



Challenge electric vehicles, enabler or barrier for smart grid?

G4V- Grid for vehicles: Results

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London




Outline



- Overview of the G4V project
- Main results of G4V
 - Effect of the EV charging process in real grids
 - V2G from different points of view
- Conclusion: EV: enabler or barrier for Smart Grids?





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The G4V consortium



12 partners from eight countries



Energy utilities







Scientific partners





North

Central



South









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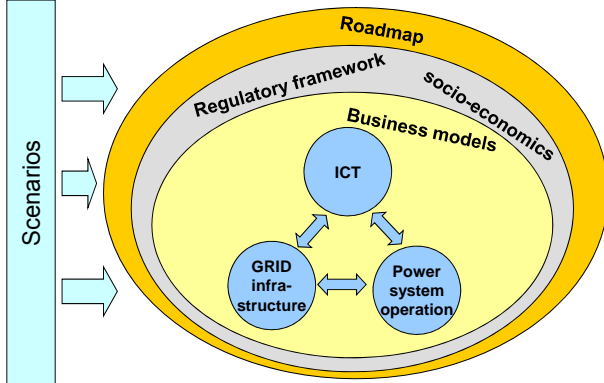



Overview – the G4V-project



time-horizon: 2030 and beyond

Key – Question:
 What needs to be started now in order to enable a mass market of EV?





- technical issues
- legal framework
- business model
- customer convenience
- environmental aspects


↓

Recommendations

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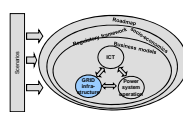
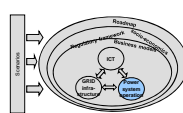
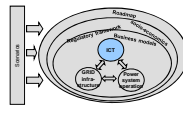
Key questions addressed in G4V...(I)





- What impact on the grids can be anticipated for a large number of EV's?
 - critical grid assets
 - potential problems (overloads, voltage violation,...)
 - influencing parameters (location of CIS, connection power,...)

- How could different charging strategies look like?
 - centralised vs. decentralised approaches
 - rather simple vs. more sophisticated strategies
 - different objectives: technical driven (e.g. congestion management) vs. market driven (e.g. aggregation for reserve markets)


- What is the most suitable (functional) ICT?
 - requirements depending on charging strategies, business cases as well as customer convenience
 - data privacy and security issues

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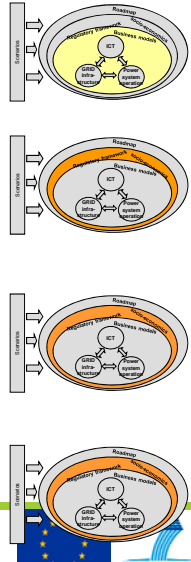



Key questions addressed in G4V...(II)




- How will the business world be affected by EV'S?
 - new products and services
 - new business models
 - new stakeholders vs. traditional stakeholders
- What is the potential impact of EV's on the generation mix?
 - integration of Renewables
 - avoidance / reduction of wind-curtailment
 - potential for CO2-reduction
 - dispatching
- What are the costumers' views on EV's?
 - expectations, needs and concerns
 - behaviour and willingness to participate in particular charging schemes (incentivation)
- Is the regulatory framework enabler or barrier for an evolving EV market?

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SEVENTH FRAMEWORK PROGRAMME

Work Plan



WP1: Scenario writing (RWTH)

WP2: Value chain analysis and business modeling (TU DO)

WP 3:
(Imperial)
Economic,
environmental
regulatory and
social aspects

WP 4:
(Endesa)
Analysis of ICT
solutions


WP 5:
(Enel)
Analysis of grid
infrastructure

WP 6: (EDF)
Analysis of
impacts &
opportunities
in power
system
management

WP7: System analysis and definition of the road map (UPV)

WP8: Project dissemination (RWE)

