Evaluation of the Environmental Benefits of The Global EV-Fleet in 38 Countries

A LCA Based Estimation in IEA HEV

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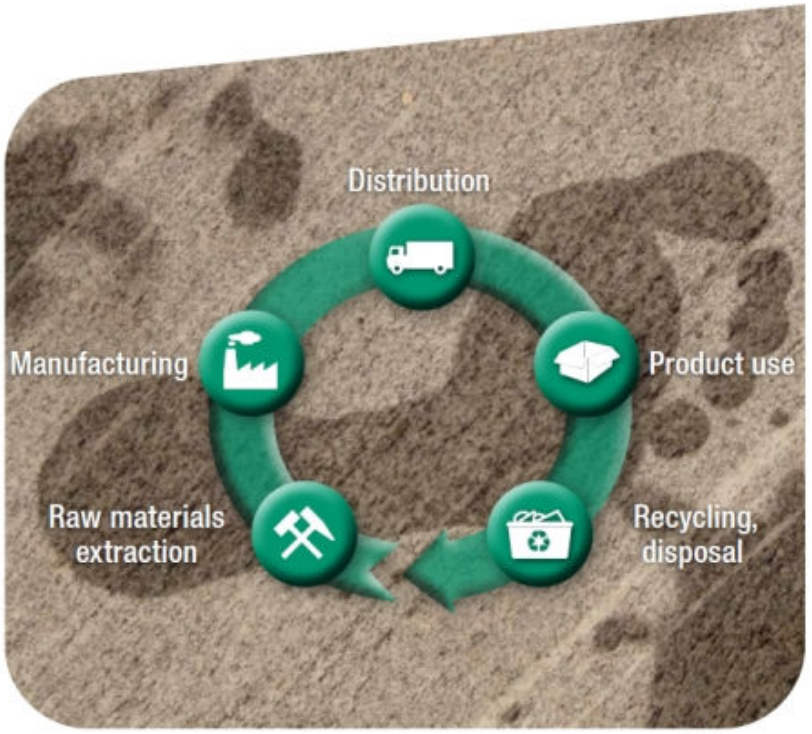


EVS 32, Lyon, May 20 – 22, 2019

JOANNEUM RESEARCH LIFE

Statement on Environmental Assessment of Elec ic Vehicles

"There is international co us that the environmental effects ehicles can only be an s of

Life C CA)

includ ation and the end the vehicles"

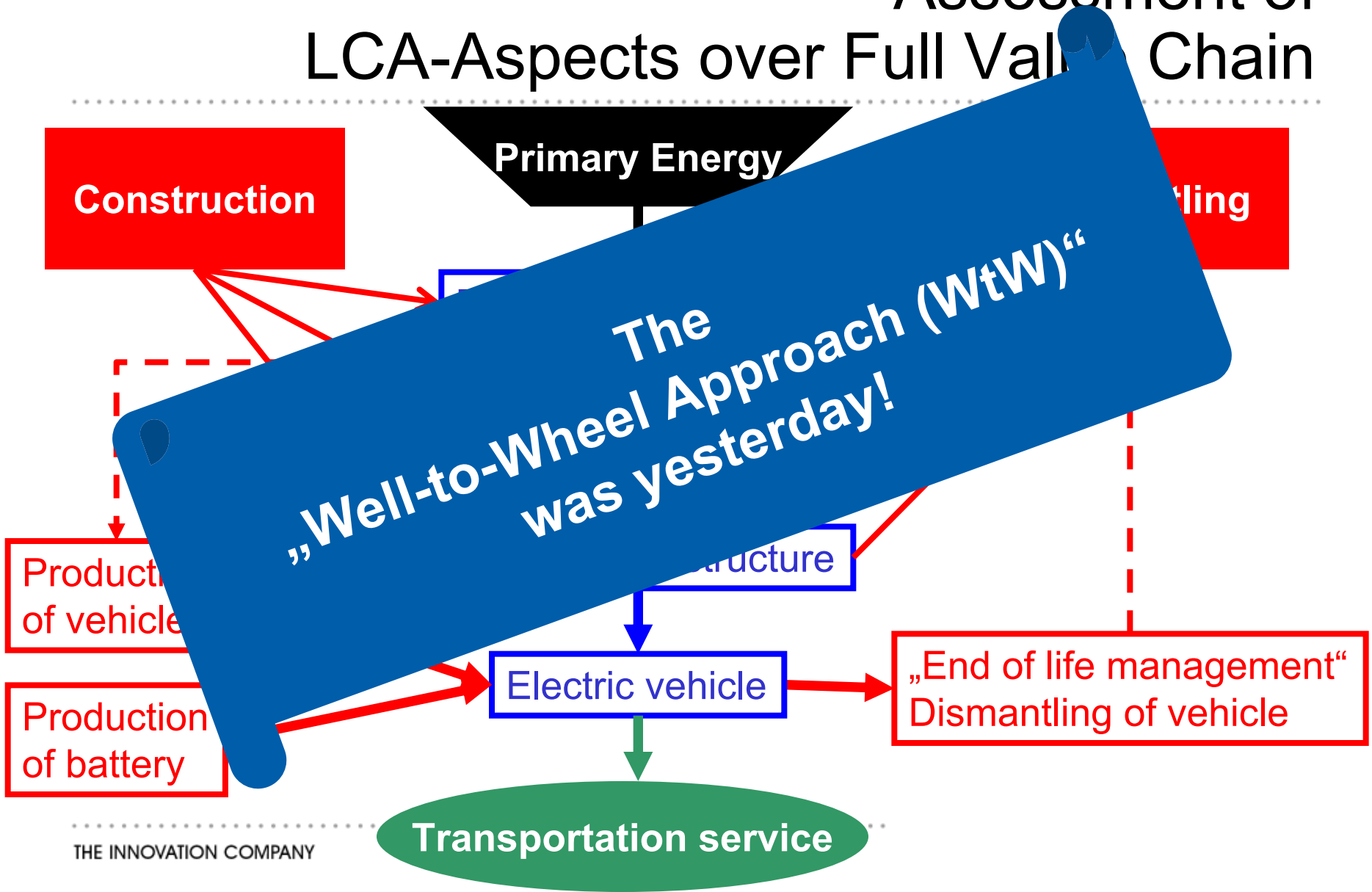
parison to conventional vehicles"

