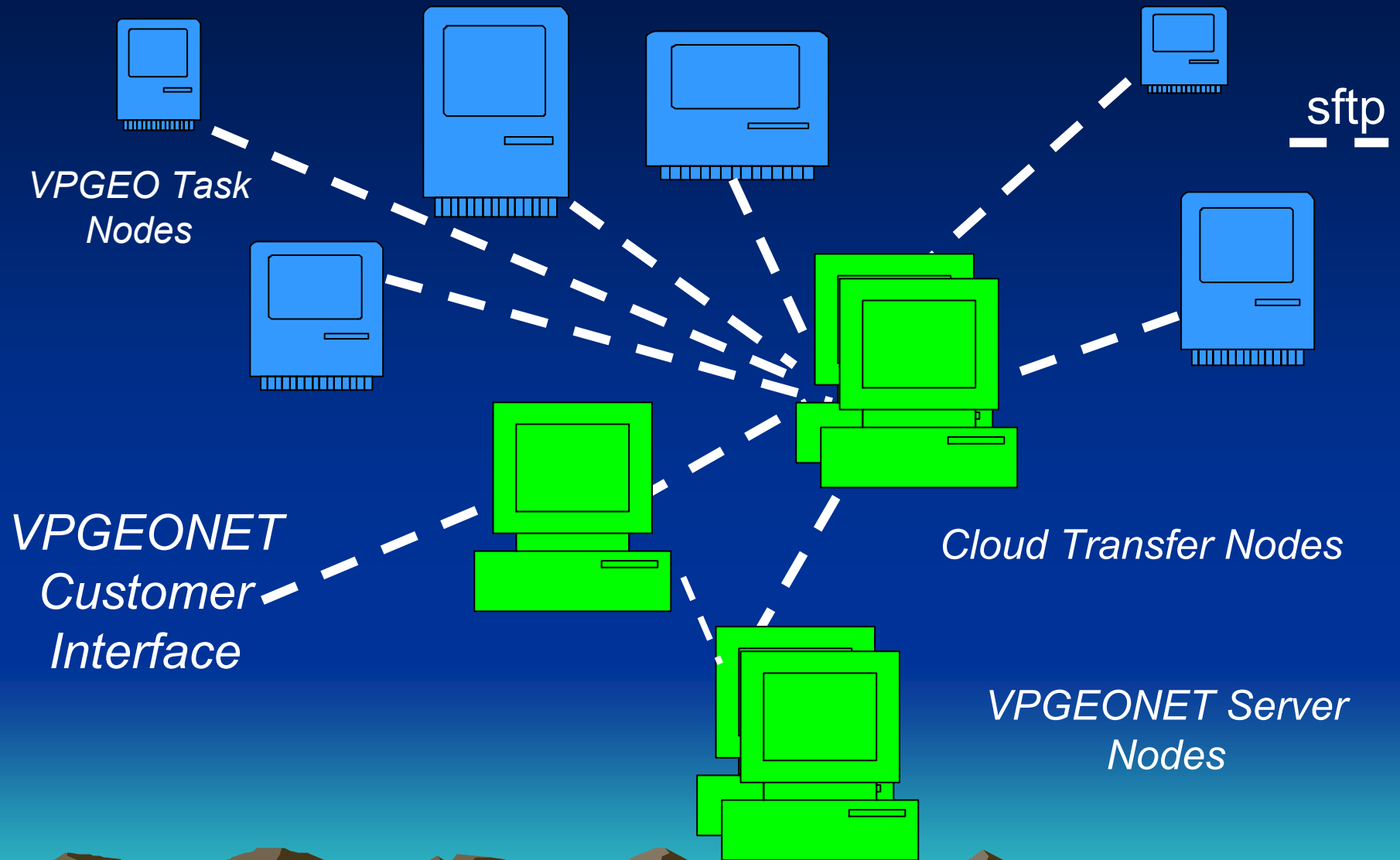
Infrastructure for heterogeneous computing