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SEVENTH FRAMEWORK PROGRAMME

Scenarios set the framework of the market development



Topic	Conservative World	Pragmatic World	Advanced World
Charging control	No	Yes, simple charging control	Yes, complex charging control
Prices	As today	Dynamic tariffs	No limitation
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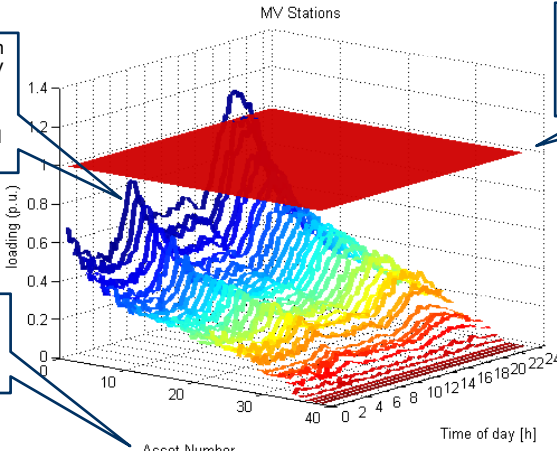
Effect of EV charging process in real grids

Simulation results: example



For each combination of EV penetration and scenario world:



Load profile per unit in a day for every MV/LV transformer (respect the rated power) and line (respect the rated current)

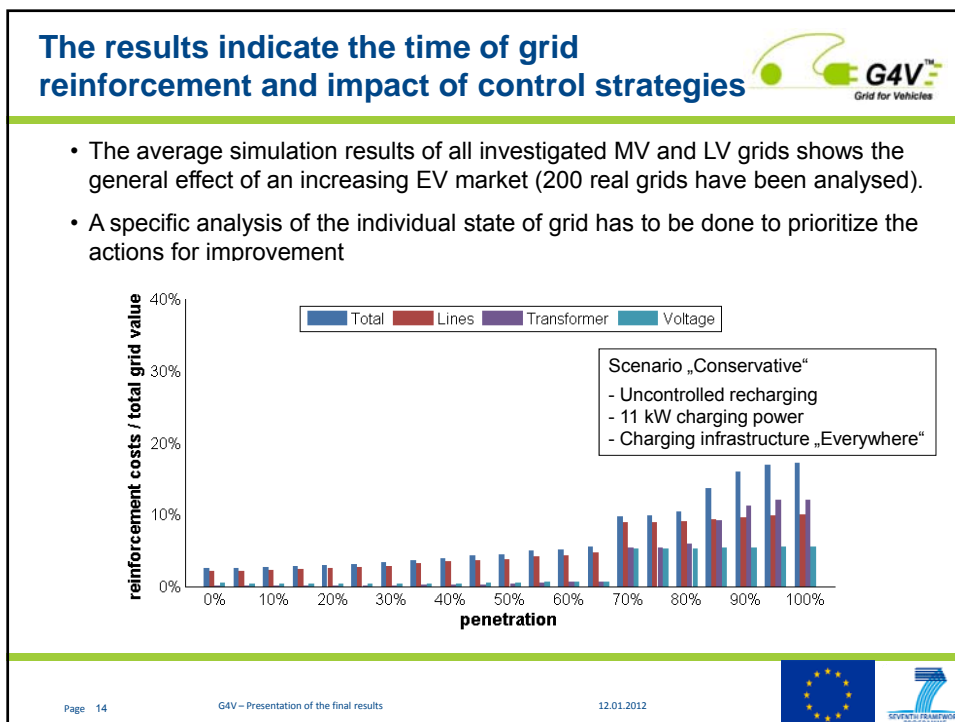
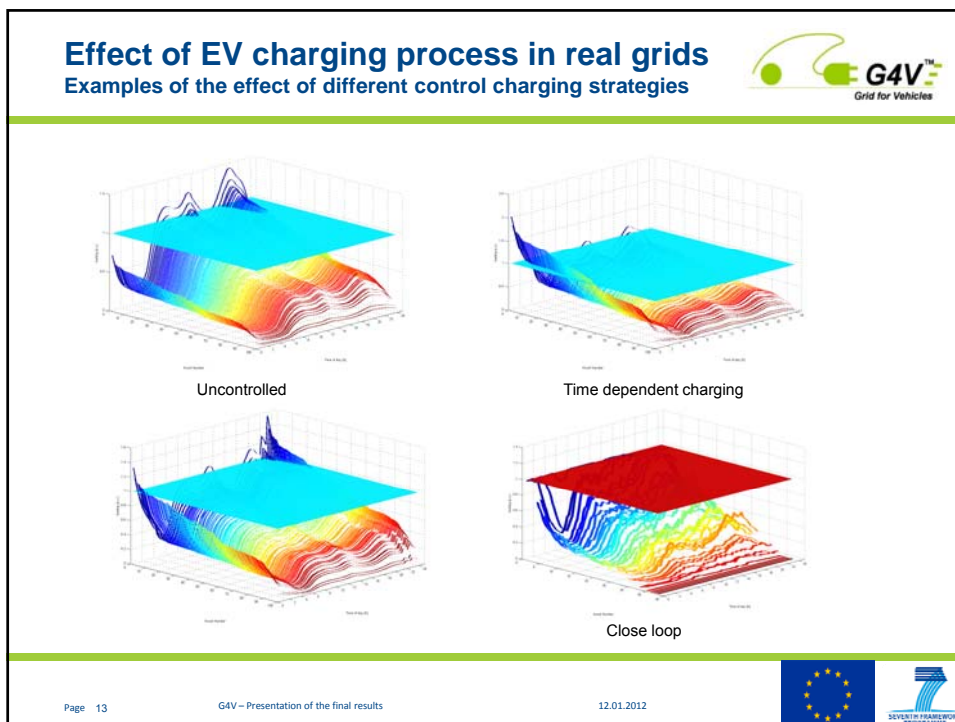