Product use

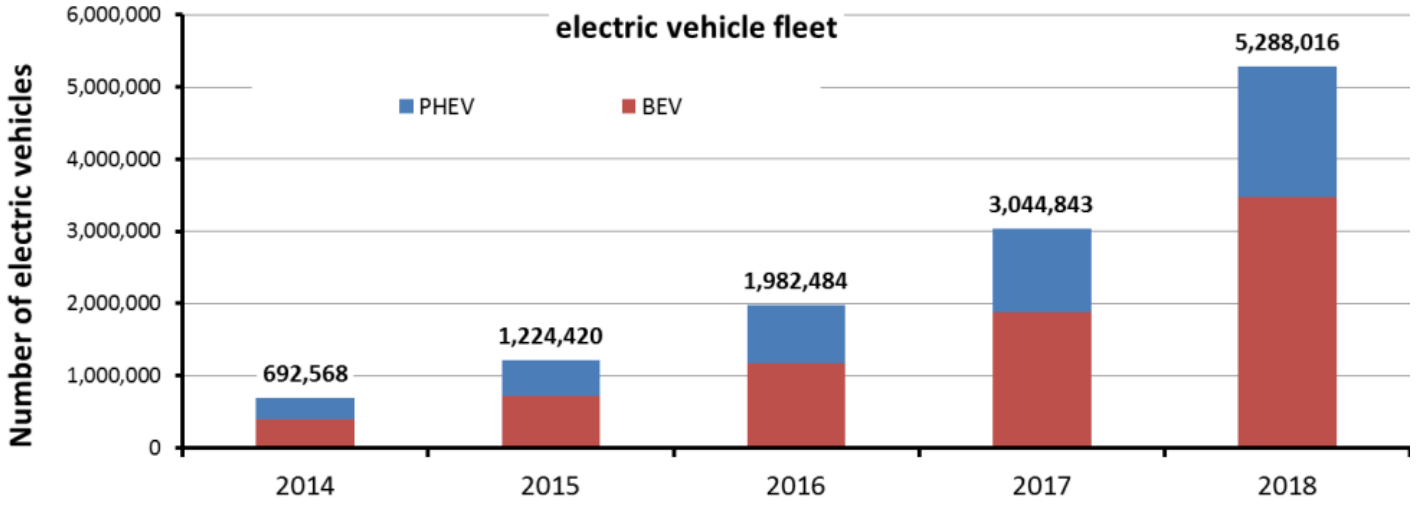
Recycling, isposal

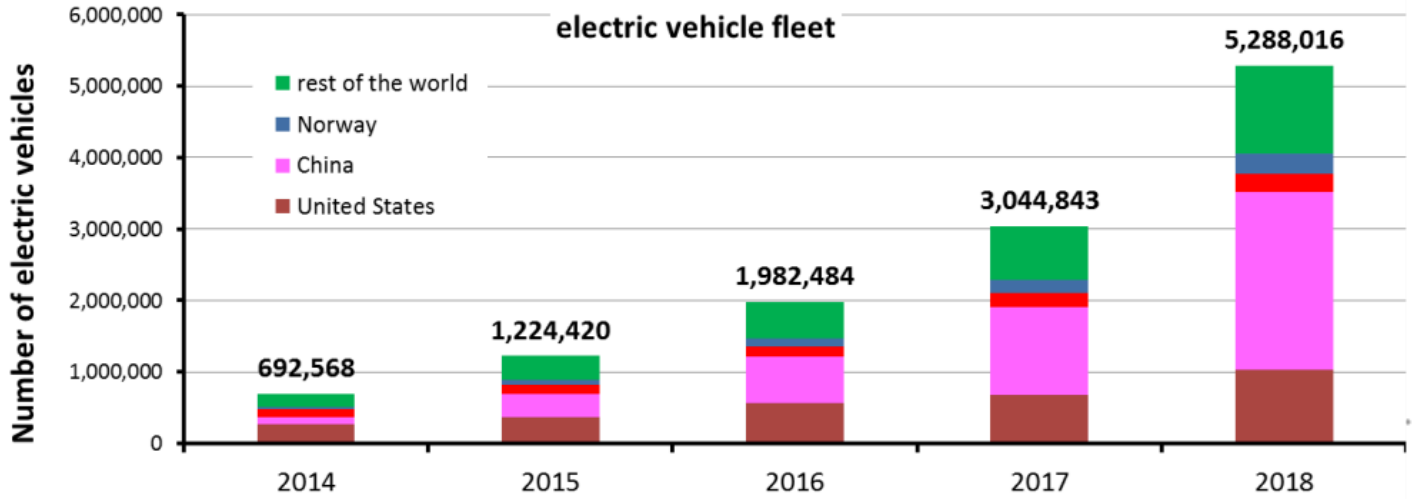
….and what does that mean for global EV fleet?