On-the-fly connections between nodes at different locations with a diversity of software applications and data

24/7 and recurrent processing of real-time data

Distinct from centralized services (SaaS) and a radical departure from the “all-in-one-box” Turing Machine architecture

# VPGEONET Cloud Architecture (schematic)



VPGEONET  
Customer  
Interface

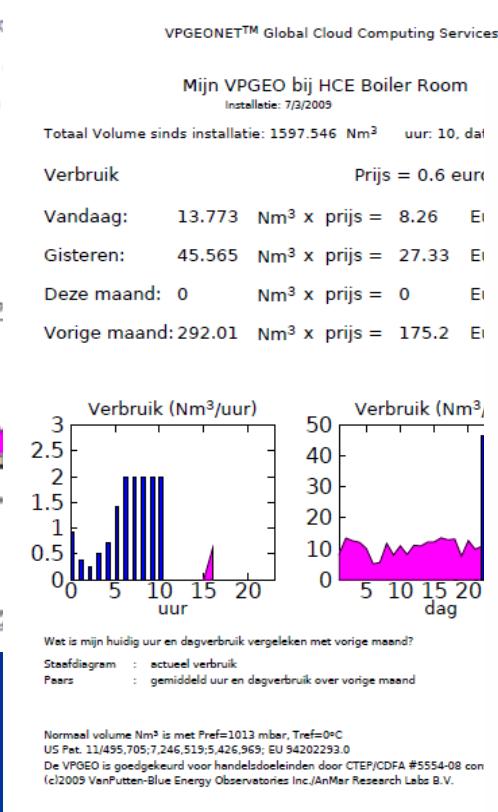
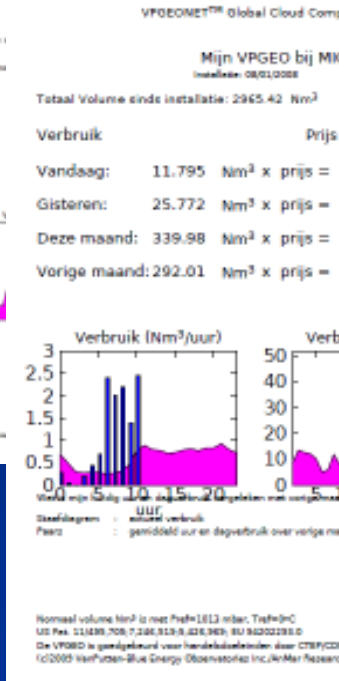