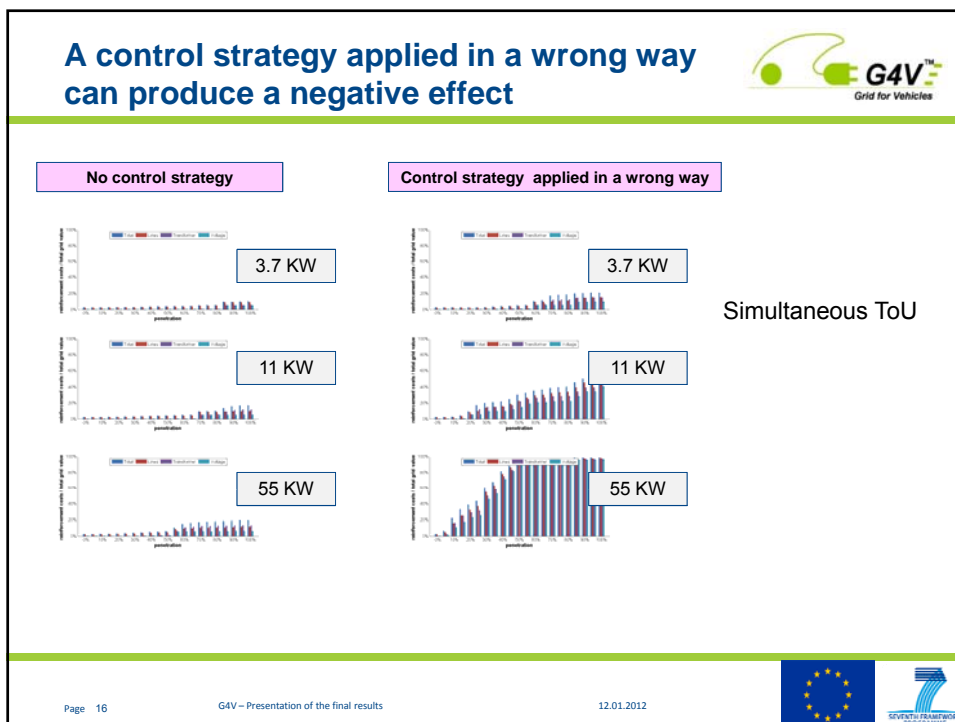
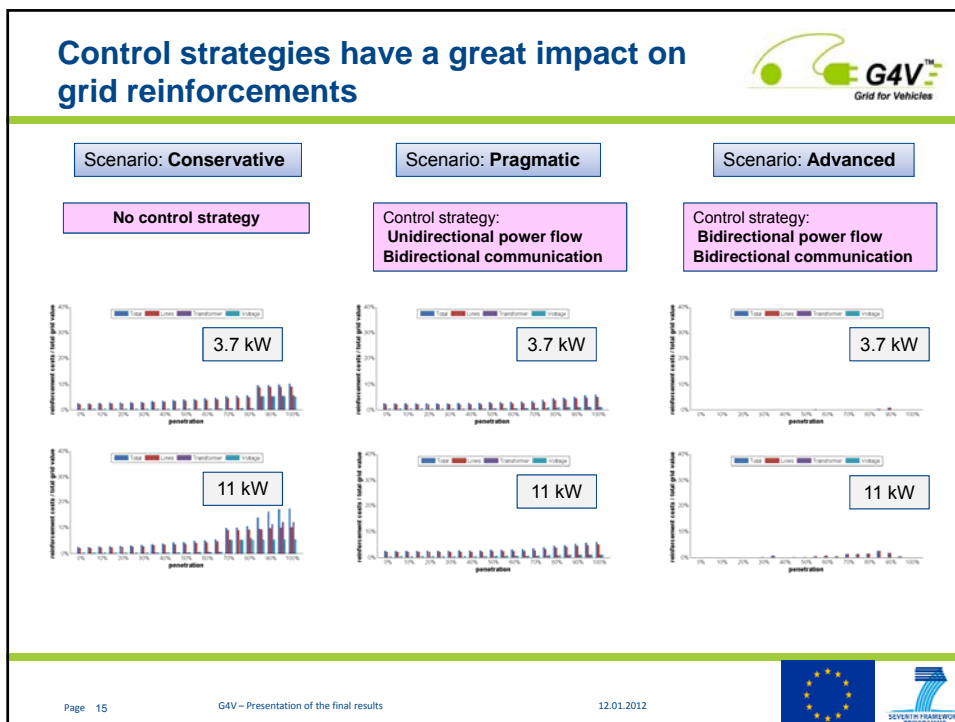
Max capability assured by the grid element