Assessment of LCA-Aspects over Full Val[illegible] Chain

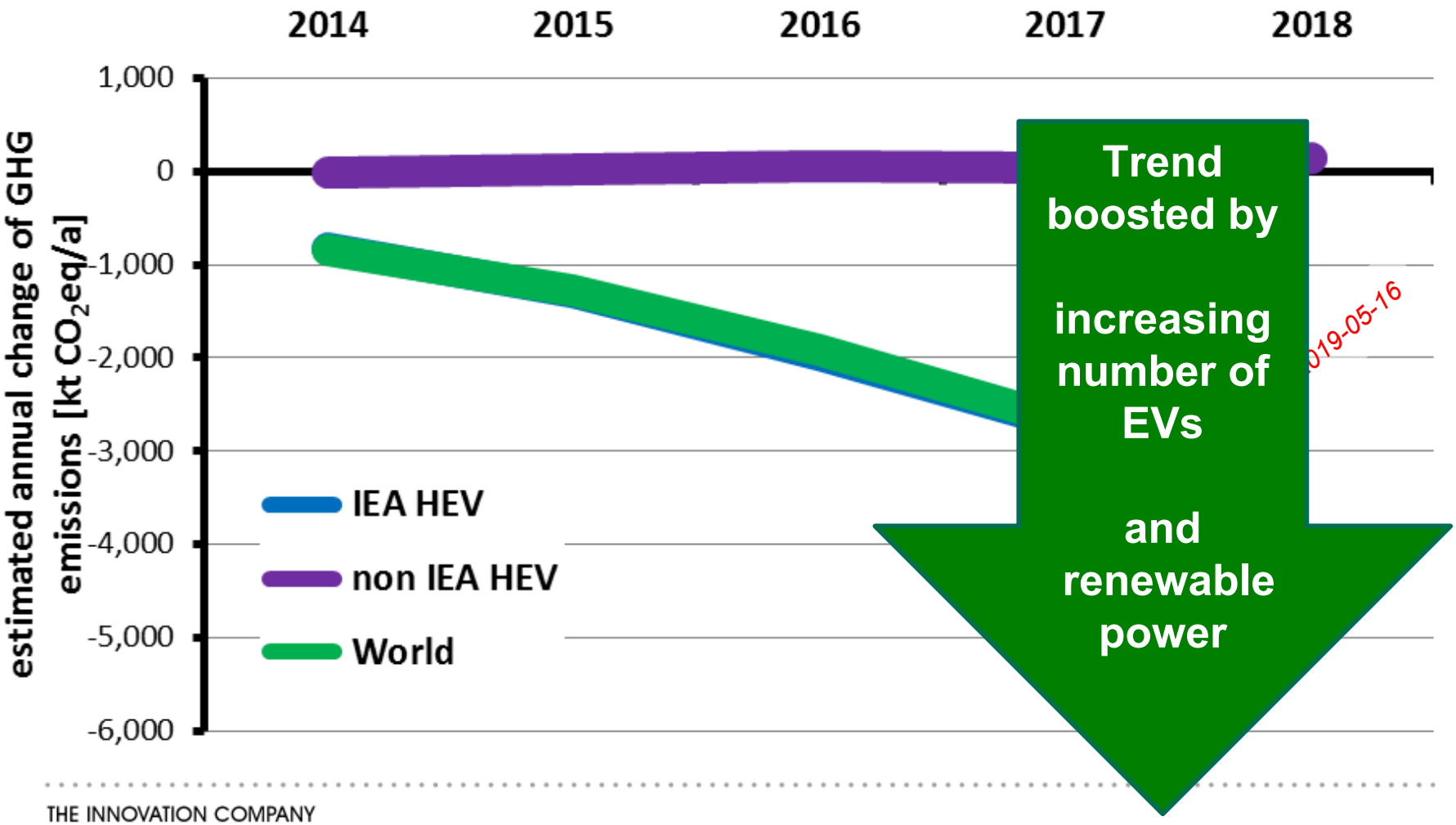


Development of Global EV-Fleet

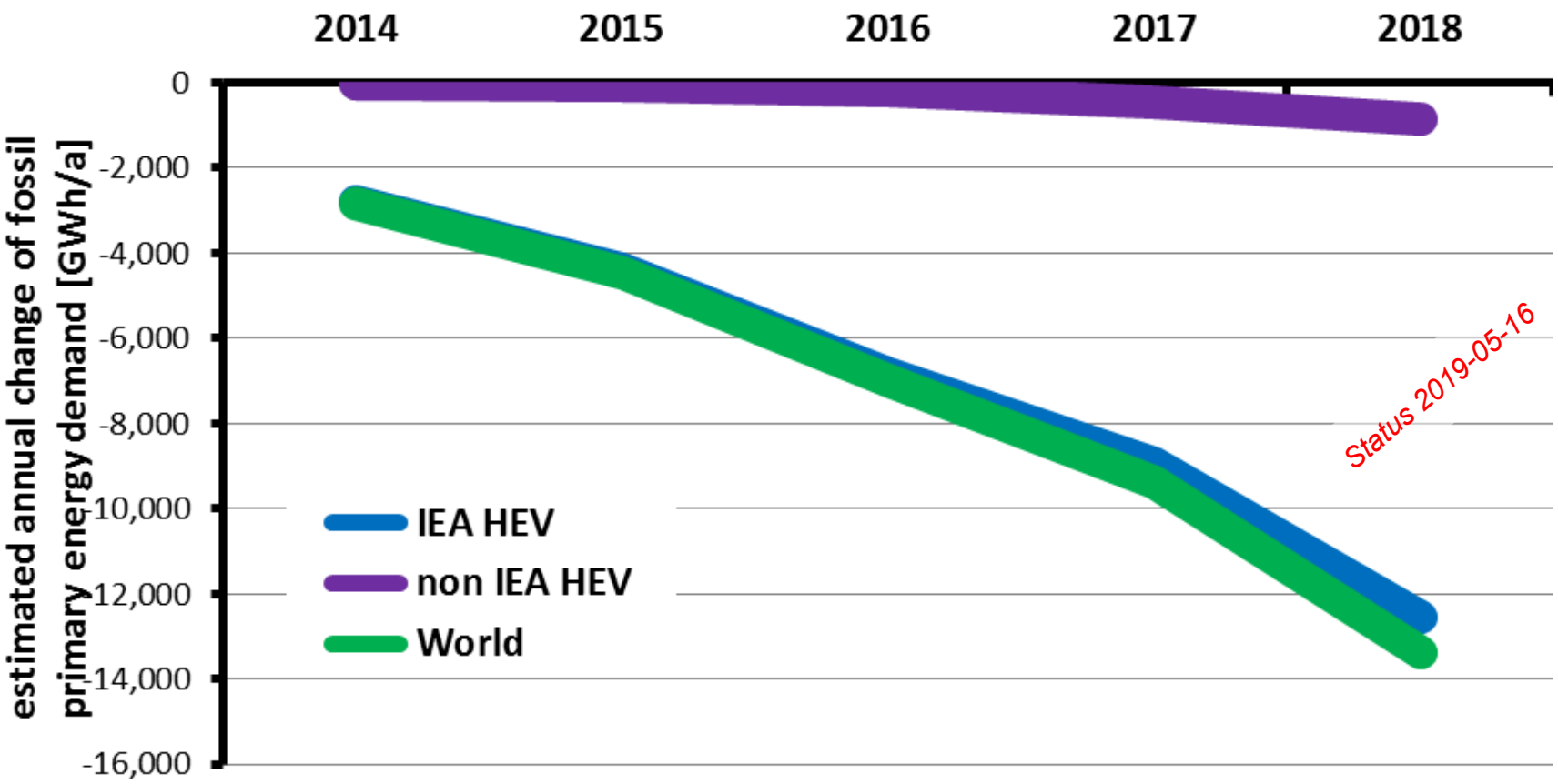




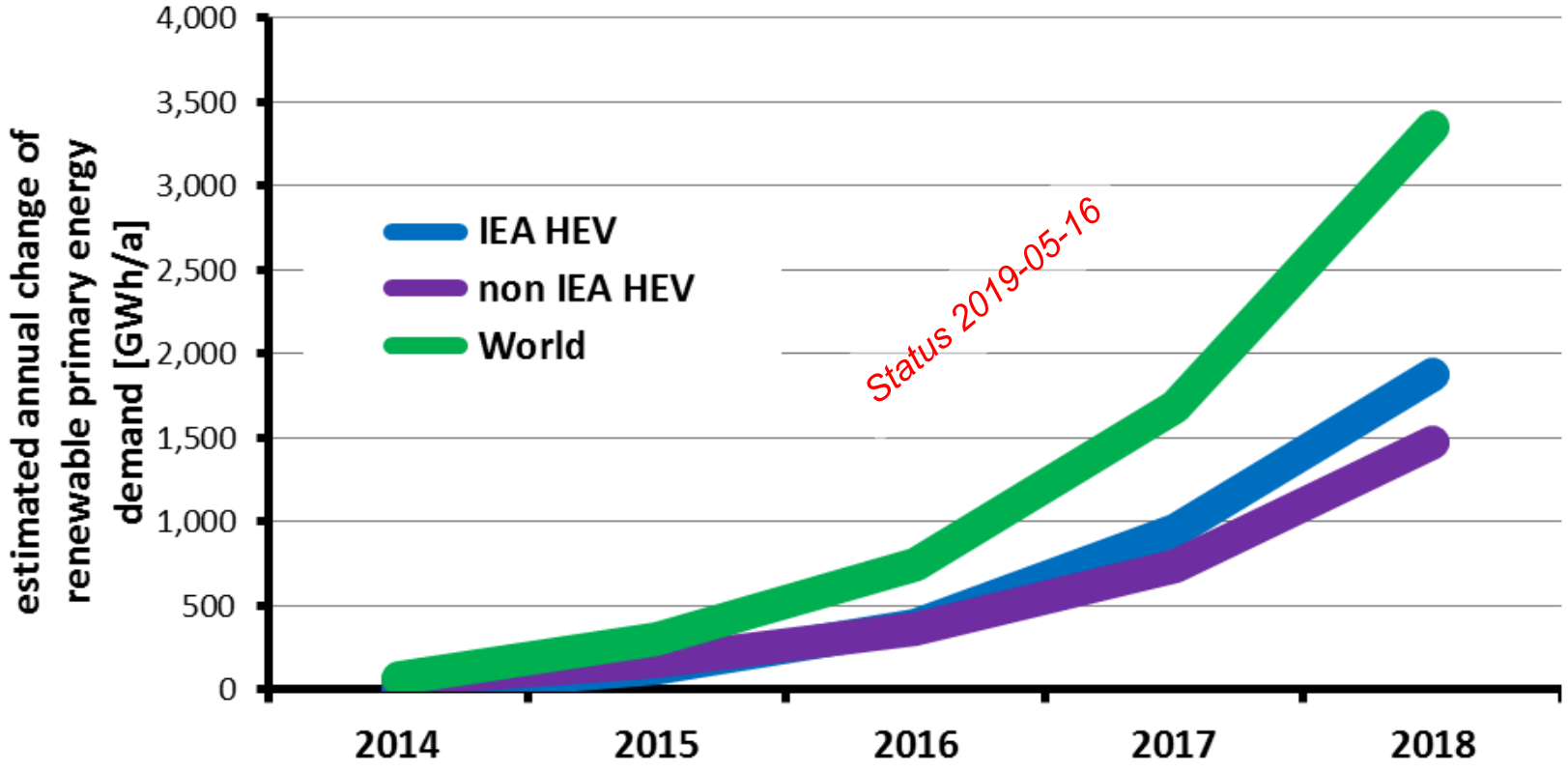
Estimated **Reduction** on GHG Emissions of Global EV-Fleet 2014 – 2018



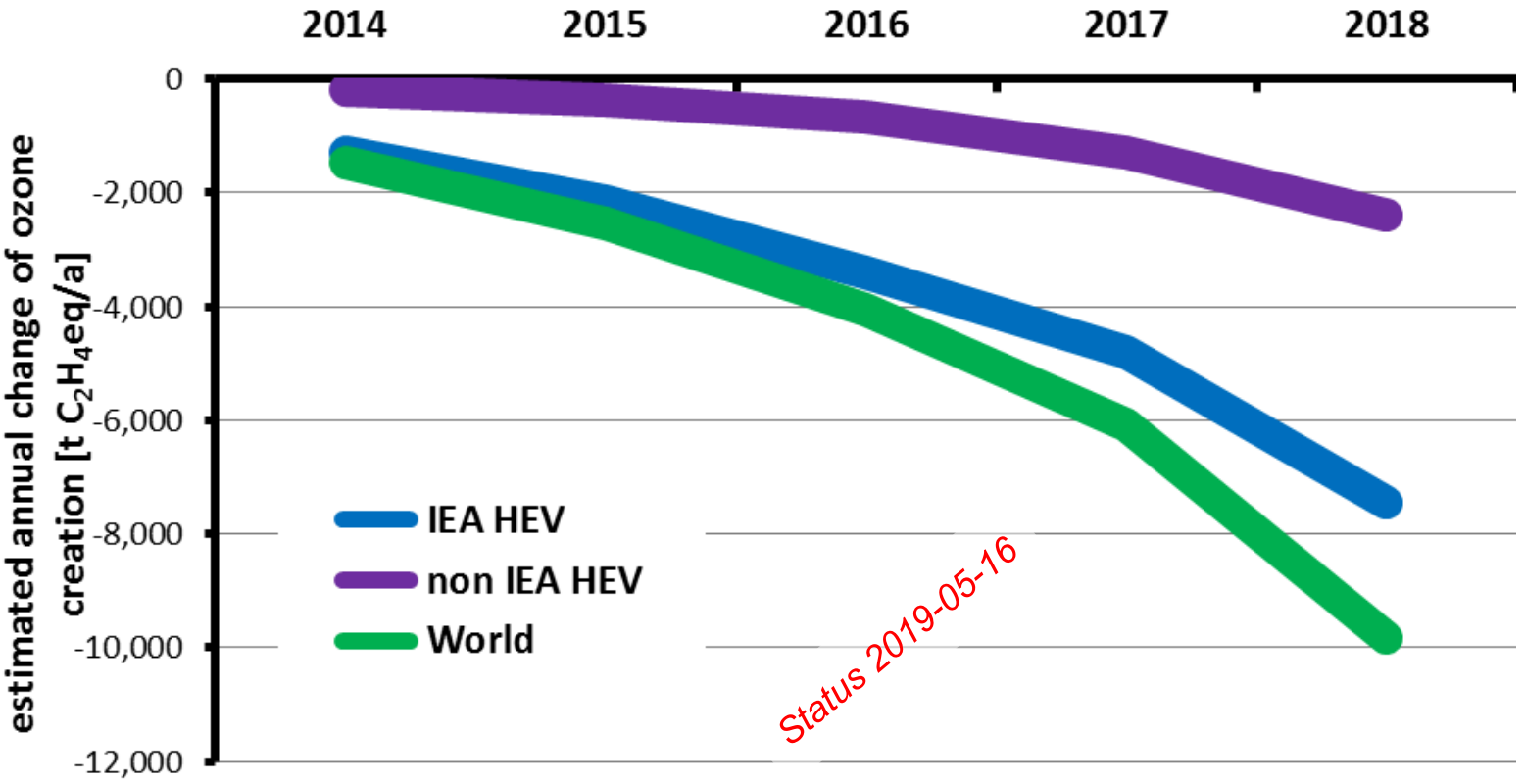
Estimated **Reduction** of Fossil Primary Energy Global EV-Fleet



Estimated **Increase** Renewable Primary Energy of Global EV-Fleet



Estimated **Reduction** on Ozone Formation of Global EV-Fleet



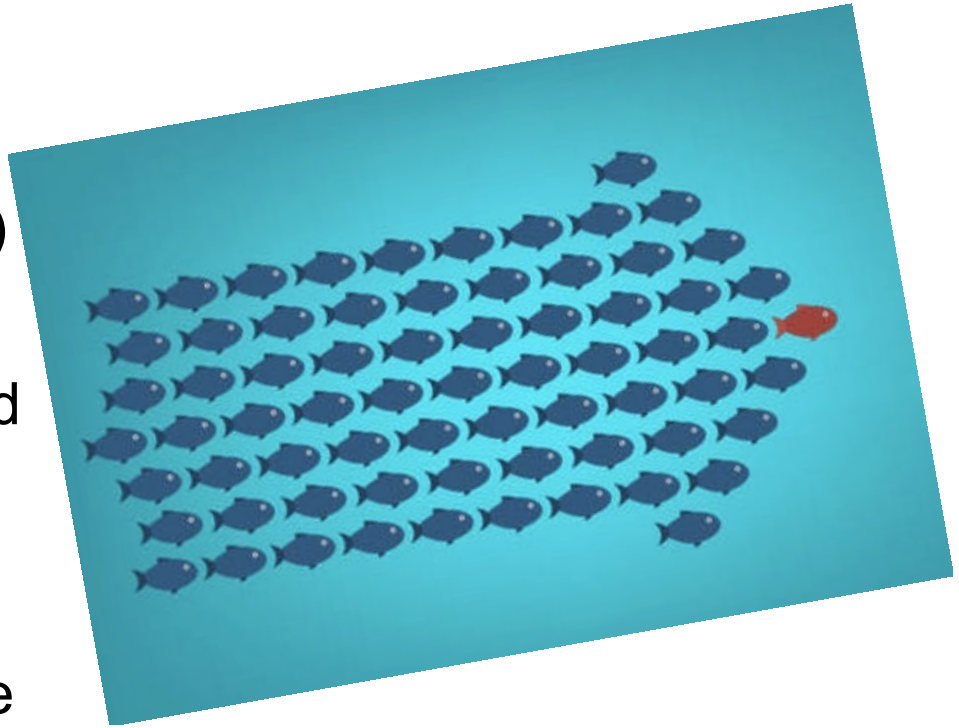
Main Influences on Environmental Effects