ARL

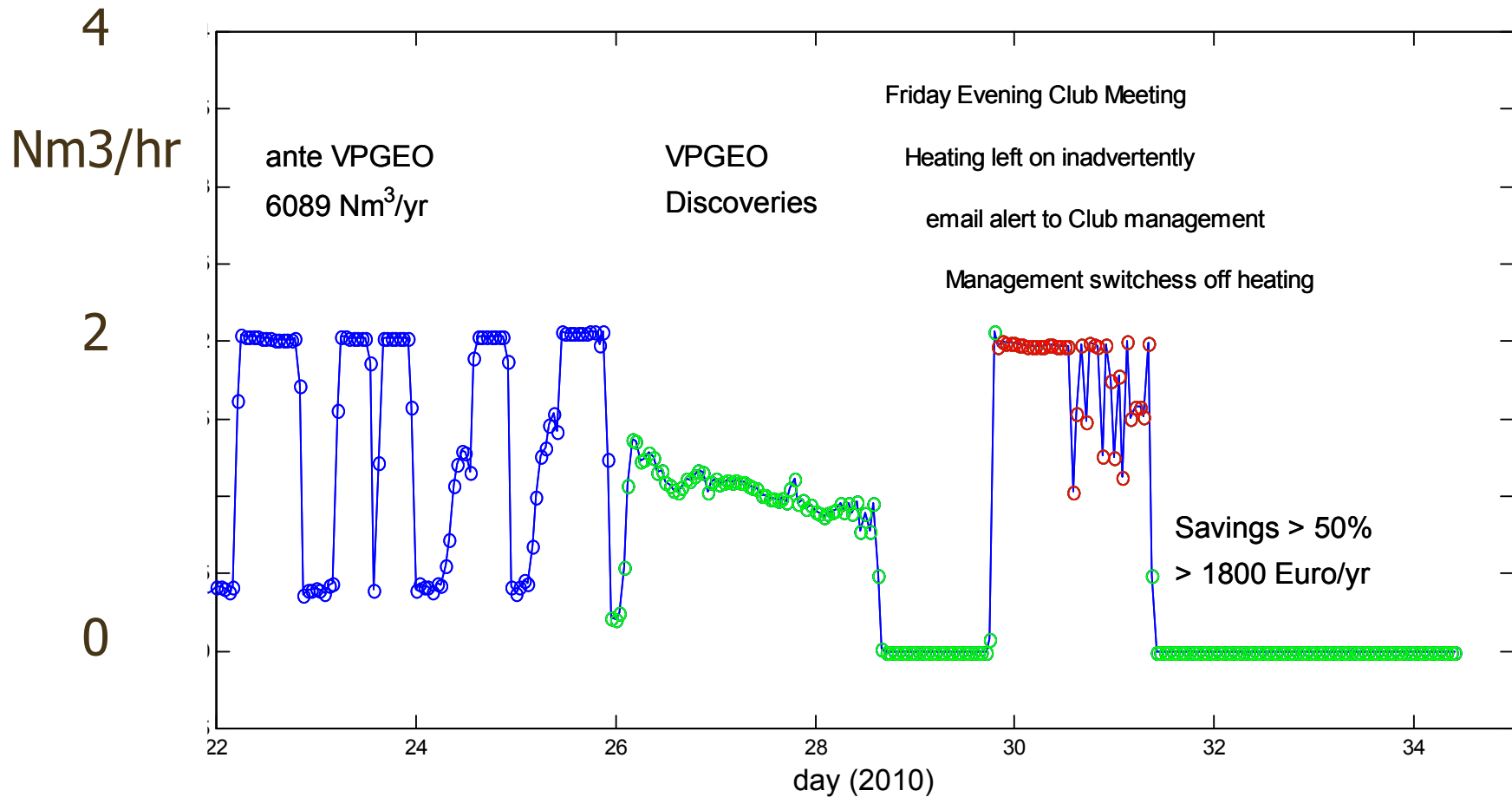
Enschede

HCE Boiler Room

HCE Club House



# VPGEO: Saving energy in HCE Club House



# Results for HCE Club House

Discovery of 24/7 heating of Meeting Room

Discovery of multiple 'hidden radiators'

Planned installation of thermal control on radiators

Energy usage limited to weekend meeting: direct savings = 2/7

Return on investment: 1 year

VPGEONET™ World Wide Cloud Computing Services

Mijn VPGEO bij HCE Club Huis

Installatie: 10/21/2009

Totaal Volume sinds installatie: 2723.922 Nm<sup>3</sup> uur 11, datum 2/3/2010

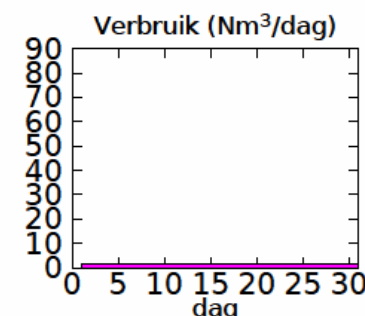
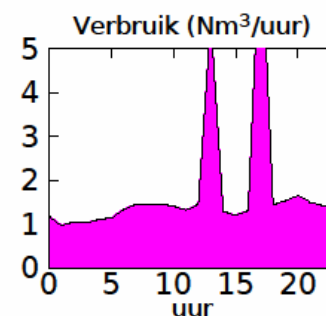
Verbruik Prijs = 0.6 euro/Nm<sup>3</sup>

Vandaag: 0 Nm<sup>3</sup> x prijs = 0 Euro

Gisteren: 0 Nm<sup>3</sup> x prijs = 0 Euro

Deze maand: 0 Nm<sup>3</sup> x prijs = 0 Euro

Vorige maand: 958.45 Nm<sup>3</sup> x prijs = 575.06 Euro



Wat is mijn huidige uur en dagverbruik vergeleken met vorige maand?