A load profile for each grid element


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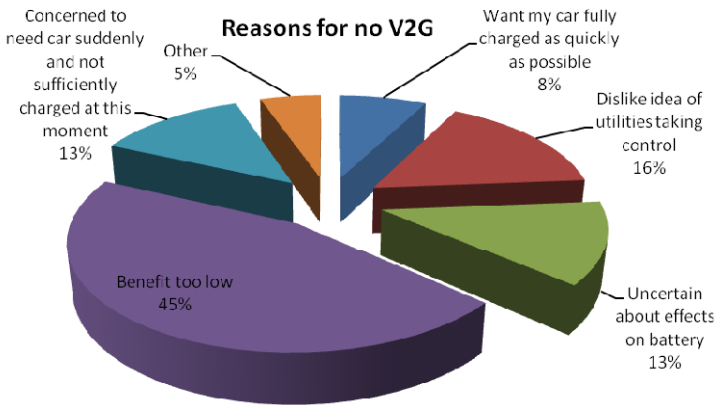
V2G from different points of view

The customer point of view





- Results based on web-survey (1900 replies, 8 countries)
 V2G: unload & recharge whenever plugged in
 Least interest compared to delayed charging.

Reasons for no V2G




Reason	Percentage
Benefit too low	45%
Dislike idea of utilities taking control	16%
Uncertain about effects on battery	13%
Concerned to need car suddenly and not sufficiently charged at this moment	13%
Other	5%
Want my car fully charged as quickly as possible	8%

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V2G from different points of view

The customer point of view



People are **interested in off-peak charging schemes** (22:00-06:00) with a price incentive compared to normal charging cost.



Biggest reason for not participating in off-peak charging schemes is the **fear of being unable to travel** when car is needed for any unforeseen reason.

- Support those charging strategies that best support the system by means of user advantageous tariff structure and assurance of user control over minimum standby battery capacity.