1) **Electricity** generation for BEV and PHEV

2) **Energy consumption** of vehicles (BEV, PHEV, ICE)

3) **Battery** production and end of life management

4) **Substitution** EVs for ICE vehicles (in growing vehicle stock)



IEA INTERNATIONAL ENERGY AGENCY

HYBRID & ELECTRIC VEHICLE TECHNOLOGY COLLABORATION PROGRAMME

IEA HEV Task 30: Environmental Effects of Electric Vehicles

Austria – JOANNEUM RESEARCH

Canada – CIRAIG

Germany – DLR

Korea –University Ulsan

USA – Argonne

Spain – IREC

Turkey – Sabanci University

Methodologies

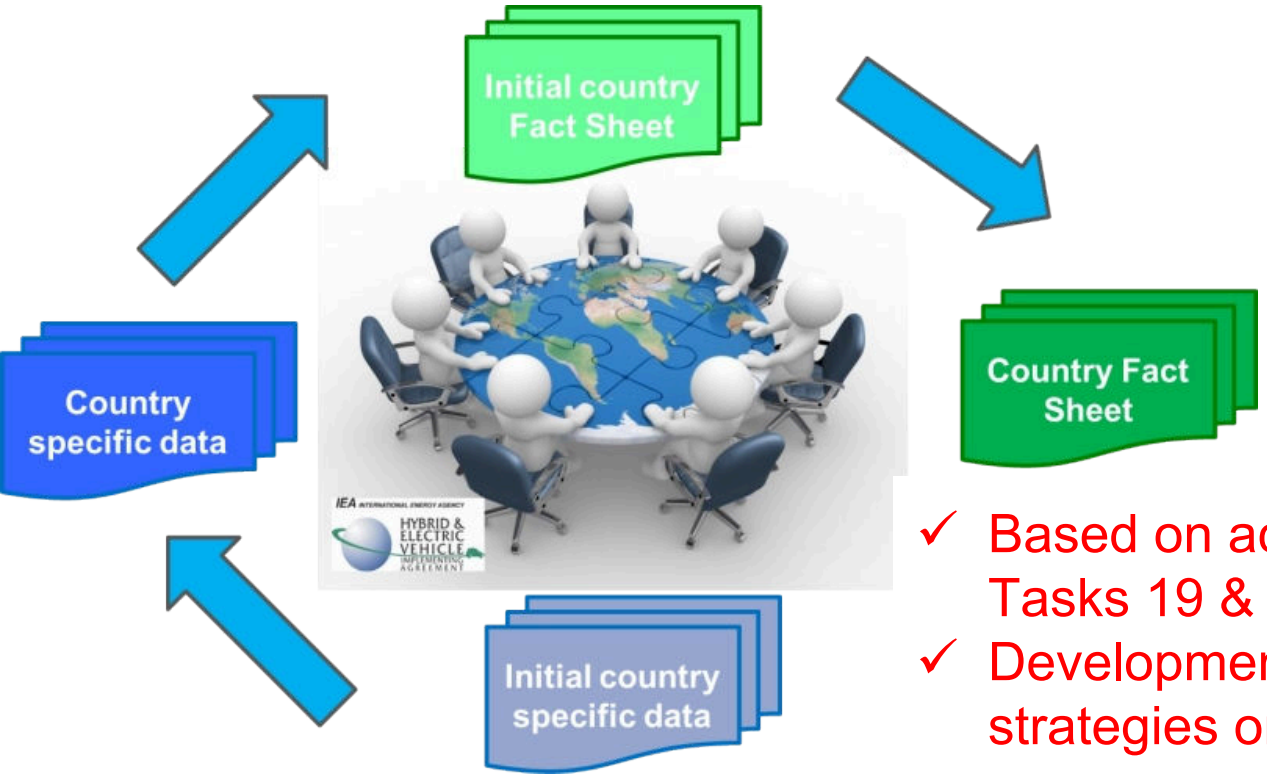
Case studies

Environmental effects of EVs based on LCA

Networking&information exchange

Aim of Assessment

Provide annually **FACTS&FIGURES** on life cycle based environmental effects of EVs (BEV&PHEV) worldwide and country specific in comparison to conventional ICE vehicles



- ✓ Based on achievements of IEA HEV Tasks 19 & 30
- ✓ Development of Communication strategies on LCA and LCA results

Methodology and Application

1) **Broad AGREEMENT on common LCA methodology** developed, discussed &applied in IEA HEV Task 19 & Task 30 (since 2011)

2) **Testing on the EV Fleet in the USA**
   - i. done by Argonne
   - ii. done by JOANNEUM
   - iii. Comparison: within the estimated ranges

3) **Database**
   - iv. **Very good**: Number of vehicles and electricity production
   - v. **Very robust:** GHG emissions and primary energy consumption
   - vi. **Weak(er):** acidification, ozone formation and particles

4) **Further developments**
   - vii. Application of LCA on vehicle fleets ongoing in Task 30
   - viii. Rapidly developing data on battery production
   - ix. Annual changes in electricity generation
   - x. Fleet development

38 Countries Considered

1.	**Austria**	**11.**	**Ireland**	**21.**	**Sweden**	**31.**	**Turkey**
2.	**Belgium**	**12.**	**Italy**	**22.**	**United Kingdom**	32.	India
3.	Bulgaria	13.	Luxembourg	23.	Australia	33.	South Africa
4.	Czech Republic	**14.**	**Netherlands**	**24.**	**Canada**	34.	Brazil
5.	**Denmark**	15.	Poland	25.	China	35.	Chile
6.	**Finland**	16.	Portugal	**26.**	**Norway**	36.	Mexico
7.	**France**	17.	Romania	**27.**	**United States**	37.	New Zealand
8.	**Germany**	18.	Slovakia	**28.**	**Switzerland**	38.	Thailand
9.	Greece	19.	Slovenia	29.	Japan	39.	…..
10.	Hungary	**20.**	**Spain**	**30.**	**Republic of Korea**	40.	…..

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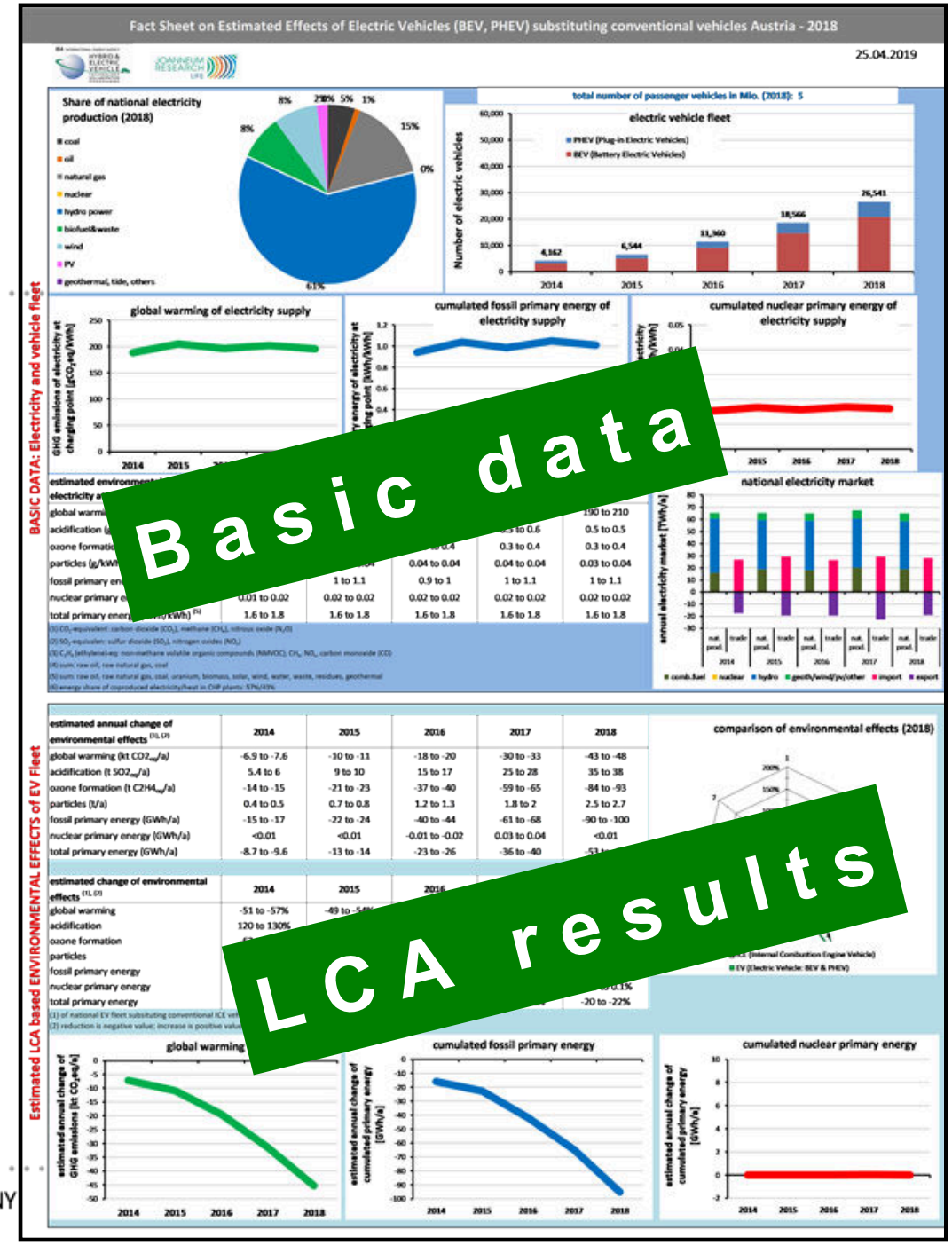
Country FACT SHEET