Staafdiagram : actueel verbruik

Paars : gemiddeld uur en dagverbruik over vorige maand

Normaal volume Nm<sup>3</sup> is met Pref=1013 mbar, Tref=0°C

US Pat. 11/495,705; 7,246,519; 5,426,969; EU 94202293.0

De VPGEO is goedgekeurd voor handelsdoeleinden door CTEP/CDFIA #5554-08 conform Handbook 44(NIST)

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# Relevance to Kyoto Protocol

Agreed CO2 reduction: 2% per year

Mean for homes in NL: 2000 Nm<sup>3</sup>/year

Planned savings (2%): 40 Nm<sup>3</sup>/year

HCE Club House savings: 3000 Nm<sup>3</sup>/year

HCE Club House savings equivalent to **75** homes meeting the planned Kyoto savings

# Archive Data

## LAST\_MM\_DATA

1712815	0	0	3	1	1	2010
1712815	1	0	0	1	1	2010
...						
...						
2723925	22	0	2	1	31	2010
2723925	23	0	3	1	31	2010

## THIS\_YY\_DATA

2723925	0	0	3	2	1	2010
2723925	1	0	0	2	1	2010
...						
...						
2723922	10	0	3	2	3	2010
2723922	11	0	2	2	3	2010

## LAST\_YY\_DATA

...						
...						
1712815	22	0	3	12	31	2009
1712815	23	0	2	12	31	2009

## THIS\_YY\_DATA

1712815	0	0	3	1	1	2010
1712815	1	0	0	1	1	2010
...						
...						
2723922	10	0	3	2	3	2010
2723922	11	0	2	2	3	2010

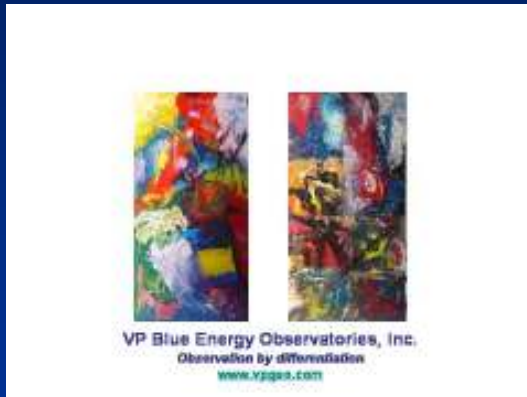
**Black Box Data:** per second, hour, day, month, year

A low-angle, upward-looking photograph of a modern glass skyscraper. The building's facade is composed of a grid of dark window frames, each reflecting the bright blue sky and scattered white clouds. The perspective creates a strong sense of height and scale. The text "Thank you!" is centered in the middle of the image in a clean, white, sans-serif font.

Thank you!

# Who we are

**The VPGEO Project is a joint-venture of VPBEO Inc., ARL B.V.**



VPBEO Inc. is a start-up in Cambridge, MA, USA, led the development of the VPGEONET World Wide Cloud (WWC) Operating System, the US Patented Home Energy Label and the world's first digital gas-energy meter approved for use in commerce by a Notified Body (conform NIST Handbook 44) (est. 2008)



ARL B.V. is a fluid dynamics research lab in Eindhoven, NL, introduced the world's first silicon flow sensor, and is a leader in experimental fluid dynamics and computerized calibration equipment (est. 1974)

and additional sub-contractors

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