Low user acceptance is observed for participation in **Vehicle-to-Grid** scheme (V2G, bidirectional communication) with main reason being low benefits and the inability to travel (due to empty battery) for any unforeseen reasons.


- **Financial benefits for the user to join V2G** schemes have to be substantial enough taking into account the different economic conditions across different countries in Europe.

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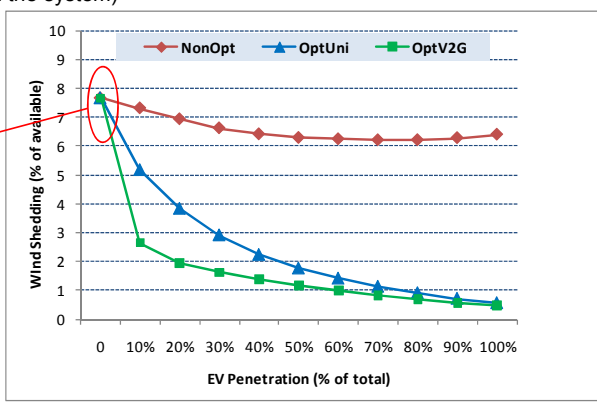
V2G from different points of view

Environmental point of view



Impact on Wind Energy Curtailment (30% wind penetration in the system)



Annual curtailed energy is more than the energy required for annual charging req. of ~15% EV



EV Penetration (% of total)	NonOpt (%)	OptUni (%)	OptV2G (%)
0	7.8	7.8	7.8
10	7.5	5.5	3.5
20	7.2	4.5	2.8
30	7.0	3.8	2.5
40	6.8	3.2	2.2
50	6.6	2.8	2.0
60	6.5	2.5	1.8
70	6.4	2.2	1.6
80	6.3	2.0	1.5
90	6.3	1.8	1.4
100	6.4	1.6	1.3


Significant avoidance of wind energy curtailment by optimized EV charging, even at low levels of EV penetration.

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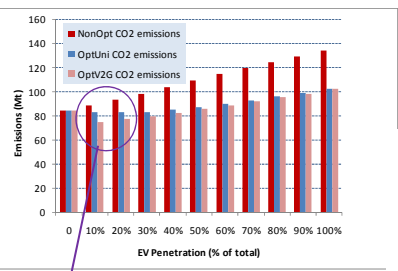



V2G from different points of view

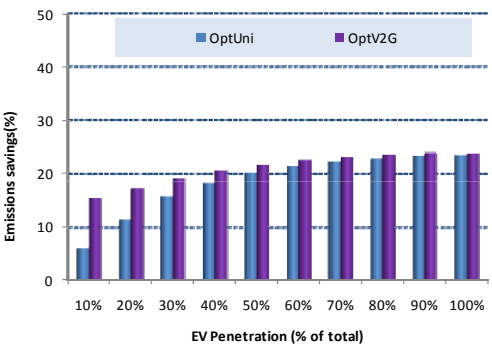
Environmental point of view





Impact on CO2 Emissions (from electricity generation)




Drop in CO2 emissions in optimized cases is due to:
 -greater absorption of wind energy and
 - reduced utilization of CO2 emitting (coal) plants



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The scenarios are the framework where the EV integration is analysed



- Opportunities and requirements appear to apply one control strategy
- If a change of scenario is desirable (mandatory to apply some strategies) some **requirements** have to be achieved:

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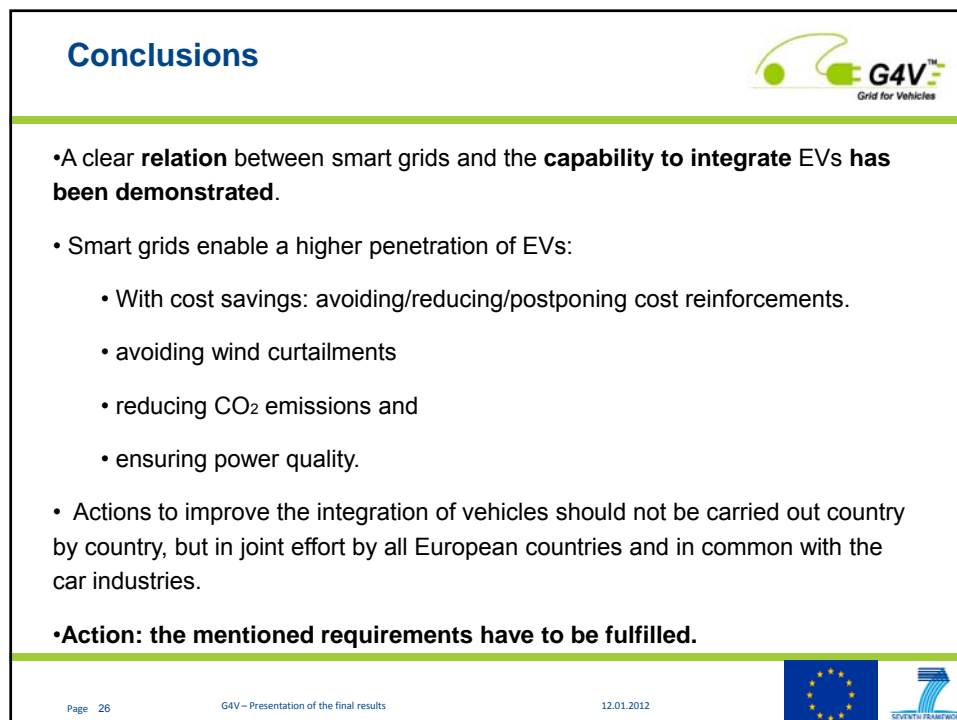
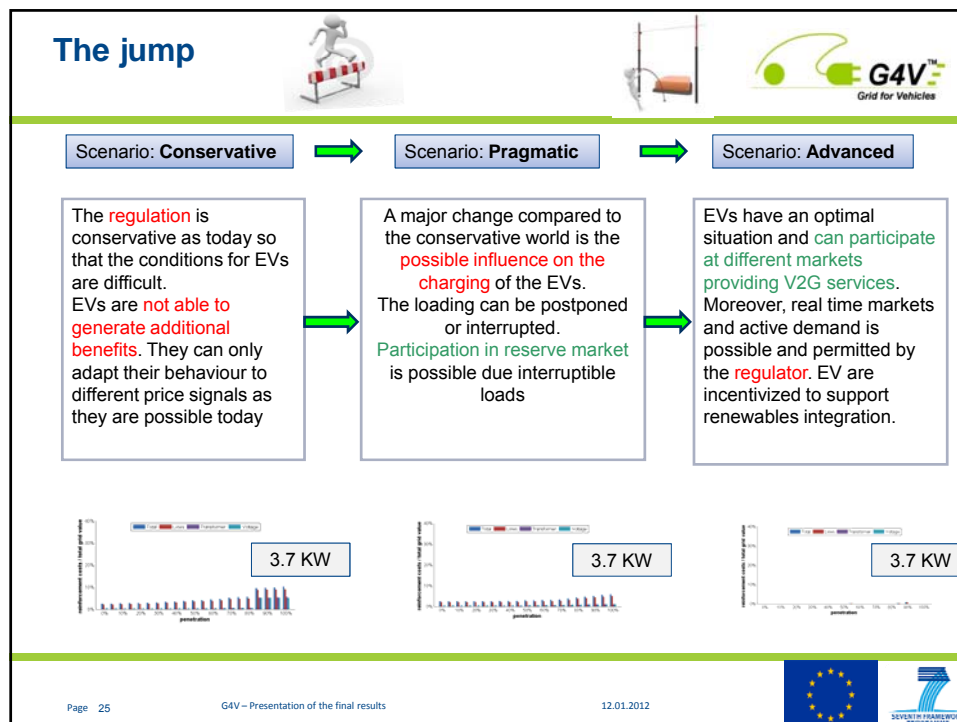
Different opportunities appear in different frameworks...



...and some **opportunities** appear as a consequence of the new framework:

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Thank you very much for
your attention!

www.g4v.eu

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