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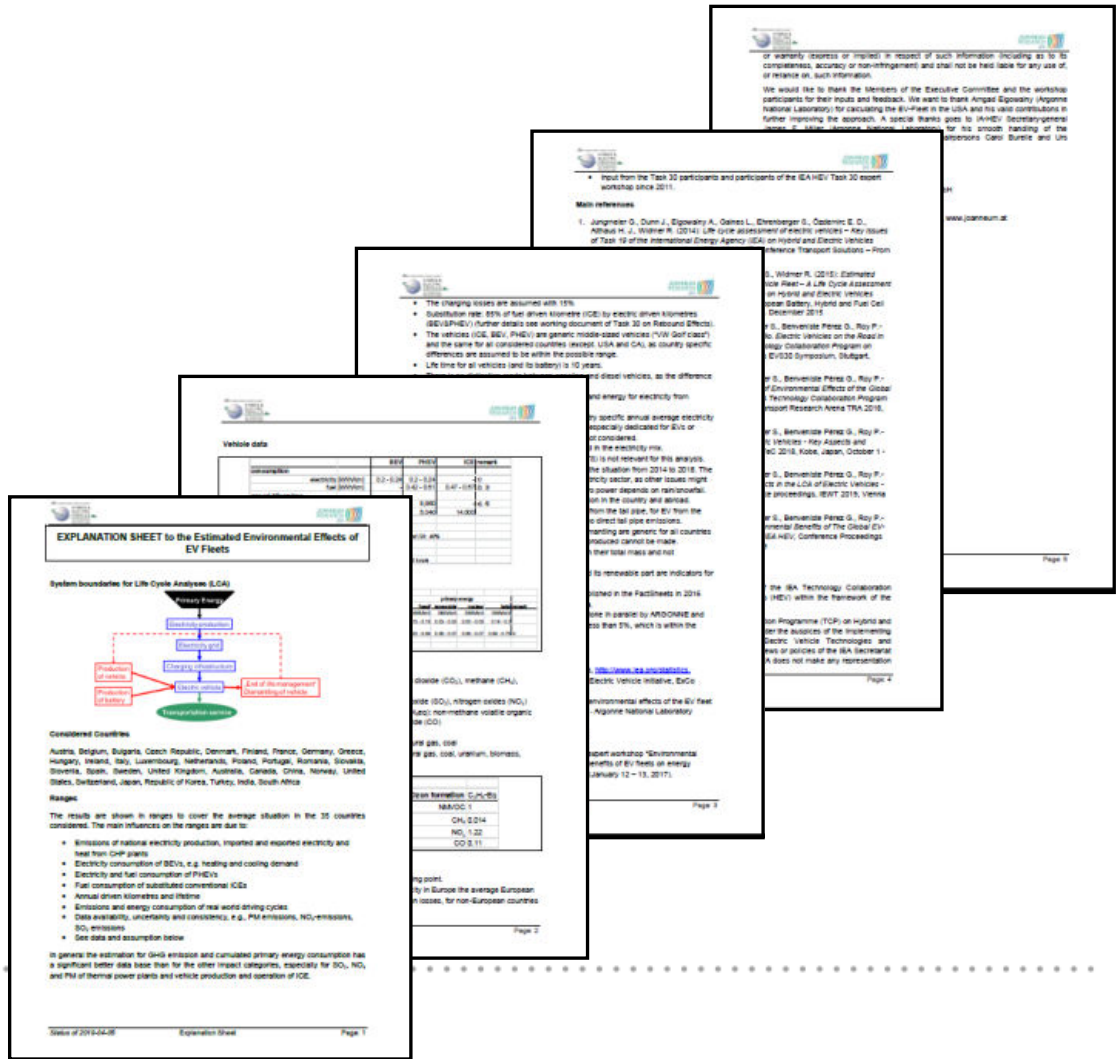
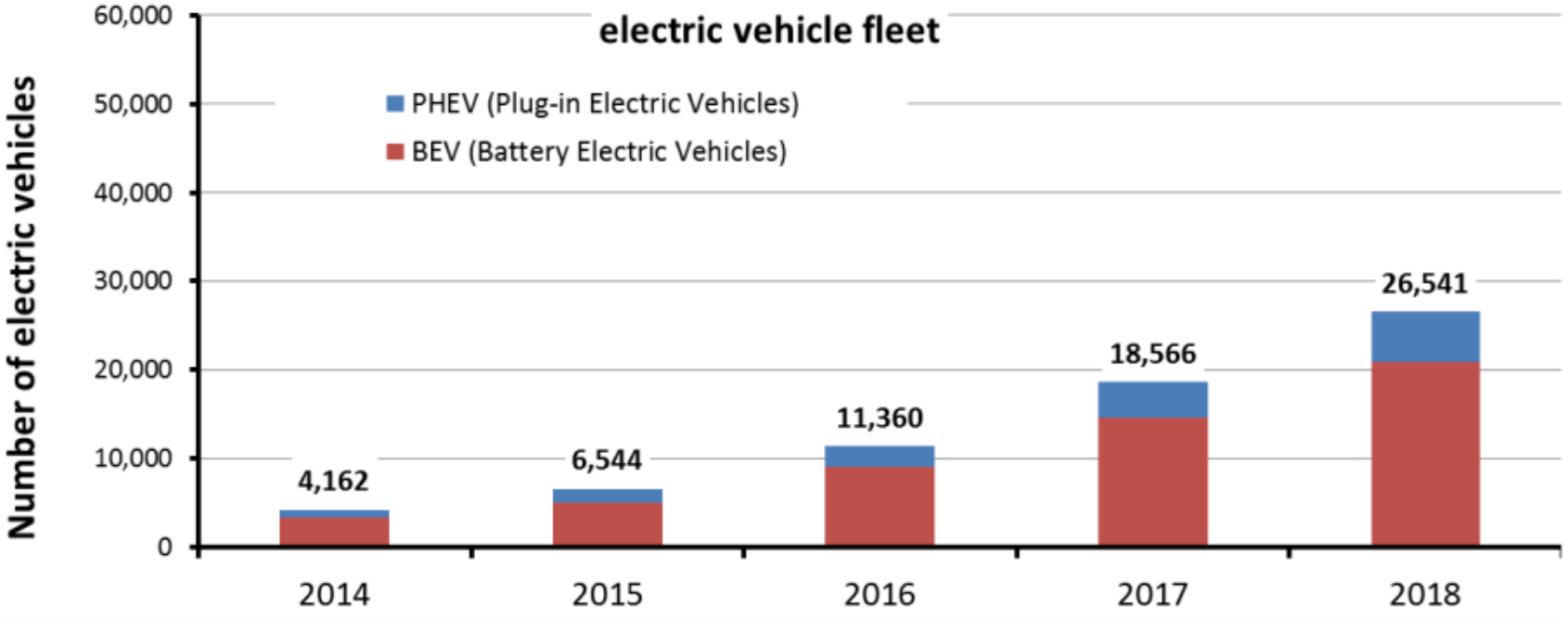
Explanation Sheets

- System boundaries
- Considered Countries
- Ranges
- Vehicle data
- Emissions
- Environmental effects
- Assumptions
- Data sources
- References



Number of Electric Vehicle

AUSTRIA



Source: IEA HEV annual report, EVI, ExCo members

National Electricity Production

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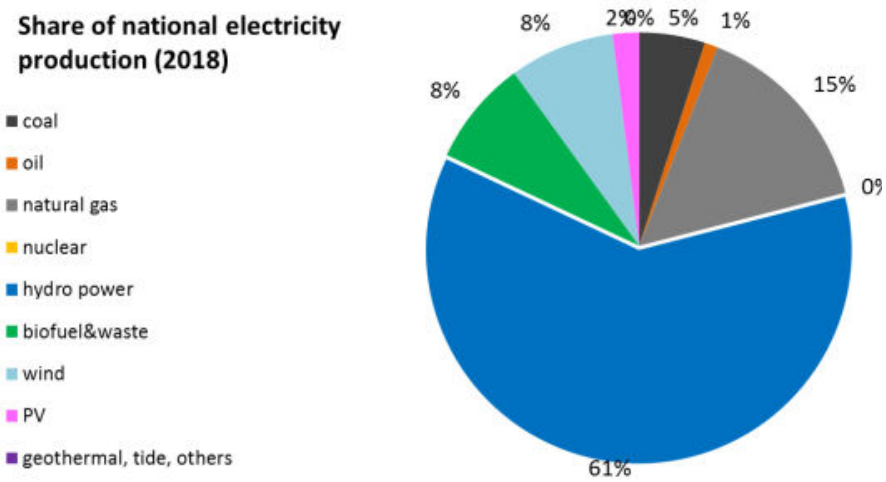
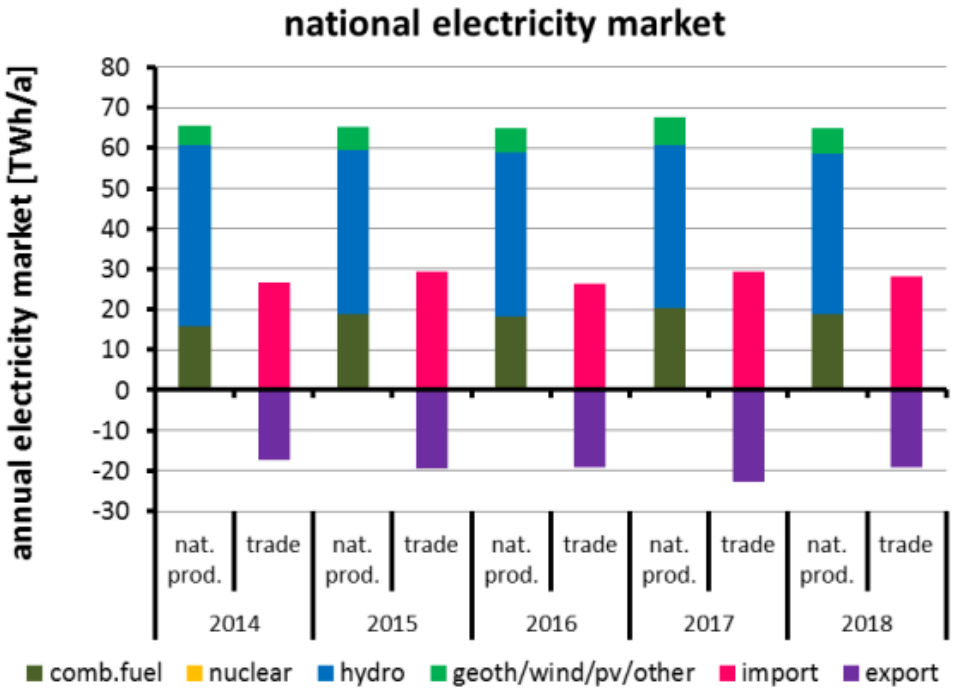


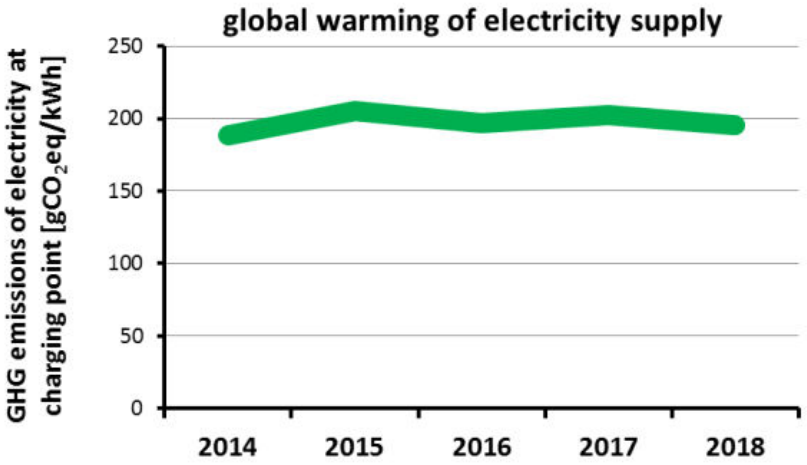


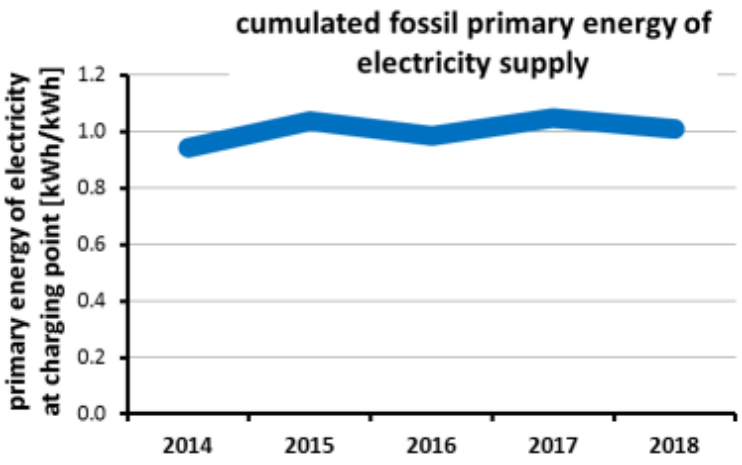
Source: IEA statistics
http://www.iea.org/statistics

Estimated Effects on GHG Emissions and Fossil Energy

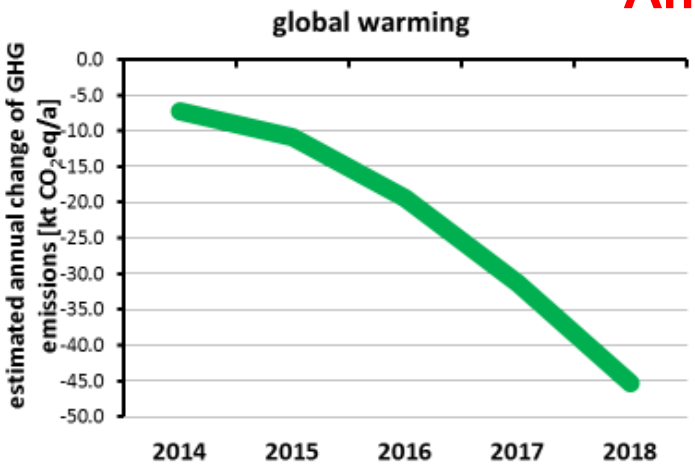
AUSTRIA

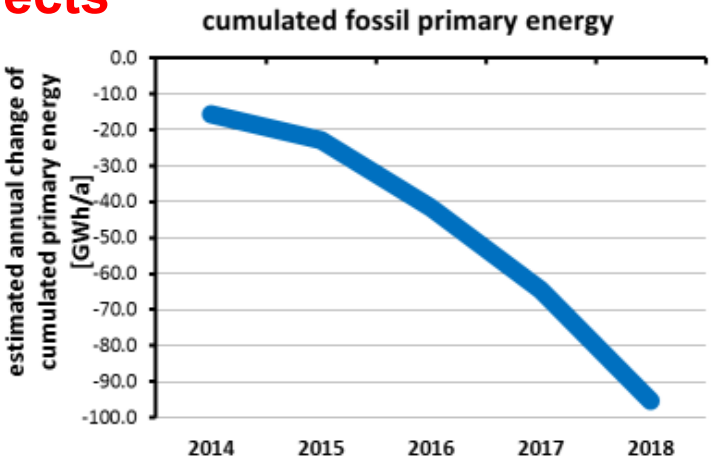
Charging electricity



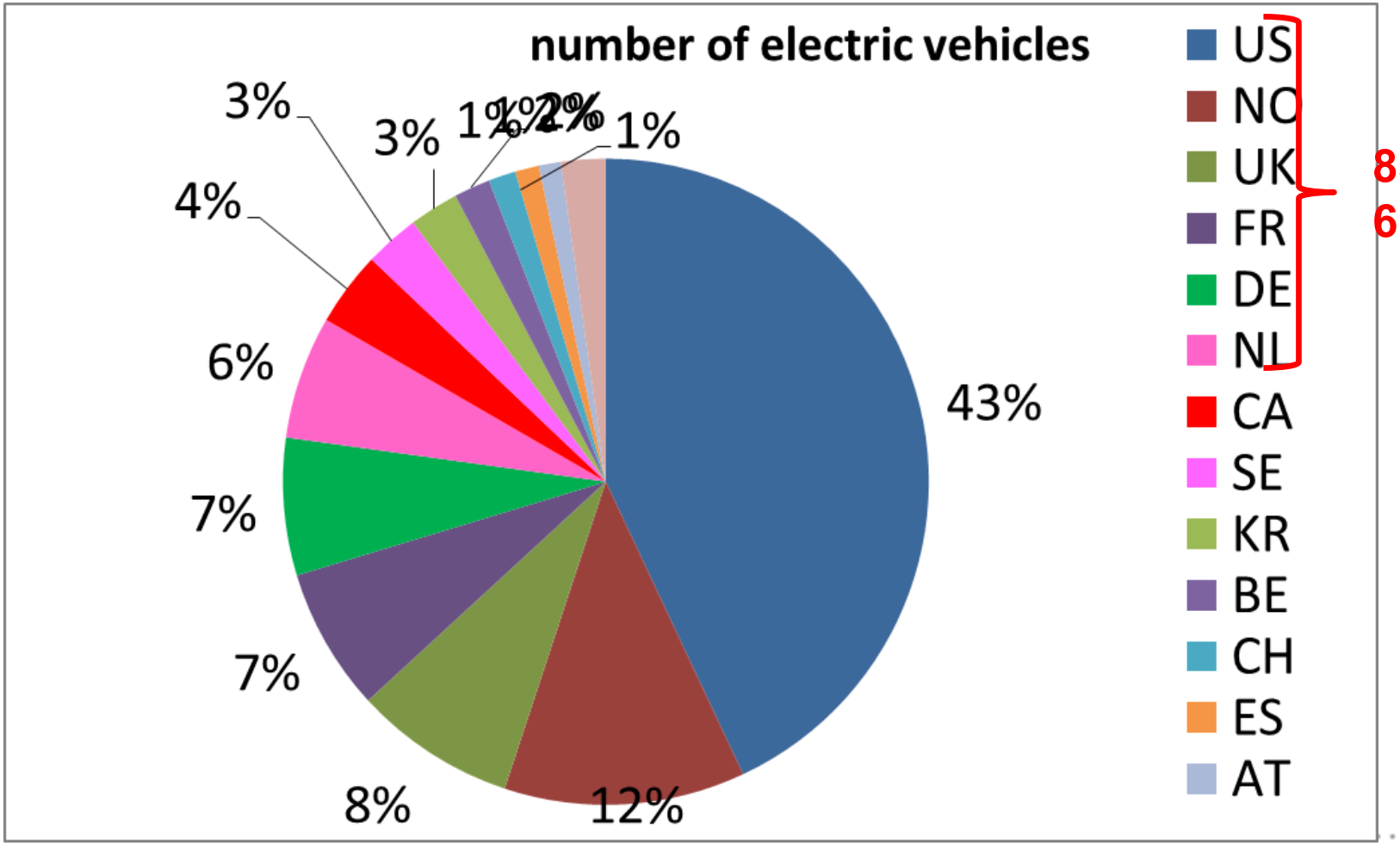


Annual effects



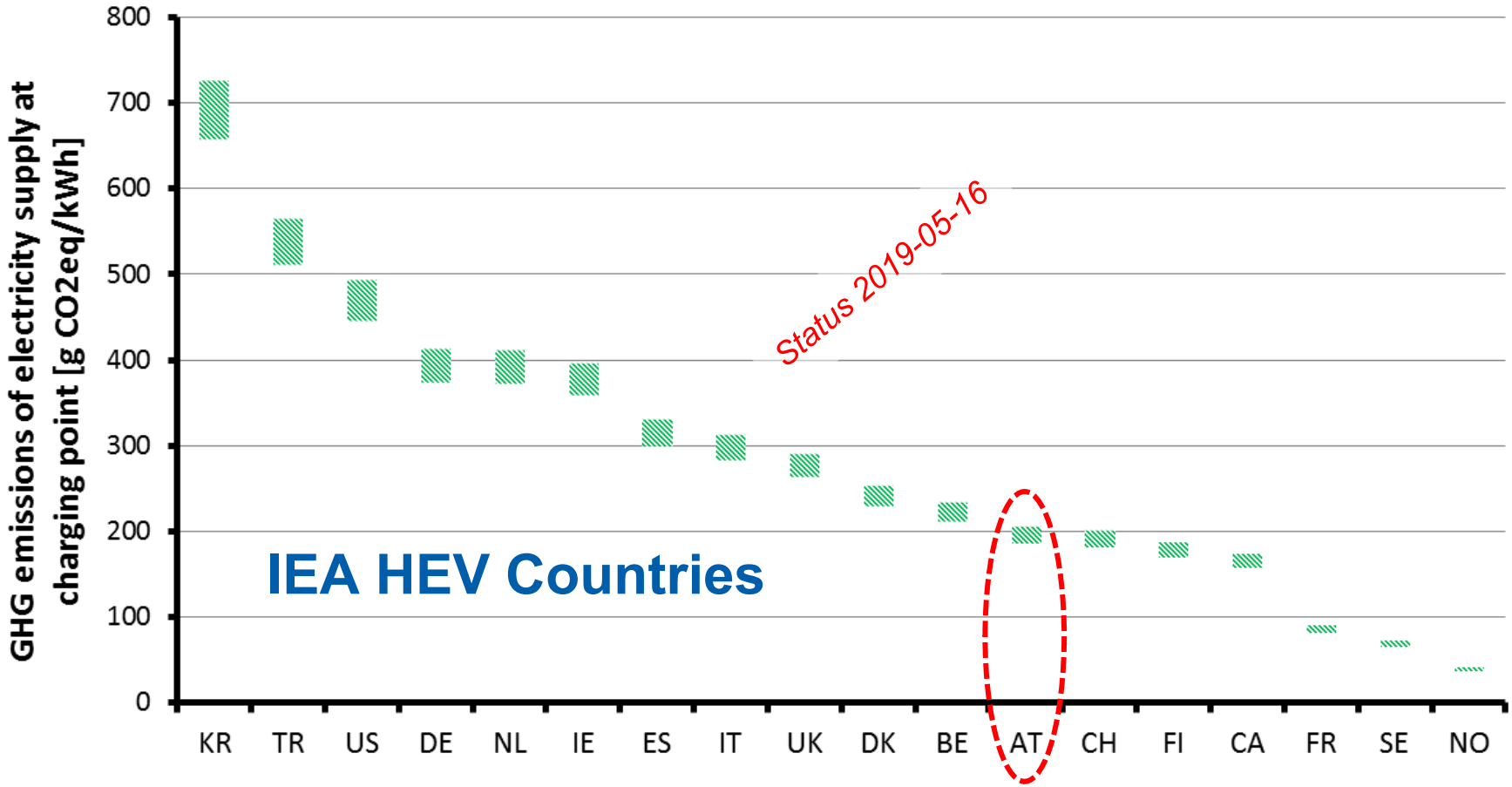


Number of Electric Vehicle in IEA HEV Countries

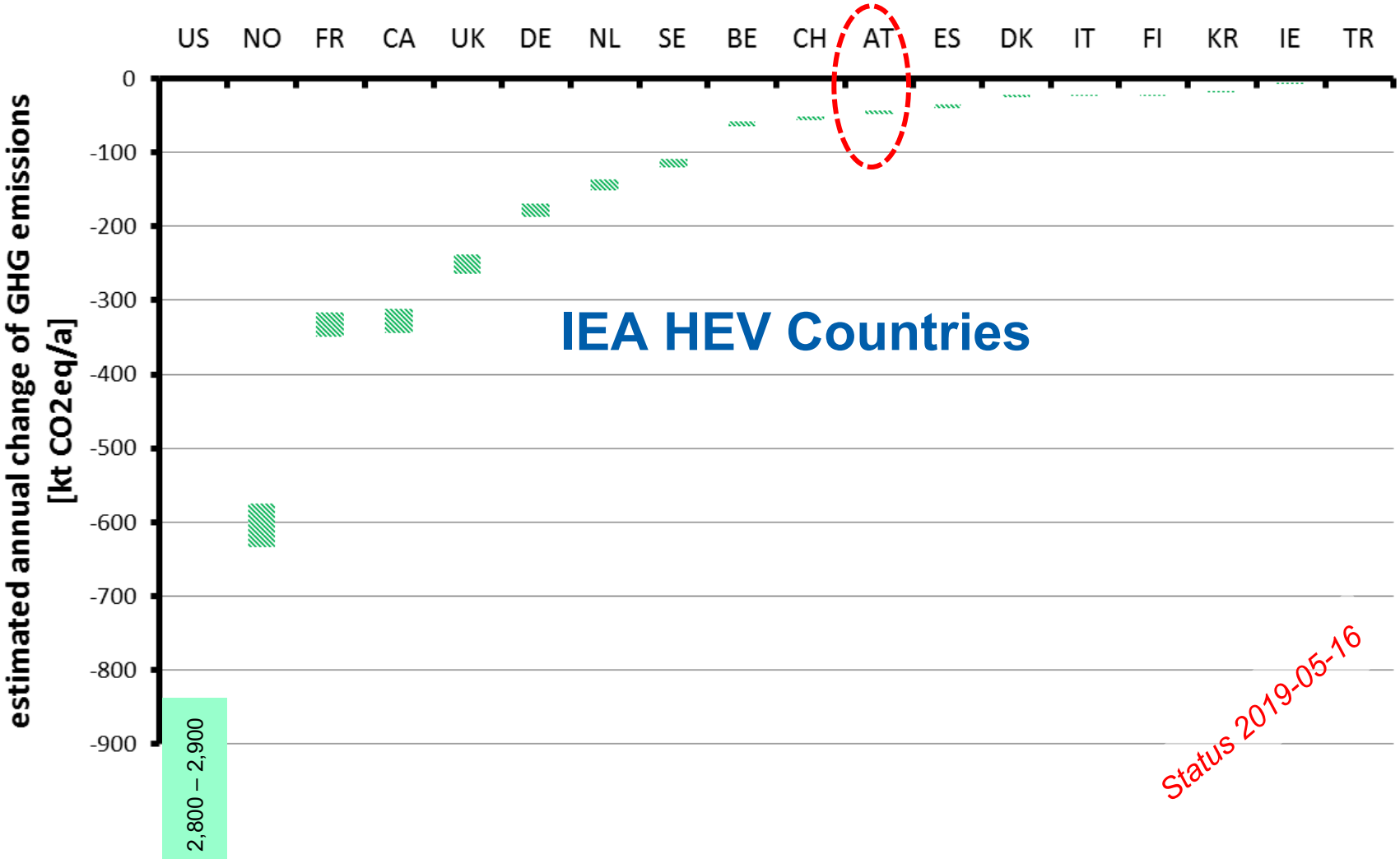


Source: IEA HEV annual report, EVI, ExCo members

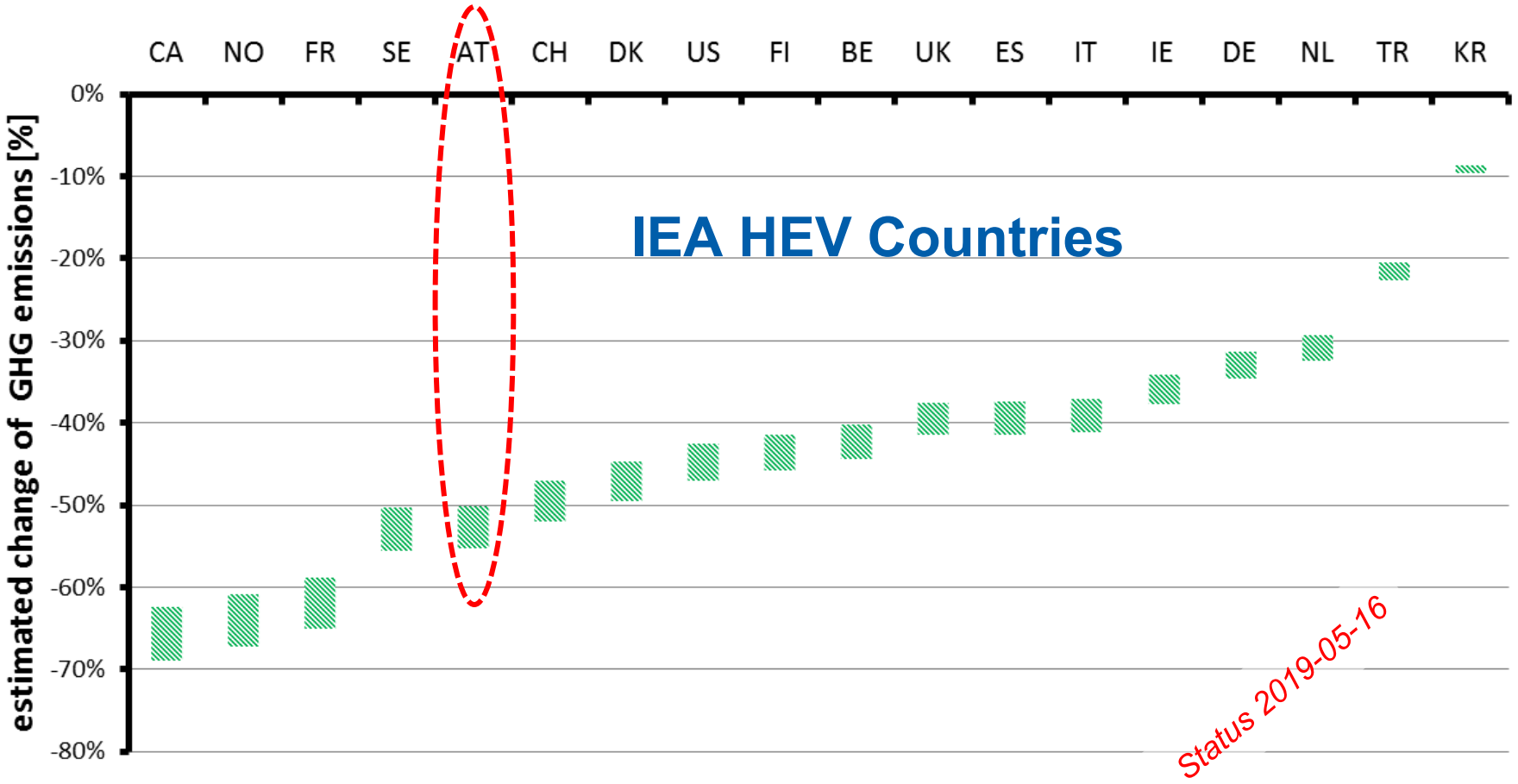
Estimated GHG Emissions of Electricity for Charging EVs



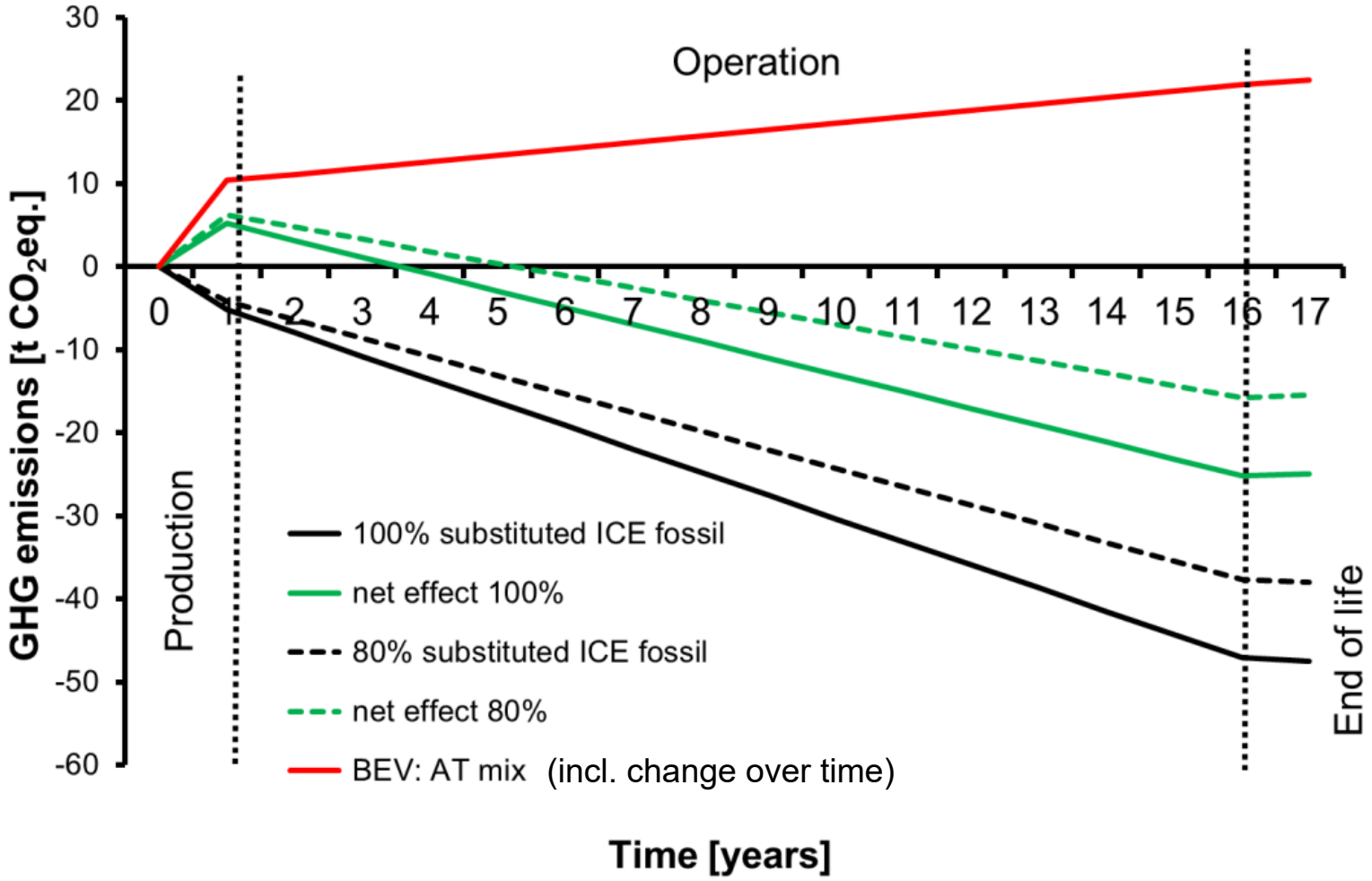
Estimated **Reduction** in 2018 of GHG Emisisons of EV Fleets



Estimated relative **Reduction** of GHG Emissions of EVs compared to ICEs



Further Developments: LCA Application on Vehicle Fleets over Lifetime & Time-resolved Scenarios



Summary

Communication strategies are essential: Interaction with stakeholders, show database, explain assumptions

Additional renewable electricity with adequate charging strategies is essential for further significant reductions

Estimation of environmental effects substituting fossil ICE show positive environmental effects of more than 5 Mio. EVs worldwide

Key factors

- ✓ Electricity generation for BEV and PHEV
- ✓ Energy consumption of vehicles (BEV, PHEV, ICE)
- ✓ Battery production and end of life management
- ✓ EVs substitution rate for ICE vehicles in growing vehicle fleet

Key issues in **LCA methodology** and key data for electric vehicles are continuously **harmonized** in IEA HEV Task 30

Environmental Assessment of EVs only possible on **Life Cycle Assessment** compared to conventional vehicles

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